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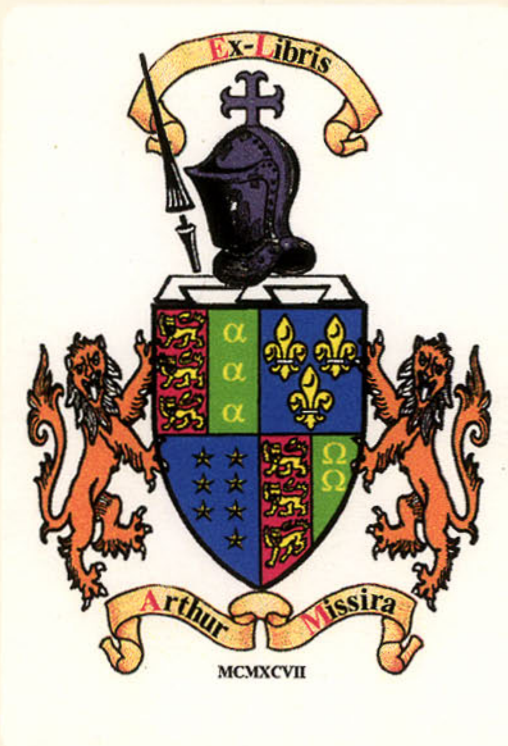
Power Devices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RCA Power Devices

This DATABOOK contains complete technical information on the full line of RCA solid-state power devices: power transistors, rf power transistors, power hybrid circuits, triacs, SCR's, diacs, silicon rectifiers, and rectifier assemblies. A complete index of these types is included on the following pages.

The index to devices is followed by a series of product selection charts that provide a quick reference to key parameters and device packages to facilitate type selection. A cross-reference guide then indicates recommended RCA replacements for more than 2000 popular industry types. Next, general operating considerations for solid-state power devices are discussed, and symbols and special terms used to characterize these devices are listed.

The DATABOOK also contains eight data sections that provide detailed ratings and characteristics for each of the various types of devices. Data pages for individual devices are given as nearly as possible in alphanumerical sequence of the basic family type numbers. Because many devices may be included in the same basic family, individual type numbers are not necessarily in sequence. *If you don't find a type number where you expect it to be, check the Index to Devices.*

General information such as test circuits and waveforms, dimensional outlines, suggested mounting arrangements, and lead forms for plastic packages are included in an Appendix at the back of the book. The Appendix also includes abstracts of relevant RCA application notes. The final pages contain listings of RCA sales offices, manufacturers' representatives, and authorized distributors.

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Index to Devices

BR = Bridge rectifier
D = Diac
GTO = Gate-turn-off SCR
ITR = Integrated thyristor/rectifier
PH = Power hybrid circuit
PT = Power transistor
R = Rectifier
RA = Rectifier assembly
RF = RF power transistor
SCR = Silicon controlled rectifier
TRI = Triac
* JAN-type versions also available.

Power Transistor Selection Charts

N-P-N SILICON POWER TRANSISTORS

Type No.	V_{CEO}(sus)	Current Gain			P_T (Max.)	I_C (Max.)	f_T	Sw. Times▲		Package	p-n-p Complement
		h_{FE}	I_C	V_{CE}				t_{ON}	t_f		
	V		A	V	W	A	MHz	µs			
I_C(Max.) = 0.15 to 1 A, f_T = 3 to 25 MHz											
40346	175	25 min.	0.010	10	10	1	15	–	–	TO-39	–
41505◆	200	20 min.	0.050	10	20	1	21	–	–	Plastic TO-5	–
2N3440	250	40-160	0.020	10	10	1	15	–	–	TO-39	2N5415
40412	250*	40 min.	0.030	20	10	1	15	–	–	TO-39	–
TIP47	250	10 min.	1	10	40	1	5	0.2	0.5	TO-220AB	–
40321	300*	25-200	0.020	10	5	1	15	–	–	TO-39	–
TIP48	300	10 min.	1	10	40	1	5	0.2	0.5	TO-220AB	–
2N3439	350	40-160	0.020	10	10	1	15	–	–	TO-39	2N5416
TIP49	350	10 min.	1	10	40	1	5	0.2	0.5	TO-220AB	–
TIP50	400	10 min.	1	10	40	1	5	0.2	0.5	TO-220AB	–
I_C (Max.) = 0.15 to 1 A, f_T = 50 to 100 MHz											
41502	30	20 min.	0.150	10	3	1	60	–	–	TO-39	41503
2N3053	40	50-250	0.150	10	5	1	60	–	–	TO-39	2N4037
2N3053A	60	50-250	0.150	10	5	0.7	60	–	–	TO-39	–
2N2102	65	25 min.	0.500	10	5	1	60	30 ns⊕	–	TO-39	2N4036
RCP115	100	50 min.	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP117	100	20 min.	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP111A	200	50-300	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP113A	200	30-150	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP111B	250	50-300	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP113B	250	30-150	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP115B	250	50 min.	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP117B	250	20 min.	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP111C	300	50-300	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP113C	300	30-150	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP111D	350	50-300	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
RCP113D	350	30-150	0.025	10	6.25	0.150	80	–	–	TO-202AB	–
I_C (Max.) = 1.5 to 2 A, f_T = 0.2 to 1.5 MHz											
2N1479	40	20-60	0.200	4	5	1.5	1.4	1.2	1	TO-39	–
2N1481	40	35-100	0.200	4	5	1.5	1.4	1.2	1	TO-39	–
40347	40	20-150	0.450	4	8.75	1.5	1.5	–	–	TO-39	–
2N1480	55	20-60	0.200	4	5	1.5	1.4	1.2	1	TO-39	–
2N1482	55	35-100	0.200	4	5	1.5	1.4	1.2	1	TO-39	–
40348	65	10 min.	1	4	8.75	1.5	1.5	–	–	TO-39	–
40349	140	10 min.	0.450	4	8.75	1.5	0.9	–	–	TO-39	–
I_C (Max.) = 1.5 to 2 A, f_T = 3 to 25 MHz											
2N5050	125	5	2	5	40	2	25	0.3@	1.2	TO-213MA	–
BUX67	150	10-150	1	5	35	2	10	3	3	TO-66	BUX66
2N5051	150	5	2	5	40	2	10	0.3@	1.2	TO-213MA	–
2N5052	200	5	2	5	40	2	10	0.3@	1.2	TO-213MA	–
2N3584	250	8-80	1	2	35	2	10	3	3	TO-66	2N6211
BUX67A	250	10-150	1	5	35	2	10	3	3	TO-66	BUX66A
2N3585	300	8-80	1	2	35	2	10	3	3	TO-66	2N6212
2N4240	300	10-100	0.750	2	35	2	15	0.5	3	TO-66	–
BUX67B	300	10-150	1	5	35	2	10	3	3	TO-66	BUX66B
BUX67C	350	10-150	1	5	35	2	10	3	3	TO-66	BUX66C
I_C (Max.) = 1.5 to 2A, f_T = 50 to 100 MHz											
RCP705	30	50 min.	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP704
RCP707	30	20 min.	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP706
RCP701A	40	50-250	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP700A
RCP703A	40	30-150	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP702A
2N5321	50	40-250	0.500	4	10	2	50	80 ns	800 ns★	TO-39	2N5323
2N6179	50	40-250	0.500	4	25	2	50	80 ns	800 ns★	Plastic TO-5	2N6181
2N6670	50	30	0.4	2	10	1.5	50	–	–	TO-202AB	–
RCP701B	60	50-250	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP700B
RCP703B	60	30-150	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP702B
RCP705B	60	50 min.	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP704B
RCP707B	60	20 min.	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP706B
2N55320	75	30-130	0.500	4	10	2	50	80 ns	800 ns★	TO-39	2N5322
2N6178	75	30-130	0.500	4	25	2	50	80 ns	800 ns★	Plastic TO-5	2N6180
RCP701C	80	50-250	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP700C
RCP703C	80	30-150	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP702C
RCA1A03	95*	70-300	0.300	4	10	2	50	–	–	TO-39	RCA1A04
RCP701D	100	50-250	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP700D
RCP703D	100	30-150	0.500	4	10	2	50	80 ns	800 ns★	TO-202AB	RCP702D

▲Measured at same current level as h_{FE} unless otherwise indicated *V_{CER}(sus) ★ t_{OFF}

◆Check availability in Europe, the Middle East, and Africa. ⊕ $t_d + t_r + t_f$ @t_r

N-P-N SILICON POWER TRANSISTORS (cont'd)

Type No.	V_{CEO}(sus)	Current Gain h_{FE}	Current Gain I_C	Current Gain V_{CE}	P_T (Max.)	I_C (Max.)	f_T	Sw. Times▲ t_{ON}	Sw. Times▲ t_f	Package	p-n-p Complement
	V		A	V	W	A	MHz	µs	µs		
I_C (Max.) = 2.5 to 5A, f_T = 0.2 to 2 MHz											
2N1483	40	20-60	0.750	4	25	3	0.8	1.2	1.1	TO-8	–
2N1485	40	35-100	0.750	4	25	3	0.8	1.2	1.1	TO-8	–
2N5786	40	20-100	1.6	2	10	3.5	1	5○	15★○	TO-39	2N5783
2N5295	40	30-120	1	4	36	4	0.8	5	15★	TO-220AB	2N6108
2N5296	40	30-120	1	4	36	4	0.8	5	15★	TO-220AB	2N6109
2N6260	40	3 min	4	2	29	3	0.8	–	–	TO-66	–
40250	40	25 min.	1.5	4	29	4	1	–	–	TO-66	2N5956
2N5785	50	20-100	1.2	2	10	3.5	1	5○	15★○	TO-39	2N5782
2N1484	55	20-80	0.750	4	25	3	0.8	1.2	1.1	TO-8	–
2N1486	55	35-100	0.750	4	25	3	0.8	1.2	1.1	TO-8	–
2N3054	55	5 min.	3	4	25	4	0.8	–	–	TO-66	2N5955
RCA3054	55	5 min.	3	4	36	4	0.8	–	–	TO-220AB	–
BDY71	55	5 min.	3	4	29	4	0.8	–	–	TO-66	–
2N5297	60	20-80	1.5	4	36	4	0.8	5	15★	TO-220AA	2N6106
2N5298	60	20-80	1.5	4	36	4	0.8	5	15★	TO-220AB	2N6107
2N5784	65	20-100	1	2	10	3.5	1	5	15★	TO-39	2N5781
2N5293	70	30-120	0.5	4	36	4	0.8	5	15★	TO-220AA	2N6106
2N5294	70	30-120	0.5	4	36	4	0.8	5	15★	TO-220AB	2N6107
2N6261	80	5 min.	4	2	50	4	0.8	–	–	TO-66	–
RCA8638E	100	10	7.5	2	200	20	2	–	–	TO-204MA	RCA9116E
RCA8638D	120	10	10	2	200	20	2	–	–	TO-204MA	RCA9116D
2N6477	120	5 min.	2.5	4	50	2.5	0.2	–	–	TO-220AB	–
2N6263	120	3 min.	3	2	20	3	0.2	–	–	TO-66	2N6468
RCA6263	120	20-150	0.5	4	36	3	0.2	–	–	TO-220AB	–
2N4347	120	10 min.	5	4	100	5	0.2	–	–	TO-3	2N6248
2N6478	140	5 min.	2.5	4	50	2.5	0.2	–	–	TO-220AB	–
2N3441	140	5 min.	2.7	4	25	3	0.2	–	–	TO-66	2N6468
RCA3441	140	20-150	0.5	4	36	3	0.2	–	–	TO-220AB	–
RCA3773	140	5	16	4	150	20	2	–	–	TO-204MA	2N6609
RCA8638C	140	10	10	2	200	20	2	–	–	TO-204MA	RCA9116C
MJ15003	140	10	10	2	250	20	2	–	–	TO-204MA	MJ15004
2N6264	150	5 min.	3	2	50	3	0.2	–	–	TO-66	–
BU207	600	2.25	4.5	5	12.5	5	1	–	0.6	TO-204MA	–
BU208	700	2.25	4.5	5	12.5	5	1	–	0.6	TO-204MA	–
BU208A	700	2.5	4.5	5	12.5	5	1	–	0.6	TO-204MA	–
I_C = 2.5 to 5 A, f_T = 3 to 25 MHz											
RCA29♦	40	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	RCA30
RCA31♦	40	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	RCA32
RCS29♦	40	15-150	1	4	30	3	3	0.4	1.2★	TO-66	RCS30
RCS31♦	40	25 min.	1	4	40	5	3	0.4	1.2★	TO-66	RCS32
TIP29	40	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	TIP30
TIP31	40	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	TIP32
BD239	45	15 min.	1	4	30	4	3	–	–	TO-220AB	BD240
BD241	45	25 min.	1	4	40	5	3	–	–	TO-220AB	BD242
BD239A	60	15 min.	1	4	30	4	3	–	–	TO-220AB	BD240A
BD241A	60	25 min.	1	4	40	5	3	–	–	TO-220AB	BD242A
RCA29A♦	60	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	RCA30A
RCA31A♦	60	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	RCA32A
TIP29A	60	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	TIP30A
TIP31A	60	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	TIP32A
BD239B	80	15 min.	1	4	30	4	3	–	–	TO-220AB	BD240B
BD241B	80	25 min.	1	4	40	5	3	–	–	TO-220AB	BD242B
RCA29B♦	80	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	RCA30B
RCA31B♦	80	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	RCA32B
TIP29B	80	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	TIP30B
TIP31B	80	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	TIP32B
2N6465	100	5 min.	4	4	40	4	5	–	–	TO-66	2N6467
2N6473	100	2 min.	4	2.5	40	4	4	–	–	TO-220AB	2N6475
2N5869	60	4	5	4	87.5	5	4	0.7@	0.8	TO-204MA	–
2N5870	80	4	5	4	87.5	5	4	0.7@	0.8	TO-204MA	–
BD239C	100	15 min.	1	4	30	4	3	–	–	TO-220AB	BD240C
BD241C	100	25 min.	1	4	40	5	3	–	–	TO-220AB	BD242C
RCA29C♦	100	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	RCA30C
RCA31C♦	100	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	RCA32C
TIP29C	100	15-150	1	4	30	3	3	0.4	1.2★	TO-220AB	TIP30C
TIP31C	100	25 min.	1	4	40	5	3	0.4	1.2★	TO-220AB	TIP32C

▲Measured at same current level as h_{FE} unless otherwise indicated   *V_{CER}(sus)   ★t_{OFF}

♦Check availability in Europe, the Middle East, and Africa.   @t_r ○At I_C = 1A

Power Transistor Selection Charts

N-P-N SILICON POWER TRANSISTORS (cont'd)

Type No.	V_{CEO}(sus) V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	f_T MHz	Sw. Times▲ t_{ON} µs	Sw. Times▲ t_f µs	Package	p-n-p Complement
I_C = 2.5 to 5 A, f_T = 3 to 25 MHz (cont'd)											
2N6466	120	5 min.	4	4	40	4	5	–	–	TO-66	2N6468
2N6474	120	2 min.	4	2.5	40	4	4	–	–	TO-220AB	2N6476
BUX16	200	5 min.	4.5	10	100	5	5	–	–	TO-3	–
2N5239	225	5 min.	4.5	10	100	5	5	–	–	TO-3	–
2N5838	250	8-40	3	2	100	3	5	0.86	0.4	TO-3	–
BU133	250	15-80	1	5	80	3	3.5	–	0.5	TO-3	–
BUX16A	250	5 min.	4.5	10	100	5	5	–	–	TO-3	–
2N5839	275	10-50	2	3	100	3	5	0.67	0.35	TO-3	–
2N5240	300	5 min.	4.5	10	100	5	5	–	–	TO-3	–
2N6542	300	7	3	2	100	5	6	0.75	0.8	TO-204MA	–
BU126	300	15-60	1	5	80	3	3.5	–	0.5	TO-3	–
BUX16B	300	5 min.	4.5	10	100	5	5	–	–	TO-3	–
2N5840	350	10-50	2	3	100	3	5	0.67	0.35	TO-3	–
BUX16C	350	5 min.	4.5	10	100	5	5	–	–	TO-3	–
I_C = 2.5 to 5 A, f_T = 50 to 100 MHz											
2N3878	50	20 min.	4	5	35	4	40	–	–	TO-66	–
2N5202	50	10-100	4	1.2	35	4	60	0.44	0.4	TO-66	–
2N6500	90	15-60	3	2	35	4	60	0.44	0.5	TO-66	–
I_C = 6 to 10 A, f_T = 0.2 to 1 MHz											
2N1487	40	15-45	1.5	4	75	6	0.8	–	–	TO-3	–
2N1489	40	25-75	1.5	4	75	6	0.8	–	–	TO-3	–
2N5490	40	20-100	2	4	50	7	0.8	5	15*	TO-220AB	2N6109
2N5491	40	20-100	2	4	50	7	0.8	5	15*	TO-220AA	2N6108
2N5494	40	20-100	3	4	50	7	0.8	5	15*	TO-220AB	2N6109
2N5495	40	20-100	3	4	50	7	0.8	5	15*	TO-220AA	2N6108
BD278	45	15-75	4	4	75	10	0.8	–	–	TO-220AB	–
2N1488	55	15-45	1.5	4	75	6	0.8	–	–	TO-3	–
2N1490	55	25-75	1.5	4	75	6	0.8	–	–	TO-3	–
2N5492	55	20-100	2.5	4	50	7	0.8	5	15*	TO-220AB	2N6107
2N5493	55	20-100	2.5	4	50	7	0.8	5	15*	TO-220AA	2N6106
2N3715	60	5	10	4	150	10	25	–	–	TO-204MA	–
2N3716	80	5	10	4	150	10	25	–	–	TO-204MA	–
2N6098	60	5 min.	10	4	75	10	0.8	–	–	TO-220AA	–
2N6099	60	5 min.	10	4	75	10	0.8	–	–	TO-220AB	–
BD278A	60	15-75	4	4	75	10	0.8	–	–	TO-220AB	–
2N5496	70	20-100	3.5	4	50	7	0.8	5	15*	TO-220AB	2N6107
2N5497	70	20-100	3.5	4	50	7	0.8	5	15*	TO-220AA	2N6106
2N6100	70	20-80	5	4	75	10	0.8	–	–	TO-220AA	–
2N6101	70	20-80	5	4	75	10	0.8	–	–	TO-220AB	–
2N5632	100	5	10	2	150	10	1	–	–	TO-204MA	–
2N4348	120	10 min.	10	4	120	10	0.2	–	–	TO-3	2N6248
2N5633	120	5	10	2	150	10	1	–	–	TO-204MA	–
2N5634	140	5	10	2	150	10	1	–	–	TO-204MA	–
2N3442	140	7.5 min.	10	4	117	10	0.8	–	–	TO-3	–
2N6262	150	5 min.	10	2	150	10	0.8	–	–	TO-3	–
2N6078	250	12-70	1.2	1	45	7	1	0.32	0.3	TO-66	–
2N6077	275	12-70	1.2	1	45	7	1	0.32	0.3	TO-66	–
2N6079	350	12-50	1.2	1	45	7	1	0.32	0.3	TO-66	–
IC = 6 to 10 A, f_T = 2.5 to 25 MHz											
41500	25	25 min.	1	4	40	7	4	–	–	TO-220AB	41501
2N6288	30	2.3 min.	7	4	40	7	4	–	–	TO-220AB	2N6111
2N6289	30	2.3 min.	7	4	40	7	4	–	–	TO-220AA	2N6110
2N6374	40	5 min.	6	4	40	6	4	–	–	TO-66	2N5956
RCA41♦	40	15-150	3	4	65	7	3	0.6•	1.4*•	TO-220AB	RCA42
TIP41	40	15-150	3	4	65	7	3	0.6•	1.4*•	TO-220AB	TIP42
BD243	45	15 min.	3	4	65	7	2	–	–	TO-220AB	BD244
2N6290	50	2.3 min.	7	4	40	7	4	–	–	TO-220AB	2N6109
2N5871	60	4	10	4	150	10	20	–	–	TO204MA	–
2N5878	80	4	10	4	150	10	20	–	–	TO-204MA	–
2N6671	300	10	5	3	150	8	15	0.8@	0.8	TO-204MA	–
2N6672	350	10	5	3	150	8	15	0.8@	0.8	TO-204MA	–
2N6673	400	10	5	3	150	8	15	0.8@	0.8	TO-204MA	–
2N6669	30	20	5	2	40	10	10	0.35	0.5	TO-220AB	–
BD243	45	15 min.	3	4	65	7	2	–	–	TO-220AB	BD244
2N6290	50	2.3 min.	7	4	40	7	4	–	–	TO-220AB	2N6109
2N6291	50	2.3 min.	7	4	40	7	4	–	–	TO-222AA	2N6108

▲Measured at same current level as h_{FE} unless otherwise indicated *t_{OFF} •At I_C = 6A

♦Check availability in Europe, the Middle East, and Africa. @t_r

N-P-N SILICON POWER TRANSISTORS (cont'd)

Type No.	V_{CEO}(sus)	Current Gain h_{FE}	Current Gain I_C	Current Gain V_{CE}	P_T (Max.)	I_C (Max.)	f_T	Sw. Times▲ t_{ON}	Sw. Times▲ t_f	Package	p-n-p Complement
	V		A	V	W	A	MHz	µs	µs		
I_C = 6 to 10 A, f_T = 2.5 to 25 MHz (cont'd)											
2N6373	60	5 min.	6	4	40	6	4	–	–	TO-66	2N5955
BD243A	60	15 min.	3	4	65	7	3	–	–	TO-220AB	BD244A
RCA41A▲	60	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	RCA42A
TIP41A	60	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	–
2N6292	70	2.3 min.	7	4	40	7	4	–	–	TO-220AB	2N6107
2N6293	70	2.3 min.	7	4	40	7	4	–	–	TO-220AA	2N6106
2N6372	80	5 min.	6	4	40	6	4	–	–	TO-66	2N5954
BD243B	80	15 min.	3	4	65	7	3	–	–	TO-220AB	BD244B
RCA41B	80	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	RCA42B
TIP41B	80	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	–
BD243C	100	15 min.	3	4	65	7	3	–	–	TO-220AB	BD244C
RCA41C	100	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	RCA42C
TIP41C	100	15-150	3	4	65	7	3	0.6●	1.4*●	TO-220AB	–
BU106	140	8 min.	4	5	75	7	3	–	1.5	TO-3	–
BUX17	150	7 min.	10	3	150	10	2.5	2	1	TO-3	–
2N6249	200	10-50	10	3	175	10	8	0.8@	0.5	TO-3	–
2N6510	200	10-50	3	3	120	7	3	0.8	0.5	TO-3	–
BUX18	200	7 min.	6	3	120	8	3	–	0.6♠	TO-3	–
RCA410	200	30 min.	1	5	125	7	4	0.35@	0.15	TO-3	–
2N6306	250	15-75	3	5	125	8	5	0.6@	0.4	TO-3	–
2N6511	250	10-50	4	3	120	7	3	0.8	0.5	TO-3	–
BUX17A	250	7 min.	10	3	150	10	2.5	2	1	TO-3	–
RCS579♦	250	12 min.	3	5	125	8	5	0.6@	0.4	TO-3	–
2N6250	275	8-50	10	3	175	10	8	0.8@	0.5	TO-3	–
BUX18A	275	7 min.	5	3	120	8	3	–	0.6♠	TO-3	–
2N6307	300	15-75	3	5	125	8	5	0.6@	0.4	TO-3	–
2N6512	300	10-50	4	3	120	7	3	1.7	1.5	TO-3	–
2N6514	300	10-50	5	3	120	7	3	0.8	0.5	TO-3	–
2N6544	300	7	5	2	125	8	6	1.05	1	TO-204MA	–
BUX17B	300	7 min.	8	3	150	10	2.5	2	1	TO-3	–
RCA411	300	30-90	1	5	125	7	2.5	0.35@	0.15	TO-3	–
RCA8767	300	8 min.	6	3	175	10	20	0.4@	0.3	TO-3	–
BUX18B	325	10 min.	4	3	120	8	3	–	0.6♠	TO-3	–
RCA413	325	15 min.	1	5	125	7	4	0.35@	0.15	TO-3	–
RCA423	325	30-90	1	5	125	7	4	0.35@	0.15	TO-3	–
RCA431	325	15-35	2.5	5	125	7	4	0.35@	0.15	TO-3	–
2N6251	350	6-50	10	3	175	10	8	0.8@	0.5	TO-3	–
2N6308	350	12-60	3	5	125	8	5	0.6@	0.4	TO-3	–
2N6513	350	10-50	4	3	120	7	3	0.8	0.5	TO-3	–
BUX17C	350	7 min.	8	3	150	10	2.5	2	1	TO-3	–
BUX18C	375	10 min.	4	3	120	8	3	–	0.6♠	TO-3	–
RCA8766	350	100 min.	6	3	150	10	10	–	–	TO-3	–
RCA8766A	350	100 min.	4	3	150	10	10	–	–	TO-3	–
RCA8767A	350	8 min.	6	3	175	10	20	0.4@	0.3	TO-3	–
BUX18C	375	10 min.	4	3	120	8	3	–	0.6♠	TO-3	–
RCA8766B	400	100 min.	6	3	150	10	10	–	–	TO-3	–
RCA8766C	400	100 min.	4	3	150	10	10	–	–	TO-3	–
RCA8767B	400	8 min.	6	3	175	10	20	0.4@	0.3	TO-3	–
RCA8766D	450	100 min.	6	3	150	10	10	–	–	TO-3	–
RCA8766E	450	100 min.	4	3	150	10	10	–	–	TO-3	–
I_C = 6 to 10 A, f_T = 50 to 100 MHz											
2N3879	75	12-100	4	2	35	7	60	0.44	0.4	TO-66	–
2N6354	120	2 min.	10	2	140	10	80	1@	0.2	TO-3	–
I_C = 12 to 20 A, f_T = 0.2 to 2 MHz											
2N6102	40	5 min.	16	4	75	16	0.8	–	–	TO-220AA	–
2N6103	40	5 min.	16	4	75	16	0.8	–	–	TO-220AB	–
2N6257	40	5 min.	20	4	150	20	0.2	–	–	TO-3	–
2N6371	40	4 min.	16	4	117	16	0.8	–	–	TO-3	2N6469
2N6569	40	5-100	12	4	100	12	1.5	1.9■	1.5■	TO-3	2N6594
RCA41/SDH♦	40	15 min.	3	4	75	16	0.8	3.23@	3.7*●	TO-220AB	–
2N6253	45	3 min.	15	4	115	15	0.8	–	–	TO-3	–
BD142	45	12.5-160	4	4	117	15	0.8	–	–	TO-3	–
BD181	45	20-70	3	4	117	15	0.8	–	–	TO-3	–
2N3055(Hom.)	60	5 min.	10	4	115	15	0.8	–	–	TO-3	2N6246
2N3772	60	5 min.	20	4	150	20	0.2	–	–	TO-3	2N6246
BD182	60	20-70	4	4	117	15	0.8	–	–	TO-3	–
RCA3055	60	5 min.	10	4	75	15	0.8	–	–	TO-220AB	–

▲Measured at same current level as h_{FE} unless otherwise indicated ●At I_C = 6A ♠At I_C = 4A @t_r *t_{OFF}
♦Check availability in Europe, the Middle East, and Africa. ■At I_C = 2A

Power Transistor Selection Charts

N-P-N SILICON POWER TRANSISTORS (cont'd)

Type No.	V_{CEO}(sus) V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	f_T MHz	Sw. Times▲ t_{ON} µs	Sw. Times▲ t_f µs	Package	p-n-p Complement
I_C = 12 to 20 A, f_T = 0.2 to 2 MHz (cont'd)											
2N5881	60	4	15	4	160	15	4	–	–	TO-204MA	2N5879
RCS258♦	60	5 min.	20	4	250	20	0.2	–	–	TO-3	–
40363	70*	20-70	4	4	115	15	0.7	–	–	TO-3	–
2N6254	80	5 min.	15	4	150	15	0.8	–	–	TO-3	–
RCS617	80	20	5	4	115	15	2.5	–	–	TO-204MA	RCS618
2N5882	80	4	15	4	160	15	4	–	–	TO-204MA	2N5880
BD183	80	20-70	3	4	117	15	0.8	–	–	TO-3	–
RCA1B01♦	95*	20-70	4	4	115	15	0.8	–	–	TO-3	–
2N3773	120	5 min.	16	4	150	16	0.2	–	–	TO-3	–
BDY37	140	15-60	8	4	150	16	0.2	–	–	TO-3	–
MJ15001	140	25	4	2	200	15	2	–	–	TO-204MA	MJ15002
2N6259	150	10 min.	16	4	250	16	0.2	–	–	TO-3	–
I_C = 12 to 20 A, f_T = 2.5 to 25 MHz											
2N6470	40	5 min.	15	4	125	15	5	–	–	TO-3	2N6469
2N6486	40	5 min.	15	4	75	15	5	–	–	TO-220AB	2N6489
2N3055	60	20-70	4	4	115	15	2.5	1.9■	1.5■	TO-3	MJ2955
2N6471	60	5 min.	15	4	125	15	5	–	–	TO-3	2N6246
2N6487	60	5 min.	15	4	75	15	5	–	–	TO-220AB	2N6490
2N6472	80	5 min.	15	4	125	15	5	–	–	TO-3	2N6247
2N6488	80	5 min.	15	4	75	15	5	–	–	TO-220AB	2N6491
RCS617	80	20-70	5	4	115	15	2.5	1.9■	1.5■	TO-3	RCS618
2N6674	300	8	10	2	175	15	15	0.7	0.5	TO-204MA	–
2N6676	300	8	15	3	175	15	15	–	–	TO-204MA	–
RCA9113	300	15 min.	5	3	175	15	20	1.03*	0.75x	TO-3/ TO-204MA	–
RCA9113A	350	15 min.	5	3	175	15	20	1.03*	0.76x	TO-3/ TO-204MA	–
2N6677	350	8	15	3	175	15	15	–	–	TO-204MA	–
2N6675	400	8	10	2	175	15	15	0.7	0.5	TO-204MA	–
2N6678	400	8	15	3	175	15	15	–	–	TO-204MA	–
RCA9113B	400	15 min.	3	3	175	15	20	1.03*	0.75x	TO-3/ TO-204MA	–
I_C = 12 to 20 A, f_T = 50 to 100 MHz											
2N6479%■	60	20-300	12	2	87	12	100	–	–	Radial■	–
2N6481%	60	20-300	12	2	117	12	100	–	–	Radial	–
2N5039	75	20-100	10	5	140	20	60	0.5@	0.5	TO-3	–
2N6480%■	80	20-300	12	2	87	12	100	–	–	Radial■	–
2N6482%	80	20-300	12	2	117	12	100	–	–	Radial	–
2N5038	90	20-100	12	5	140	20	60	0.5@	0.5	TO-3	–
2N6496	110	12-100	8	2	140	15	60	0.5@	0.5	TO-3	–
I_C = 25 to 50 A, f_T = 0.2 to 1 MHz											
2N3771	40	5 min.	30	4	150	30	0.2	–	–	TO-3	–
2N5301	40	5	30	3	200	30	2	2@	1	TO-204MA	–
2N5302	60	5	30	3	200	30	2	2@	1	TO-204MA	–
BDY29	75	15-60	15	2	220	30	0.2	–	–	TO-3	–
2N5303	80	5	20	3	200	30	2	2@	1	TO-204MA	–
I_C = 25 to 50 A, f_T = 2.5 to 25 MHz											
2N3264	60	20-80	15	3	125	25	20	0.5	0.5	Radial	–
2N3266	60	20-80	15	3	125	25	20	0.5	0.5	TO-63	–
2N5885	60	4	25	4	200	25	4	0.7@	0.8	TO-204MA	–
2N6326	60	6	30	4	200	30	3	0.45	0.9*	TO-204MA	–
2N5886	80	4	25	4	200	25	4	0.7@	0.8	TO-204MA	–
2N6327	80	6	30	4	200	30	3	0.45	0.9*	TO-204MA	–
2N3263	90	25-75	15	3	125	25	20	0.5	0.5	Radial	–
2N3265	90	25-75	15	3	125	25	20	0.5	0.5	TO-63	–
2N6546	300	6	10	2	175	15	6	1.05	0.7	TO-204MA	–
I_C = 25 to 50 A, f_T = 50 to 100 MHz											
2N6032	90	10-50	50	2.6	140	50	50	1@	0.5	Mod. TO-3	–
2N5671	90	20-100	15	2	140	30	50	0.5	0.5	TO-3	–
2N6033	120	10-50	40	2	140	40	50	1@	0.5	Mod. TO-3	–
2N5672	120	20-100	15	2	140	30	50	0.5	0.5	TO-3	–
$I_C \geq$ 60 A, f_T = 0.4 MHz											
2N5575	50	10-40	60	4	300	80	0.4	15	15	Mod. TO-3	–
2N5578	70	10-40	40	3	300	60	0.4	15	15	Mod. TO-3	–

▲Measured at same current level as h_{FE} unless otherwise indicated ●At I_C = 6A ♦At I_C = 4A *t_{OFF} @t_r

♦Check availability in Europe, the Middle East, and Africa. ■At I_C = 2A *V_{CER}(sus) ×At I_C = 10 A %Radiation hardened

P-N-P SILICON POWER TRANSISTORS

Type No.	V_{CEO}(sus)	Current Gain			P_T (Max.)	I_C (Max.)	f_T	Sw. Times▲		Package	n-p-n Complement
		h_{FE}	I_C	V_{CE}				t_{ON}	t_f		
	V		A	V	W	A	MHz	µs			
I_C = −0.15 to −1 A, f_T = 0.2 to 1 MHz											
BFT28	−100	20 min.	−0.010	−10	5	−1	25	–	–	TO-39	–
BFT19	−150	20 min.	−0.050	−10	5	−1	25	–	–	TO-39	–
BFT28A	−150	20 min.	−0.010	−10	5	−1	25	–	–	TO-39	–
RCS880♦	−150	20-150	−0.050	−10	7.5	−1	15	–	–	TO-39	–
2N5415	−200	30-150	−0.050	−10	10	−1	15	–	–	TO-39	2N3440
BFT28B	−200	20 min.	−0.010	−10	5	−1	25	–	–	TO-39	–
BFT19A	−250	20 min.	−0.050	−10	5	−1	25	–	–	TO-39	–
BFT28C	−250	20 min.	−0.010	−10	5	−1	25	–	–	TO-39	–
RC881♦	−250	20 min.	−0.035	−10	7.5	−1	15	–	–	TO-39	–
2N5416	−300	30-120	−0.050	−10	10	−1	15	–	–	TO-39	2N3439
RCS882♦	−300	20 min.	−0.035	−10	7.5	−1	15	–	–	TO-39	–
BFT19B	−350	20 min.	−0.050	−10	5	−1	25	–	–	TO-39	–
I_C = −0.15 to −1 A, f_T = 50 to 100 MHz											
41503	−30	20 min.	−0.150	−10	7	−1	60	–	–	TO-39	41502
2N4037	−40	50-250	−0.150	−10	7	−1	60	–	–	TO-39	2N3053
2N4036	−65	40-140	−0.150	−10	7	−1	60	0.11	0.1	TO-39	2N2102
2N4314	−65	50-250	−0.150	−10	7	−1	60	–	–	TO-39	–
I_C = −1.5 to −2 A, f_T = 2.5 to 25 MHz											
BUX66	−150	10-150	−1	−5	35	−2	20	0.6@	0.6	TO-66	BUX67
2N6211	−225	10-100	−1	−2.8	20	−2	20	0.6@	0.6	TO-66	2N3584
BUX66A	−250	10-150	−1	−5	35	−2	20	0.6@	0.6	TO-66	BUX67A
2N6212	−300	10-100	−1	−3.2	20	−2	20	0.6@	0.6	TO-66	2N3585
BUX66B	−300	10-150	−1	−5	35	−2	20	0.6@	0.6	TO-66	BUX67B
2N6213	−350	10-100	−1	−4	20	−2	20	0.6@	0.6	TO-66	2N3585
BUX66C	−350	10-150	−1	−5	35	−2	20	0.6@	0.6	TO-66	BUX67C
2N6214	−400	10-100	−1	−5	20	−2	20	0.6@	0.6	TO-66	–
I_C = −1.5 to −2 A, f_T = 50 to 100 MHz											
RCP704	−30	50 min.	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP705
RCP706	−30	20 min.	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP707
RCP700A	−40	50-250	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP701A
RCP702A	−40	30-150	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP703A
2N5323	−50	40-250	−0.5	−4	10	−2	50	0.1	1★	TO-39	2N5321
2N6181	−50	40-250	−0.5	−4	25	−2	50	0.1	1★	Plastic TO-5	2N6179
RCP700B	−60	50-250	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP701B
RCP702B	−60	30-150	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP703B
RCP704B	−60	50 min.	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP705B
RCP706B	−60	20 min.	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP707B
2N5322	−75	30-130	−0.5	−4	10	−2	50	0.1	1★	TO-39	2N5320
2N6180	−75	30-150	−0.5	−4	25	−2	50	0.1	1★	Plastic TO-5	2N6178
RCP700C	−80	50-250	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP701C
RCP702C	−80	30-150	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP703C
RCA1A04♦	−95*	50 min.	−0.1	−4	10	−2	50	–	–	TO-39	RCA1A03
RCP700D	−100	50-250	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP701D
RCP702D	−100	30-150	−0.5	−4	10	−2	50	0.1	1★	TO-202AB	RCP703D
I_C = −2.5 to −5 A, f_T = 2.5 to 25 MHz											
2N4915	80	7	5	2	87.5	5	4	–	–	TO-204MA	2N4906
2N4914	60	7	5	2	87.5	5	4	–	–	TO-204MA	2N4905
2N4913	40	7	5	2	87.5	5	4	–	–	TO-204MA	2N4904
2N4904	−40	25	−2.5	−2	87.5	−5	4	–	–	TO-204MA	2N4913
2N5783	−40	4 min.	−3.2	−2	10	−3.5	8	0.5○	2.5★○	TO-39	2N5786
RCA30♦	−40	15-150	−1	−4	30	−3	3	0.2	1★	TO-220AB	RCA29
RCA32♦	−40	25 min.	−1	−4	40	−5	3	0.2	1★	TO-220AB	RCA31
RCS30♦	−40	15-150	−1	−4	30	−3	3	0.2	1★	TO-66	RCS29
RCS32♦	−40	25 min.	−1	−4	40	−5	3	0.2	1★	TO-66	RCS31
TIP30	−40	15-150	−1	−4	30	−3	3	0.2	1★	TO-220AB	TIP29
TIP32	−40	25 min.	−1	−4	40	−5	3	0.2	1★	TO-220AB	TIP31
BD240	−45	15 min.	−1	−4	30	−4	3	–	–	TO-220AB	BD239
BD242	−45	25 min.	−1	−4	40	−5	3	–	–	TO-220AB	BD241
2N5782	−50	4 min.	−3.2	−4	10	−3.5	8	0.5○	2.5★○	TO-39	2N5785
2N4905	−60	25	−2.5	−2	87.5	−5	4	–	–	TO-204MA	2N4914
BD240A	−60	15 min.	−1	−4	30	−4	3	–	–	TO-220AB	BD239A
BD242A	−60	10 min.	−3	−4	40	−5	3	–	–	TO-220AB	BD241A
RCA30A♦	−60	15-150	−1	−4	30	−5	3	0.2	1★	TO-220AB	RCA29A
RCA32A♦	−60	25 min.	−1	−4	40	−5	3	0.2	1★	TO-220AB	RCA31A
RCS30A♦	−60	15-150	−1	−4	30	−3	3	0.2	1★	TO-66	RCS29A

▲Measured at same current level as h_{FE} unless otherwise indicated   *V_{CER}(sus)   @t_r ★t_{OFF}

♦Check availability in Europe, the Middle East, and Africa.   ○At I_C = 1A

Power Transistor Selection Charts

P-N-P SILICON POWER TRANSISTORS (Cont'd)

Type No.	V_{CEO}(sus) V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	f_T MHz	Sw. Times▲ t_{ON} µs	Sw. Times▲ t_f µs	Package	n-p-n Complement
I_C = −2.5 to −5 A, f_T = 2.5 to 25 MHz (cont'd)											
RCS32A♦	−60	25 min.	−1	−4	40	−5	3	0.2	1*	TO-66	RCS31A
TIP30A	−60	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	TIP29A
TIP32A	−60	25 min.	−1	−4	40	−5	3	0.2	1*	TO-220AB	TIP31A
2N5781	−65	20-100	−1	−2	10	−3.5	8	0.5	2.5*	TO-39	2N5784
2N4906	−80	25	−2.5	−2	87.5	−5	4	–	–	TO-204MA	2N4915
BD240B	−80	15 min.	−1	−4	30	−4	3	–	–	TO-220AB	BD239B
RD242B	−80	25 min.	−1	−4	40	−5	3	–	–	TO-220AB	BD241B
RCA30B♦	−80	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	RCA29B
RCA32B♦	−80	25 min.	−1	−4	40	−5	3	0.2	1*	TO-220AB	RCA31B
RCS30B♦	−80	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	RCS29B
RCS32B♦	−80	25 min.	−1	−4	40	−5	3	0.2	1*	TO-66	RCS31B
TIP30B	−80	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	TIP29B
TIP32B	−80	25 min.	−1	−4	40	−5	3	0.2	1*	TO-220AB	TIP31B
2N6467	−100	5 min.	−4	−4	40	−4	−5	–	–	TO-66	2N6465
2N6475	−100	2 min.	−2.5	−4	40	−4	10	–	–	TO-220AB	2N6473
BD240C	−100	15 min.	−1	−4	30	−4	3	–	–	TO-220AB	BD239C
BD242C	−100	10 min.	−3	−4	40	−5	−3	–	–	TO-220AB	BD241C
RCA30C♦	−100	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	RCA29C
RCA32C♦	−100	25 min.	−1	−4	40	−5	3	0.2	1*	TO-220AB	RCA31C
RCS30C♦	−100	15-150	−1	−4	30	−3	3	0.2	1*	TO-66	RCS29C
RCS32C	−100	25 min.	−1	−4	40	−5	3	0.2	1*	TO-66	RCS31C
TIP30C	−100	15-150	−1	−4	30	−3	3	0.2	1*	TO-220AB	TIP29C
TIP32C	−100	25 min.	−1	−4	40	−5	3	0.2	1*	TO-220AB	TIP32C
2N6468	−120	5 min.	−4	−4	40	−4	5	–	–	TO-66	2N6466
2N6476	−120	2 min.	−4	−2.5	40	−4	10	–	–	TO-220AB	2N6474
I_C = −6 to −10 A, f_T = 2.5 to 25 MHz											
41501	−25	25 min.	−1	−4	40	−7	10	–	–	TO-220AB	41500
2N6110	−30	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AA	2N6289
2N6111	−30	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AB	2N6288
2N5956	−40	5 min.	−6	−4	40	−6	5	–	–	TO-66	2N6374
RCA42♦	−40	15-150	−3	−4	65	−7	3	0.3•	0.7*•	TO-220AB	RCA41
BD244	−45	15 min.	−3	−4	65	−7	3	–	–	TO-220AB	BD243
BD277	−45	30-150	−1.75	−2	70	−7	10	–	–	TO-220AB	–
2N6108	−50	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AA	2N6291
2N6109	−50	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AB	2N6290
2N5955	−60	5 min.	−6	−4	40	−6	5	–	–	TO-66	2N6373
2N5875	−60	4	10	4	150	10	20	–	–	TO-204MA	–
BD244A	−60	15 min.	−3	−4	65	−7	3	–	–	TO-220AB	BD243A
RCA42A♦	−60	15-150	−3	−4	65	−7	3	0.3•	0.7*•	TO-220AB	RCA41A
2N6106	−70	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AA	2N6293
2N6107	−70	2.3 min.	−7	−4	40	−7	10	–	–	TO-220AB	2N6292
2N5954	−80	5 min.	−6	−4	40	−6	5	–	–	TO-66	2N6372
2N5876	−80	4	10	4	150	10	20	–	–	TO-204MA	–
BD244B	−80	15 min.	−3	−4	65	−7	3	–	–	TO-220AB	BD243B
RCA42B♦	−80	15-150	−3	−4	65	−7	3	0.3•	0.7*•	TO-220AB	RCA41B
2N6248	−100	5 min.	−10	−4	125	−10	10	–	–	TO-3	–
BD244C	−100	15 min.	−3	−4	65	−7	3	–	–	TO-220AB	BD243C
RCA42C♦	−100	15-150	−3	−4	65	−7	3	0.3•	0.7*•	TO-220AB	RCA41C
I_C = −12 to −20 A, f_T = 2 to 25 MHz											
2N6469	−40	5 min.	−15	−4	125	−15	5	–	–	TO-3	2N6470
2N6489	−40	5 min.	−15	−4	75	−15	5	–	–	TO-220AB	2N6486
2N6594	−40	5-100	−5	−4	100	−12	2.5	1.9■	1.5■	TO-3	2N6594
2N5879	−60	4	15	4	160	15	4	–	–	TO-204MA	2N5881
2N6246	−60	5 min.	−15	−4	125	−15	5	–	–	TO-3	2N6471
2N6490	−60	5 min.	−15	−4	75	−15	5	–	–	TO-220AB	2N6487
BDX18	−60	20	−4	−4	115	−15	4	–	–	TO-204MA	2N3055
MJ2955	−60	20-70	−4	−4	115	−15	2.5	1.9■	1.5■	TO-3	2N3055
2N6247	−80	5 min.	−15	−4	125	−15	5	–	–	TO-3	2N6472
2N6491	−80	5 min.	−15	−4	75	−15	5	–	–	TO-220AB	2N6488
RCS618	−80	20-70	−5	−4	115	−15	25	1.9■	1.5■	TO-3	RCS617
2N5880	−80	4	15	4	160	15	4	–	–	TO-204MA	2N5882
RCA9116E	−100	10	−7.5	−2	200	−20	2	–	–	TO-204MA	RCA8638E
RCA9116D	−120	10	−10	−2	200	−20	2	–	–	TO-204MA	RCA8638D
2N6609	−140	15	−8	−4	150	−16	2	–	–	TO-204MA	RCA3773
MJ15004	−140	10	−10	−2	250	−20	2	–	–	TO-204MA	MJ15003
MJ15002	−140	25	4	2	200	−15	2	–	–	TO-204MA	MJ15001
RCA9116C	−140	10	−10	−2	200	−20	2	–	–	TO-204MA	RCA8638C
RCS618	−80	20	−5	−4	115	−15	2.5	–	–	TO-204MA	RCS617

▲Measured at same current level as h_{FE} unless otherwise indicated •At I_C = 6A @t_r *t_{OFF} ■At I_C = 2A

♦Check availability in Europe, the Middle East, and Africa.

Power Transistor Selection Charts

N-P-N MONOLITHIC DARLINGTON TRANSISTORS

Type No.	V_{CEO}(sus) V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	Package	p-n-p Complement
I_C (Max.) = 4 A, $f_{UNITY\ GAIN}$ = 20 MHz for all types								
RCS683	40	1000 min.	2	3	10	4	TO-39	–
RCS683A	60	1000 min.	2	3	10	4	TO-39	–
RCS683B	80	1000 min.	2	3	10	4	TO-39	–
I_C (Max.) = 8 A, $f_{UNITY\ GAIN}$ = 20 MHz for all types								
2N6055	60	750-18,000	4	3	100	8	TO-3	–
2N6300	60	100	8	3	75	8	TO-213MA	–
RCA120♦	60	1000 min.	3	3	65	8	TO-220AB	RCA125
TIP120	60	1000 min.	3	3	65	8	TO-220AB	TIP125
RCA1000	60	1000 min.	3	3	90	8	TO-3	–
2N6056	80	750-18,000	4	3	100	8	TO-3	–
2N6301	80	100	8	3	75	8	TO-213MA	–
2N6530	80	1000-10,000	5	3	65	8	TO-220AB	–
2N6534	80	1000-10,000	5	3	36	8	TO-66	–
RCA121♦	80	1000 min.	3	3	65	8	TO-220AB	RCA126
RCA1001	80	1000 min.	3	3	90	8	TO-3	–
TIP121♦	80	1000 min.	3	3	65	8	TO-220AB	TIP126
2N6531	100	500-10,000	3	3	65	8	TO-220AB	–
2N6532	100	1000-10,000	5	3	65	8	TO-220AB	–
2N6536	100	500-10,000	3	3	36	8	TO-66	–
2N6536	100	1000-10,000	5	3	36	8	TO-66	–
RCA122♦	100	1000 min.	3	3	65	8	TO-220AB	–
TIP122	100	1000 min.	3	3	65	8	TO-220AB	TIP127
2N6533	120	1000-10,000	3	3	65	8	TO-220AB	–
2N6537	120	1000-10,000	3	3	36	8	TO-66	–
I_C (Max.) = 10 A, $f_{UNITY\ GAIN}$ = 20 MHz for all types								
2N6383	40	1000-20,000	5	3	100	10	TO-3	RCA8350
2N6386	40	1000-10,000	3	3	65	10	TO-220AB	RCA8203
BDX33	45	750 min.	4	3	70	10	TO-220AB	BDX34
BDX83	45	1000 min.	5	3	125	10	TO-3	–
2N6384	60	1000-20,000	5	3	100	10	TO-3	RCA8350A
2N6387	60	1000-20,000	5	3	65	10	TO-220AB	RCA8203A
BDX33A	60	750 min.	4	3	70	10	TO-220AB	BDX34A
BDX83A	60	1000 min.	5	3	125	10	TO-3	–
2N6385	80	1000-20,000	5	3	100	10	TO-3	RCA8350B
2N6388	80	1000-20,000	5	3	65	10	TO-220AB	RCA8203B
BDX33B	80	750 min.	3	3	70	10	TO-220AB	RDX34B
BDX83B	80	1000 min.	5	3	125	10	TO-3	–
BDX33C	100	750 min.	3	3	70	10	TO-220AB	BDX34C
BDX83C	100	1000 min.	5	3	125	10	TO-3	–
BDX33D	120	750 min.	3	3	70	10	TO-220AB	–

P-N-P MONOLITHIC DARLINGTON TRANSISTORS

Type No.	V_{CEO}(sus) V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	Package	n-p-n Complement
I_C = –8 A, $f_{UNITY\ GAIN}$ = 20 MHz for all types								
RCA8203	–40	1000-20,000	–3	–3	65	–8	TO-220AB	2N6386
TIP125	–60	1000 min.	–3	–3	65	–8	TO-220AB	TIP120
RCA125♦	–60	1000 min.	–3	–3	65	–8	TO-220AB	RCA120
TIP126	–80	1000 min.	–3	–3	65	–8	TO-220AB	TIP121
RCA126♦	–80	1000 min.	–3	–3	65	–8	TO-220AB	RCA121
TIP127	–100	1000 min.	–3	–3	65	–8	TO-220AB	TIP122

♦Check availability in Europe, the Middle East, and Africa .

Power Transistor Selection Charts

P-N-P MONOLITHIC DARLINGTON TRANSISTORS (cont'd)

Type No.	$V_{CEO}(sus)$ V	Current Gain h_{FE}	Current Gain I_C A	Current Gain V_{CE} V	P_T (Max.) W	I_C (Max.) A	Package	n-p-n Complement
I_C (Max.) = 10 A, $f_{UNITY\ GAIN}$ = 20 MHz for all types								
2N6648	−40	1000,20,000	−3	−3	70	−10	TO-204MA	2N6383
2N6666	−40	1000	−3	−3	65	−8	TO-220AB	2N6386
RCA8350	−40	1000-20,000	−5	−5	70	−10	TO-3	2N6383
BDX34	−45	750 min.	−4	−3	70	−10	TO-220AB	BDX33
2N6649	−60	1000-20,000	−3	−3	70	−10	TO-204MA	2N6384
2N6667	−60	1000	−5	−3	65	−10	TO-220AB	2N6387
BDX34A	−60	750 min.	−4	−3	70	−10	TO-220AB	BDX33A
RCA8203A	−60	1000-20,000	−5	−3	65	−10	TO-220AB	2N6387
RCA8350A	−60	1000-20,000	−5	−3	70	−10	TO-3	2N6384
2N6650	−80	1000-20,000	−3	−3	70	−10	TO-204MA	2N6385
2N6668	−80	1000	−5	−3	65	−10	TO-220AB	2N6388
BDX34B	−80	750 min.	−3	−3	70	−10	TO-220AB	BDX33B
RCA8203B	−80	1000-10,000	−5	−3	65	−10	TO-220AB	2N6388
RCA8350B	−80	1000-20,000	−5	−3	70	−10	TO-3	2N6385
BDX34C	−100	750 min.	−3	−3	70	−10	TO-220AB	BDX33C

Transistors for Audio-Amplifier Applications

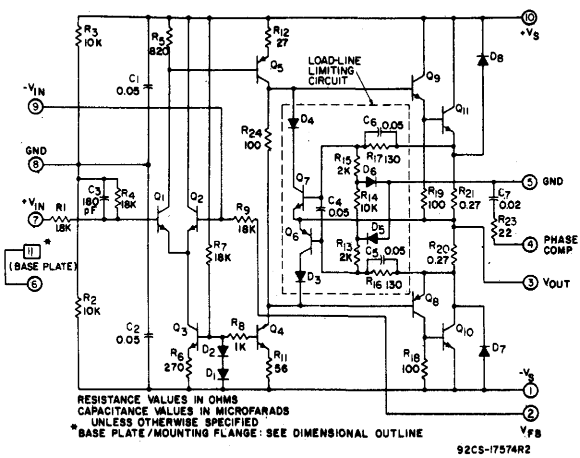
RCA Types	NPN or PNP	Package	H_{FE}	I_C/V_{CE}	V_{CER}	P_T
Full Complementary Output Darlington Pairs						
2N6385	NPN	TO-3	1000	5A/3V	80V	100W
2N6650	PNP	TO-3	1000	−5A/3V	−80V	70W
BDX33	NPN	TO-220	750	4A/3V	100V	70W
BDX34	PNP	TO-220	750	−4A/−3V	−100V	70W
RCA1C15	PNP	TO-220	1000	5A/3V	80V	65W
RCA1C16	NPN	TO-220	1000	−5A/−3V	−80V	65W
RCA900	PNP	TO-3	1000	−5A/−3V	−60V	90W
RCA1000	NPN	TO-3	1000	5A/3V	60V	90W
TA9117	PNP	TO-3	750	−10A/−3V	−100V	160W
TA9118	NPN	TO-3	750	10A/3V	100V	160W
Full Complementary Output Transistor Pairs						
2N3055	NPN	TO-3	20	4A/4V	70V	115W
BDX18	PNP	TO-3	20	−4A/−4V	−70V	115W
2N6292	NPN	TO-220	30	3A/4V	80V	40W
2N6107	PNP	TO-220	30	−3A/−4V	−80V	40W
2N6488	NPN	TO-220	20	5A/4V	85	75W
2N6491	PNP	TO-220	20	−5A/−4V	−85V	75W
BD239-243	NPN	TO-220	15	3A/4V	100V	70W
BD240-244	PNP	TO-220	15	−3A/−4V	−100V	70W
RCA1A05	PNP	TO-39	50	−0.15A/−4V	−75V	7W
RCA1A06	NPN	TO-39	50	0.15A/4V	75V	5W
RCA1C05	NPN	TO-220AB	20	3A/4V	50V	40W
RCA1C06	PNP	TO-220AB	20	−3A/−4V	−50V	40W
RCA1C07	NPN	TO-220	20	4A/4V	65	75W
RCA1C08	PNP	TO-220	20	−4A/4V	−65	75W
RCA1C10	NPN	TO-220	50	1.5A/4V	40	40W
RCA1C11	PNP	TO-220	50	−1.5A/−4V	−40	40W
RCP700	NPN	TO-202	50	0.5A/4V	100V	10W
RCP701	PNP	TO-202	50	−0.5A/4V	−100V	10W
RCS617	NPN	TO-3	20	5A/4V	85V	115W
RCS618	PNP	TO-3	20	−5A/4V	−85V	115W
TA8638	NPN	TO-3	15	8A/4V	140V	200W
TA9116	PNP	TO-3	15	−8A/4V	−140V	200W
Quasi Complementary Output Transistors						
2N3055	NPN	TO-3	20	4A/4V	70V	115W
2N3055 (Hometaxial)	NPN	TO-3	20	5A/4V	80V	150W
2N3442	NPN	TO-3	20	3A/2V	150V	150W
2N3772	NPN	TO-3	15	10A/4V	70V	250W
2N3773	NPN	TO-3	15	8A/4V	160V	250W
2N5298	NPN	TO-220	20	5A/4V	75V	75W
2N5496	NPN	TO-220	20	3,5A/4V	70V	36W
2N6103	NPN	TO-3	20	5A/4V	75V	75W
2N6292	NPN	TO-220	30	2.5A/4V	80V	40W
2N6488	NPN	TO-220	20	5A/4V	90V	75W
2N6510	NPN	TO-3	10	4A/3V	300V	120W
BUX18	NPN	TO-3	10	4A/3V	375V	120W

RCA Types	NPN or PNP	Package	H_{FE}	I_C/V_{CE}	V_{CER}	P_T
Quasi Complementary Output Transistors (Cont'd)						
RCA1A03	NPN	TO-39	70	0.3A/4V	95V	10W
RCA1A04	PNP	TO-39	70	−0.3A/−4V	−95V	10W
RCA1A05	PNP	TO-39	50	−0.15A/−4V	−75V	7W
RCA1A06	NPN	TO-39	50	0.15A/4V	75V	5W
RCA1B01	NPN	TO-3	20	4A/4V	95V	115W
RCA1B04	NPN	TO-3	15	2A/5V	200V	150W
RCA1B05	NPN	TO-3	15	2A/5V	250V	150W
RCA1B06	NPN	TO-3	10	4A/4V	100V	150W
RCA1B09	NPN	TO-3	40	2A/5V	250V	150W
RCA1C03	NPN	TO-220	50	1A/4V	100V	40W
RCA1C04	PNP	TO-220	50	−1A/−4V	−100V	40W
RCA1C09	NPN	TO-220	20	4A/4V	65V	75W
RCA1C12	NPN	TO-220	40	1A/2V	120V	40W
RCA1C13	PNP	TO-220	40	−1A/2V	−120V	40W
RCA1C14	NPN	TO-220	20	3A/4V	40V	50W
Complementary Driver Pairs/Predrivers						
2N2102	NPN	TO-39	25	0.1A/5V	100V	5W
2N3440	NPN	TO-39	40	20 mA/10V	400V	10W
2N4036	PNP	TO-39	50	0.15A/10V	65V	7W
2N5320	NPN	TO-39	40	0.5A/4V	90V	10W
2N5322	PNP	TO-39	40	−0.5A/−4V	−90V	10W
2N5415	PNP	TO-39	20	−50mA/−10V	−300V	10W
BD239-243	NPN	TO-220	15	3A/4V	100V	70W
BD240-244	PNP	TO-220	15	−3A/−4V	−100V	70W
RCA1A01	NPN	TO-39	40	0.01A/4V	70V	5W
RCA1A08	PNP	TO-39	30	−0.1A/−10V	−50V	7W
RCA1A09	NPN	TO-39	20	0.01A/10V	175V	10W
RCA1A10	PNP	TO-39	40	−0.01A/−10V	−175V	10W
RCA1A15	NPN	TO-39	20	0.01A/10V	100V	10W
RCA1A16	PNP	TO-39	40	−0.01A/−10V	−100V	10W
RCA1E02	NPN	TO-66	30	0.3A/2V	175V	35W
RCA1E03	PNP	TO-66	30	−0.3A/−2V	−175V	35W
RCP131	NPN	TO-202	50	50mA/10V	350V	10W
RCP700	NPN	TO-202	50	0.5A/4V	100V	10W
RCP701	PNP	TO-202	50	−0.5A/4V	−100V	10W
Protection Circuit Types						
RCA1A18	NPN	TO-39	40	0.01A/4V	10V	5W
RCA1A19	PNP	TO-39	40	−0.01A/−4V	−10V	7W
Input Device Types						
RCA1A02	PNP	TO-39	30	−0.1A/−10V	−50V	7W
RCA1A07	NPN	TO-39	50	0.01A/10V	40V	5W
RCA1A11	NPN	TO-39	40	0.01A/10V	175V	10W
RCA1A17	NPN	TO-39	40	0.01A/4V	90V	5W

Power Hybrid Comparison Chart

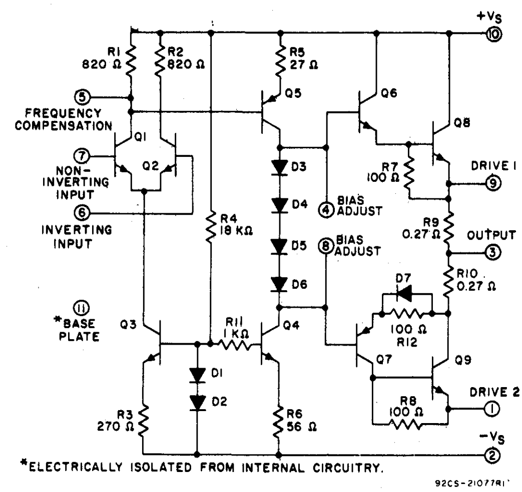
Multi-Purpose High-Power Operational Amplifiers

HC2000H*



Schematic diagram of type HC2000H operational amplifier.

HC2500



Schematic diagram of type HC2500 operational amplifier.

HC2000H* – Applications

Motor control, magnetic-deflection amplifiers, solenoid driver, low-frequency oscillator amplifier, voltage regulators, constant current source, inverting and non-inverting unity-gain amplifier.

HC2500 – Applications

Low-distortion, high-power amplifiers for audio and other end uses where internal overload protection is not required.

Ratings and Features for HC2000H* and HC2500

Ratings:

SUPPLY VOLTAGE:
Between leads 1 and 10 .... 75 V
OUTPUT CURRENT (peak) .... 7 A
OPERATING TEMPERATURE RANGE ... -55 to +150°C

Features:

Bandwidth: 30 kHz at 60 W
High power output: up to 100 W (rms)
Single or split power supply:
30 to 75 V single, ±15 to ±37.5 V split

COMPARISON CHART

TYPE	IM DIST. @ 200 mW	OUTPUT PROTECTION NETWORK	OPERATING MODE	FREQUENCY COMPENSATION	COMMUTATING DIODES
HC2000H*	0.6%	YES	CLASS B	LC FILTER ON OUTPUT	YES
HC2500	0.06%	NO	CLASS AB	CAPACITOR ON SIGNAL TERMINALS	NO

Socket for both types: RCA part DG-293A, or
Electronic Essentials, 210 Elizabeth St., New York, N.Y. 10012, Part No. MS5-1000

** HC2000H also available to MIL-spec as HC2000H/1, 2, 3, 4.*
(see data bulletin file no. 789, or pg. 404 in the "High-Reliability Devices" DATABOOK SSD-230.)

RF Power Transistor Selection Charts

Type	Package Type	Collector-Supply Voltage (V)	Frequency (MHz)	Min. Output Power (W) or Noise Figure (dB)	Data Sheet File No.
2N2857	TO-72	6-15(V_{CE})	450	NF = 4.5	61
2N2876	TO-60	28	50	10	32
2N3229	TO-60	50	50	15	50
2N3375	TO-60	28	400	3	386
2N3478	TO-72	6-15(V_{CE})	200	NF = 4.5	77
2N3553	TO-39	28	175	2.5	386
2N3600	TO-72	6-15(V_{CE})	200	NF = 4.5	83
2N3632	TO-60	28	175	13.5	386
2N3733	TO-60	28	400	10	72
2N3839	TO-72	6-15(V_{CE})	450	NF = 3.9	229
2N3866	TO-39	28	400	1	80
2N3866A	TO-39	28	800	1	–
2N4012	TO-60	28	1000 (tripler)	2.5	90
2N4427	TO-39	12	175	1	228
2N4440	TO-60	28	400	5	217
2N4932	TO-60	13.5	88	12	249
2N4933	TO-60	24	88	20	249
2N5070	TO-60	28	30	25 (PEP)	268
2N5071	TO-60	24	76	24	269
2N5090	TO-60	28	400	1.2	270
2N5102	TO-60	24	136	15	279
2N5109	TO-39	15	200	NF = 3	281
2N5179	TO-72	6(V_{CE})	200	NF = 4.5	288
2N5180	TO-72	10(V_{CE})	200	NF = 4.5	289
2N5913	TO-39	12	470	2	423
2N6670	TO-202AB	12.5	27	4	1091
40280	TO-39	13.5	175	1	68
40290	TO-39	12.5	135	2	70
40291	TO-60	12.5	135	2	70
40292	TO-60	12.5	135	6	70
40340	TO-60	13.5	50	25	74
40341	TO-60	24	50	30	74
40606	Premium high-reliability version of 2N3632				600
40608	TO-39	15	200	NF = 3	356
40894	TO-72	12	200	rf amp.	548
40895	TO-72	12	200	mixer	548
40896	TO-72	12	200	Osc.	548
40897	TO-72	12	10.7	if amp.	548
40936	TO-60	28	30	20 (PEP)	551
40964	TO-39	12	470	0.4	581
40965	TO-39	12	470	0.5	581
41024	TO-39	28	1000	1	658

Type	Operating Frequency (MHz)	Min. Output Power (W)	Collector-Supply Voltage (V)	Min. Power Gain
For VHF and UHF Mobile-Radio Applications				
2N4427	175	1	12	10
2N5913	175	1.75	12.5	12.4
40280	175	1	13.5	9
40964	470	0.4	12	6
40965	470	0.5	12	7
For Aircraft-Radio Applications				
40290	118-136	2	12.5	6
40291	118-136	2	12.5	6
40292	118-136	6	12.5	4.8
2N5102	118-136	15	24	4
For Single-Sideband Applications and For Military Communications				
40936	30	20 (PEP)	28	13
2N5070	30	25 (PEP)	28	13
2N5071	76	24	24	9
2N3866	400	1	28	10
For CB-Radio Applications				
2N6670	27	4	12.5	10
For CATV/MATV and Small-Signal Low-Noise Applications				
2N3478	200	4.5	6.15	11.5
2N5179	200	4.5	6	15
2N5109	200	3	15	11
40608	200	3	15	11
40894	200	3	12	15
40895	200	–	12	15
40896	200	–	12	15
2N3600	200	4.5	15	17
40897	200	–	12	18
2N2857	450	4.5	6	12.5
2N3839	450	3.9	6	12.5
For Microwave Applications				
41024	1000 Minimum Output Power = 1 W Collector Efficiency = 35%	5	28	5

Triac Product Matrix

RCA Triacs			TO-205MA/TO-5 Modified				Mod. TO-205MA/TO-5 With Heat Radiator				TO-202AB VERSATAB	
Standard	$I_{T(RMS)}$		2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A
	I_{TSM}(60 Hz)		25A	25A	25A	25A	25A	25A	25A	25A	25A	25A
	V_{DROM}(V)	50	T2300F	T2301F	T2302F	T2303F	T2310F	T2311F	T2312F	T2313F	T2320F	T2327F
		100	T2300A	T2301A	T2302A	2N5754	T2310A	T2311A	T2312A	T2313A	T2320A	T2327A
		200	T2300B	T2301B	T2302B	2N5755	T2310B	T2311B	T2312B	T2313B	T2320B	T2327B
		300									T2320C	T2327C
		400	T2300D	T2310D	T2302D	2N5756	T2310D	T2311D	T2312D	T2313D	T2320D	T2327D
		500									T2320E	T2327E
		600				2N5757				T2313M		
	I_{GT}(mA)	I^+, III^-	3	4	10	25	3	4	10	25	3	5
		I^-, III^+	3	4	10	40	3	4	10	40	3	5
	V_{GT}(V)	All Modes	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Zero Voltage Switch	V_{DROM}(V)	100				T2306A				T2316A		
		200				T2306B				T2316B		
		400				T2306D				T2316D		
	I_{GT}(mA)	I^+, III^+				45				45		
	V_{GT}(V)	I^+, III^+				1.5				1.5		
400-Hz Operation	$I_{T(RMS)}$				0.5A	0.5A						
	V_{DROM}(V)	200			T2304B	T2305B						
		400			T2304D	T2305D						
	I_{GT}(mA)	I^+, III^-			10	25						
		I^-, III^+			10	40						
	V_{GT}(V)	All Modes			2.2	2.2						

RCA Triacs			TO-202AB VERSATAB		TO-213MA/ TO-66		TO-213MA/ TO-66 With Heat Radiator	TO-220AB VERSAWATT				
Standard	$I_{T(RMS)}$		2.5A	2.5A	6A	15A	6A	6A	6A	8A	8A	ISOWATT* 8A
	I_{TSM}(60 Hz)		25A	25A	100A	100A	100A	60A	80A	100A	100A	100A
	V_{DROM}(V)	50	T2322F	T2323F					T2801F	T2800F	T2802F	T2850F
		100	T2322A	T2323A					T2801A	T2800A	T2802A	T2850A
		200	T2322B	T2323B	T2700B	T4700B	T2710B	T2500B	T2801B	T2800B	T2802B	T2850B
		300	T2322C	T2323C					T2801C	T2800C	T2802C	
		400	T2322D	T2323D	T2700D	T4700D	T2710D	T2500D	T2801D	T2800D	T2802D	T2850D
		500	T2322E	T2323E					T2801E	T2800E	T2802E	T2850E
		600								T2800M	T2802M	
	I_{GT}(mA)	I^+, III^-	10	25	25	30	25	25	80	25	50	25
		I^-, III^+	10	40	40	80	40	60	–	60	–	60
	V_{GT}(V)	All Modes	2.2	2.2	2.2	2.5	2.2	2.5	4.0▲	2.5	2.5▲	2.5
Zero Voltage Switch	V_{DROM}(V)	100										
		200			T2706B	T4706B	T2716B	T2506B			T2806B	T2856B
		400			T2706D	T4706D	T2716D	T2506D			T2806D	T2856D
	I_{GT}(mA)	I^+, III^+			45	45	45	45			45	45
	V_{GT}(V)	I^+, III^+			1.5	1.5	1.5	1.5			1.5	1.5

*ISOWATT – Mounting tab electrically isolated from electrodes

▲I^+, III^- only

Triac Product Matrix

RCA Triacs			TO-220AB VERSAWATT					Press-Fit (TO-203AA)			Stud		
Standard	$I_{T(RMS)}$		8A	12A	12A	12A	12A		10A	15A		10	15
	I_{TSM}(60 Hz)		100A	120A	120A	120A	100A		100A	100A		100A	100A
	V_{DROM}(V)	50							T4101F	T4100F		T4111F	T4110F
		100											
		200	T2851B	2N6342A	2N6346A	SC149B	TIC236B		2N5567	2N5571		2N5569	2N5573
		300	T2851C										
		400	T2851D	2N6343A	2N6347A	SC149D	TIC236D		2N5568	2N5572		2N5570	2N5574
		500	T2851E			SC149E			T4101E	T4100E		T4111E	T4110E
		600		2N6344A	2N6348A	SC149M			T4101M	T4100M		T4111M	T4110M
	I_{GT}(mA)	I^+, III^-	80	50	50	50	50		25	50		25	50
		I^-, III^+	–	–	75	50•	50•		40	80		40	80
	V_{GT}(V)	All Modes	3	2	2.5	2.5	2.5		2.5	2.5		2.5	2.5
Zero Voltage Switch	V_{DROM}(V)	200							T4107B	T4106B		T4117B	T4116B
		400							T4107D	T4106D		T4117D	T4116D
		600							T4107M	T4106M			
	I_{GT}(mA)	I^+, III^+							45	45		45	45
	V_{GT}(V)	All Modes							1.5	1.5		1.5	1.5
400-Hz Operation	$I_{T(RMS)}$							6A	10A	15A	6A	10A	15A
	V_{DROM}(V)	200						T4105B	T4104B	T4103B	T4115B	T4114B	T4113B
		400						T4105D	T4104D	T4103D	T4115D	T4114D	T4113D
	I_{GT}(mA)	I^+, III^-						50	50	50	50	50	50
		I^-, III^+						80	80	80	80	80	80
	V_{GT}(V)	All Modes						2.5	2.5	2.5	2.5	2.5	2.5

• I^- only

RCA Triacs			Isolated Stud		Press-Fit: With flex. leads, encap. on isolated-stud		Press-Fit: Isolated on TO-3 flange		Press-Fit: With flex. leads, encap., isolated on TO-3 flange		TO-220AB VERSAWATT	
Standard	$I_{T(RMS)}$		10A	15A	10A	15A	10A	15A	10A	15A	15A	15A
	I_{TSM}(60 Hz)		100A	100A	100A	100A	100A	100A	100A	100A	150A	150A
	V_{DROM}(V)	50	T4121F	T4120F	T4131F	T4130F	T4141F	T4140F	T4151F	T4150F		
		100										
		200	T4121B	T4120B	T4131B	T4130B	T4141B	T4140B	T4151B	T4150B	MAC15-4	MAC15A-4
		400	T4121D	T4120D	T4131D	T4130D	T4141D	T4140D	T4151D	T4150D	MAC15-6	MAC15A-6
		500	T4121E	T4120E	T4131E	T4130E	T4141E	T4140E	T4151E	T4150E		
		600	T4121M	T4120M	T4131M	T4130M	T4141M	T4140M	T4151M	T4150M	MAC15-8	MAC15A-8
	I_{GT}(mA)	I^+, III^-	25	50	25	50	25	50	25	50	50	50
		I^-, III^+	40	80	40	80	40	80	40	80	–	75
	V_{GT}(V)	All Modes	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5
Zero Voltage Switch	V_{DROM}(V)	200	T4127B	T4126B								
		400	T4127D	T4126D								
		600	T4127M	T4126M								
	I_{GT}(mA)	I^+, III^+	45	45								
	V_{GT}(V)	All Modes	1.5	1.5								

Triac Product Matrix

RCA Triacs			TO-220AB VERSAWATT				Press-Fit		Stud			Isolated Stud	
Standard	$I_{T(RMS)}$		15A	16A	16A	16A	30A	40A	30A		40A	30A	40A
	I_{TSM}(60 Hz)		150A	100A	150A	150A	300A	300A	300A		300A	300A	300A
	V_{DROM}(V)	50			T6000F	T6001F	T6401F	T6402F	T6411F		T6412F	T6421F	T6420F
		100											
		200	SC151B	TIC246B	T6000B	T6001B	T6401B	2N5441	T6411B		2N5444	T6421B	T6420B
		300			T6000C	T6001C							
		400	SC151D	TIC246D	T6000D	T6001D	T6401D	2N5442	T6411D		2N5445	T6421D	T6420D
		500	SC151E		T6000E	T6001E	T6401E	T6402E	T6411E		T6412E	T6421E	T6420E
		600	SC151M		T6000M	T6001M	T6401M	2N5443	T6411M		2N5446	T6421M	T6420M
	I_{GT}(mA)	I^+, III^-	50	50	50	80	50	50	50		50	50	50
		I^-, III^+	50•	50•	80	–	80	80	80		80	80	80
	V_{GT}(V)	All Modes	2.5	2.5	2.5	3	2.5	2.5	2.5		2.5	2.5	2.5
Zero Voltage Switch	V_{DROM}(V)	200			T6006B		T6407B	T6406B	T6417B		T6416B	T6427B	T6426B
		300			T6006C								
		400			T6006D		T6407D	T6406D	T6417D		T6416D	T6427D	T6426D
		500			T6006E								
		600			T6006M		T6407M	T6406M	T6417M		T6416M		T6426M
	I_{GT}(mA)	I^+, III^+			45		45	45	45		45	45	45
	V_{GT}(V)	All Modes			1.5		1.5	1.5	1.5		1.5	1.5	1.5
400-Hz Operation	$I_{T(RMS)}$						25A	40A	25A	25A	40A		
	V_{DROM}(V)	200					T6405B	T6404B	T6415B	2N5806	T6414B		
		400					T6405D	T6404D	T6415D	2N5807	T6414D		
		500								2N5808			
		600								2N5809			
	I_{GT}(mA)	I^+, III^-					80	80	80	80	80		
		I^-, III^+					120	120	120	150■	120		
	V_{GT}(V)	All Modes					3	3	3	2.5▲	3		

•1^- mode only ▲4 V for 111^+ mode ■80 mA for 1^- mode

RCA Triacs			Press-Fit: With flex. leads, encap. on isolated-stud		Press-Fit: Isolated on TO-3 flange		Press-Fit: With flex. leads, encap., isolated on TO-3 flange		Overmold Stud	
Standard	$I_{T(RMS)}$		30A	40A	30A	40A	30A	40A	60A	80A
	I_{TSM}(60 Hz)		300A	300A	300A	300A	300A	300A	600A	850A
	V_{DROM}(V)	50	T6431F		T6441F	T6440F	T6451F	T6450F	T8411F	T8410F
		100								
		200	T6431B	T6430B	T6441B	T6440B	T6451B	T6450B	T8411B	T8410B
		300								
		400	T6431D	T6430D	T6441D	T6440D	T6451D	T6450D	T8411D	T8410D
		500	T6431E		T6441E	T6440E	T6451E	T6450E	T8411E	T8410E
		600	T6431M	T6430M	T6441M	T6440M	T6451M	T6450M	T8411M	T8410M
	I_{GT}(mA)	I^+, III^-	50	50	50	50	50	50	75	75
		I^-, III^+	80	80	80	80	80	80	150	150
	V_{GT}(V)	All Modes	2.5	2.5	2.5	2.5	2.5	2.5	2.8	2.5

SCR Product Matrix

RCA SCR's		TO-8	TO-202AB VERSATAB						TO-220AB VERSAWATT			TO-213MA/ TO-66
$I_{T(RMS)}$		2A	4A	4A	4A	4A	4A	4A	4A	4A	4A	5A
I_{TSM} (60 Hz)		60A	20A	15A	30A	20A	20A	20A	35A	35A	35A	60A
V_{DROM} V_{RROM}(V)	15		C106Q	C107Q	C108Q	S106Q	S107Q	S108Q	S2060Q	S2061Q	S2062Q	
	25											
	30		C106Y	C107Y	C108Y	S106Y	S107Y	S108Y	S2060Y	S2061Y	S2062Y	
	50		C106F	C107F	C108F	S106F	S107F	S108F	S2060F	S2061F	S2062F	
	100		C106A	C107A	C108A	S106A	S107A	S108A	S2060A	S2061A	S2062A	
	150											
	200	2N3528	C106B	C107B	C108B	S106B	S107B	S108B	S2060B	S2061B	S2062B	2N3228
	250											
	300								S2060C	S2061C	S2062C	
	400	2N3529	C106D	C107D	C108D	S106D	S107D	S108D	S2060D	S2061D	S2062D	2N3525
	500		C106E	C107E	C108E	S106E	S107E	S108E	S2060E	S2061E	S2062E	
	600	2N4102	C106M	C107M	C108M	S106M	S107M	S108M	S2060M	S2061M	S2062M	2N4101
I_{GT}(mA)		15	0.2	0.5	0.2	0.2	0.5	2	0.2	0.5	2	15
V_{GT}(V)		2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	2

RCA SCR's		TO-213MA/TO-66						TO-213MA/ TO-66 With Heat Rad.		TO-220AB VERSAWATT		
I_T(RMS)		FTO* 5A	FTO* 5A	FTO* 5A	FTO* 5A	FTO* 5A	FTO* 5A	5A	FTO* 5A	FTO* 5A	FTO* 5A	FTO* 5A
I_{TSM}(60 Hz)		80A	80A	80A	75A(I_{PM})	80A	80A	80A	80A	80A	80A	80A
V_{DROM} V_{RROM}(V)	100			S3704A					S3714A			
	200		S3700B	S3704B				S2710B	S3714B	S5800B	S5801B	S5802B
	250											
	300									S5800C	S5801C	S5802C
	400		S3700D	S3704D				S2710D	S3714D	S5800D	S5801D	S5802D
	500	S3706E								S5800E	S5801E	S5802E
	600	S3705M	S3700M	S3704M	S3701M			S2710M	S3714M	S5800M	S5801M	S5802M
	700			S3704S		S3702S			S3714S			
	750						S3703SF					
I_{GT}(mA)		30	40	40	35	45	40	15	40	50	50	50
V_{GT}(V)		4	3.5	3.5	4	4	4	2	3.5	2.5	2.5	2.5

RCA SCR's		Low-Profile Mod. TO-205MA/ TO-5	TO-205MA/ TO-5 with Heat Rad.	TO-205MA/ TO-5 with Heat Spreader	TO-220AB VERSAWATT				TO-204MA/ TO-3	Press-Fit TO-203AA	
I_R(RMS)		7A	3.3A	7A	8A	10A	12	16	12.5	20A	35A
I_{TSM}(60 Hz)		100A	100A	100A	100A	100A	125	160	200A	200A	350A
V_{DROM} V_{RROM}(V)	50				S122F	S2800F	2N6394	2N6400			
	100				S122A	S2800A	2N6395	2N6401	2N3668	S6200A	2N3870
	150										
	200	S2600B	S2610B	S2620B	S122B	S2800B	2N6396	2N6402	2N3669	S6200B	2N3871
	250										
	300				S122C	S2800C	S6000C	S6100C			
	400	S2600D	S2610D	S2620D	S122D	S2800D	2N6397	2N6403	2N3670	S6200D	2N3872
	500				S122E	S2800E	S6000E	S6100E			
	600	S2600M	S2610M	S2620M	S122M	S2800M	2N6398	2N6406	2N4103	S6200M	2N3873
	700				S122S	S2800S	S6000S	S6100S			
I_{GT}(mA)		15	15	15	25	15	30	30	40	15	40
V_{GT}(V)		1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2

*FTO – Fast Turn-Off.

♦Check availability in Europe, the Middle East, and Africa.

SCR Product Matrix

RCA SCR's		Stud		Isolated Stud		With flex. leads, encap. on isolated stud		Press-Fit Isolated on TO-3 flange		With flex. leads, encap., isolated on TO-3 flange	
$I_{T(RMS)}$		20A	35A	20A	35A	20A	35A	20A	35A	20A	35A
I_{TSM}(60 Hz)		200A	350A	200A	350A	200A	350A	200A	350A	200A	350A
V_{DROM} V_{RROM}(V)	100	S6210A	2N3896	S6220A	S6420A	S6230A	S6430A	S6240A	S6440A	S6250A	S6450A
	200	S6210B	2N3897	S6220B	S6420B	S6230B	S6430B	S6240B	S6440B	S6250B	S6450B
	400	S6210D	2N3898	S6220D	S6420D	S6230D	S6430D	S6240D	S6440D	S6250D	S6450D
	600	S6210M	2N3899	S6220M	S6420M	S6230M	S6430M	S6240M	S6440M	S6250M	S6450M
I_{GT}(mA)		15	40	15	40	15	40	15	40	15	40
V_{GT}(V)		2	2	2	2	2	2	2	2	2	2

RCA SCR's		TO-208MA/TO-48						Overmold Stud		Overmold Isolated Stud	
$I_{T(RMS)}$		16A	25A	Pulse Modulator 35A	FTO* 35A	FTO* 35A	FTO* 40A■	75A		75A	
I_{TSM}(60 Hz)		125A	150A	150A	180A	180A	400A	750A		750A	
V_{DROM} V_{RROM}(V)	15										
	25	2N1842A	2N681								
	30										
	50	2N1843A	2N682			2N3654					
	100	2N1844A	2N683		2N3650	2N3655		S8612A	S8613A	S8622A	S8623A
	150	2N1845A	2N684								
	200	2N1846A	2N685		2N3651	2N3656	S7310B	S8612B	S8613B	S8622B	S8623B
	250	2N1847A	2N686								
	300	2N1848A	2N687		2N3652	2N3657	S7310C				
	400	2N1849A	2N688		2N3653	2N3658	S7310D	S8612D	S8613D	S8622D	S8623D
	500	2N1850A	2N689				S7310E				
	600		2N690	S6493M	S7410M	S7412M	S7310M	S8612M	S8613M	S8622M	S8623M
I_{GT}(mA)		45	25	80	180	180	80	200	200	200	200
V_{GT}(V)		3.5	3	2	3	2	3	3	3	3	3

*FTO – Fast Turn-Off ■ASCR (Asymmetrical Silicon Controlled Rectifiers)

RCA SCR's		Overmold Stud		Overmold Isolated Stud	
I_T(RMS)		100A		100A	
I_{TSM}(60 Hz)		1000A		1000A	
V_{DROM} V_{RROM}(V)	15				
	25				
	30				
	50				
	100	S8610A	S8611A	S8620A	S8621A
	150				
	200	S8610B	S8611B	S8620B	S8621B
	250				
	300				
	400.	S8610D	S8611D	S8620D	S8621D
	500				
	600	S8610M	S8611M	S8620M	S8621M
I_{GT}(mA)		200	200	200	200
V_{GT}(V)		3	3	3	3

ITR Product Matrix

For Horizontal-Deflection Circuits

RCA ITR's*		TO-220AB VERSAWATT			
		Trace	Commutating (Retrace)	Trace	Commutating (Retrace)
I_T(RMS)		8A	8A	8A	8A
I_{TSM}(60 Hz)		90A	90A	90A	90A
V_{DROM}(V)	300				
	400				
	450			S3902DF	
	500				
	550				
	600		S3901M		
	650	S3900MF	S3901MF		S3903MF
	700	S3900S	S3901S		
	750	S3900SF			
I_{GT}(mA)		30	45		
V_{GT}(V)		4	4		

*Integrated Thyristor/Rectifiers

GTO, Diac, and Rectifier Product Matrices

GTO Product Matrix

RCA GTO's*		TO-220AB VERSAWATT	
I_T(DC)		15A	15A
I_{TSM}(60 Hz)		85A	85A
V_{DRXM}(V)	100	G4000A	G4001A
	200	G4000B	G4001B
	400	G4000D	G4001D
t_{gq}		25μs	25μs

GTO — Gate-Turn-Off SCR

Diac Product Matrix

For Triggering Devices

RCA Diacs	DO-204AC/DO-15	
	D3202Y	D3202U
I_{pk}	2A	2A
$\pm V_{(BO)}$	29 min. 35 max. V	25 min. 40 max. V
$\|{+V_{(BO)}}\| - \|{-V_{(BO)}}\|$	±3 max. V	±3 max. V
$\|\Delta V\pm\|$	9 min. V	9 min. V

Rectifier Product Matrix

Standard Types

RCA Rectifiers		DO-203AA/ DO-4		DO-203AB/ DO-5	
I_O		6A	12A	20A	40A
I_{FSM}		160A	240A	350A	800A
V_{RRM}(V)	50	1N1341B	1N1199A	1N248C	1N1183A
	100	1N1342B	1N1200A	1N249C	1N1184A
	200	1N1344B	1N1202A	1N250C	1N1186A
	300	1N1345B	1N1203A	1N1195A	1N1187A
	400	1N1346B	1N1204A	1N1196A	1N1188A
	500	1N1347B	1N1205A	1N1197A	1N1189A
	600	1N1348B	1N1206A	1N1198A	1N1190A

Fast-Recovery Types

RCA Rectifier		DO-203AA/ DO-4				DO-203AB/ DO-5			
I_O		6A	6A♦	12A	12A♦	20A	20A♦	30A	40A
I_{FSM}		75A	125A	150A	250A	225A	300A	300A	700A
V_{RRM}(V)	50	1N3879	D2406F	1N3889	D2412F	1N3899	D2520F	1N3909	D2540F
	100	1N3880	D2406A	1N3890	D2412A	1N3900	D2520A	1N3910	D2540A
	200	1N3881	D2406B	1N3891	D2412B	1N3901	D2520B	1N3911	D2540B
	300	1N3882	D2406C	1N3892	D2412C	1N3902	D2520C	1N3912	
	400	1N3883	D2406D	1N3893	D2412D	1N3903	D2520D	1N3913	D2540D
	500								
	600		D2406M		D2412M		D2520M		D2540M
Reverse Recovery Time t_{rr}	Typ.	–	200 ns	–	200 ns	–	200 ns	–	200 ns
	Max.	200 ns	350 ns	200 ns	350 ns	200 ns	350 ns	200 ns	350 ns

♦Check availability in Europe, the Middle East, and Africa.

Power Devices Cross-Reference Guide
(Industry Type to Equivalent RCA Type)

This guide provides a quick reference to more than 2300 industry power devices (power transistors, silicon controlled rectifiers, and triacs) and their nearest RCA replacements. The nearest RCA device is determined on the basis of electrical similarity as well as package similarity.

POWER TRANSISTORS

Industry Type	Package	RCA Type	Package
2N656	TO-5	2N2102	TO-39
2N1132	TO-5	2N4037	TO-39
2N1132A	TO-5	2N4037	TO-39
2N1420	TO-5	2N1711	TO-39
2N1507	TO-5	2N1711	TO-39
2N1565	TO-5	40360	TO-39
2N1565A	TO-5	40360	TO-39
2N1573	TO-5	40409	TO-39HR
2N1574	TO-5	40409	TO-39HR
2N1613S	TO-5	2N1613	TO-39
2N1711S	TO-5	2N1711	TO-39
2N1714	TO-5	2N1480	TO-39
2N1889	TO-5	2N699	TO-39
2N1893S	TO-5	2N1893	TO-39
2N1974	TO-5	40360	TO-39
2N1975	TO-5	40360	TO-39
2N1984	TO-5	40360	TO-39
2N1985	TO-5	40360	TO-39
2N1986	TO-5	2N3053	TO-39
2N1987	TO-5	2N697	TO-39
2N1990	TO-5	BF257	TO-39
2N1990S	TO-5	BF257	TO-39
2N2034	TO-5	2N5784	TO-39
2N2049	TO-5	2N1711	TO-39
2N2102S	TO-5	2N2102	TO-39
2N2192	TO-5	2N1711	TO-39
2N2193	TO-39	2N1613	TO-39
2N2194	TO-39	2N699	TO-39
2N2195	TO-39	2N697	TO-39
2N2195A	TO-39	2N697	TO-39
2N2217	TO-39	2N697	TO-39
2N2218	TO-39	2N697	TO-39
2N2243	TO-39	2N1893	TO-39
2N2243A	TO-39	2N1893	TO-39
2N2270S	TO-39	2N2270	TO-39
2N2297	TO-39	2N1613	TO-39
2N2297S	TO-39	2N1613	TO-39
2N2303	TO-39	40315	TO-39
2N2330	TO-39	40814	TO-39
2N2410	TO-39	2N3053	TO-39
2N2537	TO-39	40635	TO-39
2N2538	TO-39	2N1711	TO-39
2N2800	TO-39	40406	TO-39
2N2801	TO-39	40815	TO-39
2N2846	TO-39	2N697	TO-39
2N2848	TO-39	2N697	TO-39
2N2863	TO-39	2N5321	TO-39
2N2864	TO-39	2N3053	TO-39
2N2868	TO-39	2N3053	TO-39
2N2951	TO-39	41502	TO-39
2N2958	TO-39	2N697	TO-39
2N2959	TO-39	2N1711	TO-39
2N3020	TO-39	2N1893	TO-39
2N3022	TO-3	2N4902	TO-3
2N3023	TO-3	2N4902	TO-3
2N3024	TO-3	2N4904	TO-3
2N3025	TO-3	2N4905	TO-3
2N3026	TO-3	2N4905	TO-3
2N3036	TO-5	2N5320	TO-39
2N3076	TO-36	2N6249	TO-3
2N3079	TO-36	2N6511	TO-3
2N3080	TO-36	2N6670	TO-3
2N3108	TO-39	2N2102	TO-39
2N3109	TO-39	2N1711	TO-39
2N3110	TO-39	2N3053	TO-39
2N3114	TO-39	BF257	TO-39
2N3122	TO-5	2N5321	TO-39
2N3133	TO-39	40634	TO-39
2N3134	TO-39	2N4037	TO-39
2N3171	TO-3	2N6254	TO-3
2N3172	TO-3	2N6246	TO-3
2N3173	TO-3	2N6247	TO-3
2N3174	TO-3	2N6248	TO-3
2N3183	TO-3	2N6246	TO-3
2N3184	TO-3	2N6246	TO-3
2N3185	TO-3	2N6247	TO-3
2N3186	TO-3	2N6248	TO-3
2N3195	TO-3	2N6246	TO-3
2N3196	TO-3	2N6246	TO-3
2N3197	TO-3	2N6247	TO-3
2N3198	TO-3	2N6248	TO-3
2N3202	TO-5	2N5783	TO-39
2N3203	TO-5	2N5781	TO-39
2N3208	TO-5	2N5783	TO-39
2N3224	TO-5	2N5415	TO-39
2N3225	TO-5	2N5415	TO-39
2N3226	TO-3	2N6253	TO-3
2N3233	TO-3	2N3442	TO-3
2N3234	TO-3	2N3055	TO-3
		2N6262	TO-3
2N3235	TO-3	2N3055	TO-3
2N3236	TO-3	2N6254	TO-3
2N3237	TO-3	2N5302	TO-3
2N3238	TO-3	2N5882	TO-3
2N3239	TO-3	2N5882	TO-3
2N3240	TO-3	2N5882	TO-3
2N3244	TO-39	2N5323	TO-39
2N3245	TO-39	2N5323	TO-39
2N3292	TO-5	2N697	TO-39
2N3300	TO-5	2N1711	TO-39
2N3418	TO-39	2N5320	TO-39
2N3444	TO-39	2N5321	TO-39
2N3445	TO-3	2N6471	TO-3
2N3446	TO-3	2N6472	TO-3
2N3447	TO-3	2N6471	TO-3
2N3448	TO-3	2N6472	TO-3
2N3464	TO-39	2N3053	TO-39
2N3597	TO-63	2N3266	TO-63
2N3598	TO-63	2N3266	TO-63
2N3599	TO-63	2N3265	TO-63
2N3665	TO-39	2N1893	TO-39
2N3672	TO-5	2N699	TO-39
2N3712	TO-39	2N3440	TO-39
		BF257	TO-39
2N3713	TO-3	2N3715	TO-3
		2N3715	TO-3
2N3714	TO-3	2N3716	TO-3
		2N3716	TO-3
2N3719	TO-39	2N5323	TO-39
2N3720	TO-39	2N5322	TO-39
2N3738	TO-66	2N3584	TO-66
2N3739	TO-66	2N3585	TO-66
2N3740	TO-66	2N5955	TO-66
2N3741	TO-66	2N5954	TO-66
2N3742	TO-39	2N3439	TO-39
		BF259	TO-39
2N3743	TO-39	2N5416	TO-39
		BFT19B	TO-39
2N3766	TO-66	2N3879	TO-66
		2N6373	TO-66
2N3767	TO-66	2N6372	TO-66
2N3774	TO-5	2N5783	TO-39
2N3775	TO-5	2N5781	TO-39
2N3778	TO-5	2N5783	TO-39
2N3779	TO-5	2N5781	TO-39
2N3782	TO-5	2N5783	TO-39
2N3788	TO-3	2N5840	TO-3
2N3789	TO-3	2N3791	TO-3
2N3790	TO-3	2N3792	TO-3
2N3795	TO-5	2N5415	TO-39
2N3863	TO-3	2N3055	TO-3
2N3864	TO-3	2N3442	TO-3
2N3865	TO-3	2N6262	TO-3
2N3902	TO-3	2N6308	TO-3
		BUX18C	TO-3
2N3945	TO-5	2N2102	TO-39
		2N2270	TO-39
2N4000	TO-39	2N5320	TO-39
2N4002	TO-63	2N3265	TO-63
2N4004	Radial	2N3263	Radial
2N4030	TO-39	2N4036	TO-39
2N4054	TO-202	RCP113C	TO-202
2N4055	TO-202	RCP113B	TO-202
2N4056	TO-202	RCP113B	TO-202
2N4057	TO-202	RCP113B	TO-202
2N4070	TO-3	2N6306	TO-3
2N4071	TO-3	2N6306	TO-3

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
2N4111	TO-3	2N4914	TO-3
2N4113	TO-3	2N4915	TO-3
2N4130	TO-3	2N3055	TO-3
2N4210	TO-63	2N3266	TO-63
2N4211	TO-63	2N3265	TO-63
2N4231	TO-66	2N6374	TO-66
2N4232	TO-66	2N6373	TO-66
2N4233	TO-66	2N6372	TO-66
2N4234	TO-39	2N5783	TO-39
2N4235	TO-39	2N5782	TO-39
2N4236	TO-39	2N5781	TO-39
2N4237	TO-39	2N5786	TO-39
2N4238	TO-39	2N5785	TO-39
2N4239	TO-39	2N5784	TO-39
2N4387	TO-66	2N5956	TO-66
2N4388	TO-66	2N5955	TO-66
2N4404	TO-39	2N1893	TO-39
2N4405	TO-39	2N2405	TO-39
2N4438	TO-39	2N3439	TO-39
2N4890	TO-39	2N4037	TO-39
2N4898	TO-66	2N5956	TO-66
2N4899	TO-66	2N5955	TO-66
2N4900	TO-66	2N5954	TO-66
2N4907	TO-3	2N6246	TO-3
2N4908	TO-3	2N6246	TO-3
2N4909	TO-3	2N6247	TO-3
2N4910	TO-66	2N6260	TO-66
		2N6374	TO-66
2N4911	TO-66	2N3054	TO-66
		2N6373	TO-66
2N4912	TO-66	2N6261	TO-66
		2N6372	TO-66
2N4918	Case 77	BD240	TO-220
2N4919	Case 77	BD240A	TO-220
2N4920	Case 77	BD240B	TO-220
2N4921	Case 77	BD239	TO-220
2N4922	Case 77	BD239A	TO-220
2N4923	Case 77	BD239B	TO-220
2N4926	TO-39	2N3440	TO-39
		BF258	TO-39
2N4927	TO-39	2N3440	TO-39
		BF258	TO-39
2N4928	TO-39	BFT28	TO-39
2N4929	TO-39	BFT28A	TO-39
2N4930	TO-39	2N5415	TO-39
		BFT28B	TO-39
2N4931	TO-39	2N5416	TO-39
		BFT28C	TO-39
2N5050	TO-66	2N3584	TO-66
2N5051	TO-66	2N3584	TO-66
2N5052	TO-66	2N3584	TO-66
2N5058	TO-39	2N3439	TO-39
		BF259	TO-39
2N5059	TO-39	2N3440	TO-39
		BF258	TO-39
2N5091	TO-5	2N5416	TO-39
2N5092	TO-5	2N3439	TO-39
2N5110	TO-5	2N5783	TO-39
2N5157	TO-3	2N5840	TO-3
2N5190	Case 77	BD241	TO-220
2N5191	Case 77	BD241A	TO-220

Industry Type	Package	RCA Type	Package
2N5192	Case 77	BD241B	TO-220
2N5193	Case 77	BD242	TO-220
2N5194	Case 77	BD242A	TO-220
2N5195	Case 77	BD242B	TO-220
2N5241	TO-3	2N6513	TO-3
		BUX18C	TO-3
2N5264	TO-3	2N6510	TO-3
2N5279	TO-5	2N3439	TO-39
2N5280	Flange	2N4036	TO-39FL
2N5281	TO-5	2N5415	TO-39
2N5282	TO-5	2N5416	TO-39
2N5294	TO-220	2N5294	TO-220
2N5296	TO-220	2N5298	TO-220
2N5298	TO-220	2N5298	TO-220
2N5305	TO-3	BDY29	TO-3
2N5331	TO-63	2N3265	TO-63
2N5344	TO-66	2N6211	TO-66
2N5345	TO-66	2N6212	TO-66
2N5427	TO-66	2N6372	TO-66
2N5429	TO-66	2N6465	TO-66
2N5466	TO-3	2N6671	TO-3
2N5467	TO-3	2N6671	TO-3
2N5539	TO-63	2N3265	TO-63
2N5560	TO-63	2N3265	TO-63
2N5598	TO-66	2N5202	TO-66
2N5600	TO-66	2N6500	TO-66
2N5602	TO-66	2N3879	TO-66
2N5604	TO-66	2N6500	TO-66
2N5606	TO-66	2N3879	TO-66
2N5608	TO-66	2N3879	TO-66
2N5610	TO-66	2N6500	TO-66
2N5612	TO-66	2N6500	TO-66
2N5614	TO-3	2N5039	TO-3
2N5616	TO-3	2N5038	TO-3
2N5618	TO-3	2N5038	TO-3
2N5620	TO-3	2N6496	TO-3
2N5622	TO-3	2N5039	TO-3
2N5624	TO-3	2N5038	TO-3
2N5626	TO-3	2N5038	TO-3
2N5628	TO-3	2N6496	TO-3
2N5629	TO-3	2N4348	TO-3
		RCA8638E	TO-3
2N5630	TO-3	2N4348	TO-3
		RCA8638D	TO-3
2N5631	TO-3	RCA3773	TO-3
2N5632	TO-3	RCA8638E	TO-3
2N5633	TO-3	RCA8638D	TO-3
2N5634	TO-3	MJ15003	TO-3
		BDY37	TO-3
2N5655	Case 77	2N6175	TO-5P
2N5656	Case 77	2N6176	TO-5P
2N5657	Case 77	2N6177	TO-5P
2N5660	TO-66	2N6077	TO-66
2N5661	TO-66	2N6079	TO-66
2N5664	TO-66	2N6077	TO-66
2N5665	TO-66	2N6079	TO-66
2N5672	TO-63	2N3265	TO-63
2N5678	TO-63	2N3265	TO-63
2N5685	TO-3	2N5578	Mod. TO-3
2N5686	TO-3	2N5578	Mod. TO-3

Industry Type	Package	RCA Type	Package
2N5687	TO-39	40412	TO-39
2N5732	TO-3	2N5671	TO-3
2N5733	TO-63	2N3265	TO-63
2N5734	TO-3	2N5671	TO-3
2N5737	TO-3	2N6246	TO-3
2N5738	TO-3	2N6248	TO-3
2N5739	TO-3	2N5878	TO-3
2N5758	TO-3	2N3442	TO-3
		2N6262	TO-3
2N5759	TO-3	2N3442	TO-3
		2N6262	TO-3
2N5760	TO-3	2N3442	TO-3
		2N6262	TO-3
2N5861	TO-39	2N5321	TO-39
2N5864	TO-39	40634	TO-39
2N5865	TO-39	40634	TO-39
2N5867	TO-3	2N6246	TO-3
2N5868	TO-3	2N6247	TO-3
2N5929	TO-3	2N5671	TO-3
2N5930	TO-3	2N5672	TO-3
2N5932	TO-3	2N5671	TO-3
2N5933	TO-3	2N5672	TO-3
2N5935	TO-3	2N6032	Mod. TO-3
2N5936	TO-3	2N6033	Mod. TO-3
2N5966	TO-63	2N3265	TO-63
2N5968	TO-63	2N3265	TO-63
2N5970	TO-3	2N6472	TO-3
2N5971	TO-3	2N6472	TO-3
2N5972	TO-3	2N6472	TO-3
2N5974	Case 90	2N6489	TO-220
2N5975	Case 90	2N6490	TO-220
2N5976	Case 90	2N6491	TO-220
2N5977	Case 90	2N6486	TO-220
2N5978	Case 90	2N6487	TO-220
2N5979	Case 90	2N6488	TO-220
2N5980	Case 90	2N6489	TO-220
2N5981	Case 90	2N6490	TO-220
2N5982	Case 90	2N6491	TO-220
2N5983	Case 90	2N6486	TO-220
2N5984	Case 90	2N6487	TO-220
2N5985	Case 90	2N6488	TO-220
2N5986	Case 90	2N6489	TO-220
2N5987	Case 90	2N6490	TO-220
2N5988	Case 90	2N6491	TO-220
2N5989	Case 90	2N6486	TO-220
2N5990	Case 90	2N6487	TO-220
2N5991	Case 90	2N6488	TO-220
2N6029	TO-3	RCA9116E	TO-3
2N6030	TO-3	RCA9116D	TO-3
2N6031	TO-3	2N6609	TO-3
2N6034	Case 77	2N6666	TO-220
2N6034	Case 77	2N6666	TO-220
		BDX34	TO-220
2N6035	Case 77	RCA125	TO-220
		BDX34A	TO-220
2N6036	Case 77	RCA126	TO-220
		BDX34B	TO-220
2N6037	Case 77	2N6386	TO-220
		BDX33	TO-220
2N6038	Case 77	RCA120	TO-220
		BDX33A	TO-220

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
2N6039	Case 77	RCA121	TO-220
		BDX33B	TO-220
2N6040	Case 199	RCA125	TO-220
		BDX34A	TO-220
2N6041	Case 199	RCA126	TO-220
		BDX34B	TO-220
2N6042	Case 199	RCA126	TO-220
		BDX34C	TO-220
2N6043	Case 199	RCA120	TO-220
		BDX33A	TO-220
2N6044	Case 199	RCA121	TO-220
		BDX33B	TO-220
2N6045	Case 199	2N6531	TO-220
		BDX33C	TO-220
2N6046	TO-63	2N3266	TO-63
2N6047	TO-63	2N3265	TO-63
2N6248	TO-63	2N3265	TO-63
2N6049	TO-66	2N5955	TO-66
2N6050	TO-3	2N6649	TO-3
2N6051	TO-3	2N6650	TO-3
2N6053	TO-3	2N6649	TO-3
2N6054	TO-3	2N6650	TO-3
2N6057	TO-3	2N6384	TO-3
2N6058	TO-3	2N6385	TO-3
2N6062	TO-63	2N3265	TO-63
2N6063	TO-63	2N3265	TO-63
2N6121	TO-220	2N6290	TO-220
2N6122	TO-220	2N6292	TO-220
2N6123	TO-220	RCA31B	TO-220
		BD241B	TO-220
2N6124	TO-220	2N6109	TO-220
2N6125	TO-220	2N6107	TO-220
2N6126	TO-220	RCA32B	TO-220
		BD242B	TO-220
2N6129	TO-220	2N6290	TO-220
2N6130	TO-220	2N6292	TO-220
2N6131	TO-220	2N6292	TO-220
2N6132	TO-220	2N6109	TO-220
2N6133	TO-220	2N6107	TO-220
2N6134	TO-220	RCA32B	TO-220
		BD242B	TO-220
2N6226	TO-3	2N6248	TO-3
2N6229	TO-3	2N6248	TO-3
2N6230	TO-3	RCA9116D	TO-3
2N6231	TO-3	MJ15004	TO-3
2N6233	TO-66	2N3583	TO-66
		2N6077	TO-66
2N6234	TO-66	2N3584	TO-66
		2N6077	TO-66
2N6235	TO-66	2N3585	TO-66
		2N6079	TO-66
2N6248	TO-63	2N3265	TO-63
2N6270	TO-3	2N5671	TO-3
2N6271	TO-3	2N5672	TO-3
2N6272	TO-63	2N3265	TO-63
2N6273	TO-63	2N3265	TO-63
2N6294	TO-66	2N6534	TO-66
2N6295	TO-66	2N6534	TO-66
2N6296	TO-66	RCA8350A	TO-3
2N6297	TO-66	RCA8350B	TO-3
2N6298	TO-66	RCA8350A	TO-3
2N6299	TO-66	RCA8350B	TO-3
2N6300	TO-66	2N6534	TO-66
2N6301	TO-66	2N6534	TO-66
2N6302	TO-3	RCA3773	TO-3
2N6312	TO-66	2N6308	TO-3
		2N5956	TO-66
2N6313	TO-66	2N5955	TO-66
2N6314	TO-66	2N5954	TO-66
2N6338	TO-3	2N5672	TO-3
2N6339	TO-3	2N5672	TO-3
2N6359	TO-3	2N4348	TO-3
2N6360	TO-3	2N4348	TO-3
2N6406	Case 77	RCP700B	TO-202
2N6407	Case 77	RCP700C	TO-202
2N6408	Case 77	RCP701B	TO-202
2N6409	Case 77	RCP701C	TO-202
2N6412	Case 77	RCP701A	TO-202
2N6413	Case 77	RCP701B	TO-202
2N6414	Case 77	RCP700A	TO-202
2N6415	Case 77	RCP700B	TO-202
2N6415	Case 77	RCP701C	TO-202
2N6417	Case 77	RCP701D	TO-202
2N6418	Case 77	RCP700C	TO-202
2N6419	Case 77	RCP700D	TO-202
2N6420	TO-66	2N6211	TO-66
2N6421	TO-66	2N6212	TO-66
2N6422	TO-66	2N6212	TO-66
2N6423	TO-66	2N6212	TO-66
2N6424	TO-66	2N6211	TO-66
2N6425	TO-66	2N6212	TO-66
2N6436	TO-3	2N5671	TO-3
2N6437	TO-3	2N5672	TO-3
2N6438	TO-3	2N5672	TO-3
2N6461	TO-39	2N3439	TO-39
2N6542	TO-3	2N6670	TO-3
2N6543	TO-3	2N6671	TO-3
2N6544	TO-3	2N6670	TO-3
2N6545	TO-3	2N6671	TO-3
2N6551	TO-202	RCP701B	TO-202
2N6552	TO-202	RCP701C	TO-202
2N6553	TO-202	RCP701D	TO-202
2N6554	TO-202	RCP700B	TO-202
2N6555	TO-202	RCP700C	TO-202
2N6556	TO-202	RCP700D	TO-202
2N6557	TO-202	RCP111B	TO-202
		RCP113B	TO-202
2N6558	TO-202	RCP111C	TO-202
		RCP113C	TO-202
2N6559	TO-202	RCP111D	TO-202
		RCP113D	TO-202
2N6569	TO-3	2N3055	TO-3
2SA489	TO-220	2N6107	TO-220
2SA490	TO-220	2N6109	TO-220
2SA503	TO-39	2N4314	TO-39
2SA504	TO-39	2N4037	TO-39
2SA512	TO-39	2N4314	TO-39
2SA560	TO-39	2N4314	TO-39
2SA597	TO-39	2N4037	TO-39
2SA814	TO-220	2N6476	TO-220
2SA815	TO-220	2N6475	TO-220
2SB502A	TO-66	2N5954	TO-66
2SB503A	TO-66	2N5955	TO-66
2SB530	TO-3	2N6248	TO-3
2SB531	TO-3	2N6247	TO-3
2SB558	TO-3	2N6248	TO-3
2SB595	TO-220	2N6475	TO-220
2SB596	TO-220	2N6107	TO-220
2SC481	TO-39	2N699	TO-39
2SC482	TO-39	2N1613	TO-39
2SC485	TO-39	2N1893	TO-39
2SC504	TO-39	2N1711	TO-39
2SC512	TO-39	2N699	TO-39
2SC558	TO-3	BUX17A	TO-3
2SC560	TO-39	2N2405	TO-39
2SC779	TO-66	2N3584	TO-66
2SC782	TO-66	2N3585	TO-66
2SC782A	TO-66	2N3585	TO-66
2SC783	TO-66	2N3583	TO-66
2SC789	TO-220	2N6292	TO-220
2SC790	TO-220	2N6290	TO-220
2SC792	TO-3	BUX16B	TO-3
2SC1173	TO-220	2N6288	TO-220
2SC1195	TO-3	BUX16	TO-3
2SC1448A	TO-220	TA8863	TO-220
2SC1576	TO-3	BUX16	TO-3
2SD102	TO-66	2N6261	TO-66
2SD129	TO-66	2N6372	TO-66
2SD130	TO-66	2N3054	TO-66
2SD234	TO-220	RCA3054	TO-220
2SD235	TO-220	RCA3054	TO-220
2SD369	TO-3	2N3055	TO-3
2SD371	TO-3	2N6254	TO-3
2SD404C	TO-220	2N6288	TO-220
2SD424	TO-3	2N6262	TO-3
2SD425	TO-3	2N3442	TO-3
2SD427	TO-3	2N4347	TO-3
2SD428	TO-3	2N4348	TO-3
2SD523	TO-3	2N6384	TO-3
2SD524	TO-3	2N6385	TO-3
2SD526	TO-220	2N6292	TO-220
2SD552	TO-3	BUX17A	TO-3
73T2	TO-39FL	40392	TO-39FL
74T2	TO-39FL	40628	TO-39FL
100T2	TO-3	2N4347	TO-3
104T2	TO-3	2N6253	TO-3
108T2	TO-3	2N5039	TO-3
109T2	TO-3	2N6354	TO-3
182T2A	TO-3	BUX16	TO-3
182T2B	TO-3	BUX16	TO-3
182T2C	TO-3	BUX16	TO-3
184T2A	TO-3	BUX16	TO-3
183T2B	TO-3	BUX16	TO-3
183T2C	TO-3	BUX16	TO-3
183T2A	TO-3	BUX16	TO-3
184T2B	TO-3	BUX16	TO-3
184T2C	TO-3	BUX16	TO-3
185T2A	TO-3	BUX16A	TO-3
185T2B	TO-3	BUX16A	TO-3
185T2C	TO-3	BUX16A	TO-3
40250	TO-66	2N3054	TO-66
40251	TO-3	2N3055	TO-3
40636	TO-3	2N3055	TO-3
BC119	TO-39	2N697	TO-39
BC120	TO-39	2N697	TO-39
BC139	TO-39	40406	TO-39

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
BC140	TO-39	2N5321	TO-39
BC141	TO-39	2N5320	TO-39
BC142	TO-39	40360	TO-39
BC143	TO-39	40595	TO-39
BC144	TO-39	40594	TO-39
BC160	TO-39	2N5323	TO-39
BC161	TO-39	2N5322	TO-39
BC300	TO-39	2N1893	TO-39
BC301	TO-39	2N699	TO-39
BC302	TO-39	2N2270	TO-39
BC303	TO-39	2N4314	TO-39
BC304	TO-39	2N4037	TO-39
BC310	TO-39	2N1893	TO-39
BC311	TO-39	2N4314	TO-39
BC323	TO-39	2N5320	TO-39
BC324	TO-39	2N5320	TO-39
BC429	TO-39	2N2270	TO-39
BC430	TO-39	2N2270	TO-39
BC440	TO-39	2N5321	TO-39
BC441	TO-39	2N5320	TO-39
BC460	TO-39	2N5323	TO-39
BC461	TO-39	2N5322	TO-39
BCW44	TO-39	40360	TO-39
BCW45	TO-39	40362	TO-39
BCW77-16	TO-39	2N1711	TO-39
BCW78-16	TO-39	2N1711	TO-39
BCW79-16	TO-39	2N4037	TO-39
BCW80-16	TO-39	2N4037	TO-39
BCY40	TO-39	2N4037	TO-39
BCY54	TO-39	2N4036	TO-39
BD115	TO-39	BF258	TO-39
BD116	TO-3	2N3055	TO-3
BD141	TO-3	2N4347	TO-3
BD144	TO-3	BUX18C	TO-3
BD148	TO-66	BDY71	TO-66
BD149	TO-66	BDY71	TO-66
BD160	TO-3	2N6510	TO-3
BD162	TO-66	40250	TO-66
BD163	TO-66	2N6260	TO-66
BD185	TO-126	BD239	TO-220
BD186	TO-126	BD240	TO-220
BD187	TO-126	BD239	TO-220
BD188	TO-126	BD240	TO-220
BD189	TO-126	BD239A	TO-220
BD190	TO-126	BD240A	TO-220
BD191	TO-66	2N3054	TO-66
BD192	TO-66	2N6260	TO-66
BD195	Case 90	BD243	TO-220
BD196	Case 90	BD244	TO-220
BD197	Case 90	BD243A	TO-220
BD198	Case 90	BD244A	TO-220
BD199	Case 90	CD243B	TO-220
BD200	Case 90	BD244B	TO-220
BD201	Case 199	BD243	TO-220
BD202	Case 199	BD244	TO-220
BD203	Case 199	BD243A	TO-220
BD204	Case 199	BD244A	TO-220
BD205	Case 90	2N6486	TO-220
BD206	Case 90	2N6489	TO-220
BD207	Case 90	2N6487	TO-220
BD208	Case 90	2N6490	TO-220
BD213-45	TO-3P	2N6486	TO-220
BD213-60	TO-3P	2N6487	TO-220
BD213-80	TO-3P	2N6489	TO-220
BD214-45	TO-3P	2N6489	TO-220
BD214-60	TO-3P	2N6490	TO-220
BD214-80	TO-3P	2N6491	TO-220
BD215	TO-66	2N3584	TO-66
BD216	TO-66	2N3585	TO-66
BD244A	TO-220	BD244A	TO-220
BD244B	TO-220	BD244B	TO-220
BD244C	TO-220	BD244C	TO-220
BD245	TO-3P	2N6486	TO-220
BD245A	TO-3P	2N6487	TO-220
BD245B	TO-3P	2N6488	TO-220
BD246	TO-3P	2N6489	TO-220
BD246A	TO-3P	2N6490	TO-220
BD246B	TO-3P	2N6491	TO-220
BD253	TO-3	BUX18B	TO-3
BD253A	TO-3	BUX18C	TO-3
BD253B	TO-3	BU126	TO-3
BD253C	TO-3	TA8764	TO-3
BD260	TO-66	2N3584	TO-66
BD261	TO-66	2N3584	TO-66
BD264	TO-220	RCA8203A	TO-220
BD264A	TO-220	RCA8203B	TO-220
BD264B	TO-220	BDX34C	TO-220
BD265	TO-220	2N6387	TO-220
BD265A	TO-220	2N6388	TO-220
BD265B	TO-220	BDX33C	TO-220
BD266	TO-220	BDX34A	TO-220
BD266A	TO-220	BDX34B	TO-220
BD266B	TO-220	BDX34C	TO-220
BD267	TO-220	BDX33A	TO-220
BD267A	TO-220	BDX33B	TO-220
BD267B	TO-220	BDX33C	TO-220
BD268	TO-220	BDX34A	TO-220
BD268A	TO-220	BDX34B	TO-220
BD269	TO-220	BDX33A	TO-220
BD269A	TO-220	BDX33B	TO-220
BD271	TO-220	BD241	TO-220
BD272	TO-220	BD242	TO-220
BD273	TO-220	BD241A	TO-220
BD274	TO-220	BD242A	TO-220
BD275	TO-220	BD241B	TO-220
BD276	TO-220	BD242B	TO-220
BD291	SOT-82	BD243	TO-220
BD292	SOT-82	BD244	TO-220
BD293	SOT-82	BD243A	TO-220
BD294	SOT-82	BD244A	TO-220
BD301	TO-220	BD243	TO-220
BD302	TO-220	BD244	TO-220
BD303	TO-220	BD243A	TO-220
BD304	TO-220	BD244A	TO-220
BD311	TO-3	2N6471	TO-3
BD312	TO-3	2N6246	TO-3
BD313	TO-3	2N6472	TO-3
BD314	TO-3	2N6247	TO-3
BD315	TO-3	2N6472	TO-3
BD316	TO-3	2N6247	TO-3
BD317	TO-3	2N6472	TO-3
BD318	TO-3	2N6248	TO-3
BD375	TO-126	BD239	TO-220
BD376	TO-126	BD240	TO-220
BD377	TO-126	BD239A	TO-220
BD378	TO-126	BD240A	TO-220
BD379	TO-126	BD239B	TO-220
BD380	TO-126	BD240B	TO-220
BD410	TO-126	RCP111D	TO-202
BD515	TO-202	RCP701A	TO-202
BD516	TO-202	RCP700A	TO-202
BD517	TO-202	RCP701B	TO-202
BD518	TO-202	RCP701C	TO-202
BD519	TO-202	RCP701C	TO-202
BD520	TO-202	RCP700C	TO-202
BD525	TO-202	RCP701B	TO-202
BD526	TO-202	RCP700B	TO-202
BD527	TO-202	RCP701C	TO-202
BD528	TO-202	RCP700C	TO-202
BD529	TO-202	RCP701D	TO-202
BD530	TO-202	RCP700D	TO-202
BD575	Case 199	BD241	TO-220
BD576	Case 199	BD242	TO-220
BD577	Case 199	BD241A	TO-220
BD578	Case 199	BD242A	TO-220
BD579	Case 199	BD241B	TO-220
BD580	Case 199	BD242B	TO-220
BD581	Case 199	BD242C	TO-220
BD582	Case 199	BD242C	TO-220
BD585	Case 199	BD241	TO-220
BD586	Case 199	BD242	TO-220
BD587	Case 199	BD241A	TO-220
BD588	Case 199	BD242A	TO-220
BD589	Case 199	BD241B	TO-220
BD590	Case 199	BD242B	TO-220
BD591	Case 199	BD241C	TO-220
BD592	Case 199	BD242C	TO-220
BD595	Case 199	BD243	TO-220
BD596	Case 199	BD244	TO-220
BD597	Case 199	BD243A	TO-220
BD598	Case 199	BD244A	TO-220

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
BD599	Case 199	BD243B	TO-220
BD600	Case 199	BD244B	TO-220
BD601	Case 199	BD243C	TO-220
BD602	Case 199	BD244C	TO-220
BD605	Case 199	2N6486	TO-220
BD606	Case 199	2N6489	TO-220
BD607	Case 199	2N6487	TO-220
BD608	Case 199	2N6490	TO-220
BD609	Case 199	2N6488	TO-220
BD610	Case 199	2N6491	TO-220
BD633	TO-220	40979	TO-220
BD634	TO-220	40980	TO-220
BD635	TO-220	40871	TO-220
BD636	TO-220	40872	TO-220
BD637	TO-220	40871	TO-220
BD638	TO-220	40872	TO-220
BD643	TO-220	BDX33	TO-220
BD644	TO-220	BDX34	TO-220
BD645	TO-220	BDX33A	TO-220
BD646	TO-220	BDX34A	TO-220
BD647	TO-220	BDX33B	TO-220
BD648	TO-220	BDX34B	TO-220
BD661	TO-220	2N6486	TO-220
BD662	TO-220	2N6489	TO-220
BD663	TO-220	2N6486	TO-220
BD663B	TO-220	2N6486	TO-220
BD664	TO-220	2N6489	TO-220
BD695	Case 199	BDX33	TO-220
BD695A	Case 199	BDX33	TO-220
BD696	Case 199	BDX34	TO-220
BD696A	Case 199	BDX34	TO-220
BD697	Case 199	BDX33A	TO-220
BD697A	Case 199	BDX33A	TO-220
BD698	Case 199	BDX34A	TO-220
BD698A	Case 199	BDX34A	TO-220
BD699	Case 199	BDX33B	TO-220
BD699A	Case 199	BDX33B	TO-220
BD700	Case 199	BDX34B	TO-220
BD700A	Case 199	BDX34B	TO-220

Industry Type	Package	RCA Type	Package
BD701	Case 199	BDX33C	TO-220
BD702	Case 199	BDX34C	TO-220
BD705	TO-220	2N6486	TO-220
BD706	TO-220	2N6489	TO-220
BD707	TO-220	2N6487	TO-220
BD708	TO-220	2N6490	TO-220
BD709	TO-220	2N6488	TO-220
BD710	TO-220	2N6491	TO-220
BDX14	TO-66	2N3054	TO-66
BDX16	TO-66	BUX66	TO-66
BDX27	TO-66	2N3879	TO-66
BDX28	TO-66	2N3879	TO-66
BDX30	TO-66	2N6500	TO-66
BDX53	TO-220	BDX33	TO-220
BDX53A	TO-220	BDX33A	TO-220
BDX53B	TO-220	BDX33B	TO-220
BDX53C	TO-220	BDX33C	TO-220
BDX54	TO-220	BDX34	TO-220
BDX54A	TO-220	BDX34A	TO-220
BDX54B	TO-220	BDX34B	TO-220
BDX54C	TO-220	BDX34C	TO-220
BDX60	TO-3	2N6254	TO-3
BDX61	TO-3	2N3055	TO-3
BDX62	TO-3	RCA8350A	TO-3
BDX62A	TO-3	RCA8350B	TO-3
BDX63	TO-3	2N6384	TO-3
BDX63A	TO-3	2N6385	TO-3
BDX64	TO-3	BDX84A	TO-3
BDX64A	TO-3	BDX84B	TO-3
BDX64B	TO-3	BDX84C	TO-3
BDX65	TO-3	BDX83A	TO-3
BDX65A	TO-3	BDX83B	TO-3
BDX65B	TO-3	BDX83C	TO-3
BDX77	TO-220	BD243B	TO-220
BDX78	TO-220	BD244B	TO-220
BDY10	TO-3	2N6253	TO-3
BDY12	TO-3	BUX16	TO-3
BDY13	TO-3	BUX16	TO-3
BDY15	TO-3	BUX16	TO-3
BDY17	TO-3	BUX16	TO-3
BDY20	TO-3	BUX16	TO-3
BDY25A	TO-3	BUX16	TO-3
BDY25B	TO-3	BUX16	TO-3
BDY25C	TO-3	BUX16	TO-3
BDY26A	TO-3	BUX16	TO-3
BDY26B	TO-3	BUX16	TO-3
BDY26C	TO-3	BUX16	TO-3
BDY27A	TO-3	BUX16	TO-3
BDY27B	TO-3	BUX16	TO-3
BDY27C	TO-3	BUX16	TO-3
BDY28A	TO-3	BUX16A	TO-3
BDY28B	TO-3	BUX16A	TO-3
BDY28C	TO-3	BUX16A	TO-3
BDY38	TO-3	2N6253	TO-3
BDY39	TO-3	2N3055	TO-3
BDY55	TO-3	2N5039	TO-3
BDY56	TO-3	2N5038	TO-3
BDY57	TO-3	41012	TO-3
BDY58	TO-3	41013	TO-3

Industry Type	Package	RCA Type	Package
BDY73	TO-3	2N3055	TO-3
BDY74	TO-3	2N4347	TO-3
BDY76	TO-3	2N3772	TO-3
BDY77	TO-3	2N3773	TO-3
BDY78	TO-66	2N6373	TO-66
BDY79	TO-66	2N3583	TO-66
BDY80A	TO-220	2N5296	TO-220
BDY81A	TO-220	2N5298	TO-220
BDY82A	TO-220	2N6111	TO-220
BDY83A	TO-220	2N6109	TO-220
BDY91	TO-3	2N5038	TO-3
BDY92	TO-3	2N5039	TO-3
BDY93	TO-3	BU126	TO-3
BDY94	TO-3	BU126	TO-3
BDY95	TO-3	BU126	TO-3
BDY96	TO-3	2N6513	TO-3
BDY97	TO-3	2N6512	TO-3
BDY98	TO-3	2N6511	TO-3
BDY99	TO-3	2N6511	TO-3
BF111	TO-39	2N3440	TO-39
NF137	TO-5	BF257	TO-39
BF157	TO-39	BF257	TO-39
BF174	TO-39	BF257	TO-39
BF177	TO-39	40360	TO-39
BF178	TO-39	40412	TO-39
BF179	TO-39	BF257	TO-39
BF179A	TO-39	BF257	TO-39
BF179B	TO-39	BF258	TO-39
BF179C	TO-39	BF258	TO-39
BF305	TO-39	BF257	TO-39
BF322	TO-39	40317	TO-39
BF323	TO-39	40319	TO-39
BF336	TO-39	BF258	TO-39
BF337	TO-39	BF258	TO-39
BF338	TO-39	BF258	TO-39
BF355	TO-39	2N3440	TO-39
BF380	TO-202	RCP113A	TO-202
BF381	TO-202	RCP113B	TO-202
BF382	TO-202	RCP113C	TO-202
BF390	TO-39	BF259	TO-39
BFR19	TO-39	2N1613	TO-39
BFR20	TO-39	2N1711	TO-39
BFR21	TO-39	2N1893	TO-39
BFR22	TO-39	2N2102	TO-39
BFR23	TO-39	2N4036	TO-39
BFR24	TO-39	2N4037	TO-39
BFR56	TO-39	2N5321	TO-39
BFR57	TO-39	BF257	TO-39
BFR58	TO-39	BF258	TO-39
BFR59	TO-39	BF259	TO-39
BFR77	TO-39	2N1893	TO-39
BFR78	TO-39	2N2405	TO-39
BFS90	TO-39	40987	TO-39
BFS90A	TO-39	40987	TO-39
BFS91	TO-39	40999	TO-39
BFS91A	TO-39	40999	TO-39
BFS92	TO-39	2N4036	TO-39
BFS93	TO-39	2N4314	TO-39
BFS94	TO-39	2N4037	TO-39
BFS95	TO-39	2N4037	TO-39
BFT32	TO-39	40635	TO-39

Power Devices Cross-Reference Guide
(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
BFT33	TO-39	40409	TO-39HR
BFT34	TO-39	2N2405	TO-39
BFT35	TO-39	2N4314	TO-39
BFT36	TO-39	40410	TO-39HR
BFT39	TO-39	40409	TO-39HR
BFT40	TO-39	40628	TO-39HR
BFT41	TO-39	40628	TO-39HR
BFT44	TO-39	BF259	TO-39
BFT45	TO-39	BF258	TO-39
BFT60	TO-39	2N4037	TO-39
BFT61	TO-39	2N4037	TO-39
BFT62	TO-39	40815	TO-39
BFT80	TO-39	40815	TO-39
BFW24	TO-39	2N2102	TO-39
BFW25	TO-39	2N1711	TO-39
BFW26	TO-39	2N697	TO-39
BFW33	TO-39	2N1893	TO-39
BFW44	TO-39	BFT19	TO-39
BFW45	TO-39	BF257	TO-39
BFX17	TO-39	2N3053	TO-39
BFX29	TO-39	2N4036	TO-39
BFX30	TO-39	2N4036	TO-39
BFX39	TO-39	2N4036	TO-39
BFX68	TO-39	2N1711	TO-39
BFX68A	TO-39	2N1711	TO-39
BFX69	TO-39	2N697	TO-39
BFX69A	TO-39	2N1613	TO-39
BFX74	TO-39	2N4037	TO-39
BFX74A	TO-39	2N4314	TO-39
BFX85	TO-39	2N2405	TO-39
BFX86	TO-39	2N1711	TO-39
BFX87	TO-39	2N4036	TO-39
BFX88	TO-39	2N4037	TO-39
BFX91	TO-39	BFT28B	TO-39
BFX98	TO-39	BF257	TO-39
BFY10	TO-39	40814	TO-39
BFY11	TO-39	40814	TO-39
BFY17	TO-39	40317	TO-39
BFY33	TO-39	2N697	TO-39
BFY34	TO-39	2N697	TO-39
BFY40	TO-39	40320	TO-39
BFY43	TO-39	BF257	TO-39
BFY44	TO-39	2N2102	TO-39
BFY45	TO-39	40408	TO-39
BFY46	TO-39	2N1711	TO-39
BFY50	TO-39	2N697	TO-39
BFY51	TO-39	2N697	TO-39
BFY52	TO-39	2N3053	TO-39
BFY55	TO-39	2N697	TO-39
BFY56	TO-39	2N699	TO-39
BFY57	TO-39	BF257	TO-39
BFY67	TO-39	2N3053	TO-39
BFY67A	TO-39	2N1613	TO-39
BFY68	TO-39	2N1711	TO-39
BFY70	TO-39	2N3053	TO-39
BFY94	TO-39	40594	TO-39
BSS15	TO-39	2N5320	TO-39
BSS16	TO-39	2N5321	TO-39
BSS17	TO-39	2N5322	TO-39
BSS18	TO-39	2N5323	TO-39
BSS30	TO-39	2N2102	TO-39
BSS32	TO-39	2N2405	TO-33
BSS45	TO-39	2N5320	TO-39
BSS46	TO-39	2N5322	TO-39
BSS48	TO-39	2N3440	TO-39
BSS49	TO-39	2N3439	TO-39
BSV15	TO-39	2N4037	TO-39
BSV15-6	TO-39	2N4037	TO-39
BSV15-10	TO-39	2N4037	TO-39
BSV16	TO-39	2N4314	TO-39
BSV16-6	TO-39	2N4314	TO-39
BSV16-10	TO-39	2N4314	TO-39
BSV17	TO-39	2N5322	TO-39
BSV69	TO-39	2N5321	TO-39
BSV77	TO-39	2N5321	TO-39
BSV84	TO-39	2N1893	TO-39
BSW23	TO-39	2N4037	TO-39
BSW39	TO-39	2N1893	TO-39
BSX22	TO-39	2N5321	TO-39
BSX23	TO-39	2N5320	TO-39
BSX40	TO-39	2N4037	TO-39
BSX45	TO-39	2N3053	TO-39
BSX46	TO-39	2N2102	TO-39
BSX47	TO-39	2N1893	TO-39
BSX59	TO-39	2N5321	TO-39
BSX60	TO-39	2N5321	TO-39
BSX61	TO-39	2N5321	TO-39
BSX72	TO-39	2N3053	TO-39
BSX95	TO-39	2N1613	TO-39
BSX96	TO-39	2N1711	TO-39
BSY25	TO-39	2N697	TO-39
BSY44	TO-39	2N699	TO-39
BSY45	TO-39	2N1893	TO-39
BSY46	TO-39	2N699	TO-39
BSY51	TO-39	2N697	TO-39
BSY52	TO-39	2N1711	TO-39
BSY53	TO-39	2N697	TO-39
BSY54	TO-39	2N1711	TO-39
BSY55	TO-39	2N1893	TO-39
BSY68	TO-39	2N2405	TO-39
BSY71	TO-39	2N1711	TO-39
BSY81	TO-39	2N697	TO-39
BSY82	TO-39	2N1711	TO-39
BSY83	TO-39	2N697	TO-39
BSY84	TO-39	2N1711	TO-39
BSY85	TO-39	2N1893	TO-39
BSY87	TO-39	2N2102	TO-39
BSY91	TO-39	2N697	TO-39
BSY92	TO-39	2N1711	TO-39
BU102	TO-3	BUX18B	TO-3
BU111	TO-3	2N6512	TO-3
BU114	TO-3	2N6510	TO-3
BU121	TO-3	BUX18	TO-3
BU129	TO-3	BUX18C	TO-3
BU134	TO-3	BU126	TO-3
BU135	TO-3	2N6510	TO-3
BU136	TO-3	2N6510	TO-3
BU310	TO-3	BUX17	TO-3
BU311	TO-3	BUX17	TO-3
BU312	TO-3	BUX17	TO-3
BU409	TO-220	TA8863J	TO-220
BUX26	TO-3	2N6510	TO-3
BUX27	TO-3	BUX18C	TO-3
BUX39	TO-3	2N5038	TO-3
BUX40	TO-3	2N6354	TO-3
BUX41	TO-3	BUX17A	TO-3
BUX42	TO-3	BUX17B	TO-3
BUX43	TO-3	BUX17C	TO-3
BUX44	TO-3	BUX18C	TO-3
BUX84	TO-220	TA8863A	TO-220
BUY35	TO-3	2N6511	TO-3
BUY43	TO-66	BDY71	TO-66
BUY46	TO-66	2N3054	TO-66
BUY55	TO-3	2N5239	TO-3
BUY56	TO-3	2N5239	TO-3
BUY66	TO-3	BU126	TO-3
BUY67	TO-3	BU126	TO-3
BUY69B	TO-3	BU126	TO-3
BUY69C	TO-3	BU126	TO-3
BUY70B	TO-3	BU126	TO-3
BUY70C	TO-3	BU126	TO-3
BUY72	TO-3	2N5239	TO-3
BUY74	TO-3	BUX18A	TO-3
BUY75	TO-3	BUX18C	TO-3
BUY76	TO-3	BU126	TO-3
BUY77	TO-3	BUX18A	TO-3
BUY78	TO-3	BUX18C	TO-3
BUY79	TO-3	BUX126	TO-3
D40D1	TO-202	RCP707	TO-202
D40D2	TO-202	RCP707	TO-202
D40D3	TO-202	RCP707	TO-202
D40D4	TO-202	RCP707	TO-202
D40D5	TO-202	RCP707	TO-202
D40D6	TO-202	RCP701B	TO-202
D40D7	TO-202	RCP701B	TO-202
D40D8	TO-202	RCP701B	TO-202
D40D10	TO-202	RCP701C	TO-202
D40D11	TO-202	RCP701C	TO-202
D40D13	TO-202	RCP701C	TO-202
D40E1	TO-202	RCP705	TO-202
D40E5	TO-202	RCP701B	TO-202
D40E7	TO-202	RCP701C	TO-202
D40N1	TO-202	RCP113B	TO-202
D40N2	TO-202	RCP111B	TO-202
D40N3	TO-202	RCP113C	TO-202
D40N4	TO-202	RCP111C	TO-202
D40N5	TO-202	RCP111C	TO-202
D40P1	TO-202	2N6175	TO-5P
D40P3	TO-202	2N6175	TO-5P
D40P5	TO-202	2N6175	TO-5P
D41D1	TO-202	RCP706	TO-202
D41D2	TO-202	RCP706B	TO-202
D41D4	TO-202	RCP706B	TO-202
D41D5	TO-202	RCP700B	TO-202
D41D6	TO-202	RCP700B	TO-202
D41D7	TO-202	RCP700B	TO-202
D41D8	TO-202	RCP700B	TO-202
D41D10	TO-202	RCP700C	TO-202
D41D11	TO-202	RCP700C	TO-202
D41D13	TO-202	RCP700C	TO-202
D41E1	TO-202	RCP704	TO-202
D41E5	TO-202	RCP700B	TO-202

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
D41E7	TO-202	RCP700C	TO-202
D42C1	TO-202	2N6288	TO-220
		RCP707	TO-202
D42C2	TO-202	2N6288	TO-220
		RCP705	TO-202
D42C3	TO-202	2N6288	TO-220
		RCP705	TO-202
D42C4	TO-202	2N6290	TO-220
		RCP703A	TO-202
D42C5	TO-202	2N6290	TO-220
		RCP701A	TO-202
D42C6	TO-202	2N6290	TO-220
		RCP701A	TO-202
D42C7	TO-202	2N6292	TO-220
		RCP703B	TO-202
D42C8	TO-202	2N6292	TO-220
		RCP701B	TO-202
D42C9	TO-202	2N6292	TO-220
		RCP701B	TO-202
D42C10	TO-202	2N6292	TO-220
		RCP703C	TO-202
D42C11	TO-202	2N6292	TO-220
		RCP701C	TO-202
D42C12	TO-202	RCP701C	TO-202
D43C1	TO-202	2N6111	TO-220
		RCP706	TO-202
D43C2	TO-202	2N6111	TO-220
		RCP704	TO-202
D43C3	TO-202	2N6111	TO-220
		RCP704	TO-202
D43C4	TO-202	2N6109	TO-220
		RCP702A	TO-202
D43C5	TO-202	2N6109	TO-220
		RCP700A	TO-202
D43C6	TO-202	2N6109	TO-220
		RCP700A	TO-202
D43C7	TO-202	2N6107	TO-220
		RCP702B	TO-202
D43C8	TO-202	2N6107	TO-220
		RCP700B	TO-202
D43C9	TO-202	2N6107	TO-220
		RCP700B	TO-202
D43C10	TO-202	2N6107	TO-220
		RCP700B	TO-202
D43C11	TO-202	2N6107	TO-220
		RCP700C	TO-202
D43C12	TO-202	RCP700C	TO-202
D44C1	TO-220	2N6288	TO-220
		BD239	TO-220
D44C2	TO-220	2N6288	TO-220
		BD239	TO-220
D44C3	TO-220	2N6288	TO-220
		BD239	TO-220
D44C4	TO-220	2N6290	TO-220
		BD239	TO-220
D44C5	TO-220	2N6290	TO-220
		BD239	TO-220
D44C6	TO-220	2N6290	TO-220
		BD239	TO-220
D44C7	TO-220	2N6292	TO-220
		BD239A	TO-220
D44C8	TO-220	2N6292	TO-220
		BD239A	TO-220

Industry Type	Package	RCA Type	Package
D44C9	TO-220	2N6292	TO-220
		BD239A	TO-220
D44C10	TO-220	2N6292	TO-220
		BD239B	TO-220
D44C11	TO-220	2N6292	TO-220
		BD239B	TO-220
D44C12	TO-220	BD239B	TO-220
D44E1	TO-220	2N6386	TO-220
D44E2	TO-220	2N6387	TO-220
D44E3	TO-220	2N6388	TO-220
D44H1	TO-220	2N6288	TO-220
D44H2	TO-220	2N6288	TO-220
D44H4	TO-220	2N6290	TO-220
D44H5	TO-220	2N6290	TO-220
D44H7	TO-220	2N6292	TO-220
D44H8	TO-220	2N6292	TO-220
D44H10	TO-220	2N6292	TO-220
D44H11	TO-220	2N6292	TO-220
D44R1	TO-220	TA8863B	TO-220
D44R2	TO-220	TA8863B	TO-220
D44R3	TO-220	TA8863B	TO-220
D44R4	TO-220	TA8863B	TO-220
D44R5	TO-220	TA8863F	TO-220
D44R6	TO-220	TA8863F	TO-220
D45C1	TO-220	2N6111	TO-220
		BD240	TO-220
D45C2	TO-220	2N6111	TO-220
		BD240	TO-220
D45C3	TO-220	2N6111	TO-220
		BD240	TO-220
D45C4	TO-220	2N6109	TO-220
		BD240	TO-220
D45C5	TO-220	2N6109	TO-220
		BD240	TO-220
D45C6	TO-220	2N6109	TO-220
		BD240	TO-220
D45C7	TO-220	2N6107	TO-220
		BD240A	TO-220
D45C8	TO-220	2N6107	TO-220
		BD240A	TO-220
D45C9	TO-220	2N6107	TO-220
		BD240A	TO-220
D45C10	TO-220	2N6107	TO-220
		BD240B	TO-220
D45C11	TO-220	2N6107	TO-220
		BD240B	TO-220
D45C12	TO-220	BD240B	TO-220
D45E1	TO-220	2N6666	TO-220
D45E2	TO-220	2N6667	TO-220
D45E3	TO-220	2N6668	TO-220
D45H1	TO-220	2N6111	TO-220
D45H2	TO-220	2N6111	TO-220
D45H4	TO-220	2N6109	TO-220
D45H5	TO-220	2N6109	TO-220
D45H7	TO-220	2N6107	TO-220
D45H8	TO-220	2N6107	TO-220
D45H10	TO-220	2N6107	TO-220
D45H11	TO-220	2N6107	TO-220
DTS410	TO-3	RCA410	TO-3
DTS411	TO-3	RCA411	TO-3
DTS413	TO-3	RCA413	TO-3

Industry Type	Package	RCA Type	Package
DTS423	TO-3	RCA423	TO-3
DTS431	TO-3	RCA431	TO-3
ESM113	TO-3	2N6384	TO-3
ESM114	TO-3	2N6385	TO-3
ESM159	TO-3	RCA8350A	TO-3
ESM160	TO-3	RCA8350B	TO-3
ESM213	TO-220	2N6387	TO-220
ESM214	TO-220	2N6388	TO-220
ESM217	TO-220	2N6387	TO-220
ESM218	TO-220	2N6388	TO-220
ESM259	TO-220	RCA8203A	TO-220
ESM260	TO-220	RCA8203B	TO-220
ESM261	TO-220	RCA8203A	TO-220
ESM262	TO-220	RCA8203B	TO-220
FT410	TO-3	RCA410	TO-3
FT411	TO-3	RCA411	TO-3
FT413	TO-3	RCA413	TO-3
FT423	TO-3	RCA423	TO-3
FT431	TO-3	RCA431	TO-3
MJ400	TO-66	2N3585	TO-66
MJ410	TO-3	RCA410	TO-3
MJ411	TO-3	RCA411	TO-3
MJ413	TO-3	RCA413	TO-3
MJ420	TO-39	BF258	TO-39
MJ423	TO-3	RCA423	TO-3
MJ424	TO-3	BUX16C	TO-3
MJ425	TO-3	BUX18C	TO-3
MJ431	TO-3	RCA431	TO-3
MJ450	TO-3	2N6246	TO-3
		2N6469	TO-3
MJ480	TO-3	2N6470	TO-3
MJ481	TO-3	2N6471	TO-3
MJ490	TO-3	2N6246	TO-3
		2N6469	TO-3
MJ491	TO-3	2N6246	TO-3
MJ802	TO-3	RCS258	TO-3
MJ900	TO-3	RCA8350A	TO-3
MJ901	TO-3	RCA8350B	TO-3
MJ920	TO-3	RCA8350A	TO-3
MJ921	TO-3	RCA8350B	TO-3
MJ1000	TO-3	RCA1000	TO-3
MJ1001	TO-3	RCA1001	TO-3
MJ1200	TO-3	2N6384	TO-3
MJ1201	TO-3	2N6385	TO-3
MJ1800	TO-3	2N5838	TO-3
		BUX16C	TO-3
MJ2249	TO-66	2N3879	TO-66
MJ2250	TO-66	2N3879	TO-66
MJ2251	TO-66	2N3584	TO-66
		BUX67B	
MJ2252	TO-66	2N3585	TO-66
		BUX67C	TO-66
MJ2253	TO-66	2N5955	TO-66
MJ2254	TO-66	2N5954	TO-66
MJ2267	TO-3	2N6246	TO-3
		2N6469	TO-3
MJ2268	TO-3	2N6246	TO-3
MJ2500	TO-3	2N6649	TO-204MA●
		RCA8350A	TO-3
MJ2501	TO-3	2N6650	TO-204MA●
		RCA8350B	TO-3
MJ2801	TO-3	2N6371	TO-3

● JEDEC TO-204MA was formerly designated JEDEC TO-3.

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
MJ2840	TO-3	2N3055	TO-3
		2N6471	TO-3
MJ2841	TO-3	2N6254	TO-3
		2N6472	TO-3
MJ2901	TO-3	2N6246	TO-3
		2N6249	TO-3
MJ2940	TO-3	2N6246	TO-3
		BDX18N	TO-3
MJ2941	TO-3	2N6247	TO-3
MJ3000	TO-3	2N6384	TO-3
MJ3001	TO-3	2N6385	TO-3
MJ3010	TO-3	BUX16B	TO-3
MJ3011	TO-3	BUX16B	TO-3
MJ3026	TO-3	2N5839	TO-3
MJ3027	TO-3	2N5840	TO-3
		BUX126	TO-3
MJ3028	TO-3	2N5840	TO-3
		BUX126	TO-3
MJ3029	TO-3	BUX16A	TO-3
MJ3030	TO-3	BUX16C	TO-3
MJ3101	TO-66	2N3878	TO-66
MJ3201	TO-66	BUX67A	TO-66
MJ3202	TO-66	2N3585	TO-3
		BUX67B	TO-66
MJ3430	TO-3	2N5840	TO-3
		BUX18B	TO-3
MJ3583	TO-66	2N6211	TO-3
MJ3584	TO-66	2N6212	TO-66
MJ3585	TO-66	2N6212	TO-66
MJ3701	TO-66	2N5956	TO-66
MJ3760	TO-3	BU126	TO-3
MJ3761	TO-3	BU126	TO-3
MJ3771	TO-3	2N3771	TO-3
MJ3772	TO-3	2N3772	TO-3
MJ3773	TO-3	2N3773	TO-3
MJ4000	TO-3	2N6384	TO-3
		RCA1000	TO-3
MJ4001	TO-3	2N6385	TO-3
		RCA1001	TO-3
MJ4010	TO-3	2N6649	TO-204MA●
		2N6667	TO-3
MJ4011	TO-3	2N6650	TO-204MA●
		2N6668	TO-3
MJ4240	TO-66	2N6212	TO-66
MJ4502	TO-3	2N6248	TO-3
MJ5415	TO-39	2N5415	TO-39
MJ5416	TO-39	2N5416	TO-39
MJ5600	TO-3	2N3772	TO-3
MJ5601	TO-3	2N6258	TO-3
MJ5602	TO-3	2N3773	TO-3
MJ5603	TO-3	2N3773	TO-3
MJ6000	TO-3	2N3772	TO-3
MJ6001	TO-3	2N6258	TO-3
MJ6002	TO-3	2N3773	TO-3
MJ6003	TO-3	2N6258	TO-3
MJ6004	TO-3	2N6258	TO-3
MJ6302	TO-3	2N3773	TO-3
MJ7000	TO-63	2N3265	TO-63
MJE29	Case 199	BD239	TO-220
MJE29A	Case 199	BD239A	TO-220
MJE29B	Case 199	BD239B	TO-220
MJE29C	Case 199	BD239C	TO-220
MJE30	Case 199	BD240	TO-220
MJE30A	Case 199	BD240A	TO-220
MJE30B	Case 199	BD240B	TO-220
MJE30C	Case 199	BD240C	TO-220
MJE31	Case 199	BD241	TO-220
MJE31A	Case 199	BD241A	TO-220
MJE31B	Case 199	BD241B	TO-220
MJE31C	Case 199	BD241C	TO-220
MJE32	Case 199	BD242	TO-220
MJE32A	Case 199	BD242A	TO-220
MJE32B	Case 199	BD242B	TO-220
MJE32C	Case 199	BD242C	TO-220
MJE33	Case 199	2N6486	TO-220
MJE33A	Case 199	2N6487	TO-220
MJE33B	Case 199	2N6488	TO-220
MJE34	Case 199	2N6489	TO-220
MJE34A	Case 199	2N6490	TO-220
MJE34B	Case 199	2N6491	TO-220
MJE41	Case 199	BD243	TO-220
MJE41A	Case 199	BD243A	TO-220
MJE41B	Case 199	BD243B	TO-220
MJE41C	Case 199	BD243C	TO-220
MJE42	Case 199	BD244	TO-220
MJE42A	Case 199	BD244A	TO-220
MJE42B	Case 199	BD244C	TO-220
MJE42C	Case 199	BD244C	TO-220
MJE47	Case 199	TA8863C	TO-220
MJE48	Case 199	TA8863B	TO-220
MJE49	Case 199	TA8863A	TO-220
MJE105	Case 90	BD278A	TO-220
MJE105K	Case 199	BD278A	TO-220
MJE205	Case 90	2N6290	TO-220
		BD277	TO-220
MJE205K	Case 199	BD277	TO-220
MJE340K	Case 199	TA8863B	TO-220
MJE341K	Case 199	TA8863J	TO-220
MJE344K	Case 199	TA8865J	TO-220
MJE370	Case 77	RCA30	TO-220
MJE370K	Case 199	BD242	TO-220
MJE371	Case 77	RCA30	TO-220
MJE520	Case 77	RCA29	TO-220
MJE520K	Case 199	BD241	TO-220
MJE521	Case 77	RCA29	TO-220
MJE700	TO-126	RCA125	TO-220
		2N6667	TO-220
MJE701	TO-126	RCA125	TO-220
		2N6667	TO-220
MJE702	TO-126	RCA126	TO-220
		2N6668	TO-220
MJE703	TO-126	RCA126	TO-220
		2N6668	TO-220
MJE800	TO-126	2N6387	TO-220
		RCA120	TO-220
MJE801	TO-126	2N6387	TO-220
		RCA120	TO-220
MJE802	TO-126	2N6388	TO-220
		RCA121	TO-220
MJE803	TO-126	2N6388	TO-220
		RCA121	TO-220
MJE1090	Case 90	2N6667	TO-220
		BDX34A	TO-220
MJE1091	Case 90	2N6667	TO-220
		BDX34A	TO-220
MJE1092	Case 90	2N6667	TO-220
		BDX34B	TO-220
MJE1093	Case 90	2N6667	TO-220
		BDX34B	TO-220
MJE1100	Case 90	2N6387	TO-220
		BDX33A	TO-220
MJE1101	Case 90	2N6387	TO-220
		BDX33A	TO-220
MJE1102	Case 90	2N6388	TO-220
		BDX33B	TO-220
MJE1103	Case 90	2N6388	TO-220
		BDX33B	TO-220
MJE1290	Case 90	2N6489	TO-220
MJE1291	Case 90	2N6490	TO-220
MJE1660	Case 90	2N6486	TO-220
MJE1661	Case 90	2N6487	TO-220
MJE2010	Case 199	BD244	TO-220
MJE2011	Case 199	BD244A	TO-220
MJE2020	Case 199	BD243	TO-220

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
MJE2021	Case 199	BD243A	TO-220
MJE2050	Case 199	40979	TO-220
		RCA1C10	TO-220
MJE2090	Case 199	RCA8203A	TO-220
		BDX34A	TO-220
MJE2091	Case 199	RCA8203A	TO-220
		BDX34A	TO-220
MJE2092	Case 199	RCA8203B	TO-220
		BDX34B	TO-220
MJE2093	Case 199	RCA8203B	TO-220
		BDX34B	TO-220
MJE2100	Case 199	2N6387	TO-220
		BDX33A	TO-220
MJE2101	Case 199	2N6387	TO-220
		BDX33A	TO-220
MJE2102	Case 199	2N6388	TO-220
		BDX33B	TO-220
MJE2103	Case 199	2N6388	TO-220
		BDX33B	TO-220
MJE2160	Case 90	TA8863B	TO-220
MJE2360	Case 199	TA8863E	TO-220
MJE2361	Case 199	TA8863A	TO-220
MJE2370	Case 199	2N6109	TO-220
		BD240	TO-220
MJE2371	Case 199	2N6107	TO-220
		BD240A	TO-220
MJE2480	Case 199	2N6290	TO-220
		BD243	TO-220
MJE2481	Case 199	2N6292	TO-220
		BD243A	TO-220
MJE2482	Case 199	2N6290	TO-220
		BD243	TO-220
MJE2483	Case 199	2N6292	TO-220
		BD243A	TO-220
MJE2490	Case 199	2N6109	TO-220
		BD244	TO-220
MJE2491	Case 199	2N6107	TO-220
		BD244A	TO-220
MJE2520	Case 199	2N6290	TO-220
		BD239	TO-220
MJE2521	Case 199	2N6292	TO-220
		BD239A	TO-220
MJE2522	Case 199	2N6290	TO-220
		BD241	TO-220
MJE2523	Case 199	2N6292	TO-220
		BD241A	TO-220
MJE2801	Case 90	2N6290	TO-220
		2N6487	TO-220
MJE2801K	Case 199	2N6487	TO-220
MJE2901	Case 90	2N6107	TO-220
		2N6490	TO-220
MJE2901K	Case 199	2N6490	TO-220
MJE2955	Case 90	2N6490	TO-220
		40878	TO-220
MJE2955K	Case 199	2N6490	TO-220
		40878	TO-220
MJE3054	Case 199	RCA3054	TO-220
MJE3055	Case 90	RCA3055	TO-220
MJE3055K	Case 199	RCA3055	TO-220
MJE3370	Case 199	BD242	TO-220
MJE3371	Case 90	40980	TO-220
		RCA1C11	TO-220
MJE3439	TO-126	RCP111D	TO-220
MJE3740	Case 199	2N6107	TO-220
MJE3741	Case 199	2N6107	TO-220
MJE4918	Case 199	BD240	TO-220
MJE4919	Case 199	BD240A	TO-220
MJE4920	Case 199	BD240B	TO-220
MJE4921	Case 199	BD239	TO-220
MJE4922	Case 199	BD239A	TO-220
MJE4923	Case 199	BD239B	TO-220
MJE5655	Case 199	TA8863J	TO-220
MJE5656	Case 199	TA8863F	TO-220
MJE5657	Case 199	TA8863E	TO-220
MJE5974	Case 199	2N6489	TO-220
MJE5975	Case 199	2N6490	TO-220
MJE5976	Case 199	2N6491	TO-220
MJE5977	Case 199	2N6486	TO-220
MJE5978	Case 199	2N6487	TO-220
MJE5979	Case 199	2N6488	TO-220
MJE5980	Case 199	2N6489	TO-220
MJE5981	Case 199	2N6490	TO-220
MJE5982	Case 199	2N6491	TO-220
MJE5983	Case 199	2N6486	TO-220
MJE5984	Case 199	2N6487	TO-220
MJE5985	Case 199	2N6488	TO-220
MJE6040	Case 90	RCA125	TO-220
		BDX34A	TO-220
MJE6041	Case 90	RCA125	TO-220
		BDX34B	TO-220
MJE6042	Case 90	RCA126	TO-220
		BDX34C	TO-220
MJE6043	Case 90	2N6387	TO-220
		BDX33A	TO-220
MJE6044	Case 90	2N6530	TO-220
		BDX33B	TO-220
MJE6045	Case 90	RCA122	TO-220
		BDX33C	TO-220
MM3005	TO-39	40635	TO-39
		RCA1A06	TO-39
MM4000	TO-39	BFT28	TO-39
MM4001	TO-39	BFT28A	TO-39
MM4002	TO-39	BFT28B	TO-39
MM4003	TO-39	BFT28C	TO-39
MM5005	TO-39	40634	TO-39
		RCA1A05	TO-39
MPSU01	Case 152	RCP705	TO-202
MPSU02	Case 152	RCP701B	TO-202
MPSU05	Case 152	RCP701B	TO-202
MPSU06	Case 152	RCP701C	TO-202
MPSU07	Case 152	RCP701D	TO-202
MPSU10	Case 152	RCP111D	TO-202
MPSU51	Case 152	RCP704	TO-202
MPSU52	Case 152	RCP700A	TO-202
MPSU55	Case 152	RCP700B	TO-202
MPSU56	Case 152	RCP700C	TO-202
MPSU57	Case 152	RCP700D	TO-202
NSD102	TO-202	RCP701B	TO-202
NSD103	TO-202	RCP701B	TO-202
NSD104	TO-202	RCP701C	TO-202
NSD105	TO-202	RCP701C	TO-202
NSD106	TO-202	RCP701D	TO-202
NSD131	TO-202	RCP113B	TO-202
NSD132	TO-202	RCP111B	TO-202
NSD133	TO-202	RCP113C	TO-202
NSD134	TO-202	RCP111C	TO-202
NSD135	TO-202	RCP111D	TO-202
NSD202	TO-202	RCP700B	TO-202
NSD203	TO-202	RCP700B	TO-202
NSD204	TO-202	RCP700C	TO-202
NSD205	TO-202	RCP700C	TO-202
NSD206	TO-202	RCP700D	TO-202
SDT410	TO-3	RCA410	TO-3
SDT411	TO-3	RCA411	TO-3
SDT413	TO-3	RCA413	TO-3
SDT423	TO-3	RCA423	TO-3
SDT431	TO-3	RCA431	TO-3
SDT6901	TO-66	2N6078	TO-66
SDT6902	TO-66	2N6078	TO-66
SDT6903	TO-66	2N6078	TO-66
SDT6904	TO-66	2N6078	TO-66
SDT6905	TO-66	2N6078	TO-66
SDT6906	TO-66	2N6078	TO-66
SDT6907	TO-66	2N6078	TO-66
SDT6908	TO-66	2N6078	TO-66

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
SDT7601	TO-3	2N5039	TO-3
SDT7602	TO-3	2N5039	TO-3
SDT7603	TO-3	2N5038	TO-3
SDT7604	TO-3	2N6496	TO-3
SDT7605	TO-3	2N6249	TO-3
SDT7607	TO-3	2N5039	TO-3
SDT7608	TO-3	2N5039	TO-3
SDT7609	TO-3	2N5038	TO-3
SDT7610	TO-3	2N6354	TO-3
SDT7731	TO-3	2N6470	TO-3
SDT7732	TO-3	2N6471	TO-3
SDT7733	TO-3	2N6472	TO-3
SDT8002	TO-63	2N3266	TO-63
SDT8003	TO-63	2N3265	TO-63
SDT8012	TO-63	2N3266	TO-63
SDT8013	TO-63	2N3265	TO-63
SDT8015	TO-63	2N3266	TO-63
SDT8016	TO-63	2N3265	TO-63
SDT8105	Radial	2N3264	Radial
SDT8106	Radial	2N3263	Radial
SDT8112	Radial	2N3264	Radial
SDT8113	Radial	2N3263	Radial
SDT8301	TO-63	2N3266	TO-63
SDT8302	TO-63	2N3265	TO-63
SDT8303	TO-63	2N3266	TO-63
SDT8304	TO-63	2N3265	TO-63
SDT9201	TO-3	2N3055	TO-3
SDT9202	TO-3	2N6254	TO-3
SDT9203	TO-3	2N4348	TO-3
SDT9204	TO-3	2N4348	TO-3
SDT9205	TO-3	2N3055	TO-3
SDT9206	TO-3	2N3055	TO-3
SDT9207	TO-3	2N6254	TO-3
SDT9208	TO-3	2N4348	TO-3
SDT9209	TO-3	2N4348	TO-3
SDT9210	TO-3	2N6253	TO-3
SDT9701	TO-3	2N6258	TO-3
SDT9702	TO-3	2N4348	TO-3
SDT9703	TO-3	2N4348	TO-3
SDT9704	TO-3	2N6254	TO-3
SDT9705	TO-3	2N4348	TO-3
SDT9706	TO-3	2N4348	TO-3
SDT9707	TO-3	2N3055	TO-3
SDT9801	TO-3	2N6254	TO-3
SDT9802	TO-3	2N6254	TO-3
SDT9803	TO-3	2N6254	TO-3
SDT9804	TO-3	2N3773	TO-3
SE9300	TO-220	RCA120	TO-220
SE9301	TO-220	RCA121	TO-220
SE9302	TO-220	RCA122	TO-220
SE9303	TO-3	2N6384	TO-3
SE9304	TO-3	2N6385	TO-3
SPC410	TO-3	RCA410	TO-3
SPC411	TO-3	RCA411	TO-3
SPC413	TO-3	RCA413	TO-3
SPC423	TO-3	RCA423	TO-3
SPC431	TO-3	RCA431	TO-3
STS410	TO-3	RCA410	TO-3
STS411	TO-3	RCA411	TO-3
STS413	TO-3	RCA413	TO-3
STS423	TO-3	RCA423	TO-3
STS431	TO-3	RCA431	TO-3
T1482	TO-39	40311	TO-39

Industry Type	Package	RCA Type	Package
T1484	TO-39	2N697	TO-39
T1492	TO-39	40407	TO-39
T1493	TO-39	2N1613	TO-39
TIP29	TO-220	BD239	TO-220
		RCA29	TO-220
		TIP29	TO-220
TIP29A	TO-220	BD239A	TO-220
		RCA29A	TO-220
		TIP29A	TO-220
TIP29B	TO-220	BD239B	TO-220
		RCA29B	TO-220
		TIP29B	TO-220
TIP29C	TO-220	BD239C	TO-220
		RCA29C	TO-220
		TIP29C	TO-220
TIP30	TO-220	BD240	TO-220
		RCA30	TO-220
		TIP30	TO-220
TIP30A	TO-220	BD240A	TO-220
		RCA30A	TO-220
		TIP30A	TO-220
TIP30B	TO-220	BD240B	TO-220
		RCA30B	TO-220
		TIP30B	TO-220
TIP30C	TO-220	BD240C	TO-220
		RCA30C	TO-220
		TIP30C	TO-220
TIP31	TO-220	BD241	TO-220
		RCA31	TO-220
		TIP31	TO-220
TIP31A	TO-220	BD241A	TO-220
		RCA31A	TO-220
		TIP31A	TO-220
TIP31B	TO-220	BD241B	TO-220
		RCA31B	TO-220
		TIP31B	TO-220
TIP31C	TO-220	BD241C	TO-220
		RCA31C	TO-220
		TIP31C	TO-220
TIP32	TO-220	BD242	TO-220
		RCA32	TO-220
		TIP32	TO-220
TIP32A	TO-220	BD242A	TO-220
		RCA32A	TO-220
		TIP32A	TO-220
TIP32B	TO-220	BD242B	TO-220
		RCA32B	TO-220
		TIP32B	TO-220
TIP32C	TO-220	BD242C	TO-220
		RCA32C	TO-220
		TIP32C	TO-220
TIP33	TO-3P	2N6486	TO-220
TIP33A	TO-3P	2N6487	TO-220
TIP33B	TO-3P	2N6488	TO-220
TIP34	TO-3P	2N6489	TO-220
TIP34A	TO-3P	2N6490	TO-220
TIP34B	TO-3P	2N6491	TO-220
TIP41	TO-220	BD243	TO-220
		RCA41	TO-220
		TIP41	TO-220
TIP41A	TO-220	BD243A	TO-220
		RCA41A	TO-220
		TIP41A	TO-220

Industry Type	Package	RCA Type	Package
TIP41B	TO-220	BD243B	TO-220
		RCA41B	TO-220
		TIP41B	TO-220
TIP41C	TO-220	BD243C	TO-220
		RCA41C	TO-220
		TIP41C	TO-220
TIP42	TO-220	BD244	TO-220
		RCA42	TO-220
		TIP42	TO-220
TIP42A	TO-220	BD244A	TO-220
		RCA42A	TO-220
		TIP42A	TO-220
TIP42B	TO-220	BD244B	TO-220
		RCA42B	TO-220
		TIP42B	TO-220
TIP42C	TO-220	BD244C	TO-220
		RCA42C	TO-220
		TIP42C	TO-220
TIP110	TO-220	BDX33A	TO-220
TIP111	TO-220	BDX33B	TO-220
TIP112	TO-220	BDX33C	TO-220
TIP115	TO-220	BDX34A	TO-220
TIP116	TO-220	BDX34B	TO-220
TIP117	TO-220	BDX34C	TO-220
TIP120	TO-220	BDX33A	TO-220
		RCA120	TO-220
		TIP120	TO-220
TIP121	TO-220	BDX33B	TO-220
		RCA121	TO-220
		TIP121	TO-220
TIP122	TO-220	BDX33C	TO-220
		RCA122	TO-220
		TIP122	TO-220
TIP125	TO-220	BDX34A	TO-220
		RCA125	TO-220
		TIP125	TO-220
TIP126	TO-220	BDX34B	TO-220
		RCA126	TO-220
		TIP126	TO-220
TIP127	TO-220	BDX34C	TO-220
		TIP127	TO-220
TIP140	TO-218	2N6387	TO-220
TIP141	TO-218	2N6530	TO-220
TIP142	TO-218	2N6531	TO-220
TIP145	TO-218	2N6666	TO-220
TIP146	TO-218	2N6667	TO-220
TIP147	TO-218	2N6668	TO-220
TIP525	TO-3	BUX27A	TO-3
TIP531	TO-3	2N6250	TO-3
TIP535	TO-3	BUX17A	TO-3
TIP538	TO-3	2N6250	TO-3
TIP539	TO-3	2N6250	TO-3
TIP544	TO-3	2N6248	TO-3
TIP546	TO-3	2N6469	TO-3
TIP640	TO-3	2N6384	TO-3
TIP641	TO-3	2N6385	TO-3
TIP642	TO-3	2N6385	TO-3
TIP645	TO-3	2N6666	TO-3
TIP646	TO-3	2N6667	TO-3
TIP647	TO-3	2N6668	TO-3
TIP2955	TO-3P	2N6490	TO-220
		40878	TO-220
TIP3054	TO-220	RCA3054	TO-220

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

POWER TRANSISTORS (CONT'D)

Industry Type	Package	RCA Type	Package
TIP3055	TO-3P	RCA3055	TO-220
TIP5530	TO-3P	2N6099	TO-220
TS2218	TO-39	2N1613	TO-39
TS2219	TO-39	2N1711	TO-39
TS2904	TO-39	40406	TO-39

SILICON CONTROLLED RECTIFIERS

Industry Type	Package	RCA Type	Package
2N1842	TO-48	2N1842A	TO-48
2N1843	TO-48	2N1843A	TO-48
2N1844	TO-48	2N1844A	TO-48
2N1845	TO-48	2N1845A	TO-48
2N1846	TO-48	2N1846A	TO-48
2N1847	TO-48	2N1847A	TO-48
2N1848	TO-48	2N1848A	TO-48
2N1849	TO-48	2N1849A	TO-48
2N1850	TO-48	2N1850A	TO-48
2N4441	Case 90	S122F	TO-220
2N4442	Case 90	S122B	TO-220
2N4443	Case 90	S122D	TO-220
2N4444	Case 90	S122M	TO-220
2N6236	TO-126	S2060Y	TO-220
2N6237	TO-126	S2060F	TO-220
2N6238	TO-126	S2060A	TO-220
2N6239	TO-126	S2060B	TO-220
2N6240	TO-126	S2060D	TO-220
2N6241	TO-126	S2060M	TO-220
10RC10A	TO-48	2N1844A	TO-48
10RC10AS24	TO-48	2N3650	TO-48
10RC20A	TO-48	2N1846A	TO-48
10RC20AS24	TO-48	2N3650	TO-48
10RC30A	TO-48	2N1848A	TO-48
10RC30AS24	TO-48	2N3651	TO-48
10RC40A	TO-48	2N1849A	TO-48
10RC40AS24	TO-48	2N3652	TO-48
10RC50A	TO-48	2N1850A	TO-48
10RC50AS24	TO-48	S7410M	TO-48
10RC60AS24	TO-48	S7410M	TO-48
16RC10A	TO-48	2N683	TO-48
16RC10AS24	TO-48	2N3650	TO-48
16RC20A	TO-48	2N685	TO-48
16RC20AS24	TO-48	2N3651	TO-48
16RC30A	TO-48	2N687	TO-48
16RC30AS24	TO-48	2N3652	TO-48
16RC40A	TO-48	2N688	TO-48
16RC40AS24	TO-48	2N3653	TO-48
16RC50A	TO-48	2N689	TO-48
16RC50AS24	TO-48	S7410M	TO-48
16RC60A	TO-48	2N690	TO-48
16RC60AS24	TO-48	S7410M	TO-48
BstB0106B	MU22	S2061A	TO-220
BstB0113B	MU22	S2061B	TO-220
BstB0126B	MU22	S2061D	TO-220
BstB0133B	MU22	S2061E	TO-220
BstB0140B	MU22	S2061M	TO-220
BstB0106BS4	MU22	S2061A	TO-220
BstB0113BS4	MU22	S2061B	TO-220
BstB0126BS4	MU22	S2061D	TO-220
BstB0133BS4	MU22	S2061E	TO-220
BstB0106BS5	MU22	S2061A	TO-220
BstB0113BS5	MU22	S2061B	TO-220
BstB0126BS5	MU22	S2061D	TO-220
BstB0133BS5	MU22	S2061E	TO-220
BstB0106C	MU22	S2062A	TO-220
BstB0113C	MU22	S2062B	TO-220
BstB0126C	MU22	S2062D	TO-220
BstB0133C	MU22	S2062E	TO-220
BstB0140C	MU22	S2062M	TO-220
BstB0106CS4	MU22	S2062A	TO-220
BstB0113CS4	MU22	S2062B	TO-220
BstB0126CS4	MU22	S2062D	TO-220
BstB0133CS4	MU22	S2062E	TO-220
BstB0140CS4	MU22	S2062M	TO-220
BstB0106D	MU22	S2062A	TO-220
BstB0113D	MU22	S2062B	TO-220
BstB0126D	MU22	S2062D	TO-220
BstB0133D	MU22	S2062E	TO-220
BstB0140D	MU22	S2062M	TO-220
BstB0106E	MU22	S2062A	TO-220
BstB0113E	MU22	S2062B	TO-220
BstB0126E	MU22	S2062D	TO-220
BstB0133E	MU22	S2062E	TO-220
BstB0140E	MU22	S2062M	TO-220
BstB0106F	MU22	S2062A	TO-220
BstB0113F	MU22	S2062B	TO-220
BstB0126F	MU22	S2062D	TO-220
BstB0133F	MU22	S2062E	TO-220
BstB0140F	MU22	S2062M	TO-220
BstB0206B	MU23	S2061A	TO-220
BstB0213B	MU23	S2061B	TO-220
BstB0226B	MU23	S2061D	TO-220
BstB0233B	MU23	S2061E	TO-220
BstB0206BS4	MU23	S2061A	TO-220
BstB0213BS4	MU23	S2061B	TO-220
BstB0226BS4	MU23	S2061D	TO-220
BstB0233BS4	MU23	S2061E	TO-220
BstB0206BS5	MU23	S2061A	TO-220
BstB0213BS5	MU23	S2061B	TO-220
BstB0226BS5	MU23	S2061D	TO-220
BstB0233BS5	MU23	S2061E	TO-220
BstB0206C	MU23	S2062A	TO-220
BstB0213C	MU23	S2062B	TO-220
BstB0233C	MU23	S2062E	TO-220
BstB0240C	MU23	S2062M	TO-220
BstB0206CS4	MU23	S2062A	TO-220
BstB0213CS4	MU23	S2062B	TO-220
BstB0226CS4	MU23	S2062D	TO-220
BstB0233CS4	MU23	S2062E	TO-220
BstB0240CS4	MU23	S2062M	TO-220
BstB0206D	MU23	S2062A	TO-220
BstB0213D	MU23	S2062B	TO-220
BstB0226D	MU23	S2062D	TO-220
BstB0233D	MU23	S2062E	TO-220
BstB0240D	MU23	S2062M	TO-220
BstB0206E	MU23	S2062A	TO-220
BstB0213E	MU23	S2062B	TO-220
BstB0226E	MU23	S2062D	TO-220
BstB0233E	MU23	S2062E	TO-220
BstB0240E	MU23	S2062M	TO-220
BstB0206F	MU23	S2062A	TO-220
BstB0213F	MU23	S2062B	TO-220
BstB0226F	MU23	S2062D	TO-220
BstB0233F	MU23	S2062E	TO-220
BstB0240F	MU23	S2062M	TO-220
BstC0313	SC88	2N1846	TO-48
BstC0326	SC88	2N1849	TO-48
BstC0313S6	SC88	2N1846	TO-48
BstC0326S6	SC88	2N1849	TO-48
BstC0506E	TO-66	2N3228	TO-66
BstC0513E	TO-66	2N3228	TO-66
BstC0526E	TO-66	2N3525	TO-66
BstC0533E	TO-66	2N4101	TO-66
BstC0540E	TO-66	2N4101	TO-66
BstC0546E	TO-66	2N4101	TO-66
BstC0506F	TO-66	2N3228	TO-66
BstC0513F	TO-66	2N3228	TO-66
BstC0526F	TO-66	2N3525	TO-66
BstC0533F	TO-66	2N4101	TO-66
BstC0540F	TO-66	2N4101	TO-66
BstC0546F	TO-66	2N4101	TO-66
BstC0506G	TO-66	2N3228	TO-66
BstC0513G	TO-66	2N3228	TO-66
BstC0526G	TO-66	2N3525	TO-66
BstC0533G	TO-66	2N4101	TO-66
BstC0540G	TO-66	2N4101	TO-66
BstC0546G	TO-66	2N4101	TO-66
BstC0506H	TO-66	2N3228	TO-66
BstC0513H	TO-66	2N3228	TO-66
BstC0526H	TO-66	2N3525	TO-66
BstC0533H	TO-66	2N4101	TO-66
BstC0540H	TO-66	2N4101	TO-66
BstC0546H	TO-66	2N4101	TO-66
BT102-300R	TO-220	S2800C	TO-220
BT102-500R	TO-220	S2800E	TO-220
BTW30-300	TO-48	2N3657	TO-48
BTW30-400	TO-48	2N3658	TO-48
BTW30-500	TO-48	S7432M	TO-48
BTW30-600	TO-48	S7432M	TO-48
BTW31-300	TO-48	2N3657	TO-48
BTW31-400	TO-48	2N3658	TO-48
BTW31-500	TO-48	S7412M	TO-48
BTW31-600	TO-48	S7412M	TO-48
BTW47-600	TO-48	S6410M	stud
BTW92-600	TO-48	2N3899	stud
BTW92-800	TO-48	S6410N	stud
BTX31-100	TO-48	S7310A	TO-48
BTX31-200	TO-48	S7310B	TO-48
BTX31-400	TO-48	S7310D	TO-48
BTX31-500	TO-48	S7310M	TO-48
BTX31-600	TO-48	S7310M	TO-48
BTX32-100	TO-48	S7310B	TO-48
BTX32-400	TO-48	S7310D	TO-48
BTX32-500	TO-48	S7310M	TO-48
BTX32-600	TO-48	S7310M	TO-48
BTX33-100	TO-48	S6210A	TO-48
BTX33-200	TO-48	S6210B	TO-48
BTX33-400	TO-48	S6210D	TO-48
BTX33-500	TO-48	S6210M	TO-48
BTX33-600	TO-48	S6210M	TO-48
BTX70-100	TO-48	S6210A	TO-48
BTX70-200	TO-48	S6210B	TO-48
BTX70-400	TO-48	S6210D	TO-48
BTX70-500	TO-48	S6210M	TO-48
BTX70-600	TO-48	S6210M	TO-48
BTX71-100	TO-48	S7310B	TO-48
BTX71-200	TO-48	S7310B	TO-48
BTX71-400	TO-48	S7310D	TO-48

SILICON CONTROLLED RECTIFIERS (CONT'D)

Industry Type	Package	RCA Type	Package
BTX71-500	TO-48	S7310M	TO-48
BTX71-600	TO-48	S7310M	TO-48
BTX72-100	TO-48	S7310M	TO-48
BTX72-200	TO-48	S7310M	TO-48
BTX72-400	TO-48	S7310M	TO-48
BTX72-500	TO-48	S7310M	TO-48
BTX72-600	TO-48	S7310M	TO-48
BTX73-100	TO-48	2N683	TO-48
BTX73-200	TO-48	2N685	TO-48
BTX73-400	TO-48	2N688	TO-48
BTX73-500	TO-48	2N689	TO-48
BTX73-600	TO-48	2N690	TO-48
BTX74-100	TO-48	S6210A	TO-48
BTX74-200	TO-48	S6210B	TO-48
BTX74-400	TO-48	S6210D	TO-48
BTX74-500	TO-48	S6210M	TO-48
BTX74-600	TO-48	S6210M	TO-48
BTY87-400	TO-48	S6210D	stud
BTY87-400R	TO-48	2N3898	stud
BTY87-500	TO-48	S6210M	stud
BTY87-500R	TO-48	2N3899	stud
BTY87-600	TO-48	S6210M	stud
BTY87-600R	TO-48	2N3899	stud
BTY87-800R	TO-48	S6410N	stud
BTY91-400	TO-48	S6210D	stud
BTY91-400R	TO-48	2N3898	stud
BTY91-500	TO-48	S6210M	stud
BTY91-500R	TO-48	2N3899	stud
BTY91-600	TO-48	S6210M	stud
BTY91-600R	TO-48	2N3899	stud
BTY91-800R	TO-48	S6410N	stud
C20A	stud	S6210A	stud
C20B	stud	S6210B	stud
C20C	stud	S6210C	stud
C20D	stud	S6210D	stud
C20F	stud	S6210A	stud
C20U	stud	S6210A	stud
C22A	press-fit	S6200A	press-fit
C22B	press-fit	S6200B	press-fit
C22C	press-fit	S6200C	press-fit
C22D	press-fit	S6200D	press-fit
C22F	press-fit	S6200A	press-fit
C22U	press-fit	S6200A	press-fit
C30A	stud	2N3896	stud
C30B	stud	2N3897	stud
C30C	stud	2N3898	stud
C30D	stud	2N3898	stud
C30P	stud	2N3896	stud
C30U	stud	2N3896	stud
C31A	stud	2N3896	stud
C31B	stud	2N3897	stud
C31C	stud	2N3898	stud
C31D	stud	2N3898	stud
C31P	stud	2N3896	stud
C31U	stud	2N3896	stud
C32A	press-fit	2N3870	press-fit
C32B	press-fit	2N3871	press-fit
C32C	press-fit	2N3872	press-fit
C32D	press-fit	2N3872	press-fit
C32F	press-fit	2N3870	press-fit
C32U	press-fit	2N3870	press-fit
C33A	press-fit	2N3870	press-fit
C33B	press-fit	2N3871	press-fit
C33C	press-fit	2N3872	press-fit
C33D	press-fit	2N3872	press-fit
C33F	press-fit	2N3870	press-fit
C33U	press-fit	2N3870	press-fit
C34A2	stud	2N3650	TO-48
C34B2	stud	2N3651	TO-48
C34C2	stud	2N3652	TO-48
C34D2	stud	2N3653	TO-48
C34E2	stud	S7410M	TO-48
C34F2	stud	2N3650	TO-48
C35A	TO-48	2N683	TO-48
		2N3896	stud
C35B	TO-48	2N685	TO-48
		2N3897	stud
C35C	TO-48	2N687	TO-48
		2N3898	stud
C35D	TO-48	2N688	TO-48
		2N3898	stud
C35E	TO-48	2N689	TO-48
		2N3899	stud
C35F	TO-48	2N682	TO-48
		2N3896	stud
C35G	TO-48	2N684	TO-48
		2N3897	stud
C35H	TO-48	2N686	TO-48
		2N3898	stud
C35M	TO-48	2N690	TO-48
		2N3899	stud
C35U	TO-48	2N681	TO-48
		2N3896	stud
C36A	TO-48	2N1844A	TO-48
C36B	TO-48	2N1846A	TO-48
C36C	TO-48	2N1848A	TO-48
C36D	TO-48	2N1849A	TO-48
C36E	TO-48	2N1850A	TO-48
C36F	TO-48	2N1843A	TO-48
C36G	TO-48	2N1845A	TO-48
C36H	TO-48	2N1847A	TO-48
C36U	TO-48	2N1842A	TO-48
C38A	TO-48	2N683	TO-48
C38B	TO-48	2N685	TO-48
C38C	TO-48	2N687	TO-48
C38D	TO-48	2N688	TO-48
C38E	TO-48	2N689	TO-48
C38F	TO-48	2N682	TO-48
C38G	TO-48	2N684	TO-48
C38M	TO-48	2N686	TO-48
C38U	TO-48	2N681	TO-48
C40A	TO-48	2N3650	TO-48
C40B	TO-48	2N3651	TO-48
C40C	TO-48	2N3652	TO-48
C40D	TO-48	2N3653	TO-48
C40E	TO-48	S7410M	TO-48
C40F	TO-48	2N3650	TO-48
C40G	TO-48	2N3651	TO-48
C40H	TO-48	2N3652	TO-48
C40U	TO-48	2N3650	TO-48
C45A	TO-49	TAS8612A	stud
C45B	TO-49	TAS8612B	stud
C45C	TO-49	TAS8612D	stud
C45D	TO-49	TAS8612D	stud
C45E	TO-49	TAS8612M	stud
C45F	TO-49	TAS8612A	stud
C45G	TO-49	TAS8612B	stud
C45H	TO-49	TAS8612D	stud
C45M	TO-49	TAS8612M	stud
C45N	TO-49	TAS8612N	stud
C45U	TO-49	TAS8612A	stud
C106A	TO-202	C106A	TO-202
		S106A	TO-202
C106B	TO-202	C106B	TO-202
		S106B	TO-202
C106C	TO-202	C106C	TO-202
		S106C	TO-202
C106D	TO-202	C106D	TO-202
		S106D	TO-202
C106F	TO-202	C106F	TO-202
		S106F	TO-202
C106Q	TO-202	C106Q	TO-202
		S106Q	TO-202
C106Y	TO-202	C106Y	TO-202
		S106Y	TO-202
C107A	TO-202	C107A	TO-202
		S107A	TO-202
C107B	TO-202	C107B	TO-202
		S107B	TO-202
C107C	TO-202	C107C	TO-202
		S107C	TO-202
C107D	TO-202	C107D	TO-202
		S107D	TO-202
C107F	TO-202	C107F	TO-202
		S107F	TO-202
C107Q	TO-202	C107Q	TO-202
		S107Q	TO-202
C107Y	TO-202	C107Y	TO-202
		S107Y	TO-202
C122A	TO-220	S122A	TO-220
		S2800A	TO-220
C122B	TO-220	S122B	TO-220
		S2800B	TO-220
C122C	TO-220	S122C	TO-220
		S2800C	TO-220
C122D	TO-220	S122D	TO-220
		S2800D	TO-220
C122E	TO-220	S122E	TO-220
		S2800E	TO-220
C122F	TO-220	S122F	TO-220
		S2800F	TO-220
C122G	TO-220	S122G	TO-220
		S2800G	TO-220
C122M	TO-220	S122M	TO-220
		S2800M	TO-220
C122Y	TO-220	S122A	TO-220
		S2800A	TO-220
C137E	TO-48	2N3899	stud
C137M	TO-48	2N3899	stud
C137N	TO-48	S6410N	stud
C137S	TO-48	S6410N	stud
C140A	TO-48	2N3650	TO-48
C140B	TO-48	2N3651	TO-48
C140C	TO-48	2N3652	TO-48
C140D	TO-48	2N3653	TO-48
C140F	TO-48	2N3654	TO-48
C141A	TO-48	2N3655	TO-48
C141B	TO-48	2N3656	TO-48

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

SILICON CONTROLLED RECTIFIERS (CONT'D)

Industry Type	Package	RCA Type	Package
C141C	TO-48	2N3657	TO-48
C141D	TO-48	2N3658	TO-48
C141F	TO-48	2N3654	TO-48
C220A	stud	S6210A	stud
C220A2	ISOstud	S6220A	ISOstud
C220B	stud	S6210B	stud
C220B2	ISOstud	S6220B	ISOstud
C220C	stud	S6210C	stud
C220C2	ISOstud	S6220C	ISOstud
C220D	stud	S6210D	stud
C220D2	ISOstud	S6220D	ISOstud
C220E	stud	S6210M	ISOstud
C220E2	ISOstud	S6220M	ISOstud
C220F	stud	S6210A	stud
C220F2	ISOstud	S6220A	ISOstud
C220U	stud	S6210A	stud
C220U2	ISOstud	S6220A	ISOstud
C222A	press-fit	S6200A	press-fit
C222B	press-fit	S6200D	press-fit
C222C	press-fit	S6200D	press-fit
C222D	press-fit	S6200D	press-fit
C222E	press-fit	S6200M	press-fit
C222F	press-fit	S6200A	press-fit
C222U	press-fit	S6200A	press-fit
CS5-2T	TO-66	2N3228	TO-66
CS5-4T	TO-66	2N3525	TO-66
CS5-5.5T	TO-66	2N4101	TO-66
CS10-02M	press-fit	S6200A	press-fit
CS10-02N	stud	S6210A	stud
CS10-05M	press-fit	S6200A	press-fit
CS10-05N	stud	S6210A	stud
CS10-1M	press-fit	S6200A	press-fit
CS10-1N	stud	S6210A	stud
CS10-2M	press-fit	S6200B	press-fit
CS10-2N	stud	S6210B	stud
CS10-4M	press-fit	S6200D	press-fit
CS10-4N	stud	S6210D	stud
CS10-6M	press-fit	S6200M	press-fit
CS10-6N	stud	S6210D	stud
CS20-05M	press-fit	S6200A	press-fit
CS20-05N	stud	S6210A	stud
CS20-1M	press-fit	S6200A	press-fit
CS20-1N	stud	S6210A	stud
CS20-2M	press-fit	S6200B	press-fit
CS20-2N	stud	S6210B	stud
CS20-4M	press-fit	S6200D	press-fit
CS20-4N	stud	S6210D	stud
CS20-6M	press-fit	S6200M	press-fit
CS20-6N	stud	S6210M	stud
CS35-02M	press-fit	2N3870	press-fit
CS35-02N	stud	2N3896	stud
CS35-05M	press-fit	2N3870	press-fit
CS35-05N	stud	2N3896	stud
CS35-1M	press-fit	2N3870	press-fit
CS35-1N	stud	2N3896	stud
CS35-2M	press-fit	2N3871	press-fit
CS35-2N	stud	2N3897	stud
CS35-4M	press-fit	2N3872	press-fit
CS35-4N	stud	2N3898	stud
CS35-6M	press-fit	2N3873	press-fit
CS35-6N	stud	2N3899	stud
CS0602602	MU22	S108B	TO-202
CS0602604	MU22	S107B	TO-202
CS0604602	MU22	S108D	TO-202
CS0604604	MU22	S107D	TO-202
CS0606602	MU22	S108M	TO-202
CS102603	MU23	S108B	TO-202
CS104603	MU23	S108D	TO-202
CS106603	MU23	S108E	TO-202
CS108603	MU23	S108M	TO-202
CS302D02	TO-220	S2062B	TO-220
CS304D02	TO-220	S2062D	TO-220
CS305D02	TO-220	S2062E	TO-220
CS306D02	TO-220	S2062M	TO-220
EC106A1	TO-202	S106A	TO-202
EC106B1	TO-202	S106B	TO-202
EC106M1	TO-202	S106M	TO-202
EC107A1	TO-202	S107A	TO-202
EC107B1	TO-202	S107B	TO-202
EC107M1	TO-202	S107M	TO-202
IR140A	TO-48	2N3650	TO-48
IR140B	TO-48	2N3651	TO-48
IR140C	TO-48	2N3652	TO-48
IR140D	TO-48	2N3653	TO-48
IR140F	TO-48	2N3654	TO-48
IR141A	TO-48	2N3655	TO-48
IR141B	TO-48	2N3656	TO-48
IR141C	TO-48	2N3657	TO-48
IR141D	TO-48	2N3658	TO-48
IR141F	TO-48	2N3654	TO-48
MCR106-1	Case 77	S2061Y	TO-220
MCR106-2	Case 77	S2061F	TO-220
MCR106-3	Case 77	S2061A	TO-220
MCR106-4	Case 77	S2061B	TO-220
MCR106-5	Case 77	S2061C	TO-220
MCR106-6	Case 77	S2061D	TO-220
MCR106-7	Case 77	S2061E	TO-220
MCR106-8	Case 77	S2061M	TO-220
MCR107-1	Case 77	S2062Y	TO-220
MCR107-2	Case 77	S2062F	TO-220
MCR107-3	Case 77	S2062A	TO-220
MCR107-4	Case 77	S2062B	TO-220
MCR107-5	Case 77	S2062C	TO-220
MCR107-6	Case 77	S2062D	TO-220
MCR107-7	Case 77	S2062E	TO-220
MCR406-1	Case 90	S2060Y	TO-220
MCR406-2	Case 90	S2060F	TO-220
MCR406-3	Case 90	S2060A	TO-220
MCR406-4	Case 90	S2060B	TO-220
MCR407-1	Case 90	S2061Y	TO-220
MCR407-2	Case 90	S2061F	TO-220
MCR407-3	Case 90	S2061A	TO-220
MCR407-4	Case 90	S2061B	TO-220
MCR1718-5	TO-48	2N3653	TO-48
MCR1718-6	TO-48	2N3653	TO-48
MCR1718-7	TO-48	S7410M	TO-48
MCR1718-8	TO-48	S7410M	TO-48
MCR3000-1	Case 90	S122F	TO-220
MCR3000-2	Case 90	S122F	TO-220
MCR3000-3	Case 90	S122A	TO-220
MCR3000-4	Case 90	S122B	TO-220
MCR3000-5	Case 90	S122C	TO-220
MCR3000-6	Case 90	S122D	TO-220
MCR3000-7	Case 90	S122E	TO-220
MCR3000-8	Case 90	S122M	TO-220
MCR3818-1	press-fit	S6200A	press-fit
MCR3818-3	press-fit	S6200A	press-fit
MCR3818-5	press-fit	S6200D	press-fit
MCR3818-7	press-fit	S6200M	press-fit
MCR3835-1	press-fit	2N3870	press-fit
MCR3835-2	press-fit	2N3870	press-fit
MCR3835-3	press-fit	2N3870	press-fit
MCR3835-4	press-fit	2N3871	press-fit
MCR3835-5	press-fit	2N3872	press-fit
MCR3835-6	press-fit	2N3872	press-fit
MCR3835-7	press-fit	2N3873	press-fit
MCR3835-8	press-fit	2N3873	press-fit
MCR3918-1	stud	S6210A	stud
MCR3518-3	stud	S6210A	stud
MCR3918-5	stud	S6210D	stud
MCR3918-7	stud	S6210M	stud
MCR3935-1	stud	2N3896	stud
MCR3936-2	stud	2N3896	stud
MCR9935-3	stud	2N3896	stud
MCR3935-4	stud	2N3897	stud
MCR3935-5	stud	2N3898	stud
MCR3935-6	stud	2N3898	stud
MCR3935-7	stud	2N3899	stud
MCR3935-8	stud	2N3899	stud
NL-C35A	TO-48	2N683	TO-48
NL-C35B	TO-48	2N685	TO-48
NL-C35C	TO-48	2N687	TO-48
NL-C35D	TO-48	2N688	TO-48
NL-C35E	TO-48	2N689	TO-48
NL-C35G	TO-48	2N684	TO-48
NL-C35H	TO-48	2N686	TO-48
NL-C35M	TO-48	2N689	TO-48
NL-C36A	TO-48	2N1844A	TO-48
NL-C36B	TO-48	2N1846A	TO-48
NL-C36C	TO-48	2N1848A	TO-48
NL-C36D	TO-48	2N1849A	TO-48
NL-C36E	TO-48	2N1850A	TO-48
NL-C36G	TO-48	2N1845A	TO-48
NL-C36H	TO-48	2N1847A	TO-48
NL-C40A	TO-48	2N3650	TO-48
NL-C40B	TO-48	2N3651	TO-48
NL-C40C	TO-48	2N3652	TO-48
NL-C40D	TO-48	2N3654	TO-48
NL-C40E	TO-48	S7410M	TO-48
NL-C40G	TO-48	2N3651	TO-48
NL-C40H	TO-48	2N3652	TO-48
NL570M	TO-48	2N690	TO-48
PS08	press-fit	S6200A	press-fit
PS18	press-fit	S6200A	press-fit
PS020	press-fit	S6200A	press-fit
PS28	press-fit	S6200B	press-fit
PS035	press-fit	2N3870	press-fit
PS38	press-fit	S6200D	press-fit
PS48	press-fit	S6200D	press-fit
PS58	press-fit	S6200M	press-fit
PS68	press-fit	S6200M	press-fit
PS120	press-fit	S6200M	press-fit
PS135	press-fit	2N3870	press-fit
PS220	press-fit	S6200B	press-fit
PS235	press-fit	2N3871	press-fit
PS320	press-fit	S6200D	press-fit

SILICON CONTROLLED RECTIFIERS (CONT'D)

Industry Type	Package	RCA Type	Package
PS335	press-fit	2N3872	press-fit
PS420	press-fit	S6200D	press-fit
PS435	press-fit	2N3872	press-fit
PS520	press-fit	S6200M	press-fit
PS535	press-fit	2N3873	press-fit
PS620	press-fit	S6200M	press-fit
PS635	press-fit	2N3873	press-fit
RCA106A	TO-220AB	S2060A	TO-220AB
RCA106B	TO-220AB	S2060B	TO-220AB
RCA106D	TO-220AB	S2060D	TO-220AB
RCA106E	TO-220AB	S2060E	TO-220AB
RCA106F	TO-220AB	S2060F	TO-220AB
RCA106Q	TO-220AB	S2060Q	TO-220AB
RCA106M	TO-220AB	S2060M	TO-220AB
RCA106Y	TO-220AB	S2060Y	TO-220AB
RCA107A	TO-220AB	S2061A	TO-220AB
RCA107B	TO-220AB	S2061B	TO-220AB
RCA107C	TO-220AB	S2061C	TO-220AB
RCA107D	TO-220AB	S2061D	TO-220AB
RCA107E	TO-220AB	S2061E	TO-220AB
RCA107F	TO-220AB	S2061F	TO-220AB
RCA107Q	TO-220AB	S2061Q	TO-220AB
RCA107M	TO-220AB	S2061M	TO-220AB
RCA107Y	TO-220AB	S2061Y	TO-220AB
RCA108A	TO-220-AB	S2062A	TO-220AB
RCA108B	TO-220AB	S2062B	TO-220AB
RCA108C	TO-220AB	S2062C	TO-220AB
RCA108D	TO-220AB	S2062D	TO-220AB
RCA108E	TO-220AB	S2062E	TO-220AB
RCA108F	TO-220AB	S2062F	TO-220AB
RCA108Q	TO-220AB	S2062Q	TO-220AB
RCA108M	TO-220AB	S2062M	TO-220AB
RCA108Y	TO-220AB	S2062Y	TO-220AB
RTS0202	press-fit	S6200A	press-fit
RTS0205	press-fit	S6200A	press-fit
RTS0210	press-fit	S6200A	press-fit
RTS0220	press-fit	S6200B	press-fit
RTS0230	press-fit	S6200D	press-fit
RTS0240	press-fit	S6200D	press-fit
RTS0250	press-fit	S6200M	press-fit
RTS0260	press-fit	S6200M	press-fit
RTS0502	press-fit	S6200A	press-fit
RTS0505	press-fit	S6200A	press-fit
RTS0510	press-fit	S6200A	press-fit
RTS0520	press-fit	S6200B	press-fit
RTS0530	press-fit	S6200D	press-fit
RTS0540	press-fit	S6200D	press-fit
RTS0550	press-fit	S6200M	press-fit
RTS0602	press-fit	S6200A	press-fit
RTS0605	press-fit	S6200A	press-fit
RTS0610	press-fit	S6200A	press-fit
RTS0620	press-fit	S6200B	press-fit
RTS0630	press-fit	S6200D	press-fit
RTS0640	press-fit	S6200D	press-fit
RTS0650	press-fit	S6200M	press-fit
RTS0660	press-fit	S6200M	press-fit
RTU0102	stud	S6210A	stud
RTU0105	stud	S6210A	stud
RTU0110	stud	S6210A	stud
RTU0120	stud	S6210B	stud
RTU0130	stud	S6210D	stud
RTU0140	stud	S6210D	stud
RTU0150	stud	S6210M	stud
RTU0160	stud	S6210M	stud

Industry Type	Package	RCA Type	Package
RTU0202	stud	2N3896	stud
RTU0205	stud	2N3896	stud
RTU0210	stud	2N3896	stud
RTU0220	stud	2N3897	stud
RTU0230	stud	2N3898	stud
RTU0240	stud	2N3898	stud
RTU0250	stud	S6410N	stud
RTU0260	stud	S6410N	stud
RTU0602	stud	2N3896	stud
RTU0605	stud	2N3896	stud
RTU0610	stud	2N3896	stud
RTU0620	stud	2N3897	stud
RTU0630	stud	2N3898	stud
RTU0640	stud	2N3898	stud
RTU0650	stud	2N3899	stud
RTU0660	stud	2N3899	stud
RTU0705	stud	2N3896	stud
RTU0710	stud	2N3896	stud
RTU0720	stud	2N3897	stud
RTU0730	stud	2N3898	stud
RTU0740	stud	2N3898	stud
RTU0750	stud	2N3899	stud
RTU0760	stud	2N3899	stud
S0525G	press-fit	2N3870	press-fit
S1003RS2	TO-220	S2060A	TO-220
S1003RS3	TO-220	S2061A	TO-220
S1006B	ISOstud	S6220A	ISOstud
S1006G	press-fit	S6200A	press-fit
S1006H	stud	S6210A	stud
S1008B	ISOstud	S6220A	ISOstud
S1008G	press-fit	S6200A	press-fit
S1008H	stud	S6210A	stud
S1010B	ISOstud	S6220A	ISOstud
S1010G	press-fit	S6200A	press-fit
S1010H	stud	S6210A	stud
S1016B	ISOstud	S6220A	ISOstud
S1016G	press-fit	S6200A	press-fit
S1016H	stud	S6210A	stud
S1025G	press-fit	2N3870	press-fit
S1025H	stud	2N3896	stud
S1035G	press-fit	2N3870	press-fit
S1035H	stud	2N3896	stud
S2003RS2	TO-220	S2060B	TO-220
S2003RS3	TO-220	S2061B	TO-220
S2006B	ISOstud	S6220B	ISOstud
S2006G	press-fit	S6200B	press-fit
S2006H	stud	S6210B	stud
S2008B	ISOstud	S6220B	ISOstud
S2008G	press-fit	S6200B	press-fit
S2008H	stud	S6210B	stud
S2010B	ISOstud	S6220B	ISOstud
S2010G	press-fit	S6200B	press-fit
S2010H	stud	S6210B	stud
S2016B	ISOstud	S6220B	ISOstud
S2016G	press-fit	S6200B	press-fit
S2016H	stud	S6210B	stud
S2025G	press-fit	2N3871	press-fit
S2025H	stud	2N3897	stud
S2035G	press-fit	2N3871	press-fit
S2035H	stud	2N3897	stud
S4006B	ISOstud	S6220D	ISOstud
S4006G	press-fit	S6200D	press-fit
S4006H	stud	S6210D	stud

Industry Type	Package	RCA Type	Package
S4010B	ISOstud	S6220D	ISOstud
S4010G	press-fit	S6200D	press-fit
S4010H	stud	S6210D	stud
S4016B	ISOstud	S6220D	ISOstud
S4016G	press-fit	S6200D	press-fit
S4016H	stud	S6210D	stud
S4025G	press-fit	2N3872	press-fit
S4025H	stud	2N3898	stud
S4035G	press-fit	2N3872	press-fit
S4035H	stud	2N3898	stud
S6003RS2	TO-220	S2060M	TO-220
S6003RS3	TO-220	S2061M	TO-220
S6006B	ISOstud	S6220M	ISOstud
S6006G	press-fit	S6200M	press-fit
S6006H	stud	S6210M	stud
S6008G	press-fit	S6200M	press-fit
S6008H	stud	S6210M	stud
S6010B	ISOstud	S6220M	ISOstud
S6010G	press-fit	S6200M	press-fit
S6010H	stud	S6210M	stud
S6016B	ISOstud	S6220M	ISOstud
S6016G	press-fit	S6200M	press-fit
S6016H	stud	S6210M	stud
S6025G	press-fit	2N3873	press-fit
S6025H	stud	2N3899	stud
S6035G	press-fit	2N3873	press-fit
S6035H	stud	2N3899	stud
S8025C	TO-3	S6410N	stud
S8025D	ISOstud	S6420N	ISOstud
S8025G	press-fit	S6400N	press-fit
S8025H	stud	S6410N	stud
S8035G	press-fit	S6400N	press-fit
S8035H	stud	S6410N	stud
SPS08	stud	S6210A	stud
SPS18	stud	S6210A	stud
SPS020	stud	S6210A	stud
SPS28	stud	S6210B	stud
SPS38	stud	S6210D	stud
SPS48	stud	S6210D	stud
SPS58	stud	S6210M	stud
SPS68	stud	S6210M	stud
SPS120	stud	S6210A	stud
SPS220	stud	S6210B	stud
SPS320	stud	S6210D	stud
SPS420	stud	S6210D	stud
SPS520	stud	S6210M	stud
SPS620	stud	S6210M	stud
TA-6-3-100	TO-66	S3704A	TO-66
TA6-3-200	TO-66	S3704B	TO-66
TA6-3-400	TO-66	S3704D	TO-66
TA6-3-500	TO-66	S3704E	TO-66
TA6-3-600	TO-66	S3704M	TO-66
TA6-3-700	TO-66	S3704S	TO-66
TA6-6-100	TO-66	2N3668	TO-66
TA6-6-400	TO-66	2N3670	TO-66
TA6-6-500	TO-66	2N4103	TO-66
TA6-6-600	TO-66	2N4103	TO-66
TA6-7-100	TO-48	S7310B	TO-48
TA6-7-200	TO-48	S7310B	TO-48
TA6-7-400	TO-48	S7310D	TO-48
TA6-7-500	TO-48	S7310M	TO-48
TA6-7-600	TO-48	S7310M	TO-48
TA6-10-100	TO-48	S7310B	TO-48

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

SILICON CONTROLLED RECTIFIERS (CONT'D)

Industry Type	Package	RCA Type	Package
TA6-10-200	TO-48	S7310B	TO-48
TA6-10-400	TO-48	S7310D	TO-48
TA6-10-500	TO-48	S7310M	TO-48
TA6-10-600	TO-48	S7310M	TO-48
TA6-15-100	TO-48	S6210A	TO-48
TA6-15-200	TO-48	S6210B	TO-48
TA6-15-400	TO-48	S6210D	TO-48
TA6-15-500	TO-48	S6210M	TO-48
TA6-15-600	TO-48	S6210M	TO-48
TA6-20-100	TO-48	S6210A	TO-48
TA6-20-200	TO-48	S6210B	TO-48
TA6-20-400	TO-48	S6210D	TO-48
TA6-20-500	TO-48	S6210M	TO-48
TA6-20-600	TO-48	S6210M	TO-48
TA6-35-100	TO-48	S6410A	stud
TA6-35-200	TO-48	S6410B	stud
TA6-35-400	TO-48	S6410D	stud
TA6-35-500	TO-48	S6410M	stud
TA6-35-600	TO-48	S6410M	stud
TIC106A	TO-220	S2060A	TO-220
TIC106B	TO-220	S2060B	TO-220
TIC106C	TO-220	S2060C	TO-220
TIC106D	TO-220	S2060D	TO-220
TIC106F	TO-220	S2060F	TO-220
TIC106Y	TO-220	S2060Y	TO-220
TIC116A	TO-220	S122A	TO-220
		S2800A	TO-220
TIC116B	TO-220	S122B	TO-220
		S2800B	TO-220
TIC116C	TO-220	S122C	TO-220
TIC116D	TO-220	S122D	TO-220
TIC116E	TO-220	S122E	TO-220
TIC116F	TO-220	S122F	TO-220
TIC116M	TO-220	S122M	TO-220
TIC126A	TO-220	2N6395	TO-220
TIC126B	TO-220	2N6396	TO-220
TIC126C	TO-220	S6000G	TO-220
TIC126D	TO-220	2N6397	TO-220
TIC126E	TO-220	S6000E	TO-220
TIC126F	TO-220	2N6349	TO-220
TIC126M	TO-220	2N6398	TO-220
TY504	TO-220	S2062A	TO-220
TY1004	TO-220	S2062A	TO-220
TY2004	TO-220	S2062B	TO-220
TY3004	TO-220	S2062C	TO-220
TY4004	TO-220	S2062D	TO-220
TY5004	TO-220	S2062E	TO-220
TY6004	TO-220	S2062M	TO-220
TY507	TO-220	S122A	TO-220
TY1007	TO-220	S122A	TO-220
TY2007	TO-220	S122B	TO-220
TY3007	TO-220	S122C	TO-220
TY4007	TO-220	S122D	TO-220
TY5007	TO-220	S122E	TO-220
TY6007	TO-220	S122M	TO-220
TY510	TO-220	S2800F	TO-220
TY1010	TO-220	S2800A	TO-220
TY2010	TO-220	S8200B	TO-220
TY3010	TO-220	S2800C	TO-220
TY4010	TO-220	S2800D	TO-220
TY5010	TO-220	S2800E	TO-220
TY6010	TO-220	S2800M	TO-220
40216	TO-48	S6493M	TO-48
40504	TO-66	S2710B	TO-66
40505	TO-66	S2710D	TO-66
40506	TO-66	S2710M	TO-66
40553	TO-66	S3700B	TO-66
40554	TO-66	S3700D	TO-66
40555	TO-66	S3700M	TO-66
40654	TO-5	S2600B	TO-5
40655	TO-5	S2600D	TO-5
40656	TO-5	S2620B	TO-5
40657	TO-5	S2620D	TO-5
40658	TO-5	S2610B	TO-5
40659	TO-5	S2610D	TO-5
40680	stud	S6420A	stud
40681	stud	S6420B	stud
40682	ISOstud	S6420D	ISOstud
40683	ISOstud	S6420M	ISOstud
40735	TO-48	S7410M	TO-48
40749	TO-48	S6200M	TO-48
40750	press-fit	S6200B	press-fit
40751	press-fit	S6200D	press-fit
40752	press-fit	S6200M	press-fit
40753	stud	S6210A	stud
40754	stud	S6210B	stud
40755	stud	S6210D	stud
40756	stud	S6210M	stud
40757	ISOstud	S6220A	ISOstud
40758	ISOstud	S6220B	ISOstud
40759	ISOstud	S6220D	ISOstud
40760	ISOstud	S6220M	ISOstud
40833	TO-5	S2600M	TO-5
40834	TO-5	S2620M	TO-5
40835	TO-5	S2610M	TO-5
40867	TO-220AB	S2800A	TO-220AB
40868	TO-220AB	S2800B	TO-220AB
40869	TO-220AB	S2800D	TO-220AB
40888	TO-66	S37035F	TO-66
40889	TO-66	S3702S	TO-66

TRIACS

Industry Type	Package	RCA Type	Package
2N6068	Case 77	T2303F	TO-5
		T2500Q	TO-220
2N6068A	Case 77	T2301F	TO-5
2N6068B	Case 77	T2300F	TO-5
2N6069	Case 77	T2303F	TO-5
		T2500Y	TO-220
2N6069A	Case 77	T2301F	TO-5
2N6069B	Case 77	T2300F	TO-5
2N6070	Case 77	2N5754	TO-5
		T2500A	TO-220
2N6070A	Case 77	T2301A	TO-5
2N6070B	Case 77	T2300A	TO-5
2N6071	Case 77	2N5755	TO-5
		T2500B	TO-220
2N6071A	Case 77	T2301B	TO-5
2N6071B	Case 77	T2300B	TO-5
2N6072	Case 77	2N5756	TO-5
		T2500C	TO-220
2N6072A	Case 77	2N5756	TO-5
2N6072B	Case 77	T2300D	TO-5
2N6073	Case 77	2N5756	TO-5
		T2500D	TO-220
2N6073A	Case 77	T2301D	TO-5
2N6073B	Case 77	T2300D	TO-5
2N6074	Case 77	2N5757	TO-5
2N6075	Case 77	2N5757	TO-5
2N6139	stud	2N5569	stud
2N6140	stud	2N5570	stud
2N6141	stud	T4111M	stud
2N6142	stud	2N5569	stud
2N6143	stud	2N5570	stud
2N6144	stud	T4111M	stud
2N6145	ISOstud	T4120B	ISOstud
2N6146	ISOstud	T4120D	ISOstud
2N6147	ISOstud	T4120M	ISOstud
2N6151	Case 90	T2800B	TO-220
2N6152	Case 90	T2800D	TO-220
2N6153	Case 90	T2800M	TO-220
2N6154	Case 90	T2802B	TO-220
2N6155	Case 90	T2802D	TO-220
2N6156	Case 90	T2802M	TO-220
2N6157	press-fit	T6401B	press-fit
2N6158	press-fit	T6401D	press-fit
2N6159	press-fit	T6401M	press-fit
2N6160	stud	T6411B	stud
2N6161	stud	T6411D	stud
2N6162	stud	T6411M	stud
2N6163	ISOstud	T6421B	ISOstud
2N6164	ISOstud	T6421D	ISOstud
2N6165	ISOstud	T6421M	ISOstud
2N6342	TO-220	T2802B	TO-220
2N6343	TO-220	T2802D	TO-220
2N6344	TO-220	T2802M	TO-220
2N6345	TO-220	T2802N	TO-220
2N6346	TO-220	T2800B	TO-220
2N6347	TO-220	T2800D	TO-220
2N6348	TO-220	T2800M	TO-220
2N6349	TO-220	T2800N	TO-220
6T06	TO-66	T2700B	TO-66
6T08	TO-66	T4700B	TO-66
6T16	TO-66	T2700B	TO-66
6T18	TO-66	T4700B	TO-66
6T26	TO-66	T2700B	TO-66
6T28	TO-66	T4700B	TO-66
6T36	TO-66	T2700D	TO-66
6T38	TO-66	T4700D	TO-66
6T46	TO-66	T2700D	TO-66
6T48	TO-66	T4700D	TO-66
BRY41-100	TO-39	2N5754	TO-39
BRY41-200	TO-39	2N5755	TO-39
BRY41-300	TO-39	2N5756	TO-39
BRY41-400	TO-39	2N5757	TO-39
BRY41-500	TO-39	2N5757	TO-39
BRY45-100	TO-39	2N5754	TO-39
BRY45-200	TO-39	2N5755	TO-39
BRY45-300	TO-39	2N5756	TO-39
BRY45-400	TO-39	2N5757	TO-39
BRY45-500	TO-39	2N5757	TO-39
BTR0205	TO-66	T2700B	TO-66
BTR0210	TO-66	T2700B	TO-66
BTR0220	TO-66	T2700B	TO-66
BTR0230	TO-66	T2700D	TO-66
BTR0240	TO-66	T2700D	TO-66
BTR0305	TO-66	T2700B	TO-66
BTR0310	TO-66	T2700B	TO-66
BTR0320	TO-66	T2700B	TO-66

TRIACS (CONT'D)

Industry Type	Package	RCA Type	Package
BTR0330	TO-66	T2700D	TO-66
BTR0340	TO-66	T2700D	TO-66
BTR0405	TO-66	T4700B	TO-66
BTR0410	TO-66	T4700B	TO-66
BTR0420	TO-66	T4700B	TO-66
BTR0430	TO-66	T4700D	TO-66
BTR0440	TO-66	T4700D	TO-66
BTS0305	press-fit	2N5567	press-fit
BTS0310	press-fit	2N5567	press-fit
BTS0320	press-fit	2N5567	press-fit
BTS0330	press-fit	2N5568	press-fit
BTS0340	press-fit	2N5568	press-fit
BTS0350	press-fit	T4101M	press-fit
BTS0360	press-fit	T4101M	press-fit
BTS0405	press-fit	2N5567	press-fit
BTS0410	press-fit	2N5567	press-fit
BTS0420	press-fit	2N5567	press-fit
BTS0430	press-fit	2N5568	press-fit
BTS0440	press-fit	2N5568	press-fit
BTS0450	press-fit	T4101M	press-fit
BTS0460	press-fit	T4101M	press-fit
BTS0505	press-fit	2N5571	press-fit
BTS0510	press-fit	2N5571	press-fit
BTS0520	press-fit	2N5571	press-fit
BTS0530	press-fit	2N5572	press-fit
BTS0540	press-fit	2N5572	press-fit
BTS0550	press-fit	T4100M	press-fit
BTS0560	press-fit	T4100M	press-fit
BTS0605	press-fit	2N5441	press-fit
BTS0610	press-fit	2N5441	press-fit
BTS0620	press-fit	2N5441	press-fit
BTS0630	press-fit	2N5442	press-fit
BTS0640	press-fit	2N5442	press-fit
BTS0650	press-fit	2N5443	press-fit
BTS0660	press-fit	2N5443	press-fit
BTU0305	stud	2N5569	stud
BTU0310	stud	2N5569	stud
BTU0320	stud	2N5569	stud
BTU0330	stud	2N5570	stud
BTU0340	stud	2N5570	stud
BTU0350	stud	T4111M	stud
BTU0360	stud	T4111M	stud
BTU0405	stud	2N5569	stud
BTU0410	stud	2N5569	stud
BTU0420	stud	2N5569	stud
BTU0430	stud	2N5570	stud
BTU0440	stud	2N5570	stud
BTU0450	stud	T4111M	stud
BTU0460	stud	T4111M	stud
BTU0505	stud	2N5573	stud
BTU0510	stud	2N5573	stud
BTU0520	stud	2N5573	stud
BTU0530	stud	2N5574	stud
BTU0540	stud	2N5574	stud
BTU0550	stud	T4110M	stud
BTU0560	stud	T4110M	stud
BTU0605	stud	T6411B	stud
BTU0610	stud	T6411B	stud
BTU0620	stud	T6411B	stud
BTU0630	stud	T6411D	stud
BTU0640	stud	T6411D	stud
BTU0650	stud	T6411M	stud
BTU0660	stud	T6411M	stud

Industry Type	Package	RCA Type	Package
BTV0405	ISOstud	T4121B	ISOstud
BTV0410	ISOstud	T4121B	ISOstud
BTV0420	ISOstud	T4121B	ISOstud
BTV0430	ISOstud	T4121D	ISOstud
BTV0440	ISOstud	T4121D	ISOstud
BTV0450	ISOstud	T4121M	ISOstud
BTV0460	ISOstud	T4121M	ISOstud
BTW10-100	TO-66	T2700B	TO-66
BTW10-200	TO-66	T2700B	TO-66
BTW10-300	TO-66	T2700D	TO-66
BTW10-400	TO-66	T2700D	TO-66
BTW11-100	TO-66	T2700B	TO-66
BTW11-200	TO-66	T2700B	TO-66
BTW11-300	TO-66	T2700D	TO-66
BTW11-400	TO-66	T2700D	TO-66
BTW12-100	press-fit	2N5567	press-fit
BTW12-200	press-fit	2N5567	press-fit
BTW12-300	press-fit	2N5568	press-fit
BTW12-400	press-fit	2N5568	press-fit
BTW12-500	press-fit	T4101M	press-fit
BTW13-100	stud	2N5569	stud
BTW13-200	stud	2N5569	stud
BTW13-300	stud	2N5570	stud
BTW13-400	stud	2N5570	stud
BTW13-500	stud	T4111M	stud
BTW14-100	TO-66	T4700B	TO-66
BTW14-200	TO-66	T4700B	TO-66
BTW14-300	TO-66	T4700D	TO-66
BTW14-400	TO-66	T4700D	TO-66
BTW15-100	press-fit	2N5567	press-fit
BTW15-200	press-fit	2N5567	press-fit
BTW15-300	press-fit	2N5568	press-fit
BTW15-400	press-fit	2N5568	press-fit
BTW15-500	press-fit	T4101M	press-fit
BTW16-100	stud	2N5569	stud
BTW16-200	stud	2N5569	stud
BTW16-300	stud	2N5570	stud
BTW16-400	stud	2N5570	stud
BTW16-500	stud	T4111M	stud
BTW18-100	press-fit	2N5571	press-fit
BTW18-200	press-fit	2N5571	press-fit
BTW18-300	press-fit	2N5572	press-fit
BTW18-400	press-fit	2N5572	press-fit
BTW18-500	press-fit	T4101M	press-fit
BTW19-100	press-fit	2N5571	press-fit
BTW19-200	press-fit	2N5571	press-fit
BTW19-300	press-fit	2N5572	press-fit
BTW19-400	press-fit	2N5572	press-fit
BTW19-500	press-fit	T4101M	press-fit
BTW20-100	stud	T6411B	stud
BTW20-200	stud	T6411B	stud
BTW20-300	stud	T6411D	stud
BTW20-400	stud	T6411D	stud
BTW20-500	stud	T6411M	stud
BTX94-400	stud	T6411D	stud
BTX94-500	stud	T6411M	stud
BTX94-600	stud	T6411M	stud
BTX0505	ISOstud	T4120B	ISOstud
BTX0510	ISOstud	T4120B	ISOstud
BTX0520	ISOstud	T4120B	ISOstud
BTX0530	ISOstud	T4120D	ISOstud
BTX0540	ISOstud	T4120D	ISOstud

Industry Type	Package	RCA Type	Package
BTX0550	ISOstud	T4120M	ISOstud
BTX0560	ISOstud	T4120M	ISOstud
BTX0605	ISOstud	T6421B	ISOstud
BTX0610	ISOstud	T6421B	ISOstud
BTX0620	ISOstud	T6421B	ISOstud
BTX0630	ISOstud	T6421D	ISOstud
BTX0640	ISOstud	T6421D	ISOstud
BTX0650	ISOstud	T6421M	ISOstud
BTX0660	ISOstud	T6421M	ISOstud
HB26	TO-5	2N5755	TO-5
HB46	TO-5	2N5756	TO-5
H103SC	TO-5	T2301F	TO-5
H103SD	TO-5	T2301A	TO-5
H103SG	TO-5	T2302F	TO-5
H103SH	TO-5	T2303F	TO-5
H103SS	TO-5	T2300F	TO-5
H113SC	TO-5	T2301A	TO-5
H113SD	TO-5	T2301A	TO-5
H113SG	TO-5	T2302A	TO-5
H113SH	TO-5	2N5754	TO-5
H113SS	TO-5	T2300A	TO-5
H123SC	TO-5	T2301B	TO-5
H123SD	TO-5	T2301B	TO-5
H123SG	TO-5	T2302B	TO-5
H123SH	TO-5	2N5755	TO-5
H123SS	TO-5	T2300B	TO-5
H133SC	TO-5	T2301D	TO-5
H133SD	TO-5	T2301D	TO-5
H133SG	TO-5	T2302D	TO-5
H133SH	TO-5	2N5756	TO-5
H133SS	TO-5	T2300D	TO-5
H143SC	TO-5	T2301D	TO-5
H143SD	TO-5	T2301D	TO-5
H143SG	TO-5	T2302D	TO-5
H143SH	TO-5	2N5756	TO-5
H143SS	TO-5	T2300D	TO-5
H153SH	TO-5	2N5757	TO-5
H163SH	TO-5	2N5757	TO-5
IT06	TO-220	T2850A	TO-220
IT08	TO-220	T2850A	TO-220
IT16	TO-220	T2850A	TO-220
IT18	TO-220	T2850A	TO-220
IT26	TO-220	T2850B	TO-220
IT28	TO-220	T2850B	TO-220
IT36	TO-220	T2850D	TO-220
IT38	TO-220	T2850D	TO-220
IT46	TO-220	T2850D	TO-220
IT48	TO-220	T2850D	TO-220
L2001M3	TO-39 low profile	T2300B	TO-39
L2001M4	TO-39 low profile	T2300B	TO-39
L2001M5	TO-39 low profile	T2301B	TO-39
L2001M7	TO-39 low profile	T2302B	TO-39
L2001M9	TO-39 low profile	2N5755	TO-5
L4001M3	TO-39 low profile	T2300D	TO-39
L4001M4	TO-39 low profile	T2300D	TO-39

Power Devices Cross-Reference Guide

(Industry Type to Equivalent RCA Type)

TRIACS (CONT'D)

Industry Type	Package	RCA Type	Package
L4001M5	TO-39 low profile	T2301D	TO-39
L4001M7	TO-39 low profile	T2302D	TO-39
L4001M9	TO-39 low profile	2N5756	TO-5
MAC-1-1	Case 85	2N5567	press-fit
MAC-1-2	Case 85	2N5567	press-fit
MAC-1-3	Case 85	2N5567	press-fit
MAC-1-4	Case 85	2N5567	press-fit
MAC-1-5	Case 85	2N5568	press-fit
MAC-1-6	Case 85	2N5568	press-fit
MAC-1-7	Case 85	T4101M	press-fit
MAC-1-8	Case 85	T4101M	press-fit
MAC-2-1	Case 86	2N5569	stud
MAC-2-2	Case 86	2N5569	stud
MAC-2-3	Case 86	2N5569	stud
MAC-5-1	stud	2N5569	stud
MAC-5-2	stud	2N5569	stud
MAC-5-3	stud	2N5569	stud
MAC-5-4	stud	2N5569	stud
MAC-5-5	stud	2N5570	stud
MAC-5-6	stud	2N5570	stud
MAC-5-7	stud	T4111M	stud
MAC-5-8	stud	T4111M	stud
MAC-10-1	Case 90	T2800B	TO-220
MAC-10-2	Case 90	T2800B	TO-220
MAC-10-3	Case 90	T2800B	TO-220
MAC-10-4	Case 90	T2800B	TO-220
MAC-10-5	Case 90	T2800C	TO-220
MAC-10-6	Case 90	T2800D	TO-220
MAC-10-7	Case 90	T2800E	TO-220
MAC-10-8	Case 90	T2800M	TO-220
MAC-11-1	Case 90	T2802B	TO-220
MAC-11-2	Case 90	T2802B	TO-220
MAC-11-3	Case 90	T2802B	TO-220
MAC-11-4	Case 90	T2802B	TO-220
MAC-11-5	Case 90	T2802C	TO-220
MAC-11-6	Case 90	T2802D	TO-220
MAC-11-7	Case 90	T2802E	TO-220
MAC-11-8	Case 90	T2802M	TO-220
MAC-35-1	press-fit	T6401B	press-fit
MAC-35-2	press-fit	T6401B	press-fit
MAC-35-3	press-fit	T6401B	press-fit
MAC-35-4	press-fit	T6401B	press-fit
MAC-35-5	press-fit	T6401D	press-fit
MAC-35-6	press-fit	T6401D	press-fit
MAC-35-7	press-fit	T6401M	press-fit
MAC-36-1	stud	T6411B	stud
MAC-36-2	stud	T6411B	stud
MAC-36-3	stud	T6411B	stud
MAC-36-4	stud	T6411B	stud
MAC-36-5	stud	T6411D	stud
MAC-36-6	stud	T6411D	stud
MAC-36-7	stud	T6411M	stud
MAC-37-1	press-fit	T6401B	press-fit
MAC-37-2	press-fit	T6401B	press-fit
MAC-37-3	press-fit	T6401B	press-fit
MAC-37-4	press-fit	T6401B	press-fit
MAC-37-5	press-fit	T6401D	press-fit
MAC-37-6	press-fit	T6401D	press-fit

Industry Type	Package	RCA Type	Package
MAC-37-7	press-fit	T6401M	press-fit
MAC-38-1	stud	T6411B	stud
MAC-38-2	stud	T6411B	stud
MAC-38-3	stud	T6411B	stud
MAC-38-4	stud	T6411B	stud
MAC-38-5	stud	T6411D	stud
MAC-38-6	stud	T6411D	stud
MAC-38-7	stud	T6411M	stud
MAC92A-1	TO-92	T2301F	TO-5
MAC92A-2	TO-92	T2301A	TO-5
MAC92A-3	TO-92	T2301A	TO-5
MAC92A-4	TO-92	T2301B	TO-5
MAC92A-5	TO-92	T2301D	TO-5
MAC92A-6	TO-92	T2301D	TO-5
MAC93A-1	TO-92	T2301F	TO-5
MAC93A-2	TO-92	T2301A	TO-5
MAC93A-3	TO-92	T2301A	TO-5
MAC93A-4	TO-92	T2301B	TO-5
MAC94A-1	TO-92	T2301F	TO-5
MAC94A-2	TO-92	T2301A	TO-5
MAC94A-3	TO-92	T2301A	TO-5
MAC94A-4	TO-92	T2301B	TO-5
MAC40688	ISOstud	T6420B	ISOstud
MAC40689	ISOstud	T6420D	ISOstud
MAC40690	ISOstud	T6420M	ISOstud
MAC40797	press-fit	T4100M	press-fit
MAC40798	stud	T4110M	stud
PT06	press-fit	2N5567	press-fit
PT08	press-fit	2N5567	press-fit
PT10	press-fit	2N5567	press-fit
PT15	press-fit	2N5567	press-fit
PT16	press-fit	2N5567	press-fit
PT18	press-fit	2N5567	press-fit
PTO25	press-fit	T6401B	press-fit
PTO26	press-fit	2N5867	press-fit
PTO28	press-fit	2N6567	press-fit
PTO30	press-fit	T6401B	press-fit
PTO36	press-fit	2N5568	press-fit
PTO38	press-fit	2N5568	press-fit
PTO40	press-fit	2N5441	press-fit
PTO46	press-fit	2N5568	press-fit
PTO48	press-fit	2N5568	press-fit
PTO56	press-fit	T4101M	press-fit
PTO58	press-fit	T4101M	press-fit
PTO66	press-fit	T4101M	press-fit
PTO68	press-fit	T4101M	press-fit
PT110	press-fit	2N5567	press-fit
PT115	press-fit	2N5571	press-fit
PT125	press-fit	T6401B	press-fit
PT130	press-fit	T6401B	press-fit
PT140	press-fit	2N5441	press-fit
PT210	press-fit	2N5567	press-fit
PT215	press-fit	2N5571	press-fit
PT225	press-fit	T6401B	press-fit
PT230	press-fit	T6401B	press-fit
PT240	press-fit	2N5441	press-fit
PT310	press-fit	2N5568	press-fit
PT315	press-fit	2N5572	press-fit
PT325	press-fit	T6401D	press-fit
PT330	press-fit	T6401D	press-fit
PT340	press-fit	2N5442	press-fit

Industry Type	Package	RCA Type	Package
PT410	press-fit	2N5568	press-fit
PT415	press-fit	2N5572	press-fit
PT425	press-fit	T6401D	press-fit
PT430	press-fit	T6401D	press-fit
PT440	press-fit	2N5442	press-fit
PT510	press-fit	T4101M	press-fit
PT515	press-fit	T4100M	press-fit
PT525	press-fit	T6401M	press-fit
PT530	press-fit	T6401M	press-fit
PT540	press-fit	2N5443	press-fit
PT610	press-fit	T4101M	press-fit
PT615	press-fit	T4100M	press-fit
PT625	press-fit	T6401M	press-fit
PT630	press-fit	T6401M	press-fit
Q2001MS2	TO-5	T2302B	TO-5
Q2001M2	TO-5	2N5755	TO-5
Q2003P	TO-5	T2800B	TO-5
Q2004	ISOstud	T4120B	ISOstud
Q2006L4	ISO TO-220	T2850B	ISO TO-220
Q2008	ISOstud	T4121B	ISOstud
Q2010	ISOstud	T4121B	ISOstud
Q2015	ISOstud	T4120B	ISOstud
Q2025	ISOstud	T6421B	ISOstud
Q2040	ISOstud	T6420B	ISOstud
Q4001MS2	TO-5	T2302D	TO-5
Q4001M2	TO-5	2N5756	TO-5
Q4003L4	ISO TO-220	T2850D	ISO TO-220
Q4004	ISOstud	T4121D	ISOstud
Q4004L4	ISO TO-220	T2850D	ISO TO-220
Q4006	ISOstud	T4121D	ISOstud
Q4006L4	ISO TO-220	T2850D	ISO TO-220
Q4008	ISOstud	T4121D	ISOstud
Q4010	ISOstud	T4121D	ISOstud
Q4015	ISOstud	T4120D	ISOstud
Q4025	ISOstud	T6421D	ISOstud
Q4040	ISOstud	T6420D	ISOstud
Q5006L4	ISO TO-220	T2850D	ISO TO-220
Q5008	ISOstud	T4121M	ISOstud
Q5010	ISOstud	T4121M	ISOstud
Q4015	ISOstud	T4120M	ISOstud
Q5025	ISOstud	T6421M	ISOstud
Q5040	ISOstud	T6420M	ISOstud
Q6008	ISOstud	T4121M	ISOstud
Q6010	ISOstud	T4121M	ISOstud
Q6015	ISOstud	T4120M	ISOstud
Q6025	ISOstud	T6421M	ISOstud
Q6040	ISOstud	T6420M	ISOstud
Q8025	ISOstud	T6420N	ISOstud
Q8040	ISOstud	T6420N	ISOstud
SC35A	stud	2N5569	stud
SC35B	stud	2N5569	stud
SC35D	stud	2N5570	stud
SC35F	stud	2N5569	stud
SC36A	press-fit	2N5567	press-fit
SC36B	press-fit	2N5567	press-fit
SC36D	press-fit	2N5568	press-fit

TRIACS (CONT'D)

Industry Type	Package	RCA Type	Package
SC36F	press-fit	2N5567	press-fit
SC40A	stud	2N5569	stud
SC40B	stud	2N5569	stud
SC40B2	ISOstud	T4121B	ISOstud
SC40D	stud	2N5570	stud
SC40D2	ISOstud	T4121D	ISOstud
SC40E	stud	T4111M	stud
SC40E2	ISOstud	T4121M	ISOstud
SC40F	stud	2N5569	stud
SC41A	press-fit	2N5567	press-fit
SC41B	press-fit	2N5567	press-fit
SC41D	press-fit	2N5568	press-fit
SC41E	press-fit	T4101M	press-fit
SC41F	press-fit	2N5567	press-fit
SC45A	stud	2N5569	stud
SC45B	stud	2N5569	stud
SC45B2	ISOstud	T4121B	ISOstud
SC45D	stud	2N5570	stud
SC45D2	ISOstud	T4121D	ISOstud
SC45E	stud	T4111M	stud
SC45E2	ISOstud	T4121M	ISOstud
SC45F	stud	2N5569	stud
SC46A	press-fit	2N5567	press-fit
SC46B	press-fit	2N5567	press-fit
SC46D	press-fit	2N5568	press-fit
SC46E	press-fit	T4101M	press-fit
SC46F	press-fit	2N5567	press-fit
SC50A	stud	2N5573	stud
SC50B	stud	2N5573	stud
SC50B2	ISOstud	T4120B	ISOstud
SC50D	stud	2N5574	stud
SC50D2	ISOstud	T4120D	ISOstud
SC50E	stud	2N5573	stud
		T4110M	stud
SC50E2	ISOstud	T4120M	ISOstud
SC50F	stud	2N5573	stud
SC51A	press-fit	2N5571	press-fit
SC51B	press-fit	2N5571	press-fit
SC51D	press-fit	2N5572	press-fit
SC51E	press-fit	T4100M	press-fit
SC51F	press-fit	2N5571	press-fit
SC60B	stud	T6411B	stud
SC60B2	ISOstud	T6421B	ISOstud
SC60B12	stud	T6411B	stud
SC60B13	stud	T6411B	stud
SC60B14	stud	T6414B	stud
SC60B22	ISOstud	T6421B	ISOstud
SC60B23	ISOstud	T6421B	ISOstud
SC60D	stud	T6411D	stud
SC60D2	ISOstud	T6421D	ISOstud
SC60D12	stud	T6411D	stud
SC60D13	stud	T6411D	stud
SC60D14	stud	T6414D	stud
SC60D22	ISOstud	T6421D	ISOstud
SC60D23	ISOstud	T6421D	ISOstud
SC60E	stud	T6411M	stud
SC60E2	ISOstud	T6421M	ISOstud
SC60E12	stud	T6411M	stud
SC60E13	stud	T6411M	stud
SC60E22	ISOstud	T6421M	ISOstud
SC60E23	ISOstud	T6421M	ISOstud
SC61B	press-fit	T6401B	press-fit

Industry Type	Package	RCA Type	Package
SC61B12	press-fit	T6401B	press-fit
SC61B13	press-fit	T6401B	press-fit
SC61B14	press-fit	T6404B	press-fit
SC61D	press-fit	T6401D	press-fit
SC61D12	press-fit	T6401D	press-fit
SC61D13	press-fit	T6401D	press-fit
SC61D14	press-fit	T6404D	press-fit
SC61E	press-fit	T6401M	press-fit
SC61E12	press-fit	T6401M	press-fit
SC61E13	press-fit	T6401M	press-fit
SC136A	TO-202	2N5754	TO-5
SC136B	TO-202	2N5755	TO-5
SC136D	TO-202	2N5756	TO-5
SC141B	TO-220	T2800B	TO-220
SC141D	TO-220	T2800D	TO-220
SC141E	TO-220	T2800E	TO-220
SC141M	TO-220	T2800M	TO-220
SC146B	TO-220	T2800B	TO-220
SC146D	TO-220	T2800D	TO-220
SC146E	TO-220	T2800E	TO-220
SC146M	TO-220	T2800M	TO-220
SC240B	stud	2N5569	stud
SC240B2	ISOstud	T4121B	ISOstud
SC240B12	stud	2N5569	stud
SC240B13	stud	2N5569	stud
SC240B22	ISOstud	T4121B	ISOstud
SC240B23	ISOstud	T4121B	ISOstud
SC240D	stud	2N5570	stud
SC240D2	ISOstud	T4121D	ISOstud
SC240D12	stud	2N5570	stud
SC240D13	stud	2N5570	stud
SC240D22	ISOstud	T4121D	ISOstud
SC240D23	ISOstud	T4121D	ISOstud
SC240E	stud	T4111M	stud
SC240E2	ISOstud	T4121M	ISOstud
SC240E12	stud	T4111M	stud
SC240E13	stud	T4111M	stud
SC240E22	ISOstud	T4121M	ISOstud
SC240E23	ISOstud	T4121M	ISOstud
SC241B	press-fit	2N5567	press-fit
SC241B12	press-fit	2N5567	press-fit
SC241B13	press-fit	2N5567	press-fit
SC241D	press-fit	2N5568	press-fit
SC241D12	press-fit	2N5568	press-fit
SC241D13	press-fit	2N5568	press-fit
SC241E	press-fit	T4101M	press-fit
SC241E12	press-fit	T4101M	press-fit
SC241E13	press-fit	T4101M	press-fit
SC245B	stud	2N5569	stud
SC245B2	ISOstud	T4121B	ISOstud
SC245B12	stud	2N5569	stud
SC245B13	stud	2N5569	stud
SC245B14	stud	T4115B	stud
SC245B22	ISOstud	T4121B	ISOstud
SC245B23	ISOstud	T4121B	ISOstud
SC245D	stud	2N5570	stud
SC245D2	ISOstud	T4121D	ISOstud
SC245D12	stud	2N5570	stud
SC245D13	stud	2N5570	stud
SC245D14	stud	T4115D	stud
SC245D22	ISOstud	T4121D	ISOstud
SC245D23	ISOstud	T4121D	ISOstud

Industry Type	Package	RCA Type	Package
SC245E	stud	T4111M	stud
SC245E2	ISOstud	T4121M	ISOstud
SC245E12	stud	T4111M	stud
SC245E13	stud	T4111M	stud
SC245E22	ISOstud	T4121M	ISOstud
SC245E23	ISOstud	T4121M	ISOstud
SC246B	press-fit	2N5567	press-fit
SC246B12	press-fit	2N5567	press-fit
SC246B13	press-fit	2N5567	press-fit
SC246B14	press-fit	T4105B	press-fit
SC246D	press-fit	2N5568	press-fit
SC246D12	press-fit	2N5568	press-fit
SC246D13	press-fit	2N5568	press-fit
SC246D14	press-fit	T4105D	press-fit
SC246E	press-fit	T4101M	press-fit
SC246E12	press-fit	T4101M	press-fit
SC246E13	press-fit	T4101M	press-fit
SC250B	stud	2N5573	stud
SC250B2	ISOstud	T4120B	ISOstud
SC250B12	stud	2N5573	stud
SC250B13	stud	2N5573	stud
SC250B14	stud	T4113B	stud
SC250B22	ISOstud	T4120B	ISOstud
SC250D	stud	2N5574	stud
SC250D2	ISOstud	T4120D	ISOstud
SC250D12	stud	2N5574	stud
SC250D13	stud	2N5574	stud
SC250D14	stud	T4113D	stud
SC250D22	ISOstud	T4120D	ISOstud
SC250E	stud	T4110M	stud
SC250E2	ISOstud	T4120M	ISOstud
SC250E12	stud	T4110M	stud
SC250E13	stud	T4110M	stud
SC250E22	ISOstud	T4120M	ISOstud
SC251B	press-fit	2N5571	press-fit
SC251B12	press-fit	2N5571	press-fit
SC251B13	press-fit	2N5571	press-fit
SC251B14	press-fit	T4103B	press-fit
SC251D	press-fit	2N5572	press-fit
SC251D12	press-fit	2N5572	press-fit
SC251D13	press-fit	2N5572	press-fit
SC251D14	press-fit	T4103D	press-fit
SC251E	press-fit	T4100M	press-fit
SC251E12	press-fit	T4100M	press-fit
SC251E13	press-fit	T4100M	press-fit
SPT06	stud	2N5569	stud
SPT08	stud	2N5569	stud
SPT10	stud	2N5569	stud
SPT15	stud	2N5573	stud
SPT16	stud	2N5569	stud
SPT18	stud	2N5569	stud
SPT025	stud	T6411B	stud
SPT030	stud	T6411B	stud
SPT26	stud	2N5569	stud
SPT28	stud	2N5569	stud
SPT36	stud	2N5570	stud
SPT38	stud	2N5570	stud
SPT40	stud	2N5444	stud
SPT46	stud	2N5570	stud
SPT48	stud	2N5570	stud
SPT56	stud	T4111M	stud
SPT58	stud	T4111M	stud

Power Devices Cross-Reference Guide
(Industry Type to Equivalent RCA Type)

TRIACS (CONT'D)

Industry Type	Package	RCA Type	Package
SPT68	stud	T4111M	stud
SPT110	stud	2N5569	stud
SPT115	stud	2N5573	stud
SPT125	stud	T6411B	stud
SPT130	stud	T6411B	stud
SPT140	stud	2N5444	stud
SPT210	stud	2N5569	stud
SPT215	stud	2N5573	stud
SPT225	stud	T6411B	stud
SPT230	stud	T6411B	stud
SPT240	stud	2N5444	stud
SPT310	stud	2N5570	stud
SPT315	stud	2N5574	stud
SPT325	stud	T6411D	stud
SPT330	stud	T6411D	stud
SPT340	stud	2N5445	stud
SPT410	stud	2N5570	stud
SPT415	stud	2N5574	stud
SPT425	stud	T6411D	stud
SPT430	stud	T6411D	stud
SPT440	stud	2N5445	stud
SPT510	stud	T4111M	stud
SPT515	stud	T4110M	stud
SPT525	stud	T6411M	stud
SPT530	stud	T6411M	stud
SPT540	stud	2N5446	stud
SPT610	stud	T4111M	stud
SPT615	stud	T4110M	stud
SPT625	stud	T6411M	stud
SPT630	stud	T6411M	stud
SPT640	stud	2N5446	stud
TA6136	TO-202	T2322D	TO-202
TA6-200-100	TO-39	T2302A	TO-39
TA6-201-100	TO-39	T2303A	TO-39
TA6-200-200	TO-39	T2302B	TO-39
TA6-201-200	TO-39	T2303B	TO-39
TA6-200-400	TO-39	T2302D	TO-39
TA6-202-100	TO-39	T2302A	TO-39
TA6-202A-100	TO-39	T2302A	TO-39
TA6-202-200	TO-39	T2302B	TO-39
TA6-202A-200	TO-39	T2302B	TO-39
TA6-202-400	TO-39	T2302D	TO-39
TA6-202A-400	TO-39	T2302D	TO-39
TA6-203-100	TO-39	T2301A	TO-39
TA6-203A-100	TO-39	T2301A	TO-39
TA6-203-200	TO-39	T2301B	TO-39
TA6-203A-200	TO-39	T2301B	TO-39
TA6-203-400	TO-39	T2301D	TO-39
TA6-203A-400	TO-39	T2301D	TO-39
TA6-204-100	TO-39	T2300A	TO-39
TA6-204A-100	TO-39	T2300A	TO-39
TA6-204-200	TO-39	T2300B	TO-39
TA6-204A-200	TO-39	T2300B	TO-39
TA6-204-400	TO-39	T2300D	TO-39
TA6-204A-400	TO-39	T2300D	TO-39
TA6-205-100	TO-39	T2303A	TO-39
TA205-200	TO-39	T2303B	TO-39
TA6-205-400	TO-39	T2303D	TO-39
TA6-206-100	TO-39	T2302A	TO-39
TA6-206-200	TO-39	T2302B	TO-39
TA6-206-400	TO-39	T2302D	TO-39
TA6-220-200	TO-220	T2500B	TO-220
TA6-220-400	TO-220	T2500D	TO-220
TA6-224-200	TO-220	T2800B	TO-220

Industry Type	Package	RCA Type	Package
TA6-224-400	TO-220	T2802D	TO-220
TA6-224-600	TO-220	T2802M	TO-220
TA6-225-200	TO-220	T2800B	TO-220
TA6-225-400	TO-220	T2800D	TO-220
TA6-225-600	TO-220	T2800M	TO-220
TA6-240-200	TO-220	T2850B	TO-220
TA6-240-400	TO-220	T2850D	TO-220
TA6-241-200	TO-220	T2850D	TO-220
TA6-245-200	TO-220	T2850B	TO-220
TA6-245-400	TO-220	T2850D	TO-220
TA6-246-200	TO-220	T2850B	TO-220
TA6-246-400	TO-220	T2850D	TO-220
TA6-255-200	TO-220	T6000B	TO-220
TA6-255-400	TO-220	T6000D	TO-220
TA6-255-600	TO-220	T6000M	TO-220
TA6-255A-200	TO-220	T6000B	TO-220
TA6-255A-200	TO-220	T6000D	TO-220
TA6-255A-200	TO-220	T6000M	TO-220
TA6-260-200	TO-66	T2700B	TO-66
TA6-260-400	TO-66	T2700D	TO-66
TA6-261-200	TO-66	T2700B	TO-66
TA6-261-400	TO-66	T2700D	TO-66
TA6-265-200	TO-66	T4700B	TO-66
TA6-265-400	TO-66	T4700D	TO-66
TA6-266-200	TO-66	T4700B	TO-66
TA6-266-400	TO-66	T4700D	TO-66
TA6-280-200	TO-220	T6000B	TO-220
TA6-280-400	TO-220	T6000D	TO-220
TA6-280-600	TO-220	T6000M	TO-220
TIC20	press-fit	2N5567	press-fit
TIC21	press-fit	2N5568	press-fit
TIC22	stud	2N5569	stud
TIC23	stud	2N5570	stud
TIC226B	TO-220	T2800B	TO-220
TIC226D	TO-220	T2800D	TO-220
TIC236B	TO-220	T2800B	TO-220
TIC236D	TO-220	T2800D	TO-220
TIC250B	press-fit	T6401B	press-fit
TIC250D	press-fit	T6401D	press-fit
TIC250E	press-fit	T6401M	press-fit
TIC250M	press-fit	T6401M	press-fit
TIC252B	stud	T6411B	stud
TIC252D	stud	T6411D	stud
TIC252E	stud	T6411M	stud
TIC252M	stud	T6411M	stud
TIC260B	press-fit	T6401B	press-fit
TIC260D	press-fit	T6401D	press-fit
TIC260E	press-fit	T6401M	press-fit
TIC260M	press-fit	T6401M	press-fit
TIC262B	stud	T6411B	stud
TIC262D	stud	T6411D	stud
TIC262E	stud	T6411M	stud
TIC262M	stud	T6411M	stud
TIC270B	press-fit	2N5441	press-fit
TIC270D	press-fit	2N5442	press-fit
TIC270E	press-fit	2N5443	press-fit
TIC270M	press-fit	2N5443	press-fit
TIC272B	stud	2N5444	stud
TIC272D	stud	2N5445	stud
TIC272E	stud	2N5446	stud
TIC272M	stud	2N5446	stud
TDAL113A	TO-39	2N5754	TO-39
TDAL223A	TO-39	2N5756	TO-39
TDAL113B	TO-39	T2302B	TO-39

Industry Type	Package	RCA Type	Package
TDAL223B	TO-39	T2302D	TO-39
TDAL113S	TO-39	T2300B	TO-39
TDAL2235	TO-39	T2300D	TO-39
TJAL602D	stud	T8411B	stud
TJAL604D	stud	T8411D	stud
TJAL606D	stud	T8411M	stud
TRAL1110D	TO-48	2N5569	stud
TRAL1115D	TO-48	2N5573	stud
TRAL1125D	TO-48	T6411B	stud
TRAL1130D	ISOstud	T6421B	ISOstud
TRAL1140D	ISOstud	T6420B	ISOstud
TRAL2210D	TO-48	2N5570	stud
TRAL2215D	TO-48	2N5574	stud
TRAL2225D	TO-48	T6411D	stud
TRAL2230D	ISOstud	T6421D	ISOstud
TRAL2240D	ISOstud	T6420D	ISOstud
TX01A10	TO-66	T2700A	TO-66
TXC01A20	TO-66	T2700B	TO-66
TXC01A40	TO-66	T2700D	TO-66
TXC01B10	TO-66	T2700A	TO-66
TXC01B20	TO-66	T2700B	TO-66
TXC01B40	TO-66	T2700D	TO-66
TXC01C10	TO-66	T2700A	TO-66
TXC01C20	TO-66	T2700B	TO-66
TXC01C40	TO-66	T2700D	TO-66
TXC01D10	TO-66	T2700A	TO-66
TXC01D20	TO-66	T2700B	TO-66
TXC01D40	TO-66	T2700D	TO-66
TXC01E10	TO-66	T2700A	TO-66
TXC01E20	TO-66	T2700B	TO-66
TXC01E40	TO-66	T2700D	TO-66
TXC01F10	TO-66	T2700A	TO-66
TXC01F20	TO-66	T2700B	TO-66
TXC01F40	TO-66	T2700D	TO-66
TXC03A10	MU22	T2500A	TO-220
TXC03A20	MU22	T2500B	TO-220
TXC03A40	MU22	T2500D	TO-220
TXC03A50	MU22	T2500E	TO-220
TXC03B10	MU22	T2500A	TO-220
TXC03B20	MU22	T2500B	TO-220
TXC03B40	MU22	T2500D	TO-220
TXC03B50	MU22	T2500E	TO-220
TXC03C10	MU22	T2500A	TO-220
TXC03C20	MU22	T2500B	TO-220
TXC03C40	MU22	T2500D	TO-220
TXC03C50	MU22	T2500E	TO-220
TXC03D10	MU22	T2500A	TO-220
TXC03D20	MU22	T2500B	TO-220
TXC03D40	MU22	T2500D	TO-220
TXC03D50	MU22	T2500E	TO-220
TXC03E10	MU22	T2500A	TO-220
TXC03E20	MU22	T2500B	TO-220
TXC03E40	MU22	T2500D	TO-220
TXC03E50	MU22	T2500E	TO-220
TXC03F10	MU22	T2500A	TO-220
TXC03F20	MU22	T2500B	TO-220
TXC03F40	MU22	T2500D	TO-220
TXC03F50	MU22	T2500E	TO-220
TXD98A20	stud	2N5573	stud
TXD98A40	stud	2N5574	stud
TXD98A50	stud	T4110M	stud
TXD99A20	stud	2N5569	stud

TRIACS (CONT'D)

Industry Type	Package	RCA Type	Package
TXD99A40	stud	2N5570	stud
TXD99A50	stud	T4111M	stud
TXE99A20	stud	T6411B	stud
TXE99A40	stud	T6411D	stud
TXE99A50	stud	T6411M	stud
TYAL113B	TO-220	T2500B	TO-220
TYAL113C	TO-220	T2500B	TO-220
TYAL113M	TO-220	T2801B	TO-220
TYAL116B	TO-220	T2500B	TO-220
TYAL116C	TO-220	T2500B	TO-220
TYAL116M	TO-220	T2801B	TO-220
TYAL118B	TO-220	T2800B	TO-220
TYAL118C	TO-220	T2800B	TO-220
TYAL118M	TO-220	T2802B	TO-220
TYAL223B	TO-220	T2500D	TO-220
TYAL223C	TO-220	T2500D	TO-220
TYAL223M	TO-220	T2801D	TO-220
TYAL226B	TO-220	T2500D	TO-220
TYAL226C	TO-220	T2500D	TO-220
TYAL226M	TO-220	T2801D	TO-220
TYAL228B	TO-220	T2800D	TO-220
TYAL228C	TO-220	T2800D	TO-220
TYAL228M	TO-220	T2802D	TO-220
TYAL1110B	TO-220	T2800B	TO-220
TYAL1110C	TO-220	T2800B	TO-220
TYAL1110M	TO-220	T2802B	TO-220
TYAL2210B	TO-220	T2800D	TO-220
TYAL2210C	TO-220	T2800D	TO-220
TYAL2210M	TO-220	T2802D	TO-220
40429	TO-66	T2700B	TO-66
40430	TO-66	T2700D	TO-66
40502	TO-66	T2710B	TO-66
40503	TO-66	T2710D	TO-66
40525	TO-5	T2300A	TO-5
40526	TO-5	T2300B	TO-5
40527	TO-5	T2300D	TO-5
40528	TO-5	T2302A	TO-5
40529	TO-5	T2302B	TO-5
40530	TO-5	T2302D	TO-5
40531	TO-5	T2310A	TO-5
40532	TO-5	T2310B	TO-5
40533	TO-5	T2310D	TO-5
40534	TO-5	T2312A	TO-5
40535	TO-5	T2312B	TO-5
40536	TO-5	T2312D	TO-5
40575	TO-66	T4700B	TO-66
40576	TO-66	T4700D	TO-66
40660	press-fit	T6401B	press-fit
40661	press-fit	T6401D	press-fit
40662	stud	T6411B	stud
40663	stud	T6411D	stud
40668	TO-220AB	T2800B	TO-220AB
40669	TO-220AB	T2800D	TO-220AB
40670	TO-220AB	T2800M	TO-220AB
40671	press-fit	T6401M	press-fit
40672	stud	T6411M	stud
40684	TO-5	T2313A	TO-5
40685	TO-5	T2313B	TO-5
40686	TO-5	T2313D	TO-5
40687	TO-5	T2313M	TO-5
40688	ISOstud	T6420B	ISOstud
40689	ISOstud	T6420D	ISOstud
40690	ISOstud	T6420M	ISOstud
40691	TO-5	T2301B	TO-5
40692	TO-5	T2301D	TO-5
40693	TO-5	T2316A	TO-5
40694	TO-5	T2316B	TO-5
40695	TO-5	T2316D	TO-5
40696	TO-5	T2306A	TO-5
40697	TO-5	T2306B	TO-5
40698	TO-5	T2306D	TO-5
40699	press-fit	T6406B	press-fit
40700	press-fit	T6406D	press-fit
40701	press-fit	T6406M	press-fit
40702	stud	T6416B	stud
40703	stud	T6416D	stud
40704	stud	T6416M	stud
40705	press-fit	T6407M	press-fit
40706	press-fit	T6407D	press-fit
40709	press-fit	T6407M	press-fit
40711	press-fit	T4106B	press-fit
40712	press-fit	T4106D	press-fit
40713	stud	T4116B	stud
40714	stud	T4116D	stud
40715	TO-66	T4706B	TO-66
40716	TO-66	T4706D	TO-66
40717	press-fit	T4107B	press-fit
40718	press-fit	T4107D	press-fit
40719	stud	T4117B	stud
40720	stud	T4117D	stud
40721	TO-220AB	T2806B	TO-220AB
40722	TO-220AB	T2806D	TO-220AB
40727	TO-66	T2706B	TO-66
40728	TO-66	T2706D	TO-66
40729	TO-66	T2716B	TO-66
40730	TO-66	T2716D	TO-66
40761	TO-5	T2311B	TO-5
40762	TO-5	T2311D	TO-5
40766	TO-5	T2301A	TO-5
40767	TO-5	T2311A	TO-5
40769	TO-5	T2304B	TO-5
40770	TO-5	T2304D	TO-5
40771	TO-5	T2305B	TO-5
40772	TO-5	T2305D	TO-5
40775	press-fit	T4105B	press-fit
40776	press-fit	T4105D	press-fit
40777	stud	T4115B	stud
40778	stud	T4115D	stud
40779	press-fit	T4104B	press-fit
40780	press-fit	T4104D	press-fit
40781	stud	T4114B	stud
40782	stud	T4114D	stud
40783	press-fit	T4103B	press-fit
40784	press-fit	T4103D	press-fit
40785	stud	T4113B	stud
40786	stud	T4113D	stud
40787	press-fit	T6405B	press-fit
40788	press-fit	T6405D	press-fit
40789	stud	T6415B	stud
40790	stud	T6415D	stud
40791	press-fit	T6404D	press-fit
40793	stud	T6414B	stud
40794	stud	T6414D	stud
40795	press-fit	T4101M	press-fit
40796	stud	T4111M	stud
40797	press-fit	T4100M	press-fit
40798	stud	T4110M	stud
40799	ISOstud	T4121B	ISOstud
40800	ISOstud	T4121D	ISOstud
40801	ISOstud	T4121M	ISOstud
40802	ISOstud	T4120B	ISOstud
40803	ISOstud	T4120D	ISOstud
40804	ISOstud	T4120M	ISOstud
40805	ISOstud	T6421B	ISOstud
40806	ISOstud	T6421D	ISOstud
40807	ISOstud	T6421M	ISOstud
40900	TO-220AB	T2850A	TO-220AB
40901	TO-220AB	T2850B	TO-220AB
40902	TO-220AB	T2850D	TO-220AB
40927	ISOstud	T6420N	ISOstud
41014	TO-220AB	T2500B	TO-220AB
41015	TO-220AB	T2500D	TO-220AB

Operating Considerations

Solid state devices are being designed into an increasing variety of electronic equipment because of their high standards of reliability and performance. However, it is essential that equipment designers be mindful of good engineering practices in the use of these devices to achieve the desired performance.

This Note summarizes important operating recommendations and precautions which should be followed in the interest of maintaining the high standards of performance of solid state devices.

The ratings included in RCA Solid State Devices data bulletins are based on the Absolute Maximum Rating System, which is defined by the following Industry Standard (JEDEC) statement:

Absolute-Maximum Ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

It is recommended that equipment manufacturers consult RCA whenever device applications involve unusual electrical, mechanical or environmental operating conditions.

GENERAL CONSIDERATIONS

The design flexibility provided by these devices makes possible their use in a broad range of applications and under many different operating conditions. When incorporating these devices in equipment, therefore, designers should anticipate the rare possibility of device failure and make certain that no safety hazard would result from such an occurrence.

The small size of most solid state products provides obvious advantages to the designers of electronic equipment. However, it should be recognized that these compact devices usually provide only relatively small insulation area between adjacent leads and the metal envelope. When these devices are used in moist or contaminated atmospheres, therefore, supplemental protection must be provided to prevent the development of electrical conductive paths across the relatively small insulating surfaces. For specific information on voltage creepage, the user should consult references such as the JEDEC Standard No. 7 "Suggested Standard on Thyristors," and JEDEC Standard RS282 "Standards for Silicon Rectifier Diodes and Stacks".

The metal shells of some solid state devices operate at the collector voltage and for some rectifiers and thyristors at the anode voltage. Therefore, consideration should be given to the possibility of shock hazard if the shells are to operate at voltages appreciably above or below ground potential. In general, in any application in which devices are operated at voltages which may be dangerous to personnel, suitable precautionary measures should be taken to prevent direct contact with these devices.

Devices should not be connected into or disconnected from circuits with the power on because high transient voltages may cause permanent damage to the devices.

TESTING PRECAUTIONS

In common with many electronic components, solid-state devices should be operated and tested in circuits which have reasonable values of current limiting resistance, or other forms of effective current overload protection. Failure to observe these precautions can cause excessive internal heating of the device resulting in destruction and/or possible shattering of the enclosure.

TRANSISTORS AND THYRISTORS WITH FLEXIBLE LEADS

Flexible leads are usually soldered to the circuit elements. It is desirable in all soldering operatings to provide some slack or an expansion elbow in each lead to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. Some of the heat can be absorbed if the flexible lead of the device is grasped between the case and the soldering point with a pair of pliers.

TRANSISTORS AND THYRISTORS WITH MOUNTING FLANGES

The mounting flanges of JEDEC-type packages such as the TO-3 or TO-66 often serve as the collector or anode terminal. In such cases, it is essential that the mounting flange be securely fastened to the heat sink, which may be the equipment chassis. Under no circumstances, however, should the mounting flange of a transistor be soldered directly to the heat sink or chassis because the heat of the soldering operation could permanently damage the device. Soldering is the preferred method for mounting thyristors; see "Rectifiers and Thyristors," below. Devices which cannot be soldered can be installed in commercially available sockets. Electrical connections may also be made by soldering directly to the terminal pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals; otherwise the heat of the soldering operation could crack the pin seals and damage the device.

During operation, the mounting-flange temperature is higher than the ambient temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the device mounting-flange temperature above the rated value. The heat sink or chassis may be connected to either the positive or negative supply.

In many applications the chassis is connected to the voltage-supply terminal. If the recommended mounting hardware shown in the data bulletin for the specific solid-state device is not available, it is necessary to use either an anodized aluminum insulator having high thermal conductivity or a mica insulator between the mounting-flange and the chassis. If an insulating aluminum washer is required, it should be drilled or punched to provide the two mounting holes for the terminal pins. The burrs should then be removed from the washer and the washer anodized. To insure that the anodized insulating layer is not destroyed during mounting, it is necessary to remove the burrs from the holes in the chassis.

It is also important that an insulating bushing, such as glass-filled nylon, be used between each mounting bolt and the chassis to prevent a short circuit. However, the insulating bushing should not exhibit shrinkage or softening under the operating temperatures encountered. Otherwise the thermal resistance at the interface between device and heat sink may increase as a result of decreasing pressure.

PLASTIC POWER TRANSISTORS AND THYRISTORS

RCA power transistors and thyristors (SCR's and triacs) in molded-silicone-plastic packages are available in a wide range of power-dissipation ratings and a variety of package configurations. The following paragraphs provide guidelines for handling and mounting of these plastic-package devices, recommend forming of leads to meet specific mounting requirements, and describe various mounting arrangements, thermal considerations, and cleaning methods. This information is intended to augment the data on electrical characteristics, safe operating area, and performance capabilities in the technical bulletin for each type of plastic-package transistor or thyristor.

Lead-Forming Techniques

The leads of the RCA VERSAWATT in-line plastic packages can be formed to a custom shape, provided they are not indiscriminately twisted or bent. Although these leads can be formed, they are not flexible in the general sense, nor are they sufficiently rigid for unrestrained wire wrapping

Before an attempt is made to form the leads of an in-line package to meet the requirements of a specific application, the desired lead configuration should be determined, and a lead-bending fixture should be designed and constructed. The use of a properly designed fixture for this operation eliminates the need for repeated lead bending. When the use of a special bending fixture is not practical, a pair of long-nosed pliers may be used. The pliers should hold the lead firmly between the bending point and the case, but should not touch the case.

When the leads of an in-line plastic package are to be formed, whether by use of long-nosed pliers or a special bending fixture, the following precautions must be observed to avoid internal damage to the device:

1. Restrain the lead between the bending point and the plastic case to prevent relative movement between the lead and the case.
2. When the bend is made in the plane of the lead (spreading), bend only the narrow part of the lead.
3. When the bend is made in the plane perpendicular to that of the leads, make the bend at least 1/8 inch from the plastic case.
4. Do not use a lead-bend radius of less than 1/16 inch.
5. Avoid repeated bending of leads.

The leads of the TO-220AB VERSAWATT in-line package are not designed to withstand excessive axial pull. Force in this direction greater than 4 pounds may result in permanent damage to the device. If the mounting arrangement tends to impose axial stress on the leads, some method of strain relief should be devised.

Wire wrapping of the leads is permissible, provided that the lead is restrained between the plastic case and the point of the wrapping. Soldering to the leads is also allowed. The maximum soldering temperature, however, must not exceed 275°C and must be applied for not more than 5 seconds at a distance not less than 1/8 inch from the plastic case. When wires are used for connections, care should be exercised to assure that movement of the wire does not cause movement of the lead at the lead-to-plastic junctions.

The leads of RCA molded-plastic high-power packages are not designed to be reshaped. However, simple bending of the leads is permitted to change them from a standard vertical to a standard horizontal configuration, or conversely. Bending of the leads in this manner is restricted to three 90-degree bends; repeated bendings should be avoided.

Mounting

Recommended mounting arrangements and suggested hardward for the VERSAWATT package are given in the data bulletins for specific devices and in RCA Application Note AN-4142.* When the package is fastened to a heat sink, a rectangular washer (RCA Part No. NR231A) is recommended to minimize distortion of the mounting flange. Excessive distortion of the flange could cause damage to the package. The washer is particularly important when the size of the mounting hole exceeds 0.140 inch (6-32 clearance). Larger holes are needed to accommodate insulating bushings; however, the holes should not be larger than necessary to provide hardware clearance and, in any case, should not exceed a diameter of 0.250 inch.

*This Note is included in the Appendix to this DATABOOK.

Operating Considerations

Flange distortion is also possible if excessive torque is used during mounting. A maximum torque of 8 inch-pounds is specified. Care should be exercised to assure that the tool used to drive the mounting screw never comes in contact with the plastic body during the driving operation. Such contact can result in damage to the plastic body and internal device connections. An excellent method of avoiding this problem is to use a spacer or combination spacer-isolating bushing which raises the screw head or nut above the top surface of the plastic body. The material used for such a spacer or spacer-isolating bushing should, of course, be carefully selected to avoid "cold flow" and consequent reduction in mounting force. Suggested materials for these bushings are diallphtalate, fiberglass-filled nylon, or fiberglass-filled polycarbonate. Unfilled nylon should be avoided.

Modification of the flange can also result in flange distortion and should not be attempted. The package should not be soldered to the heat sink by use of lead-tin solder because the heat required with this type of solder will cause the junction temperature of the device to become excessively high.

The TO-220AA plastic package can be mounted in commercially available TO-66 sockets, such as UID Electronics Corp. Socket No. PTS-4 or equivalent. For testing purposes, the TO-220AB in-line package can be mounted in a Jetron Socket No. DC74-104 or equivalent. Regardless of the mounting method, the following precautions should be taken:

1. Use appropriate hardware.
2. Always fasten the package to the heat sink before the leads are soldered to fixed terminals.
3. Never allow the mounting tool to come in contact with the plastic case.
4. Never exceed a torque of 8 inch-pounds.
5. Avoid oversize mounting holes.
6. Provide strain relief if there is any probability that axial stress will be applied to the leads.
7. Use insulating bushings to prevent hot-creep problems. Such bushings should be made of diallphthalate, fiberglass-filled nylon, or fiberglass-filled polycarbonate.

The maximum allowable power dissipation in a solid state device is limited by the junction temperature. An important factor in assuring that the junction temperature remains below the specified maximum value is the ability of the associated thermal circuit to conduct heat away from the device.

When a solid state device is operated in free air, without a heat sink, the steady-state thermal circuit is defined by the junction-to-free-air thermal resistance given in the published data for the device. Thermal considerations require that a free flow of air around the device is always present and that the power dissipation be maintained below the level which would cause the junction temperature to rise above the maximum rating. However, when the device is mounted on a heat sink, care must be taken to assure that all portions of the thermal circuit are considered.

To assure efficient heat transfer from case to heat sink when mounting RCA molded-plastic solid state power devices, the following special precautions should be observed:

1. Mounting torque should be between 4 and 8 inch-pounds.
2. The mounting holes should be kept as small as possible.
3. Holes should be drilled or punched clean with no burrs or ridges, and chamfered to a maximum radius of 0.010 inch.
4. The mounting surface should be flat within 0.002 inch/inch.
5. Thermal grease (Dow Corning 340 or equivalent) should always be used on both sides of the insulating washer if one is employed. The bleed rate of the thermal-grease compound should be such that it does not exceed 0.5 per cent after 24 hours at 200°C.
6. Thin insulating washers should be used. (Thickness of factory-supplied mica washers range from 2 to 4 mils).
7. A lock washer or torque washer, made of material having sufficient creep strength, should be used to prevent degradation of heat sink efficiency during life.

A wide variety of solvents is available for degreasing and flux removal. The usual practice is to submerge components in a solvent bath for a specified time. However, from a reliability stand point it is extremely important that the solvent, together with other chemicals in the solder-cleaning system (such as flux and solder covers), do not adversely affect the life of the component. This consideration applies to all non-hermetic and molded-plastic components.

It is, of course, impractical to evaluate the effect on long-term device life of all cleaning solvents, which are marketed with numerous additives under a variety of brand names. These solvents can, however, be classified with respect to their component parts as either acceptable or unacceptable. Chlorinated solvents tend to dissolve the outer package and, therefore, make operation in a humid atmosphere unreliable. Gasoline and other hydrocarbons cause the inner encapsulant to swell and damage the transistor. Alcohol is an acceptable solvent. Examples of specific, acceptable alcohols are isopropanol, methanol, and special denatured alcohols, such as SDA1, SDA30, SDA34, and SDA44.

Under certain conditions, dimethyl silicone fluids may react chemically with the encapsulant of plastic devices and cause damage to the package. These fluids do not cause damage when they are contained in materials such as thermal compounds. These fluids, however, are unacceptable for use as baths or encapsulants for plastic-package devices. In addition, plastic-package devices should not be used or stored in environments that contain significant amounts of dimethyl silicone fluid.

Care must also be used in the selection of fluxes for lead soldering. Rosin or activated rosin fluxes are recommended, while organic or acid fluxes are not. Examples of acceptable fluxes are:

1. Alpha Reliaros No. 320-33
2. Alpha Reliaros No. 346
3. Alpha Reliaros No. 711
4. Alpha Reliafoam No. 807
5. Alpha Reliafoam No. 809
6. Alpha Reliafoam No. 811-13
7. Alpha Reliafoam No. 815-35
8. Kester No. 44

If the completed assembly is to be encapsulated, the effect on the molded-plastic transistor must be studied from both a chemical and a physical standpoint.

RECTIFIERS AND THYRISTORS

A surge-limiting impedance should always be used in series with silicon rectifiers and thyristors. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer winding, or by an external resistor or choke.

A very efficient method for mounting thyristors utilizing the "modified TO-5" package is to provide intimate contact between the heat sink and at least one half of the base of the device opposite the leads. This package can be mounted to the heat sink mechanically with glue or an expoxy adhesive, or by soldering, the most efficient method.

The use of a "self-jigging" arrangement and a solder preform is recommended. If each unit is soldered individually, the heat source should be held on the heat sink and the solder on the unit. Heat should be applied only long enough to permit solder to flow freely. For more detailed thyristor mounting considerations, refer to Application Note AN3822, "Thermal Considerations in Mounting of RCA Thyristors".

RF POWER TRANSISTORS

Mounting and Handling

Stripline rf devices should be mounted so that the leads are not bent or pulled away from the stud (heat sink) side of the device. When leads are formed, they should be supported to avoid transmitting the bending or cutting stress to the ceramic portion of the device. Excessive stresses may destroy the hermeticity of the package without displaying visible damage.

Devices employing silver leads are susceptible to tarnishing; these parts should not be removed from the original tarnish-preventive containers and wrappings until ready for use. Lead solderability is retarded by the presence of silver tarnish; the tarnish can be removed with a silver cleaning solution, such as thiourea.

The ceramic bodies of many rf devices contain beryllium oxide as a major ingredient. These portions of the transistors should not be crushed, ground, or abraded in any way because the dust created could be hazardous if inhaled.

Operating

Forward-Biased Operation. For Class A or AB operation, the allowable quiescent bias point is determined by reference to the infrared safe-area curve in the appropriate data bulletin. This curve depicts the safe current/voltage combinations for extended continuous operation.

Load VSWR. Excessive collector load or tuning mismatch can cause device destruction by over-dissipation or secondary breakdown. Mismatch capability is generally included on the data bulletins for the more recent rf transistors.

See RCA RF Power Transitor Manual, Technical Series RMF-430, pp 39-41, for additional information concerning the handling and mounting of rf power transistors.

SOLID STATE CHIPS

Solid state chips, unlike packaged devices, are non-hermetic devices, normally fragile and small in physical size, and therefore, require special handling considerations as follows:

1. Chips must be stored under proper conditions to insure that they are not subjected to a moist and/or contaminated atmosphere that could alter their electrical, physical, or mechanical characteristics. After the shipping container is opened, the chip must be stored under the following conditions:
   A. Storage temperature, 40°C max.
   B. Relative humidity, 50% max.
   C. Clean, dust-free environment.
2. The user must exercise proper care when handling chips to prevent even the slightest physical damage to the chip.
3. During mounting and lead bonding of chips the user must use proper assembly techniques to obtain proper electrical, thermal, and mechanical performance.
4. After the chip has been mounted and bonded, any necessary procedure must be followed by the user to insure that these non-hermetic chips are not subjected to moist or contaminated atmosphere which might cause the development of electrical conductive paths across the relatively small insulating surfaces. In addition, proper consideration must be given to the protection of these devices from other harmful environments which could conceivably adversely affect their proper performance.

Terms and Symbols

General

AQL	acceptance quality level
CM	cross modulation
IMD	intermodulation distortion
K	post-radiation neutron-damage constant
LTPD	lot tolerance per cent defective
MTBF	mean time between failures
MTTF	mean time to failure
NF	noise factor (or noise figure)
P_D	device dissipation
pps	pulses per second
P_{rr}	pulse repetition rate
prt	pulse recurrence time
PW	pulse width
RMS	root mean square
$R_{\theta JA}$	thermal resistance, junction-to-ambient
$R_{\theta JC}$	thermal resistance, junction-to-case
$R_{\theta JF}$	thermal resistance, junction-to-flange
$R_{\theta JFA}$	thermal resistance, junction-to-free air
$R_{\theta JHS}$	thermal resistance, junction-to-heat sink
T_A	ambient temperature
T_C	case temperature
THD	total harmonic distortion
T_J	operating (junction) temperature
T_L	lead temperature during soldering
t_p	pulse duration
T_{stg}	storage temperature
η	efficiency
θ	conduction angle
ϕ	phase angle
ϕ L	lead radius (for bending)
τ	torque
τ_s	device stud torque

Power Transistors

(C)	collector-to-base charge-generation constant (during gamma exposure)
$C_{b'c}$	feedback capacitance
C_c	collector-to-case capacitance
C_{cb}	collector-to-base feedback capacitance
C_{ib}	common-base input capacitance
C_{ob}	common-base output capacitance
C_{obo}	open-circuit common-base output capacitance
$E_{S/b}$	reverse-bias second-breakdown energy
f_{ab}	base (alpha) cutoff frequency
f_{ae}	emitter (beta) cutoff frequency
h_{FE}	dc forward-current transfer ratio
h_{fe}	common-emitter, small-signal, short-circuit, forward-current transfer ratio
$\|h_{fe}\|$	magnitude of common-emitter, small-signal, short-circuit, forward-current transfer ratio
f_{hfe}	common-emitter, small-signal, short-circuit forward-current transfer ratio cutoff frequency
f_T	gain-bandwidth product (unity-gain frequency for devices in which gain roll off has a −1 slope)
G_c	conversion gain
G_{pb}	small-signal, common-base power gain
G_{PB}	large-signal, common-base power gain
G_{pe}	small-signal, common-emitter power gain
G_{PE}	large-signal, common-emitter power gain
G_{VE}	wide-band voltage gain
h_{ib}	common-base, small-signal, short-circuit input impedance
h_{ie}	common-emitter, small-signal, short-circuit input impedance
h_{ob}	common-base, small-signal, open circuit output admittance
h_{rb}	common-base, small-signal, open-circuit reverse-voltage transfer ratio
I_B	continuous base current
I_{BEV}	base-cutoff current with specified voltage between collector and emitter
I_{BM}	peak base current
I_C	continuous collector current
I_{CBO}	collector-cutoff current, emitter open
I_{CEO}	collector-cutoff current, base open
I_{CER}	collector-cutoff current with specified resistance between base and emitter
I_{CES}	collector-cutoff current with base-emitter junction short-circuited
I_{CEV}	collector-cutoff current with specified voltage between base and emitter
I_{CEX}	collector-cutoff current with specified circuit between base and emitter
I_{CM}	peak collector current
I_C(sat)	collector current at which h_{FE}, V_{BE}(sat), V_{CE}(sat), and switching speeds are measured
I_E	continuous emitter current
I_{EBO}	emitter-cutoff current, collector open
I_{EM}	peak emitter current
$I_{S/b}$	forward-bias, second-breakdown collector current
P_G	power gain
PRT	power rating test
P_T	transistor dissipation at specified temperature
$r_{bb'}$	base spreading resistance
R_{BB}	base bias resistor
$r_{b'}C_c$	collector-to-base time constant
R_{BE}	external base-to-emitter resistance
R_C	collector resistor
r_{CE}(sat)	dc collector-to-emitter saturation resistance
Re(h_{ie})	real part of common-emitter, small-signal, short-circuit input impedance
R_s	collector-to-emitter saturation resistance
t_c	clamped turn-off switching time of an inductive load
t_d	delay time
t_f	fall time
t_{OFF}	turn-off time (storage time + fall time)
t_{ON}	turn-on time (delay time + rise time)
t_r	rise time
t_s	storage time

Power Transistors (Cont'd)

T_{VI} clamped inductive turn-off time
V_{BB} base supply voltage
V_{BE} base-to-emitter voltage
$V_{BE}(sat)$ base-to-emitter saturation voltage
$V_{(BR)CBO}$ collector-to-base breakdown voltage, emitter open
$V_{(BR)CEO}$ collector-to-emitter breakdown voltage, base open
$V_{(BR)CEV}$ collector-to-emitter breakdown voltage with specified voltage between base and emitter
$V_{(BR)CEX}$ collector-to-emitter breakdown voltage with specified circuit between base and emitter
$V_{(BR)EBO}$ emitter-to-base breakdown voltage, collector open
V_{CB} collector-to-base voltage
V_{CBO} collector-to-base voltage, emitter open
V_{CC} collector supply voltage
V_{CE} collector-to-emitter voltage
V_{CEO} collector-to-emitter voltage, base open
$V_{CE}(sat)$ collector-to-emitter saturation voltage
$V_{CEO}(sus)$ collector-to-emitter sustaining voltage, base open
V_{CER} collector-to-emitter voltage with specified resistance between base and emitter
$V_{CER}(sus)$ collector-to-emitter sustaining voltage with specified resistance between base and emitter
V_{CES} collector-to-emitter voltage with base-emitter junction short-circuited
V_{CEV} collector-to-emitter voltage with specified voltage between base and emitter
$V_{CEV}(sus)$ collector-to-emitter sustaining voltage with specified voltage between base and emitter
V_{CEX} collector-to-emitter voltage with specified circuit between base and emitter
$V_{CEX}(sus)$ collector-to-emitter sustaining voltage with specified circuit between base and emitter
V_{EB} emitter-to-base voltage
V_{EBO} emitter-to-base voltage, collector open
V_F diode forward-voltage drop
V_{RT} collector-to-emitter reach-through (or punch through) voltage
α common-base current gain (alpha)
β collector-emitter current gain (beta)
η_C collector efficiency
τ_I thermal time constant

Power Hybrid Operational Amplifiers

A voltage gain
A_{CL} closed-loop voltage gain
A_{OL} open-loop voltage gain
CMRR common-mode rejection ratio
f_H closed-loop bandwidth
I_i idling current
I_{IB} input bias current
I_{IO} input offset current
I_o quiescent current
I_{om} maximum peak quiescent current
I_S short-circuit current
P_T total power dissipation for each output transistor
R_{em} common-mode input impedance
S/N signal-to-noise ratio
SR slew rate
V_{ICR} common-mode input voltage range
V_{IN} input signal voltage swing
V_{IO} input offset voltage
V_{offset} offset voltage
V_{OUT} output voltage swing
V_{OUT}/V_{IN} voltage gain
V_{RR} supply-voltage ripple rejection ratio
V_S supply voltage
Z_{IN} input impedance
ΔI_i idling-current drift

Silicon Rectifiers

I_F forward current
$I_{F(AV)}$ average forward current
$I_{F(RMS)}$ rms forward current
I_{FM} maximum (peak) forward current
I_{FRM} repetitive peak forward current
I_{FSM} peak surge (nonrepetitive) forward current
I_o average forward current, 180-degree conduction angle, half-sine wave
I_R reverse current
$I_{R(AV)}$ average dynamic reverse current, single-phase, full-cycle
I_{RM} maximum (peak) reverse current
I_{rr} reverse recovery current
I^2t amperes squared-seconds (fusing current for rectifier protection)
P_F forward power dissipation
$P_{F(AV)}$ average forward power dissipation
P_{FM} maximum (peak) forward power dissipation
P_R reverse power dissipation
R_s surge-limiting resistance
t_{rr} reverse recovery time
V_F forward voltage drop
v_F instantaneous forward voltage drop
V_R reverse (dc blocking) voltage
$V_{R(RMS)}$ RMS reverse voltage
V_{RRM} repetitive peak reverse voltage
V_{RSM} nonrepetitive peak reverse voltage
V_{RWM} working peak reverse voltage

Thyristors (Triacs, SCR's, GTO's, and ITR's) and Diacs

di/dt rate of change of on-state current
di_F/dt rate of change of forward current (rectifier unit of ITR)
dv/dt critical rate of rise of off-state voltage
$I_{(BO)}$ peak breakover current
i_D instantaneous off-state current
i_{DO} instantaneous off-state current, gate open
I_{DOM} maximum (peak) off-state current, gate open
I_{DROM} maximum peak (repetitive) off-state current, gate open
I_{DRX} dc off-state current, specified circuit between gate and cathode

Terms and Symbols

Thyristors (Triacs, SCR's, GTO's, and ITR's and Diacs) (Cont'd)

Symbol	Definition
I_{DRXM}	maximum (peak) repetitive dc off-state current with specified circuit between gate and cathode
I_{DXM}	maximum (peak) off-state current, specified circuit between gate and cathode
i_F	instantaneous forward current
I_{FM}	peak forward current
I_{FRM}	peak repetitive forward current
I_{FSM}	peak surge forward current (nonrepetitive)
I_G	dc gate current
I_g	pulsed gate trigger current (gate drive current)
I_{ggM}	maximum gate turn-off current
I_{GM}	maximum (peak) gate current
$I_{GR(BR)}$	reverse gate breakdown current
I_{GRRM}	maximum (peak) reverse gate current
I_{GT}	dc gate trigger current
i_{HO}	instantaneous holding current, gate open
I_{HO}	dc holding current, gate open
i_L	instantaneous latching current
I_L	dc latching current
I_o	average dc forward current
I_R	dc reverse current
i_R	instantaneous reverse current
i_{RO}	instantaneous reverse current, gate open
I_{RM}	maximum (peak) reverse current
I_{RROM}	maximum (peak) reverse current, gate open
I_{RRX}	dc reverse current, specified circuit between gate and cathode
I_{RRXM}	maximum (peak) reverse current, specified circuit between gate and cathode
I^2t	amperes squared-seconds (fusing current for device protection)
i_T	instantaneous on-state current
I_T	dc on-state current
I_{TGQM}	maximum (peak) on-state current gate-turn-off capability
$I_{T(AV)}$	average on-state current
I_{TM}	maximum (peak) on-state current
$I_{TM(pulse)}$	maximum (peak) pulse on-state current
$I_{T(RMS)}$	rms on-state current
I_{TRXM}	maximum (peak) (repetitive) on-state current, specified operating circuit
I_{TSM}	maximum (peak) surge (non-repetitive) on-state current
I_{TXM}	maximum (peak) on-state current, specified operating circuit
P_D	device dissipation
$P_{D(AV)}$	average device dissipation
$P_{G(AV)}$	average gate power dissipation
P_{GM}	maximum (peak) gate power dissipation
P_{GRM}	maximum (peak) reverse gate power
P_T	on-state power dissipation
$P_{T(AV)}$	average on-state power dissipation
t_d	delay time
t_f	fall time
t_{gq}	gate controlled turn-off time $(t_s + t_f)$
$t_{g(rec)}$	gate recovery time
t_{gt}	gate controlled turn-on time $(t_d + t_r)$
t_q	circuit commutated turn-off time $(t_{rr} + t_{g(rec)})$
t_r	rise time
t_{rr}	reverse recovery time
t_s	storage time
$V_{(BO)}$	breakover voltage
$\lvert +V_{(BO)}\rvert - \lvert -V_{(BO)}\rvert$	breakover voltage symmetry (for diacs)
$v_{(BO)O}$	instantaneous breakover voltage, gate open
V_D	dc off-state voltage
v_D	instantaneous off-state voltage
V_{DM}	maximum (peak) dc off-state voltage
V_{DROM}	maximum (peak) (repetitive) off-state voltage, gate open
V_{DRXM}	maximum (peak) (repetitive) off-state voltage, specified circuit between gate and cathode
V_{DSOM}	maximum (peak) (nonrepetitive) off-state voltage, gate open
V_{DSXM}	maximum (peak) (nonrepetitive) off-state voltage, specified circuit between gate and cathode
v_{DX}	instantaneous off-state voltage, specified circuit between gate and cathode
V_{DX}	dc off-state voltage, specified circuit between gate and cathode
v_F	instantaneous forward voltage drop
V_{FM}	maximum (peak) forward voltage
V_G	dc gate voltage
V_{GK}	dc gate-to-cathode voltage
V_{gq}	gate turn-off voltage
V_{GR}	dc reverse gate voltage
$V_{GR(BR)}$	reverse gate breakdown voltage
V_{GRM}	maximum (peak) gate reverse voltage
V_{GRRM}	Maximum (peak) repetitive reverse gate voltage
V_{GT}	dc gate trigger voltage
V_R	dc reverse voltage
V_{RROM}	maximum (peak) (repetitive) reverse voltage, gate open
V_{RRXM}	maximum (peak) (repetitive) voltage, specified circuit between gate and cathode
V_{RSOM}	maximum (peak) (nonrepetitive)reverse voltage, gate open
V_{RSXM}	maximum (peak) (nonrepetitive) reverse voltage, specified circuit between gate and cathode
V_{RX}	dc reverse voltage, specified circuit between gate and cathode
V_{RXM}	maximum (peak) reverse voltage, specified circuit between gate and cathode
v_T	instantaneous on-state voltage
V_T	dc on-state voltage
$v_{T(I)}$	initial on-state voltage
V_{TM}	maximum (peak) dc on-state voltage
Z_{GS}	gate source impedance
$\Delta V\pm$	dynamic breakback voltage

Power Transistors
Technical Data

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102, 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

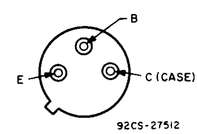
Low-Power Silicon N-P-N Planar Transistors

For Small-Signal Applications In Industrial and Commercial Equipment

These RCA types are silicon n-p-n planar transistors intended for a variety of small-signal and medium-power applications. They feature exceptionally high collector-to-emitter sustaining voltage, low leakage characteristics, high switching speeds, and high pulse beta (h_{FE}).

RCA-2N2102 is a direct replacement for the 2N1613. RCA-2N2405 is a direct replacement for the 2N1893. All of these devices are supplied in the JEDEC TO-39 hermetic package.

TERMINAL DESIGNATIONS



JEDEC TO-39

Features:

- Planar construction for low noise and low leakage
- Low output capacitance
- Low saturation voltages

Additional Features for 40366:

- High reliability assured by five pre-conditioning steps
- Group A test data included in data sheet.

Maximum Ratings, *Absolute-Maximum Values:*

		2N697	2N699	2N2102 40366	2N1613 2N1711	2N1893	2N2270	2N2405	2N3053 40389 40392	2N3053A	41502	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	120	120	75	120	60	120	60	80	–	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:												
With external base-to-emitter resistance (R_{BE}) ≤ 10 Ω	$V_{CER}(sus)$		80	80	50	100	60	140	50	70	–	V
With base-emitter junction reverse-biased	$V_{CEV}(sus)$	–	–	–	–	120	–	120	60	80	–	V
* With base open	$V_{CEO}(sus)$	–	–	65	–	80	45	90	40	60	30	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	7	7	7	7	7	5	5	4	V
* COLLECTOR CURRENT	I_C	0.5	1	1	1	0.5	1	1	0.7	0.7	1	A
* TRANSISTOR DISSIPATION:	P_T											
At case temperatures up to 25°C		2	2	5	3	3	5	5	5●	5	3	W
At free-air temperatures up to 25°C		0.6	0.6	1	0.8	0.8	1	1	1■	1	0.8	W
At temperatures above 25°C		Derate linearly to maximum temperature										
* TEMPERATURE RANGE:												
Storage	T_{stg}	−65 to +175				−65 to 200						°C
Operating (Junction)	T_C	−65 to +175				−65 to 200						°C
* LEAD TEMPERATURE (During soldering):												
At distance from seating plane for 10 s max. ≥ 1/16 in. (1.58 mm)	T_L	255	230	300	300	255	230	255	235	235	300	°C

* 2N-Series types in accordance with JEDEC registration data

●7 for 40392. ■3.5 for 40389

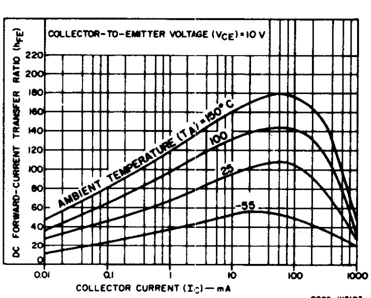


Fig. 1 - Typical dc beta characteristics for 2N699, 2N1613, 2N2102, 2N2270, 41502.

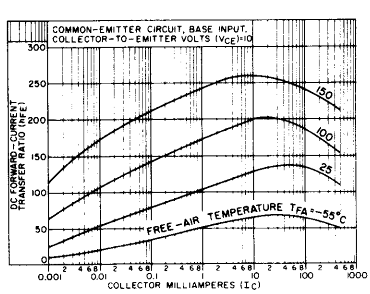


Fig. 2 - Typical dc beta characteristics for 2N1711.

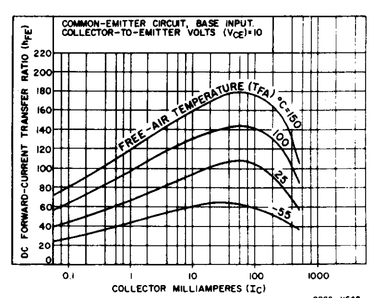


Fig. 3 - Typical dc beta characteristics for 2N1893, 2N2405.

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102 , 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS											UNITS
		VOLTAGE V dc		CURRENT mA dc		2N697			2N699		2N1613		2N2102 40366		2N1711		
		V_{CB}	V_{CE}	I_C	I_B	MIN.	TYP.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
*Collector Cutoff Current:	I_{CBO}	30				–	0.01	1	–	–	–	–	–	–	–	–	μA
With emitter open		60				–	–	–	–	0.05	–	0.01	–	0.002	–	0.01	
At T_C = 150°C		60				–	–	–	–	–	–	10	–	2	–	10	
*Emitter Cutoff Current: V_{EB} = 5 V	I_{EBO}			0		–	–	–	–	0.05	–	0.01	–	0.002	–	0.005	μA
*DC Forward-Current Transfer Ratio	h_{FE}		10	0.01		–	–	–	–	–	–	–	10	–	20	–	
			10	0.1		–	–	–	–	–	20	–	20	–	35	–	
			10	10ª		–	–	–	–	–	35	–	35	–	75	–	
			10	150ª		40	–	120	40	120	40	120	40	120	100	300	
			10	500ª		–	–	–	–	–	20	–	25	–	40	–	
At T_C = −55°C			10	10ª		–	–	–	–	–	20	–	20	–	35	–	
*Collector-to-Emitter Reachthrough Voltage: V_{EB} = 1.5 V, I_E = 0	V_{RT}					–	–	–	–	–	–	–	120	–	75	–	V
*Collector-to-Base Breakdown Voltage: With emitter open	$V_{(BR)CBO}$			0.1		60	75	–	120	–	75	–	120	–	75	–	V
*Emitter-to-Base Breakdown Voltage: I_E = 0.1 mA	$V_{(BR)EBO}$			0		5	7.5	–	–	–	7	–	7	–	7	–	V
*Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			100ª	0	–	–	–	–	–	–	–	65	–	–	–	V
With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER}(sus)$			100ª		40	60	–	80	–	50	–	80	–	50	–	V
*Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			150ª	15	–	1	1.3	–	1.3	–	1.3	–	1.1	–	1.3	V
*Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			150ª	15	–	0.7	1.5	–	5	–	1.5	–	0.5	–	1.5	V
*Common-Emitter, Small-Signal, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}		5	1		–	–	–	35	100	30	100	30	100	50	200	
			10	5		–	–	–	45	–	35	150	35	150	70	300	
Magnitude of Common-Emitter, Small-Signal, Forward Current Transfer Ratio (f = 20 MHz)	$\|h_{fe}\|$		10	50		2.5	5	–	2.5	–	3	–	3	–	3.5	–	
*Input Resistance: f = 1 kHz	h_{ib}	5		1		–	–	–	20	30	24	34	24	34	24	34	Ω
		10		5		–	–	–	–	10	4	8	4	8	4	8	
*Small-Signal Reverse Voltage Transfer (Feedback) Ratio: f = 1 kHz	h_{rb}	5		1		–	–	–	–	3×10^{-4}	–	3×10^{-4}	–	3×10^{-4}	–	5×10^{-4}	
		10		1		–	–	–	–	–	–	3×10^{-4}	–	–	–	–	
		10		5		–	–	–	–	3×10^{-4}	–	–	–	3×10^{-4}	–	5×10^{-4}	
*Output Conductance: f = 1 kHz	h_{ob}	5		1		–	–	–	0.05	0.5	0.05	0.5	0.01	0.5	0.05	0.5	μmho
		10		5		–	–	–	–	1	0.05	0.5	0.01	1	0.05	0.5	
*Output Capacitance: I_E = 0	C_{ob}	10				–	20	35	–	20	–	25	–	15	–	25	pF
*Input Capacitance: V_{EB} = 0.5 V	C_{ib}			0		–	–	–	–	–	–	80	–	80	–	80	pF
Gain-Bandwidth Product	f_T					50	100	–	50	–	60	–	60	–	70	–	MHz
*Noise Figure: Circuit Bandwidth (BW) = 1 Hz, Reference signal freq. = 1 kHz, Generator resistance (R_G) = 510 Ω (2N1613, 2N1711)	NF	10		0.3		–	–	–	–	–	–	12	–	–	–	8	dB
1 KΩ (2N2102)						–	–	–	–	–	–	–	–	6	–	–	
*Saturated Switching Time	$t_d+t_r+t_f$					–	–	–	–	–	–	30	–	30	–	–	ηs
Thermal Resistance: Junction-to-case	$R_{\theta JC}$					–	–	75	–	75*	–	58.3*	–	35*	–	58.3*	°C/W
Junction-to-ambient	$R_{\theta JA}$					–	–	250	–	250*	–	219*	–	175*	–	219*	°C/W

*2N-Series types in accordance with JEDEC registration data

ª Pulsed, pulse duration = 300 μs, duty factor = 2% (1.8% for 2N2102 only).

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102, 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CB}	V_{CE}	CURRENT mA dc I_C	I_B	LIMITS 2N1893 MIN.	2N1893 MAX.	2N2405 MIN.	2N2405 MAX.	2N2270 MIN.	2N2270 MAX.	2N3053 40389 40392 MIN.	2N3053 40389 40392 MAX.	2N3053A MIN.	2N3053A MAX.	41502 MIN.	41502 MAX	UNITS
* Collector Cutoff Current: With emitter open	I_{CBO}	15				–	–	–	–	–	–	–	–	–	–	–	2	μA
		30				–	–	–	–	–	–	–	0.25	–	–	–	–	
		60				–	–	–	–		0.05	–	–	–	–	–	–	
		90				–	0.01	–	0.01	–	–	–	–	–	–	–	–	
At T_C = 150°C		60				–	–	–	–	–	50	–	–	–	–	–	–	
		90				–	15	–	10	–	–	–	–	–	–	–	–	
* Emitter Cutoff Current: V_{EB} = 5 V, (4 V for 2N3053, 2N3053A)	I_{EBO}			0		–	0.01	–	0.01	–	0.1	–	0.25	–	0.25	–	–	μA
* DC Forward-Current Transfer Ratio	h_{FE}		10	0.1		–	–	20	–	–	–	–	–	–	–	–	–	
			10	1		–	–	–	–	30	–	–	–	–	–	–	–	
			10	10[a]		35	–	35	–	–	–	–	–	–	–	–	–	
			10	150[a]		40	120	60	200	50	200	50	250	50	250	20	–	
At T_C = 55°C			10	10[a]		20	–	20	–	–	–	–	–	–	–	–	–	
* Collector-to-Base Breakdown Voltage: With emitter open	$V_{(BR)CBO}$			0.1		120	–	120	–	60	–	60	–	80	–	–	–	V
* Emitter-to-Base Breakdown Voltage: I_E = 0.1 mA	$V_{(BR)EBO}$			0		7	–	7	–	7	–	5	–	5	–	4	–	V
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$			100[a]	0	–	–	90	–	45	–	40	–	–	–	–	–	V
				30[a]		80	–	90	–	–	–	–	–	–	–	30	–	
				0.1[a]	0	–	–	–	–	–	–	–	–	60	–	–	–	
With external base-to-emitter resistance (R_{BE}) = 10Ω	$V_{CER(sus)}$			100[a]		100	–	140	–	60	–	50	–	70	–	–	–	V
= 500Ω				100[a]		–	–	120	–	–	–	–	–	–	–	–	–	
* Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$			150[a]	15	–	1.3	–	1.1	–	0.9	–	1.4	0.6	1	–	–	V
				50[a]	5	–	0.9	–	0.9	–	–	–	–	–	–	–	–	
* Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			150[a]	15	–	5	–	0.5	–	1.2	–	1.7	–	0.3	–	1.5	V
				50[a]	5	–	1.3	–	0.2	–	–	–	–	–	–	–	–	
Base-to-Emitter Voltage	V_{BE}		2.5	150		–	–	–	–	–	–	–	1.7	–	1	–	–	V
			10	150[a]		–	–	–	–	–	–	–	–	–	–	–	2.5	
* Common Emitter, Small-Signal, Forward Current Transfer Ratio	h_{fe}																	
* f = 1 kHz			5	1		30	100	–	–	–	–	–	–	–	–	–	–	
* = 1 kHz			5	5		–	–	50	275	5	–	–	–	–	–	–	–	
* = 1 kHz			10	5		45	–	–	–	5	275	–	–	–	–	–	–	
= 20 MHz			10	50		2.5*	–	6	–	5*	–	5*	–	5	–	–	–	
* Input Resistance: f = 1 kHz	h_{ib}	5		1		20	30	24	34	–	–	–	–	–	–	–	–	Ω
		10		5		4	8	4	8	–	–	–	–	–	–	–	–	
* Small Signal Reverse Voltage Transfer (Feedback) Ratio: f = 1 kHz	h_{rb}	5		1		–	1.25×10^{-4}	–	3×10^{-4}	–	–	–	–	–	–	–	–	
		10		5		–	1.25×10^{-4}	–	3×10^{-4}	–	–	–	–	–	–	–	–	
* Output Conductance: f = 1 kHz	h_{ob}	5		1		–	0.5	–	0.5	–	–	–	–	–	–	–	–	μmho
		10		5		–	0.5	–	0.5	–	–	–	–	–	–	–	–	
* Output Capacitance: I_E = 0	C_{ob}	10				–	15	–	15	–	15	–	15	–	15	–	25	pF
* Input Capacitance: V_{EB} = 0.5 V	C_{ib}			0		–	85	–	85	–	80	–	80	–	80	–	80	pF
Gain-Bandwidth Product	f_T					50	–	120	–	100	–	100	–	100	–	–	–	MHz
Noise Figure: Circuit Bandwidth (BW) = 1 Hz, Reference signal freq. = 1 kHz, Generator resistance (R_G) = 500 Ω (2N2405), 1 kΩ (2N2270)	NF	10		0.3		–	–	–	6	–	10*	–	–	–	–	–	–	dB
* Saturated Switching Time	$t_d+t_r+t_f$					–	–	–	–	–	30	–	–	–	–	–	–	ηs
Thermal Resistance: Junction-to-case	$R_{\theta JC}$					–	58.3	–	35	–	35	–	35●	–	35	–	58.3	°C/W
Junction-to-ambient	$R_{\theta JA}$					–	219	–	175	–	175	–	175■	–	175	–	219	

* 2N-Series types in accordance with JEDEC registration data.

a Pulsed; pulse duration = 300 μs, duty factor ≤ 2%.

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102, 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

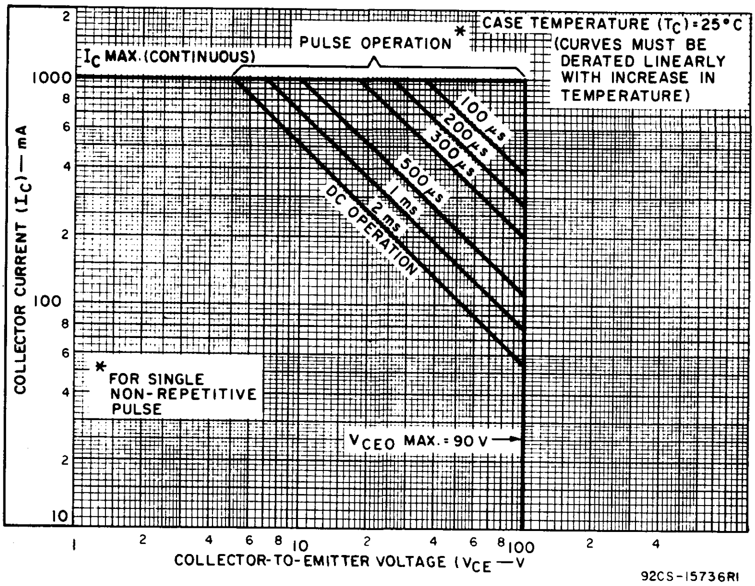


Fig. 4 - Maximum operating areas for 2N2405.

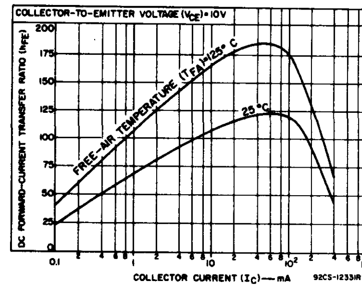


Fig. 6 — Typical dc beta characteristics for 2N3053, 2N3053A, 40389, 40392.

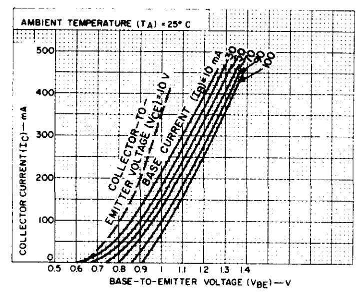


Fig. 7 - Typical transfer characteristics for 2N1613, 2N1711, 2N1893, 2N2102, 2N2405.

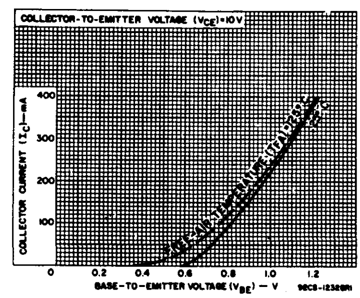


Fig. 8 - Typical transfer characteristics for 2N3053, 2N3053A, 40389, 40392.

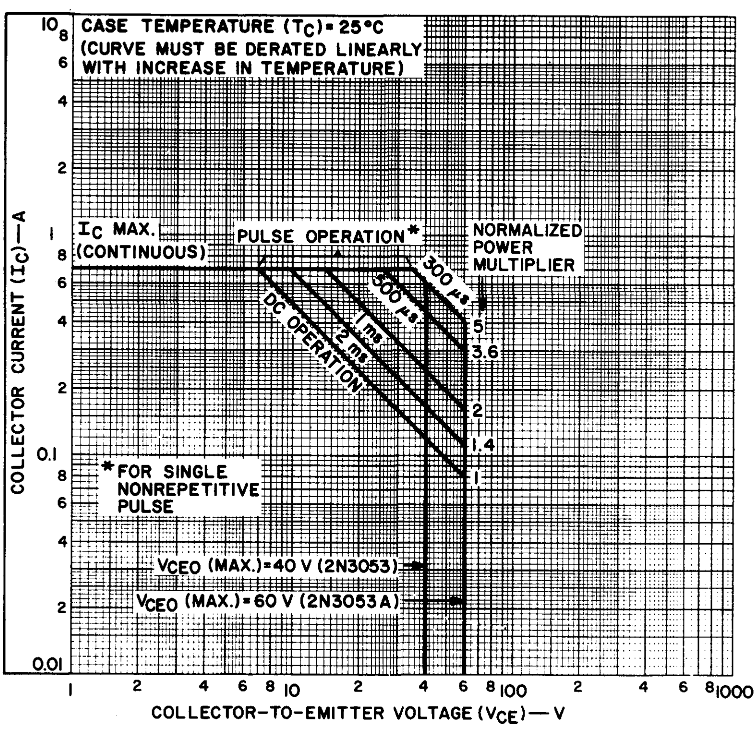


Fig. 5 — Maximum operating areas for 2N3053 and 2N3053A.

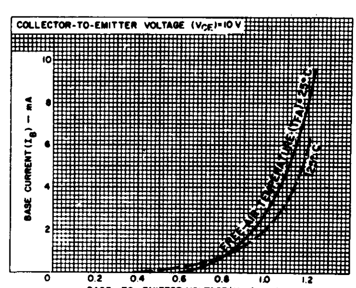


Fig. 9 - Typical input characteristics for 2N3053, 2N3053A, 40389, 40392.

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102, 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

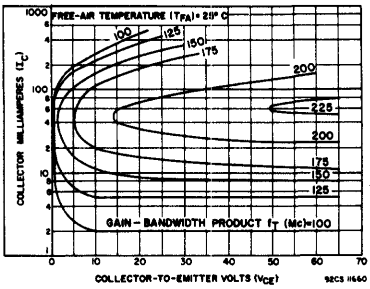


Fig. 10 - Typical gain bandwidth product (f_T) for 2N1711, 2N1893, 2N2405.

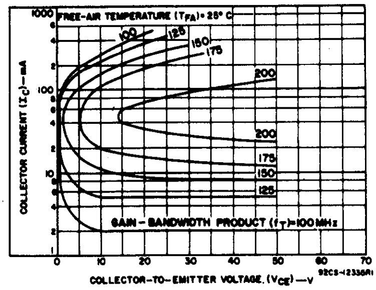


Fig. 11 - Typical gain bandwidth product (f_T) for 2N699, 2N1613, 2N2102, 2N2270, 2N3053, 2N3053A, 40389, 40392.

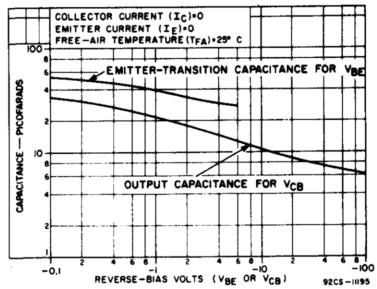


Fig. 12 - Typical capacitance characteristics for all types.

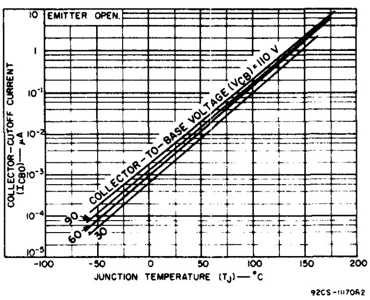


Fig. 13 - Typical collector-cutoff current characteristics for 2N699, 2N1893, 2N2405.

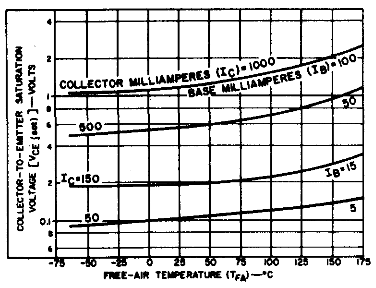


Fig. 14 - Typical collector-to-emitter saturation characteristics for 2N1893, 2N2405.

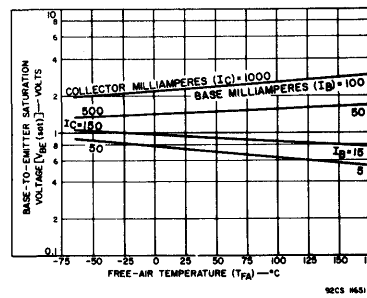


Fig. 15 - Typical base-to-emitter saturation characteristics for 2N1893, 2N2405.

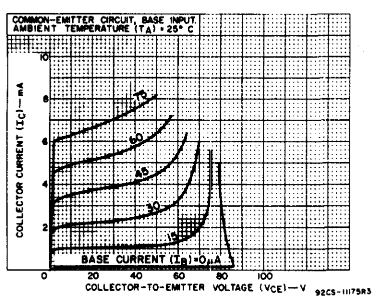


Fig. 16 - Typical low-current output characteristics for 2N699, 2N1613, 2N2102, 2N2270, 41502.

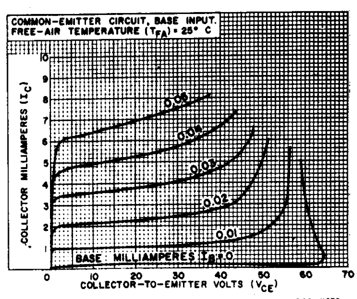


Fig. 17 - Typical low-current output characteristics for 2N1711.

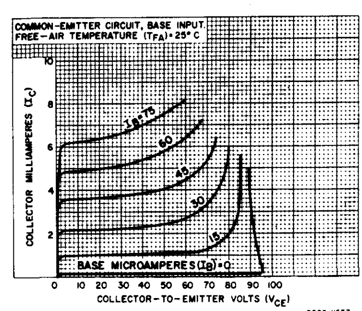


Fig. 18 - Typical low-current output characteristics for 2N1893.

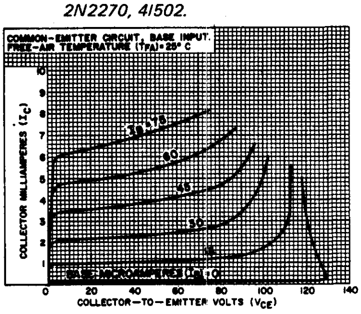


Fig. 19 - Typical low-current output characteristics for 2N2405.

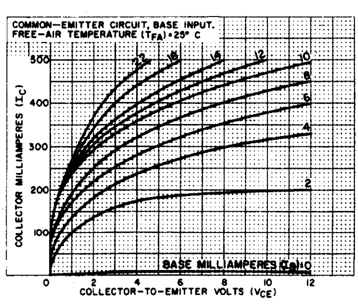


Fig. 20 - Typical high-current output characteristics for 2N699, 2N2270.

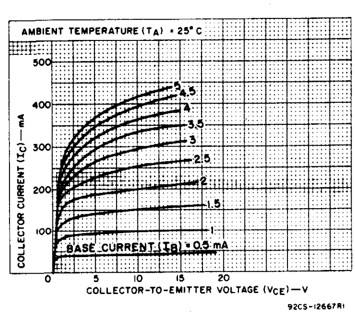


Fig. 21 - Typical high-current output characteristics for 2N1613, 2N2102, 41502.

2N697, 2N699, 2N1613, 2N1711, 2N1893, 2N2102, 2N2270, 2N2405, 2N3053, 2N3053A, 40366, 40389, 40392, 41502

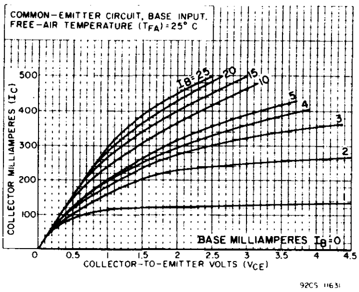


Fig. 22 - Typical high-current output characteristics for 2N1711.

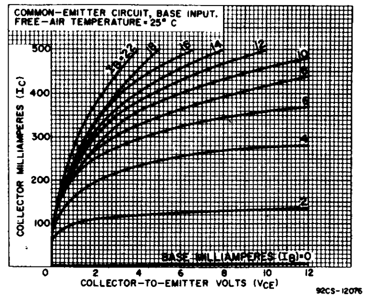


Fig. 23 - Typical high-current output characteristics for 2N1893.

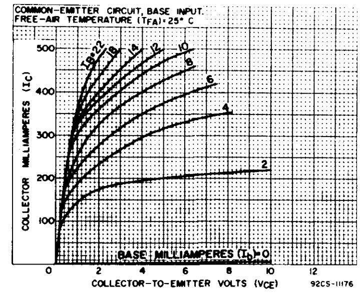


Fig. 24 - Typical high-current output characteristics for 2N2405.

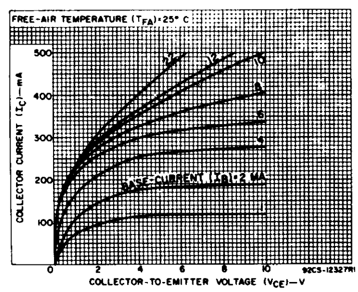


Fig. 25 - Typical high-current output characteristics for 2N3053, 2N3053A, 40389, 40392.

2N1479-2N1482, 2N1700, 40347-40349, 40367
Hometaxial-Base Silicon N-P-N Power Transistors

General-Purpose Types for Low-Power Applications

These RCA types are hometaxial-base, silicon n-p-n power transistors intended for a wide variety of applications in industrial and military equipment. They are particularly useful in power-switching circuits such as in dc-to-dc converters, inverters, choppers, solenoid and relay controls; in oscillator, regulator, and pulse-amplifier circuits; and as class A and class B push-pull audio and servo amplifiers.

The 2N1700 and 40367 are supplied in the hermetic JEDEC TO-39 package or TO-39 with factory-attached mounting flange or heat radiator.

Features:
- High-temperature characterization
- High dc beta at 200 mA
- Full switching-time characterization at 200 mA

Additional features for 40367:
- High realiability assured by five preconditioning steps
- Group A test data in data bulletin

Maximum Ratings, *Absolute-Maximum Values:*		2N1479 2N1481	2N1480 2N1482	2N1700	40347 40347V1 40347V2	40348 40348V1 40348V2	40349 40349V1 40349V2	40367	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	100	60	60	90	160	100	V
* COLLECTOR-TO-EMITTER VOLTAGE:									
With base open, sustaining	$V_{CEO}(sus)$	40	55	40	40	65	140	55	V
With emitter-to-base reverse biased (V_{EB} = 1.5 volts)	V_{CEV}	60	100	60	60	90	160	100	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	12	12	6	7	7	7	12	V
* COLLECTOR CURRENT	I_C	1.5	1.5	1	1.5	1.5	1.5	1.5	A
PEAK COLLECTOR CURRENT	I_{CM}	–	–	–	3.0	3.0	3.0	–	A
* EMITTER CURRENT	I_E	−1.75	−1.75	–	–	–	–	–	A
* BASE CURRENT	I_B	1	1	0.75	0.5	0.5	0.5	1	A
* TRANSISTOR DISSIPATION:	P_T								
At case temperature of 25°C		5	5	5	11.7 (40347V2) 8.75 (40347)	11.7 (40348V2) 8.75 (40348)	11.7 (40349V2) 8.75 (40349)	5	W
At ambient temperature up to 25°C		–	–	–	1.0 (40347) 4.4 (40347V1)	1.0 (40348) 4.4 (40348V1)	1.0 (40349) 4.4 (40349V1)	1	W
* TEMPERATURE RANGE:									
Operating and Storage	T_C, T_{stg}	←			−65 to 200			→	°C
* LEAD TEMPERATURE (During soldering):									
At distances ≥ 1/32 in (0.8 mm) from seating plane for 10 s max.	T_L	–	–	255	230	230	230	255	°C

*2N-Series types in accordance with JEDEC registration data

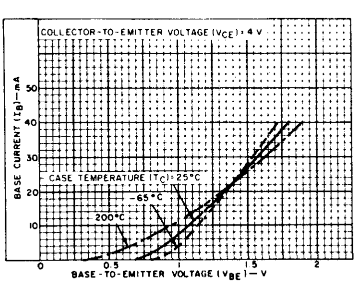


Fig. 1 — Typical input characteristics for 2N1479–2N1482.

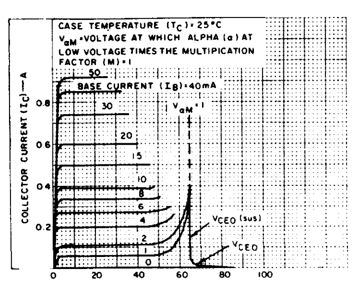
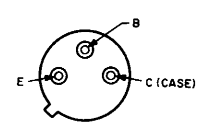
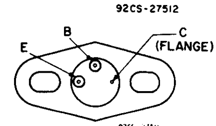


Fig. 2 — Typical output characteristics for 2N1479–2N1482.

TERMINAL DESIGNATIONS

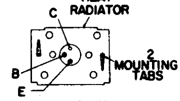


JEDEC TO-39
2N1479-2N1482,2N1700,
40347-40349,40367



JEDEC TO-39 with Mounting Flange
40347V2, 40348V2,40349V2

HEAT RADIATOR



JEDEC TO-39 with Heat Radiator
40347V1,40348V1,40349V1

2N1479-2N1482, 2N1700, 40347-40349, 40367

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CB}	V_{CE}	V_{EB}	CURRENT mA dc I_C	I_B	I_E	LIMITS 2N1479 MIN.	MAX.	2N1480 MIN.	MAX.	2N1481 MIN.	MAX.	2N1482 MIN.	MAX.	2N1700 MIN.	MAX.	40367 MIN.	MAX.	UNITS
* Collector Cutoff Current:	I_{CBO}	30					0	–	10	–	10	–	10	–	10	–	75	–	4	μA
T_C = 150°C		30					0	–	500	–	500	–	500	–	500	–	1000	–	–	
* Emitter Cutoff Current	I_{EBO}			12	0			–	10	–	10	–	10	–	10	–	–	–	2	μA
				6	0			–	–	–	–	–	–	–	–	–	25	–	–	
* Collector-To-Emitter Voltage: With base-emitter junction reverse-biased	V_{CEV}			1.5	0.25			60	–	100	–	60	–	100	–	–	–	100	–	V
				1.5	0.5			–	–	–	–	–	–	–	–	60	–	–	–	
With base open, sustaining	$V_{CEO}(sus)$				50	0		40	–	55	–	40	–	55	–	–	–	55	–	
* Base-To-Emitter Voltage	V_{BE}		4		200			–	3	–	3	–	3	–	3	–	–	–	3	V
			4		100			–	–	–	–	–	–	–	–	–	2	–	–	
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$				200	10		–	–	–	–	–	–	–	–	–	–	–	1.4	V
* DC Current Transfer Ratio	h_{FE}		4		200			20	60	20	60	35	100	35	100	–	–	35	100	
			4		100			–	–	–	–	–	–	–	–	20	80	–	–	
Small-Signal Current Transfer Ratio	h_{fe}		4		5			50 Typ.*		50 typ.*		50 Typ.*		50 Typ.*		40 Typ.		–	–	
* DC Collector-To-Emitter Saturation Resistance	$r_{CE}(sat)$				200	20		–	7	–	7	–	–	–	–	–	–	–	–	Ω
					200	10	–	–	–	–	–	–	7	–	7	–	–	–	–	
					100	10	–	–	–	–	–	–	–	–	–	–	10	–	–	
Collector-To-Base Capacitance	C_{ob}	40						150 Typ.*		150 Typ.*		150 Typ.*		150 Typ.*		150 Typ.		–	–	pF
Thermal Time Constant	τ_1							10 Typ.*		10 Typ.*		10 Typ.*		10 Typ.*		10 Typ.		–	–	ms
Alpha-Cutoff Frequency	$f_{\alpha b}$	28			5			1.5 Typ.*		1.5 Typ.*		1.5 Typ.*		1.5 Typ.*		1.5 Typ.		–	–	MHz
Switching Time:																				
Delay Time	t_d●							0.2 Typ.*		0.2 Typ.*		0.2 Typ.*		0.2 Typ.*		0.2 Typ.		–	–	
Rise Time	t_r●							1 Typ.*		1 Typ.*		1 Typ.*		1 Typ.*		1 Typ.		–	–	
Storage Time	t_s●							0.6 Typ.*		0.6 Typ.*		0.6 Typ.*		0.6 Typ.*		0.6 Typ.		–	–	
Fall Time	t_f●							1 Typ.*		1 Typ.*		1 Typ.*		1 Typ.*		1 Typ.		–	–	
* Thermal Resistance: Junction-to-case	$R_{\theta JC}$								35		35		35		35		35	–	35	
Junction-to-free air	$R_{\theta JFA}$								200		200		200		200		200	–	–	

*2N-Series types in accordance with JEDEC registration data.

● I_C = 200 mA, I_{B_1} = 20 mA, I_{B_2} = –85. mA

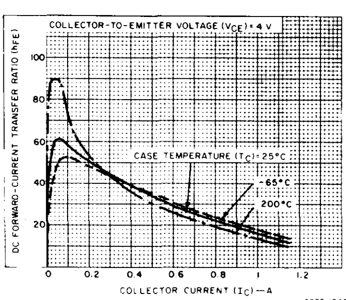


Fig. 3— Typical dc beta characteristics for 2N1479–2N1482.

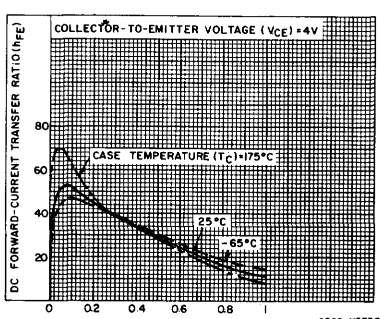


Fig.4—Typical dc beta characteristics for 2N1700.

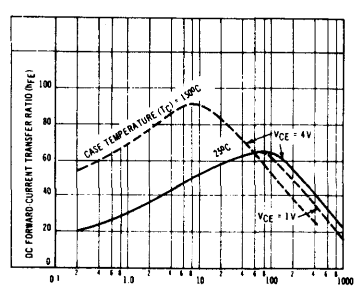


Fig.5—Typical dc beta characteristics for 40347.

2N1479-2N1482, 2N1700, 40347-40349, 40367

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 40347 MIN.	40347 MAX.	40348 MIN.	40348 MAX.	40349 MIN.	40349 MAX.	UNITS
Collector-Cutoff Current With external base-to-emitter resistance (R_{BE}) = 1 kΩ	I_{CER}	30				–	1	–	–	–	–	µA
		60				–	–	–	1	–	–	
		90				–	–	–	–	–	2	
With R_{BE} = 1 kΩ and T_C = 150°C	I_{CER}	30				–	1	–	–	–	–	mA
		60				–	–	–	1	–	–	
		90				–	–	–	–	–	1	
Emitter-Cutoff Current	I_{EBO}		−7			–	10	–	10	–	10	µA
DC Forward-Current Transfer Ratio	h_{FE}	4		0.15		–	–	–	–	30	125	
		4		0.30		–	–	30	125	–	–	
		4		0.45		25	100	–	–	10	–	
		4		1.00		–	–	10	–	–	–	
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse biased	$V_{CEV}(sus)$		−1.5	0.050		60	–	90	–	160[a]	–	V
With base open	$V_{CEO}(sus)$			0.050		40	–	65	–	140[a]	–	V
Base-to-Emitter Voltage	V_{BE}	4		0.15		–	–	–	–	–	1.1	V
		4		0.30		–	–	–	1.3	–	–	
		4		0.45		–	1.5	–	–	–	–	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			0.15	15 mA	–	–	–	–	–	0.15	V
				0.30	30 mA	–	–	–	0.75	–	–	
				0.45	45 mA	–	1	–	–	–	–	
Forward-Bias Second Break-down Collector Current (1-s non-repetitive pulse)	$I_{S/b}$	38				345	–	–	–	–	–	mA
		63				–	–	208	–	–	–	
		138				–	–	–	–	95	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					20(max.) 40347 15(max.) 40347V2		20(max.) 40348 15(max.) 40348V2		20(max.) 40349 15(max) 40349V2		°C/W
Thermal Resistance: Junction-to-Ambient	$R_{\theta JA}$					40(max.) 40347V1		40(max.) 40348V1		40(max) 40349V1		°C/W

[a] Pulsed; pulse duration = 300 µs, duty factor ≤ 2%.

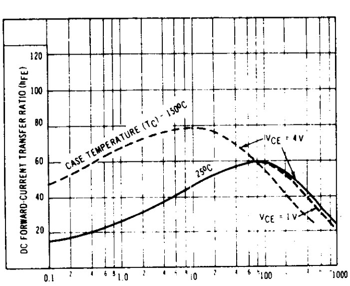


Fig.6—Typical dc beta characteristics for 40348.

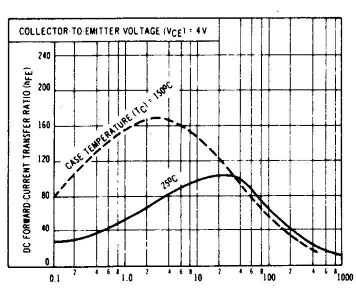


Fig.7—Typical dc beta characteristics for 40349.

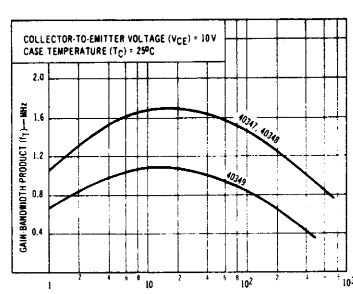


Fig.8—Typical gain-bandwidth product vs. collector current for 40347, 40348 and 40349.

2N1479-2N1482, 2N1700, 40347-40349, 40367

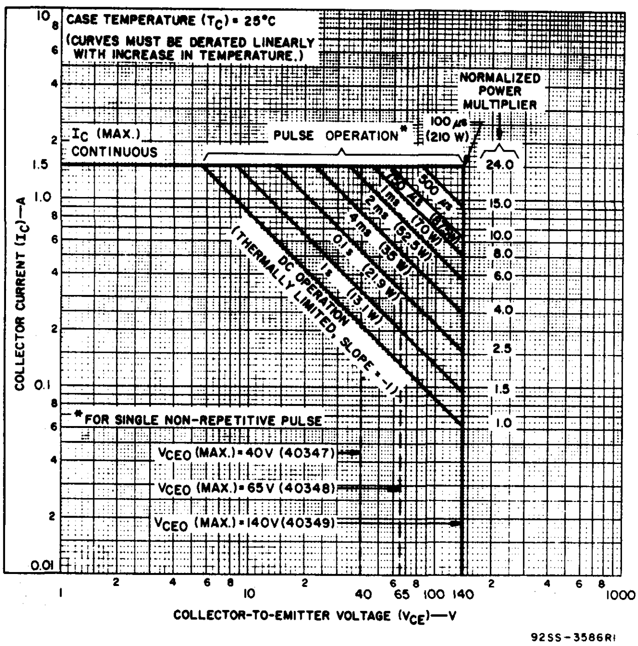


Fig.9—Maximum operating areas for 40347, 40348, and 40349.

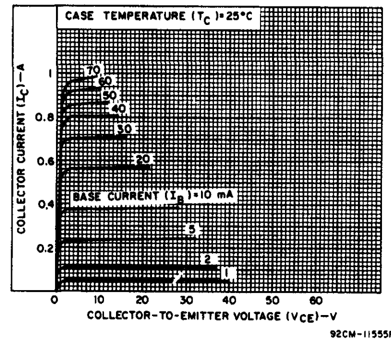


Fig.10—Typical output characteristics for 2N1700.

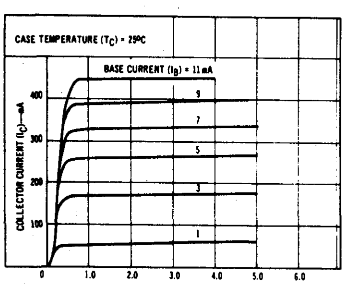


Fig.11—Typical output characteristics for 40347.

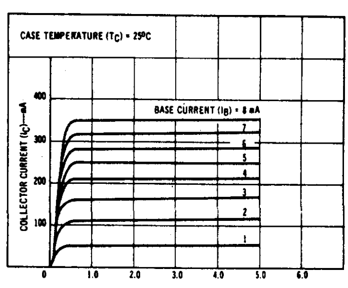


Fig.12—Typical output characteristics for 40348.

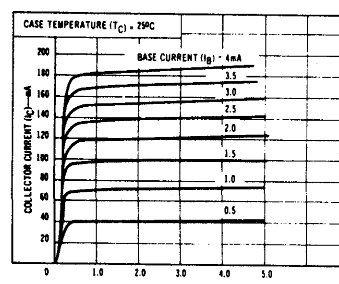


Fig.13—Typical output characteristics for 40349.

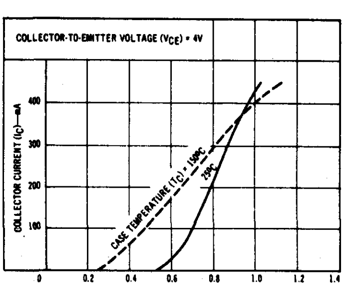


Fig.14—Typical transfer characteristics for 40347.

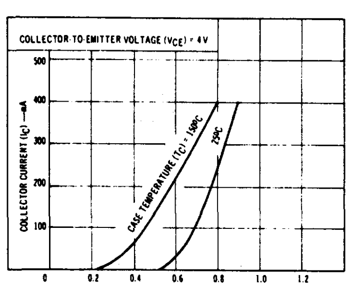


Fig.15—Typical transfer characteristics for 40348.

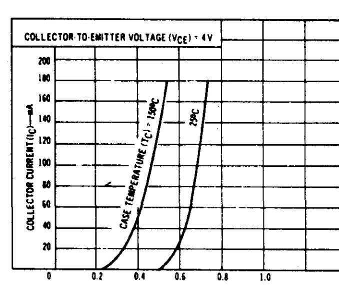


Fig.16—Typical transfer characteristics for 40349.

2N1479-2N1482, 2N1700, 40347-40349, 40367

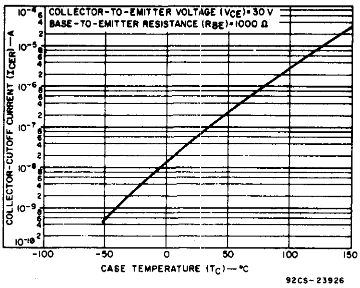


Fig.17—Collector-cutoff-current characteristic for 40347.

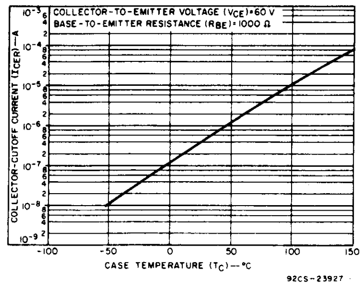


Fig.18—Collector-cutoff-current characteristic for 40348.

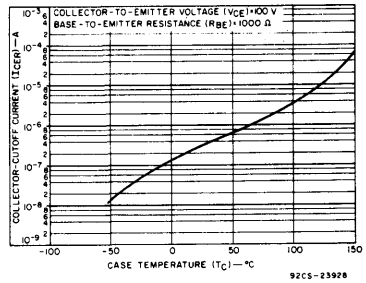


Fig.19—Collector-cutoff-current characteristic for 40349.

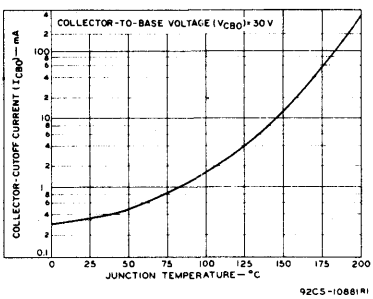


Fig.20—Typical leakage characteristics for 2N1479—2N1482.

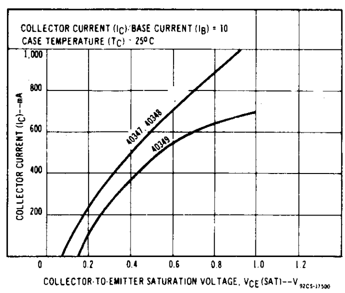


Fig.21—Typical saturation characteristics for 40347, 40348 and 40349.

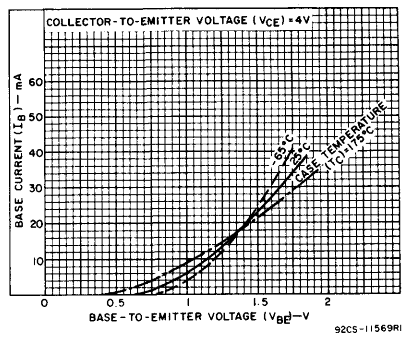


Fig.22—Typical input characteristics for 2N1700.

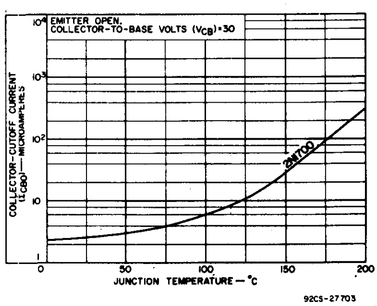


Fig. 23 — Typical leakage characteristics for 2N1700.

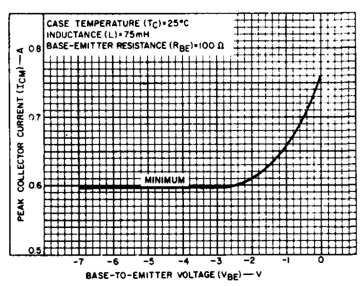


Fig.24—Reverse-bias second-breakdown characteristics for 40347, 40348 and 40349.

2N1483-2N1486, 2N1701, 40368

Hometaxial-Base Silicon N-P-N Power Transistors

General-Purpose Types for Medium-Power Applications

These RCA types are hometaxial-base power transistors of the silicon n-p-n type intended for a wide variety of applications in industrial and military equipment. They are particularly useful in power-switching circuits such as in dc-to-dc converters, inverters, choppers, solenoid and relay control; in oscillator, regulator, and pulse amplifier circuits; and as class-A and class-B push-pull audio and servo amplifiers.

These transistors feature high beta at high current, and excellent high-temperature performance. They are supplied in the JEDEC TO-8 hermetic package.

Features:

- High-temperature characterization
- High dc beta at 750 mA
- Full switching-time characterization at 750 mA

Additional Features for 40368:

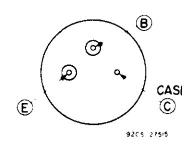
- High reliability assured by five preconditioning steps
- Group A test data in data bulletin.

Maximum Ratings, ***Absolute-Maximum Values:***

		2N1483 2N1485	2N1484 2N1486 40368	2N1701	
• COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	100	60	V
• COLLECTOR-TO-EMITTER VOLTAGE:					
With base open (sustaining voltage)	$V_{CEO}(sus)$	40	55	40	V
With emitter-to-base reverse biased (V_{EB}) = 1.5 volts)	V_{CEV}	60	100	60	V
• EMITTER-TO-BASE VOLTAGE	V_{EBO}	12	12	6	V
• COLLECTOR CURRENT	I_C	3	3	2.5	A
• EMITTER CURRENT	I_E	−3.5	−3.5	–	A
• BASE CURRENT	I_B	1.5	1.5	1	A
• TRANSISTOR DISSIPATION:	P_T				
At case temperature of 25°C		25	25	25	W
At case temperature of 100°C		14.1	14.1		
• TEMPERATURE RANGE:					
Operating and Storage	T_J, T_{stg}		−65 to +200		°C
PIN TEMPERATURE (During soldering):					
At distance ≥1/32 in. (0.79 mm) from seating plane for 10 s max.	T_L		235		°C

•2N-Series types in accordance with JEDEC registration data

TERMINAL DESIGNATIONS



JEDEC-TO-8

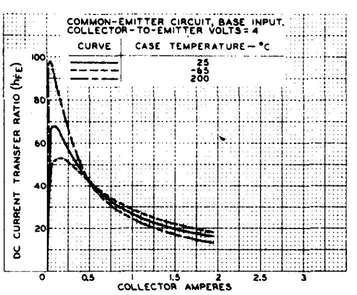


Fig. 1 – Typical dc beta characteristics for 2N1483–2N1486, and 40368.

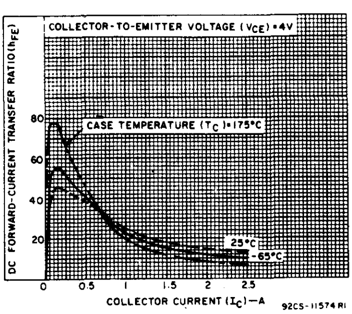


Fig. 2 – Typical dc beta characteristics for 2N1701.

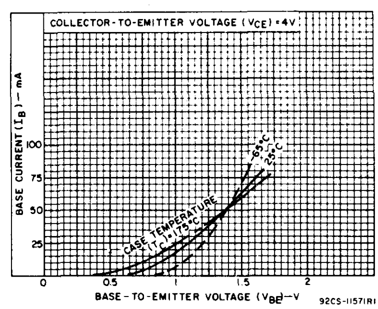


Fig. 3 – Typical input characteristics for 2N1701.

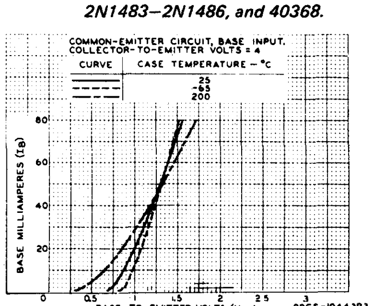


Fig. 4 – Typical input characteristics for 2N1483–2N1486, and 40368.

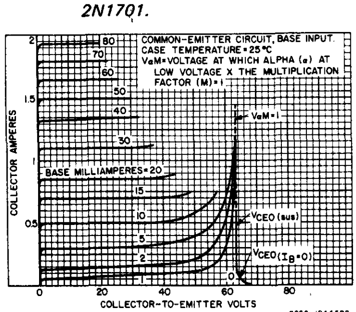


Fig. 5 – Typical output characteristics for 2N1483–2N1486, and 40368.

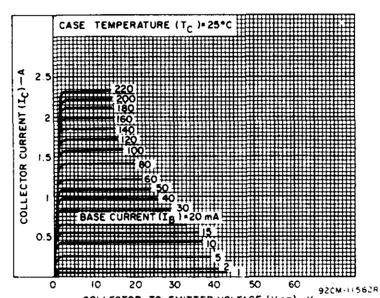


Fig. 6 – Typical output characteristics for 2N1701.

2N1483-2N1486, 2N1701, 40368

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		CURRENT mA dc		LIMITS 2N1483		2N1484		2N1485		2N1486		2N1701		40368		UNITS
	V_{CB}	V_{CE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CBO}	60				–	–	–	–	–	–	–	–	–	750	–	–	µA
	30				–	15	–	15	–	15	–	15	–	100	–	9	µA
At T_C = 150°C	30				–	750	–	750	–	750	–	750	–	1500	–	–	µA
* I_{EBO} V_{EB} = 12 V			0		–	15	–	15	–	15	–	15	–	–	–	5	µA
= 6			0		–	–	–	–	–	–	–	–	–	50	–	–	µA
* h_{FE}		4	750[a]		20	60	20	60	35	100	35	100	–	–	35	100	
		4	300[a]		–	–	–	–	–	–	–	–	20	80	–	–	
		20	2500[a]		–	–	–	–	–	–	–	–	5	–	–	–	
* V_{CEO}(sus)			100[a]	0	40	–	55	–	40	–	55	–	40[b]	–	55	–	V
* V_{CEV} V_{BE} = −1.5 V			0.25		60	–	100	–	60	–	100	–	–	–	100	–	V
* V_{CEX} V_{BE} = −1.5 V			0.75		–	–	–	–	–	–	–	–	60[b]	–	–	–	V
* V_{BE}		4	750[a]		–	3.5	–	3.5	–	2.5	–	2.5	–	–	–	2.5	V
		4	300[a]		–	–	–	–	–	–	–	–	–	3	–	–	V
		20	2500[a]		–	–	–	–	–	–	–	–	–	13	–	–	V
* V_{CE}(sat)			750	40	–	–	–	–	–	–	–	–	–	–	–	0.75	V
			2500[a]	1000	–	–	–	–	–	–	–	–	–	12.5	–	–	V
* r_{CE}(sat)			750	75	–	2.67	–	2.67	–	1	–	1	–	–	–	–	Ω
			300	30	–	–	–	–	–	–	–	–	–	5	–	–	Ω
* C_{ob}	40				175 (typ.)		175 (typ.)		175 (typ.)		175 (typ.)		175 (typ.)		–	–	pF
* τ_1					10 (typ.)		10 (typ.)		(10 (typ.)		10 (typ.)		10 (typ.)		–	–	ms
* $f_{\alpha b}$	28		5		1.25 (typ.)		1.25 (typ.)		1.25 (typ.)		1.25 (typ.)		–		–	–	MHz
* f_{hfb}	6			5	–	–	–	–	–	–	–	–	350	–	–	–	kHz
	28		0.5	100	–		–		–		–		1 (typ.)		–		MHz
t_d•					0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		–	–	µs
t_r•					1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		–	–	µs
t_s•					0.8 (typ.)		0.8 (typ.)		0.8 (typ.)		0.8 (typ.)		0.8 (typ.)		–	–	µs
t_f•					1.1 (typ.)		1.1 (typ.)		1.1 (typ.)		1.1 (typ.)		1.1 (typ.)		–	–	µs
* $R_{\theta JC}$					–	7	–	7	–	7	–	7	–	7	–	–	°C/W
* $R_{\theta JA}$					–	100	–	100	–	100	–	100	–	100	–	–	°C/W

[a] Pulsed, pulse duration = 300 µs, duty factor = 1.8%. • I_C = 750 mA, $I_{B_1'}$ = 20 mA, I_{B_2} = −8.5 mA. * 2N-Series types in accordance with JEDEC registration data.

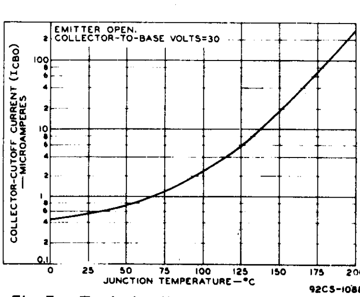


Fig. 7 – Typical collector-cutoff current for 2N1483–2N1486 and 40368.

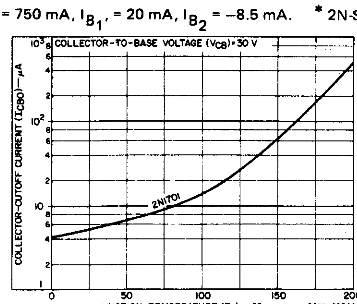


Fig. 8 – Typical collector-cutoff current characteristics for 2N1701.

2N1487-2N1490, 2N1702, 40369

Hometaxial-Base Silicon N-P-N Power Transistors

General-Purpose Types for High-Power Applications

These RCA types are hometaxial-base power transistors of the silicon n-p-n type intended for a wide variety of applications in industrial and military equipment. They are particularly useful in power-switching circuits such as in dc-to-dc converters, inverters, choppers, solenoid and relay controls; in oscillator, regulator, and pulse-amplifier circuits; and as class-A and class-B push-pull audio and servo amplifiers.

These transistors feature high power-dissipation ratings, high beta at high current, and excellent high-temperature performance. They are supplied in the JEDEC TO-3 hermetic package.

Features:

- High-temperature characterization
- High dc beta at 1.5A
- Full switching-time characterization at 1.5A

Additional Features for 40369:

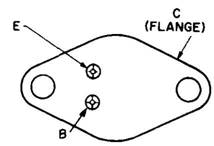
- High reliability assured by five pre-conditioned steps
- Group A test data included.

Maximum Ratings, ***Absolute-Maximum Values:***

		2N1487 2N1489	2N1488 2N1490 40369	2N1702	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	100	60	V
* COLLECTOR-TO-EMITTER VOLTAGE:					
With base open (sustaining voltage)	$V_{CEO}(sus)$	40	55	40	V
With emitter-to-base reverse biased (V_{EB}) = 1.5 volts)	V_{CEV}	60	100	60	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	10	10	6	V
* COLLECTOR CURRENT	I_C	6	6	5	A
* EMITTER CURRENT	I_E	−8	−8	−	A
* BASE CURRENT	I_B	3	3	2.5	A
* TRANSISTOR DISSIPATION:	P_T				
At mounting-flange temperature of 25°C		75	75	75	W
At mounting-flange temperature of 100°C		43	43		W
* TEMPERATURE RANGE:					
Operating and Storage	T_C, T_{stg}		-65 to 200		°C
PIN TEMPERATURE (During soldering): At distance ≥ 1/32 in. (0.79 mm) from seating plane for 10 s max.	T_L		235		°C

*2N-Series types in accordance with JEDEC registration data

TERMINAL DESIGNATIONS



JEDEC TO-3

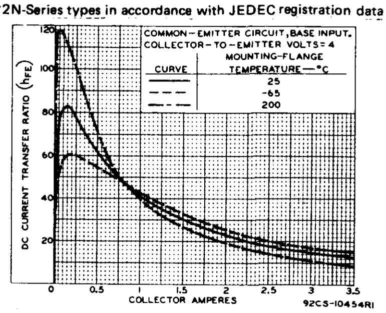


Fig. 1 – Typical dc beta characteristics for 2N1487–2N1490, and 40369.

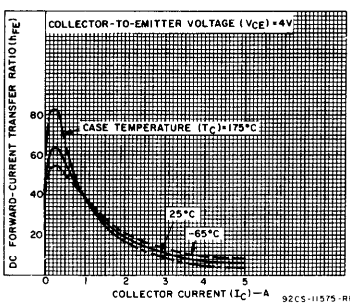


Fig. 2 – Typical dc beta characteristics for 2N1702.

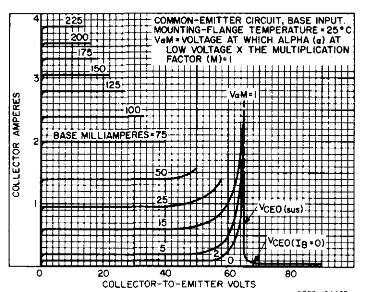


Fig. 3 – Typical output characteristics for 2N1487–2N1490, and 40369.

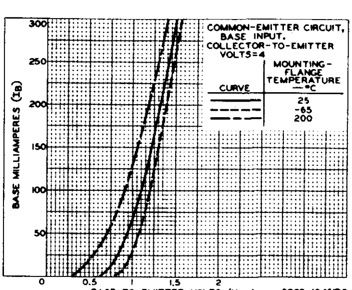


Fig. 4 – Typical input characteristics for 2N1487–2N1490, and 40369.

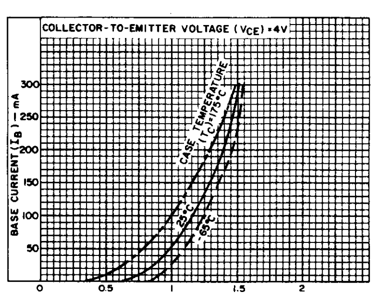


Fig. 5 – Typical input characteristics for 2N1702.

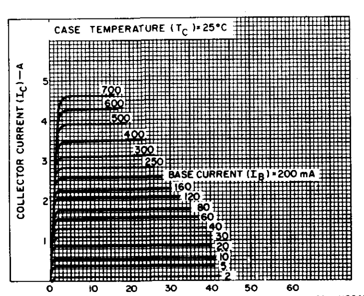


Fig. 6 – Typical output characteristics for 2N1702.

2N1487-2N1490, 2N1702, 40369

ELECTRICAL CHARACTERISTICS *Mounting-flange temperature = 25°C unless otherwise specified*

	TEST CONDITIONS					LIMITS												
CHARACTERISTIC	DC COLLECTOR VOLTAGE (VOLTS)		DC EMITTER VOLTAGE (VOLTS)	DC COLLECTOR CURRENT (mA)	DC BASE CURRENT (mA)	TYPE 2N1487		TYPE 2N1488		TYPE 2N1489		TYPE 2N1490		TYPE 2N1702		TYPE 40369		UNITS
	V_{CB}	V_{CE}	V_{EB}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CBO}	30					–	25	–	25	–	25	–	25	–	200	–	10	μA
	60					–	–	–	–	–	–	–	–	–	1000	–	–	
At T_C = 150°C	30					–	1000	–	1000	–	1000	–	1000	–	2000	–	–	μA
* I_{EBO}			6	0		–	–	–	–	–	–	–	–	–	100	–	–	μA
I_{EBO}			10	0		–	25	–	25	–	25	–	25	–	–	–	6	μA
* V_{CEX}			1.5 1.5 1.5	0.25 0.5 1		– 60 –	– – –	– 100 –	– – –	– 60 –	– – –	– 100 –	– – –	– – 60[b]	– – –	100 – –	– – –	V
* V_{CEO}(sus)				100	0	40	–	55	–	40	–	55	–	40[b]	–	55	–	V
* h_{FE}		4 4 20		1500 800 5000		15 – –	45 – –	15 – –	45 – –	25 – –	75 – –	25 – –	75 – –	– 15 3.5	– 60 –	25 – –	75 – –	
* r_{CE}(sat)				1500 1500 800	300 100 80	– – –	2 – –	– – –	2 – –	– – –	– 0.67 –	– – –	– 0.67 –	– – –	– – 4	– – –	– – –	Ω
* V_{BE}		4 4 20		1500 250 300		– – –	3.5 – –	– – –	3.5 – –	– – –	2.5 – –	– – –	2.5 – –	– – –	– 4 20.5	– – –	2.5 – –	V
* V_{CE}(sat)				5000	2000	–	–	–	–	–	–	–	–	–	20	–	–	V
* C_{ob}	40					200(typ.)		200(typ.)		200(typ.)		200(typ.)		200 (typ.)		–	–	pF
* τ_l						12 (typ.)		12 (typ.)		12 (typ.)		12 (typ.)		12 (typ.)		–	–	ms
* f_{ab}	12			100		1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		–	–	–	–	MHz
* f_{hfb}	6				100	–	–	–	–	–	–	–	–	300	–	–	–	kHz
	28			0.5		–	–	–	–	–	–	–	–	1 (typ.)		–	–	MHz
t_d●						0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		–	–	μs
t_r●						1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		–	–	μs
t_s●						1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		–	–	μs
t_f●						1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		–	–	μs
* $R_{\theta JC}$						–	2.33	–	2.33	–	2.33	–	2.33	–	2.33	–	–	°C/W

* 2N-Series types in accordance with JEDEC registration data.

● I_C = 1.5 A, I_{B_1} = 300 mA, I_{B_2} = −150 mA

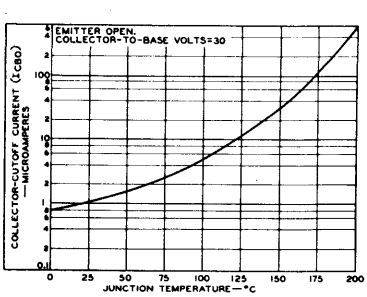


Fig. 7 — Typical collector-cutoff current characteristic for 2N1487—2N1490, and 40369.

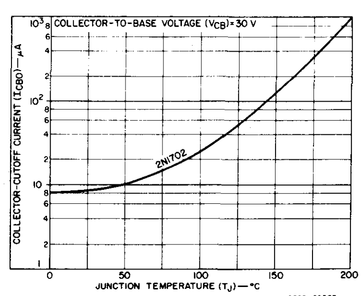


Fig. 8 — Typical collector-cutoff current characteristics for 2N1702.

2N3054, 2N6260, 2N6261, 40250, 40372, 40910, 40911

Hometaxial-Base, Medium-Power Silicon N-P-N Transistors

Rugged Devices for Intermediate-Power Applications in Industrial and Commercial Equipment

These RCA types are hometaxial-base silicon n-p-n transistors intended for a wide variety of medium- to high-power applications. Types 2N3054, 2N6260, 2N6261, and 40250 are supplied in the JEDEC TO-66 hermetic package.

Types 40250V1, 40372, 40910, and 40911 are the 40250, 2N3054, 2N6260, and 2N6061 with factory-attached heat radiators intended for printed-circuit-board applications.

Features:

- f_T = 800 kHz at 0.2A (2N3064, 40372)
- Maximum safe-area-of-operation curves for dc and pulse operation
- V_{CEV}(sus) = 90 V min (2N3054, 2N6261)
- Low saturation voltage: V_{CE}(sat) = 1.0 V at I_C = 0.5 A (2N3054)

Applications:

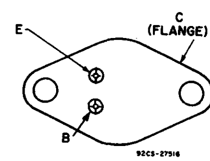
- Power switching circuits
- Series- and shunt-regulator driver and output stages
- High-fidelity amplifiers
- Solenoid drivers.

Maximum Ratings, *Absolute-Maximum Values:*

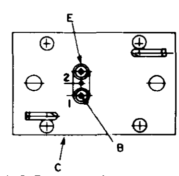
		40250 40250V1	2N6260 40910	2N3054 40372	2N6261 40911	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	50	50	90	90	V
COLLECTOR-TO-EMITTER VOLTAGE:						
* With base open	V_{CEO}	40	40	55	80	V
* With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}(sus)	–	45	60	85	V
With base reverse-biased (V_{BE} = -1.5 V)	V_{CEV}(sus)	50	50	90	90	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	7	7	V
* CONTINUOUS COLLECTOR CURRENT	I_C	4	3	4	4	A
* CONTINUOUS BASE CURRENT	I_B	2	2	2	2	A
* TRANSISTOR DISSIPATION:	P_T					
* At case temperature up to 25°C		29 (40250)	29 (2N6260)	25 (2N3054)	50 (2N6261)	W
At ambient temperatures up to 25°C		5.8 (40250V1)	5.8 (40910)	5.8 (40372)	5.8 (40911)	W
* At temperatures above 25°C		Derate linearly to 200 °C				
* TEMPERATURE RANGE:						
Storage & Operating (Junction)		-65 to 200				°C
PIN TEMPERATURE (During soldering): At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235				°C

*In accordance with JEDEC registration data format JS-9 RDF-10 (2N3054), JS-6 RDF-2 (2N6260, 2N6261)

TERMINAL DESIGNATIONS



JEDEC TO-66
2N3054, 2N6260, 2N6261, 40250



JEDEC TO-66 with Heat Radiator
40250V1, 40372, 40910, 40911

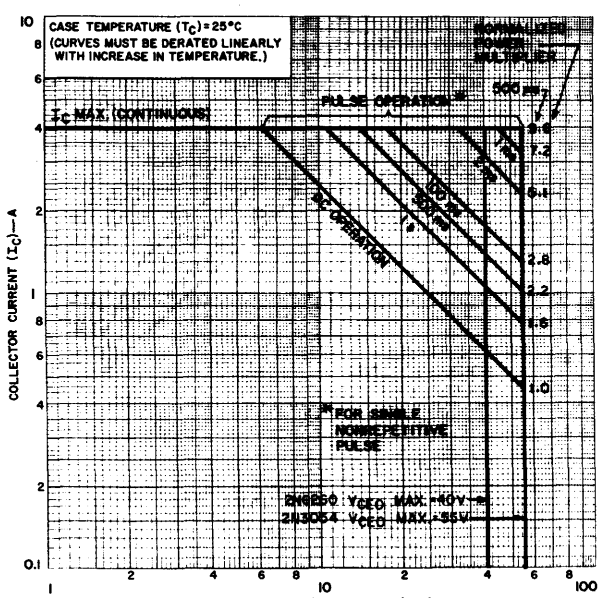


Fig. 1—Maximum operating areas for 2N3054 and 2N6260.

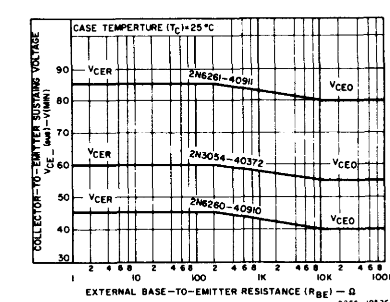


Fig. 2 — Sustaining voltage vs. base-to-emitter resistance for 2N3054, 2N6260, 2N6261, 40372, 40910 and 40911.

2N3054, 2N6260, 2N6261, 40250, 40372, 40910, 40911

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc: V_{CE}	V_{BE}	CURRENT A dc: I_C	I_B	LIMITS: 2N6260 40910 MIN.	MAX.	2N3054 40372 MIN.	MAX.	2N6261 40911 MIN.	MAX.	40250 40250V1 MIN.	MAX.	UNITS
* Collector-Cutoff Current: With base open	I_{CBO}	V_{CB} = 30		I_E = 0		–	–	–	–	–	–	–	1	mA
	I_{CEO}	30			0	–	1	–	0.5	–	–	–	–	mA
		60			0	–	–	–	–	–	0.5	–	–	mA
With base-emitter junction reverse-biased	I_{CEV}	40	−1.5			–	5	–	–	–	–	–	–	mA
		80	−1.5			–	–	–	–	–	0.5	–	–	mA
		90	−1.5			–	–	–	1.0	–	–	–	–	mA
At T_C = 150°C	I_{CBO}	V_{CB} = 30		I_E = 0		–	–	–	–	–	–	–	5	mA
	I_{CEV}	40	−1.5			–	25	–	–	–	–	–	–	mA
		80	−1.5			–	–	–	–	–	1.0	–	–	mA
		90	−1.5			–	–	–	6.0	–	–	–	–	mA
* Emitter-Cutoff Current	I_{EBO}		−5		0	–	5	–	–	–	–	–	5	mA
			−7		0	–	–	–	1.0	–	0.2	–	–	mA
Collector-to-Base Breakdown Votlage	$V_{(BR)CBO}$			0.05		–	–	–	–	–	–	50	–	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEV}$		−1.5	0.05		–	–	–	–	–	–	50	–	V
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.1[a]	0	40	–	55	–	80	–	40	–	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$			0.1[a]		45	–	60	–	85	–	–	–	V
Emitter-to-Base Breakdown Voltage I_E = 0.005 mA	$V_{(BR)EBO}$					–	–	–	–	–	–	5	–	V
* DC Forward-Current Transfer Ratio	h_{FE}	2		4[a]		3	–	–	–	5	–	–	–	
		2		1.5[a]		–	–	–	–	25	100	–	–	
		4		3[a]		–	–	5	–	–	–	–	–	
		4		0.5[a]		–	–	25	150	–	–	–	–	
		4		1.5[a]		20	100	–	–	–	–	25	100	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			0.5[a]	0.05[a]	–	–	–	1.0	–	–	–	–	V
				1.5[a]	0.15[a]	–	1.5	–	–	–	0.5	–	1.5	V
				3[a]	1[a]	–	–	–	6.0	–	–	–	–	V
* Base-to-Emitter Voltage	V_{BE}	2		1.5		–	–	–	–	–	1.5	–	–	V
		4		1.5		–	2.2	–	–	–	–	–	2.2	V
		4		0.5		–	–	–	1.7	–	–	–	–	V
* Common-Emitter Small-Signal Short-Circuit, Forward Current Transfer Ratio Cutoff Frequency	f_{hfe}	4		0.1		0.03	–	0.03	–	0.03	–	–	–	MHz
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 0.4 MHz)	$\|h_{fe}\|$	4		0.1		2	–	–	–	2	–	–	–	
* Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		0.1		25		25	–	25	–	–	–	
Forward-Bias Second Breakdown Collector Current (t - 1 s)	$I_{S/b}$	40				0.725	–	–	–	–	–	–	–	A
		80				–	–	–	–	0.625	–	–	–	A
		55				–	–	0.455	–	–	–	–	–	A
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					6 (max.) 2N6260		7 (max.) 2N3054		3.5 (max.) 2N6261		6 (max.) 40250		°C/W
Junction-to-Ambient	$R_{\theta JA}$					30 (max.) 40901		30 (max.) 40372		30 (max.) 40911		30 (max.) 40250V1		°C/W

[a]Pulsed: Pulse duration = 300 μs duty factor = 1.8%. *In accordance with JEDEC registration data format JS-9 RDF-10 (2N3054) JS-6 RDF-2 (2N6260-61)

2N3054, 2N6260, 2N6261, 40250, 40372, 40910, 40911

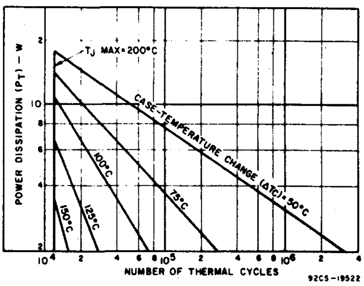


Fig. 3 - Thermal-cycling rating chart for 2N3054.

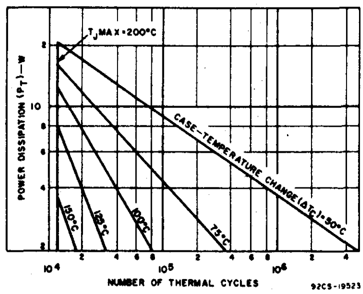


Fig. 4 - Thermal-cycling rating chart for 2N6260.

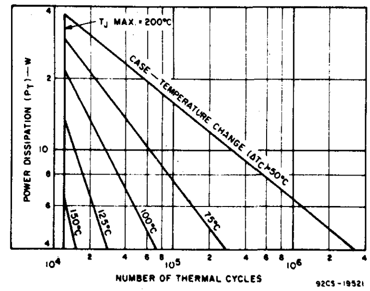


Fig. 5 - Thermal-cycling rating chart for 2N6261.

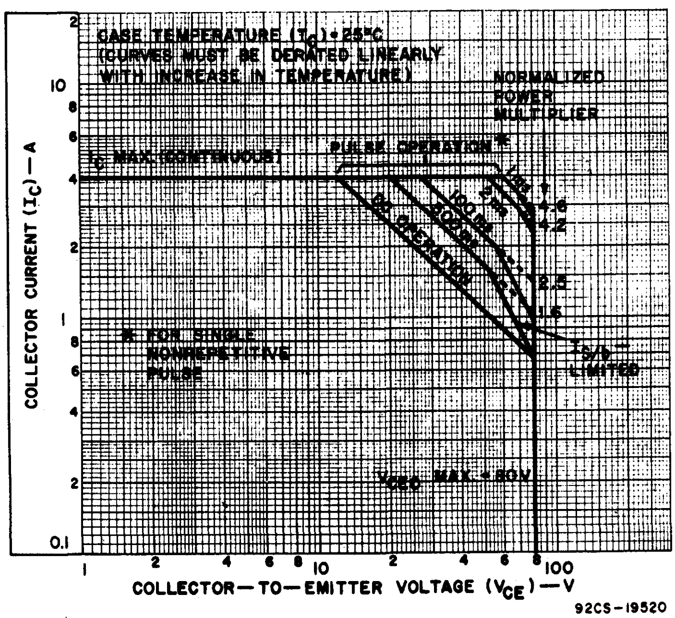


Fig. 6 - Maximum operating areas for 2N6261.

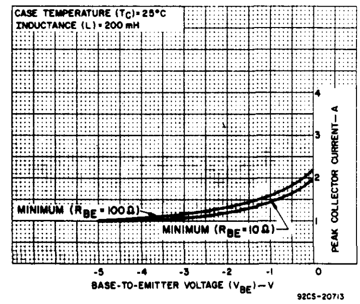


Fig. 7 - Reverse-bias second-breakdown characteristics for all types.

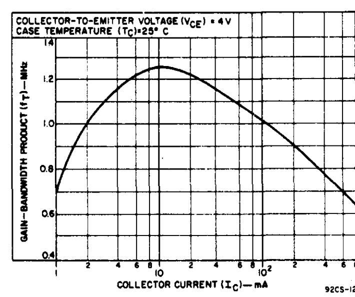


Fig. 8 - Typical gain-bandwidth product for all types.

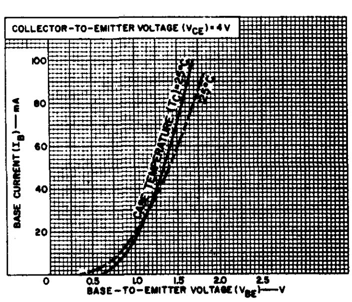


Fig. 9 - Typical input characteristics for 2N3054, 2N6260, 40250, 40250V1, 40372, and 40910.

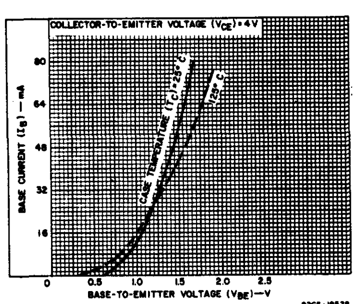


Fig. 10 - Typical input characteristics for 2N6261 and 40911.

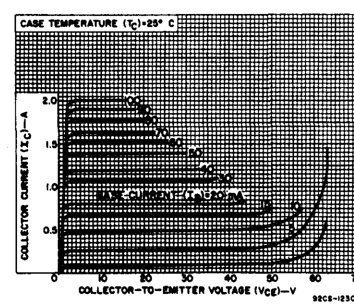


Fig. 11 — Typical output characteristics for 2N3054 and 40372.

2N3054, 2N6260, 2N6261, 40250, 40372, 40910, 40911

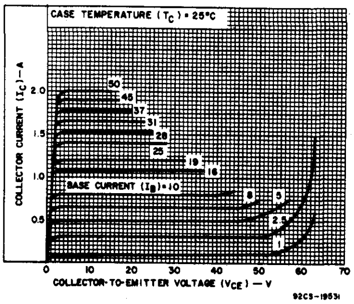


Fig. 12 – Typical output characteristics for 2N6260 and 40910.

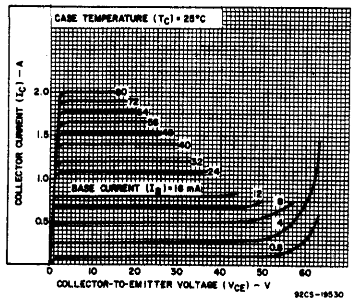


Fig. 13 – Typical output characteristics for 2N6261 and 40911.

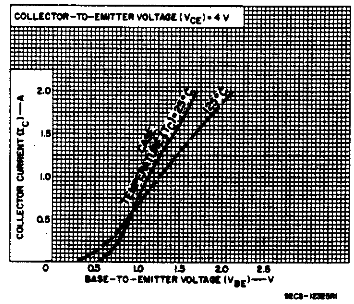


Fig. 14 – Typical transfer characteristics for 2N3054, 2N6260, 40250, 40250V1, 40372 and 40910.

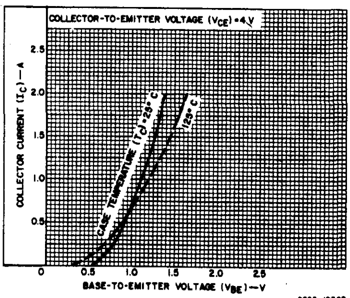


Fig. 15 - Typical transfer characteristics for 2N6261 and 40911.

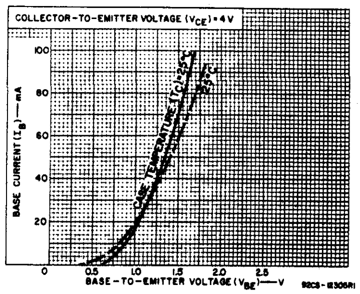


Fig. 16 – Typical input characteristics for 2N6260, 40250, 40250V1, 40372 and 40910.

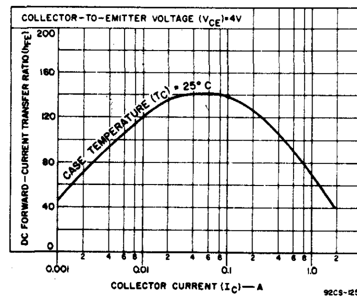


Fig. 17 – Typical dc beta characteristics for 2N6260 40250, 40250V1 and 40910.

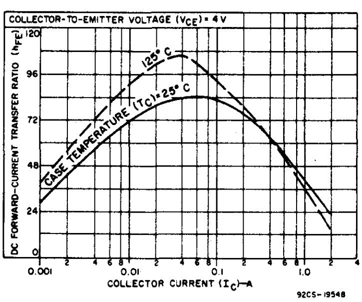


Fig. 18 - Typical dc beta characteristics for 2N6261 and 40911.

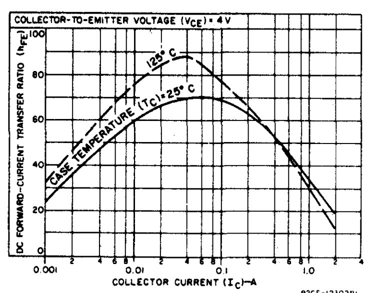


Fig. 19 – Typical dc beta characteristics for 2N3054 and 40372.

2N3055, 2N6569, RCS617, BDX18, 2N6594, RCS618, MJ2955

Silicon N-P-N and P-N-P Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices
For Industrial and Commercial Use

The RCA-2N6594, BDX18, MJ2955, and RCS618 are epitaxial-base silicon p-n-p transistors featuring gain at high current. The RCA-2N6569, 2N3055, and RCS617 are epitaxial-base silicon n-p-n transistors. They may be used as complements to the 2N6594, BDX18 or MJ2955, and RCS618, respectively. These devices have a dissipation capability of 100 watts (2N6569 and 2N6594), 115 watts (2N3055, BDX18, RCS617, and RCS618), and 150 watts (MJ2955) at case temperatures up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

The 2N3055 is also available in a hometaxial-base version. To obtain the hometaxial-base type order the 2N3055 (Hometaxial).

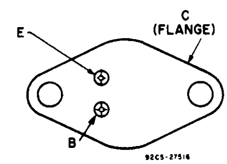
Features:

- **High dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **Hermetically sealed JEDEC TO-204MA package**
- **High gain at high current**

Applications:

- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	N-P-N	2N6569	2N3055	RCS617	
	P-N-P	2N6594♦	BDX18♦ MJ2955♦	RCS618♦	
* V_{CBO}		45	100	100	V
$V_{CER}(sus)$ R_{BE} = 100 Ω		45	70*	85	V
* $V_{CEO}(sus)$		40	60	80	V
* V_{EBO}		5	7	7	V
* I_C		12	15	15	A
I_{CM}		24	–	–	A
* I_B		5	7	7	A
* I_E		17	–	–	A
* P_T At $T_C \leqslant 25°C$		100	150 (MJ2955) 115 (Others)	115	W
At $T_C > 25°C$ Derate linearly		0.572	0.86 (MJ2955) 0.66 (Others)	0.66	W/°C
* T_{stg}, T_J			–65 to 200		°C
* T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.			235		°C

* 2N-types in accordance with JEDEC registration data.

♦ For p-n-p devices, voltage and current values are negative.

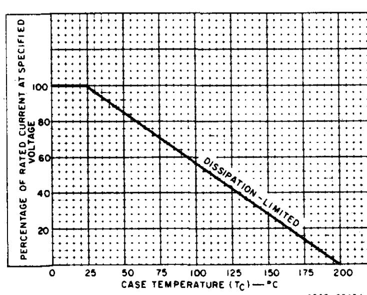


Fig. 1 — Derating curve.

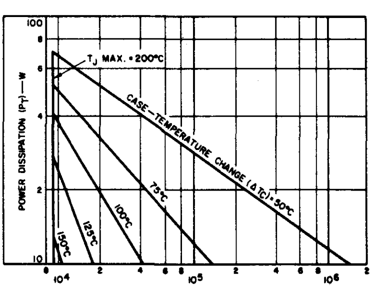


Fig. 2 — Thermal cycling rating chart for 2N6569 and 2N6594.

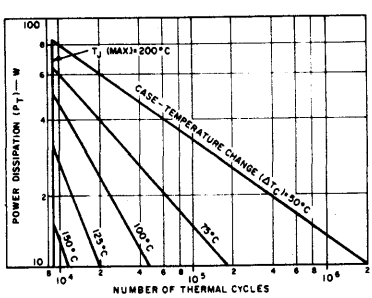


Fig. 3 — Thermal-cycling rating chart for 2N3055, BDX18, RCS617 and RCS618.

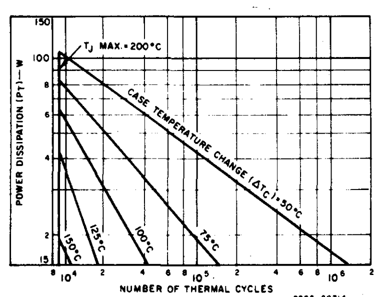


Fig. 4 — Thermal cycling rating chart for MJ2955.

♦For p-n-p devices, voltage and current values are negative.

2N3055, 2N6569, RCS617, BDX18, 2N6594, RCS618, MJ2955

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6569 2N6594♦		2N3055 BDX18♦ MJ2955♦		RCS617 RCS618♦		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	45	–1.5			–	1	–	–	–	–	
2N3055, BDX18	100	–1.5			–	–	–	5	–	–	
MJ2955	100	–1.5			–	–	–	1	–	–	mA
RCS617, RCS618	100	–1.5			–	–	–	–	–	1	
* I_{CEX}, T_C = 100°C	45	–1.5			–	10	–	–	–	–	mA
* I_{CEX}, T_C = 150°C MJ2955	100	–1.5			–	–	–	5	–	5	
2N3055	100	–1.5			–	–	–	30	–	–	mA
BDX18	60	–1.5			–	–	–	10	–	–	
I_{CEO}	30			0	–	0.7	–	0.7*	–	0.7	mA
* I_{EBO}		5	0		–	5	–	–	–	–	
2N3055, BDX18		7	0		–	–	–	5	–	–	mA
MJ2955		7	0		–	–	–	5	–	–	
RCS617, RCS618		7	0		–	–	–	–	–	1	
* V_{CEO}(sus)			0.2	0	40[b]		60[b]		80[b]		V
V_{CER}(sus) R_{BE} = 100Ω			0.2	0	45[b]		70[b]*		85[b]	–	V
* h_{FE}	3		4[a]		15	200					
	4		4[a]				20	70		–	
	4		5[a]				–		20	70	
Except BDX18	4		10[a]				5				
	4		12[a]		5	100					
V_{BE}	4		4[a]			1.8*		1.8*			V
	4		5[a]							1.8	
* V_{BE}(sat)			4	0.55		2					V
			4	0.4		2					
* V_{CE}(sat)			4[a]	0.4		1.5		1.1			
			4[a]	0.55		1.5					
			5[a]	0.5						1.1	V
2N3055 only			10[a]	3.3				8			
MJ2955 only			10[a]	3.3				3			
			12[a]	2.4		4					
* f_T 2N6569	4		1		1.5					–	MHz
f = 0.5 MHz 2N6594	4		1		2.5			–		–	
* f_{hfe} 2N3055	4		1				20			–	kHz
f = 10 kHz MJ2955	4		1				10		–	–	
$\|h_{fe}\|$ f = 1 MHz	4		1		–	–	2.5		2.5	–	
MJ2955 (only)	4		0.5				4	–			
h_{fe} f = 1 kHz	4		1		15	–	15*	120*	15	–	
$I_{S/b}$ t_p = 1 s nonrep.	40				2.5	–	2.87	–	2.87	–	A
* C_{obo} V_{CB} = 10 V, f = 1 MHz					75	750	–	–	–	–	pF
* t_d V_{CC} = 30 V			2	0.2	–	0.4	–	–	–	–	
* t_r I_{B1} = I_{B2}			2	0.2	–	1.5	–	–	–	–	μs
* t_s			2	0.2	–	5	–	–	–	–	
* t_f			2	0.2	–	1.5	–	–	–	–	
$R_{\theta JC}$ 2N3055, BDX18					–	1.75*	–	1.5	–	–	°C/W
MJ2955					–		–	1.17	–	–	

♦ For p-n-p devices, voltage and current values are negative.
* 2N types in accordance with JEDEC registration data.
[a] Pulsed; pulse duration = 300 μs, duty factor = 1.8%.
[b] CAUTION: Sustaining voltages V_{CEO}(sus) and V_{CER}(sus) *MUST NOT* be measured on a curve tracer.

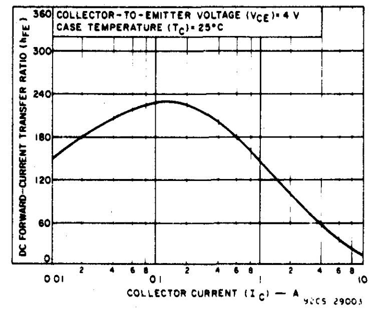


Fig. 5 — Typical dc beta characteristics.♦

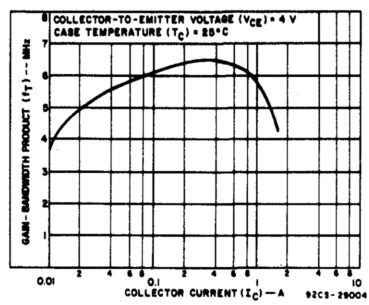


Fig. 6 — Typical gain-bandwidth product.♦

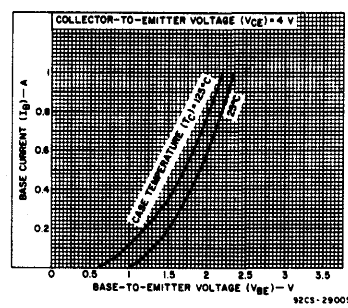


Fig. 7 — Typical input characteristics.♦

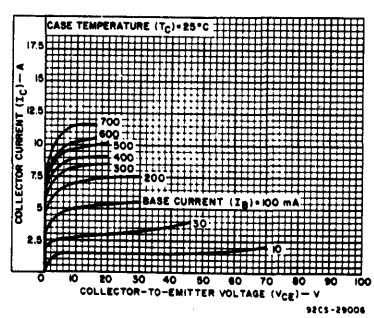


Fig. 8 — Typical output characteristics.♦

♦For p-n-p devices, voltage and current values are negative.

2N3055, 2N6569, RCS617, BDX18, 2N6594, RCS618, MJ2955

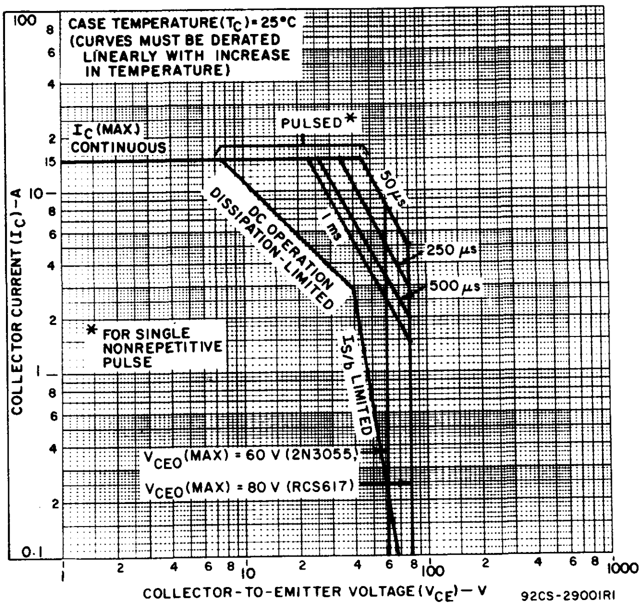


Fig. 9 — Maximum operating areas for 2N3055 and RCS617.

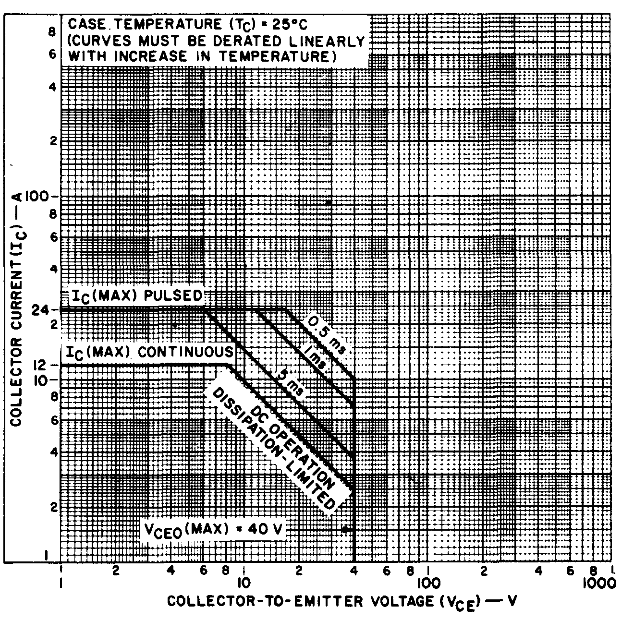


Fig. 10 — Maximum operating areas for 2N6569 and 2N6594.♦

♦ For p-n-p devices, voltage and current values are negative.

2N3055, 2N6569, RCS617, BDX18, 2N6594, RCS618, MJ2955

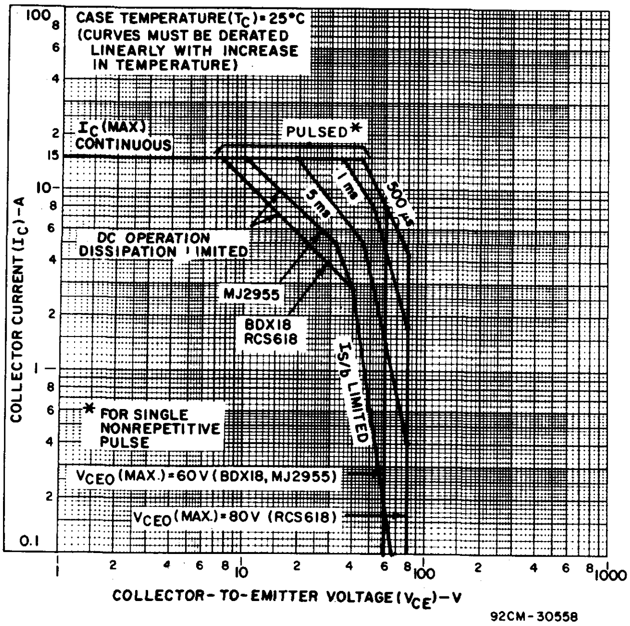


Fig. 11 — Maximum operating areas for BDX18, MJ2955 and RCS618.♦

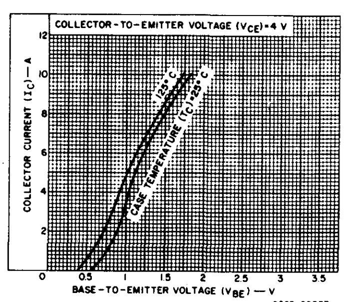


Fig. 12 — Typical transfer characteristics.♦

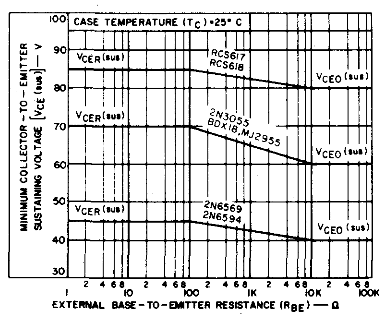


Fig. 13 — Sustaining voltage vs. base-to-emitter resistance.♦

♦For p-n-p devices, voltage and current values are negative.

2N3055 (Hometaxial), 2N6253, 2N6254, 2N6371, 40251

Hometaxial-Base High-Power Silicon N-P-N Transistors

Rugged, Broadly Applicable Devices
For Industrial and Commercial Use

The RCA-2N3055 (Hometaxial)*, 2N6253, 2N6254 and 2N6371 are silicon n-p-n transistors intended for a wide variety of high-power applications. The hometaxial-base construction of these devices renders them highly resistant to second breakdown over a wide range of operating conditions.

These devices differ in maximum ratings for voltage and power dissipation. All are supplied in JEDEC TO-204MA hermetic steel packages.

The 2N3055 is also available in an epitaxial-base version. To obtain the hometaxial-base type described in this data sheet, order the 2N3055 (Hometaxial).

*Formerly 2N3055H.

Features:

- **2N6254: premium type from 2N3055 (Hometaxial) family**
- **Maximum safe-area-of-operation curves**
- **Low saturation voltages**
- **High dissipation capability**
- **Thermal-cycling rating curves**

Applications:

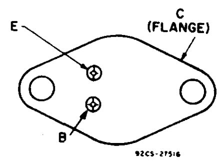
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**
- **Low-frequency inverters**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N3055 (Hometaxial)	2N6253	2N6254	2N6371	40251	
* V_{CBO}	100	55	100	50	50	V
* V_{CER}(sus) R_{BE} = 100 Ω	70	55	85	45	—	V
* V_{CEO}(sus)	60	45	80	40	40	V
V_{CEV}(sus) V_{BE} = −1.5 V	90	55	90	50	50	V
* V_{EBO}	7	5	7	5	5	V
* I_C	15	15	15	15	15	A
* I_B	7	7	7	7	7	A
* P_T: ≤25°C		115	115	150	117	W
>25°C	Derate linearly to 200°C					
* T_J, T_{stg}	−65 to +200					°C
* T_L: During soldering, at distances 1/32 in. (0.8 mm) from seating plane for 10 s max.	235					°C

*In accordance with JEDEC registration data formats JS-9 RDF-10; 2N3055 (Hometaxial) JS-6 RDF-2; 2N6253, 2N6254, 2N6371.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

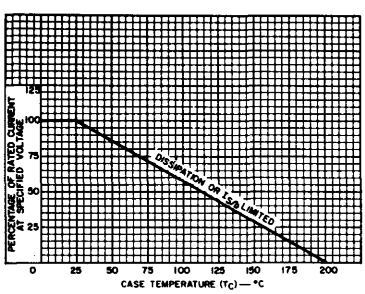


Fig. 1 — Current derating curve for all types.

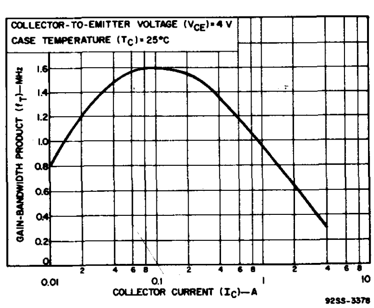


Fig. 2 — Typical gain-bandwidth product for all types.

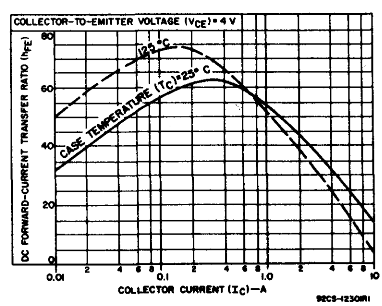


Fig. 3 — Typical dc-beta characteristics for 2N3055 (Hometaxial) and 2N6371.

2N3055 (Hometaxial), 2N6253, 2N6254, 2N6371, 40251

ELECTRICAL CHARACTERISTICS, *T_C = 25°C Unless Otherwise Specified.*

CHARACTERISTIC	TEST CONDITIONS				LIMITS										UNITS
	VOLTAGE V dc		CURRENT A dc		2N3055 (Hometaxial)		2N6253		2N6254		2N6371		40251		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	25			0	–	–	–	1.5	–	–	–	1.5	–	–	mA
	30			0	–	0.7	–	–	–	–	–	–	–	–	
	60			0	–	–	–	–	–	1	–	–	–	–	
* I_{CEX}	40	−1.5			–	–	–	–	–	–	–	–	–	2	mA
	45	−1.5			–	–	–	–	–	–	–	2	–	–	
	55	−1.5			–	–	–	2	–	–	–	–	–	–	
	100	−1.5			–	5	–	–	–	0.5	–	–	–	–	
* T_C = 150°C	40	−1.5			–	–	–	–	–	–	–	10	–	10	
	50	−1.5			–	–	–	10	–	–	–	–	–	–	
	100	−1.5			–	30	–	–	–	5	–	–	–	–	
* I_{EBO}		−5			–	–	–	10	–	–	–	–	–	–	mA
		−7			–	5	–	–	–	0.5	–	–	–	–	
$V_{(BR)CBO}$			0.1		–	–	–	–	–	–	–	–	50	–	V
$V_{(BR)CEV}$		−1.5	0.1		–	–	–	–	–	–	–	–	50	–	V
$V_{(BR)EBO}$ I_E = 0.01 mA			0		–	–	–	–	–	–	–	–	5	–	V
* $V_{CEO}(sus)$			0.2[a]	0	60	–	45	–	80	–	40	–	40	–	V
* $V_{CER}(sus)$ R_{BE} = 100 Ω			0.2[a]		70	–	55	–	85	–	45	–	–	–	
$V_{CEV}(sus)$		−1.5	0.1[a]		90	–	55	–	90	–	50	–	–	–	
* h_{FE}	4		3[a]		–	–	20	70	–	–	–	–	–	–	
	4		4[a]		20	70	–	–	–	–	–	–	–	–	
	2		5[a]		–	–	–	–	20	70	–	–	–	–	
	4		8[a]		–	–	–	–	–	–	15	60	15	60	
	4		10[a]		5	–	–	–		–	–	–	–	–	
	4		15[a]		–	–	3	–	5	–	–	–	–	–	
	4		16[a]		–	–	–	–	–	–	4	–	–	–	
* V_{BE}	4		3[a]		–	–	–	1.7	–	–	–	–	–	–	V
	4		4[a]		–	1.8	–	–	–	–	–	–	–	–	
	2		5[a]		–	–	–	–	–	1.5	–	–	–	–	
	4		8[a]		–	–	–	–	–	–	–	–	–	2.2	
	4		16[a]		–	–	–	–	–	–	–	4	–	–	
* $V_{CE}(sat)$			3[a]	0.3[a]	–	–	–	1	–	–	–	–	–	–	V
			4[a]	0.4[a]	–	1.1	–	–	–	–	–	–	–	–	
			5[a]	0.5[a]	–	–	–	–	–	0.5	–	–	–	–	
			8[a]	0.8[a]	–	–	–	–	–	–	–	1.5	–	1.5	
			10[a]	3.3[a]	–	8	–	–	–	–	–	–	–	–	
			15[a]	3[a]	–	–	–	–	–	4	–	–	–	–	
			15[a]	5[a]	–	–	–	4	–	–	–	–	–	–	
			16[a]	4[a]	–	–	–	–	–	–	–	4	–	–	
* h_{fe} f = 1 kHz	4		1		15	120	10	–	10	–	10	–	–	–	
f_T			1		800	–	–	–	–	–	800	–	–	–	kHz
* $\|h_{fe}\|$ f = 0.4 MHz	4		1		–	–	2	–	2	–	2	–	–	–	
* f_{hfe}	4		1		10	–	10	–	10	–	–	–	–	–	kHz
$I_{S/b}$ t_p = 1 s nonrep.	39				–	–	–	–	–	–	–	–	3	–	A
	40				2.9	–	–	–	–	–	2.9	–	–	–	
	45				–	–	2.55	–	–	–	–	–	–	–	
	60				1.95	–	–	–	–	–	–	–	–	–	
	80				–	–	–	–	1.87	–	–	–	–	–	
$R_{\theta JC}$					–	1.5	–	1.5	–	1.17	–	1.5	–	1.5	°C/W

* In accordance with JEDEC registration data formats JS-9 RDF-10: 2N3055H; JS-6 RDF-2: 2N6253, 2N6254, 2N6371.

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

2N3055 (Hometaxial), 2N6253, 2N6254, 2N6371, 40251

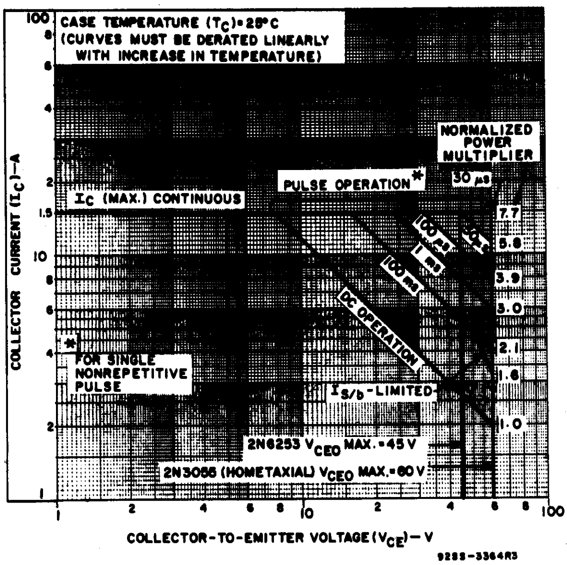


Fig. 4 — Maximum operating areas for 2N6253 and 2N3055 (Hometaxial).

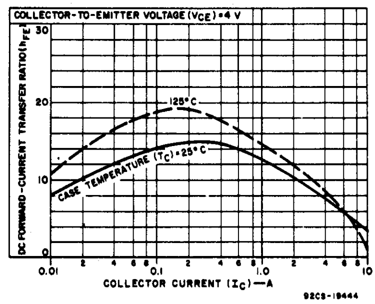


Fig. 5 — Typical dc-beta characteristics for 2N6253.

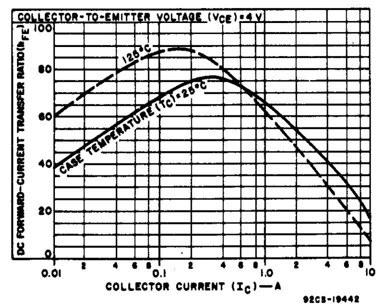


Fig. 6 — Typical dc-beta characteristics for 2N6254.

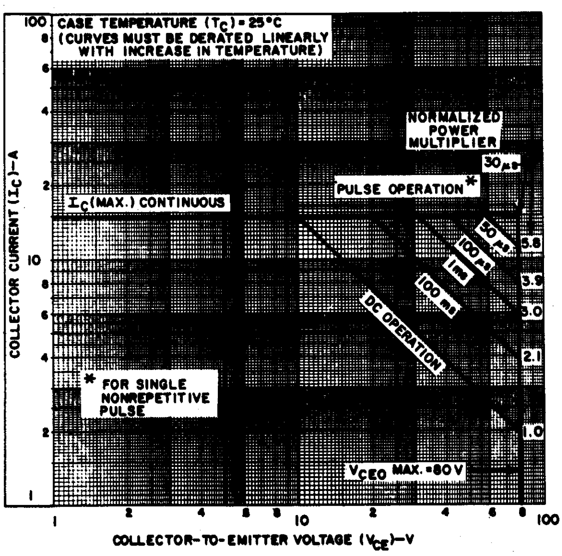


Fig. 7 — Maximum operating areas for 2N6254.

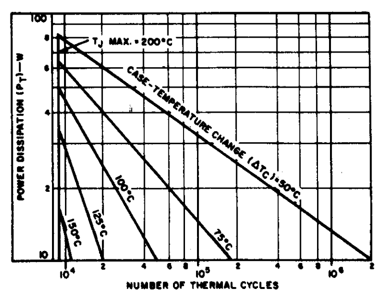


Fig. 8 — Thermal-cycling rating chart for 2N3055 (Hometaxial), 2N6253 and 2N6371.

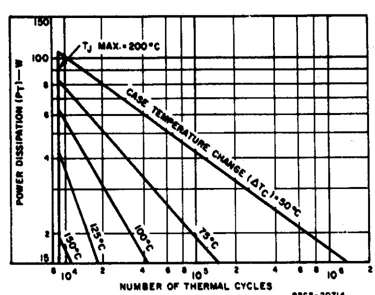


Fig. 9 — Thermal-cycling rating chart for 2N6254.

2N3055 (Hometaxial), 2N6253, 2N6254, 2N6371, 40251

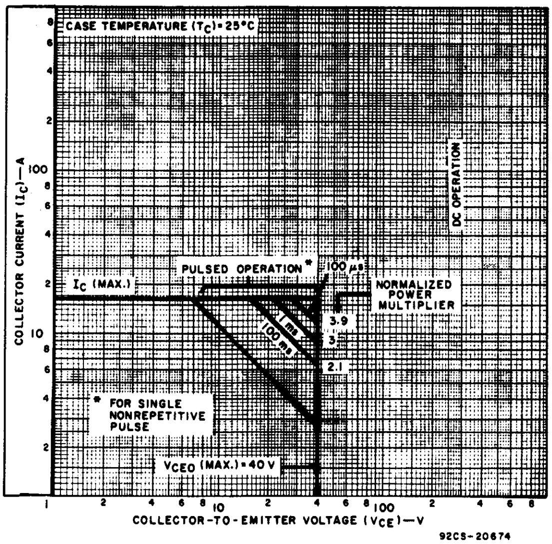


Fig. 10 — Maximum safe-area-of-operation at case temperature of 25° C for 2N6371.

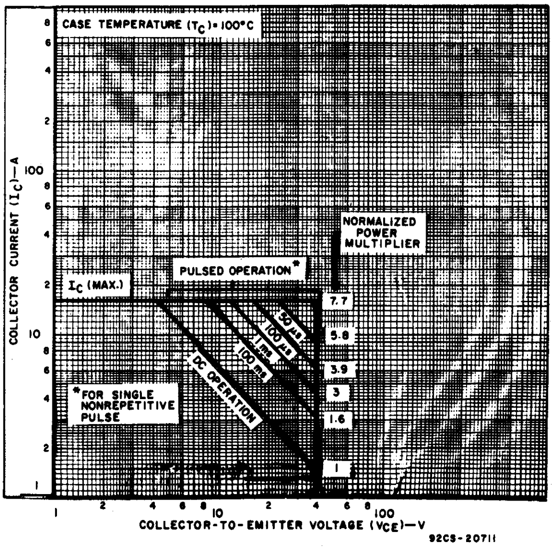


Fig. 11 — Maximum safe-area-of-operation at case temperature of 100° C for 2N6371.

2N3055 (Hometaxial), 2N6253, 2N6254, 2N6371, 40251

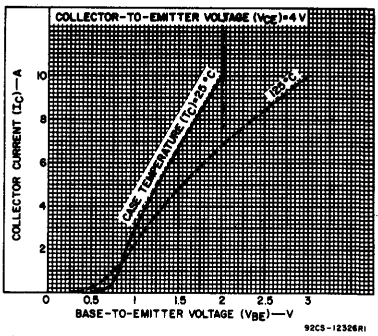


Fig. 12 – Typical transfer characteristics for 2N6253, 2N3055 (Hometaxial), 2N6371 and 40251.

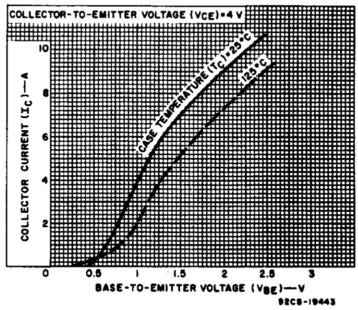


Fig. 13 – Typical transfer characteristics for 2N6254.

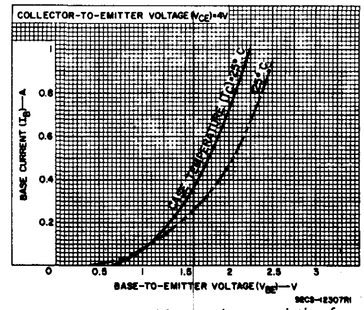


Fig. 14 – Typical input characteristics for 2N3055 (Hometaxial), 2N6371 and 40251.

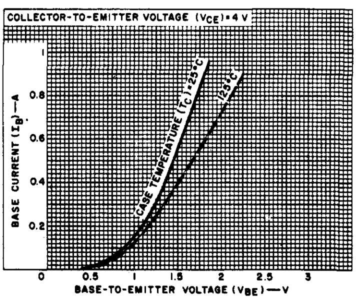


Fig. 15 – Typical input characteristics for 2N6253.

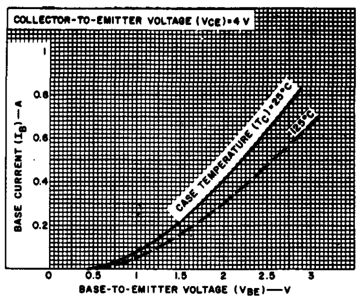


Fig. 16 – Typical input characteristics for 2N6254.

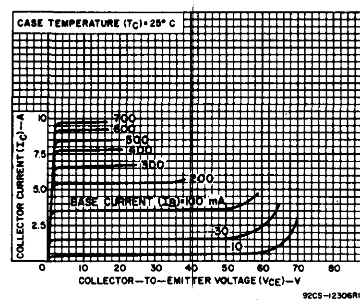


Fig. 17 – Typical output characteristics for 2N3055 (Hometaxial) and 2N6371.

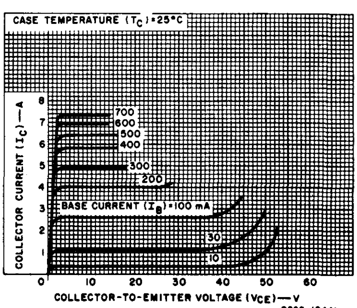


Fig. 18 – Typical output characteristics for 2N6253.

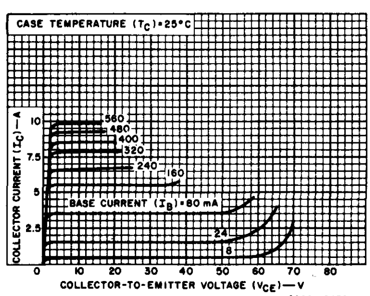


Fig. 19 – Typical output characteristics for 2N6254.

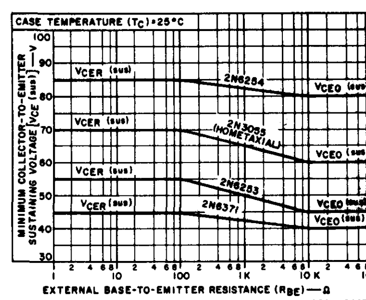


Fig. 20 – Sustaining voltage vs. base-to-emitter resistance for all types.

2N3263-2N3266

High-Power, High-Speed, High-Current Silicon N-P-N Power Transistors

Epitaxial Types for Aerospace, Military, and Industrial Applications

RCA-2N3263, 2N3264, 2N3265, and 2N3266● are n-p-n epitaxial silicon power transistors designed for high-reliability aerospace, military, and industrial equipment. Their high current-handling capability and fast switching speed make them desirable in applications where high circuit efficiency is required.

The 2N3263 and 2N3264 are sealed in flat 3/4-inch-diameter packages with radial leads. Types 2N3265 and 2N3266 utilize the JEDEC TO-63 package.

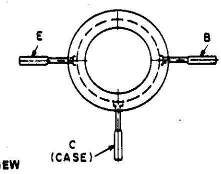
Typical high-speed switching applications for these transistors include switching-control amplifiers, power gates, switching regulators, dc-dc converters, and dc-ac inverters. Other recommended applications include dc-rf amplifiers and power oscillators.

● Formerly RCA Dev. Nos. TA2492, TA2493, TA2494, and TA2495, respectively.

Features:

- Low saturation voltages –
  - 2N3263 and 2N3265
    - $V_{CE}(sat)$ = 0.75 V (max.) at I_C = 15 A
    - $V_{BE}(sat)$ = 1.60 V (max.) at I_C = 15 A
  - 2N3264 and 2N3266
    - V_{CE} (sat) = 1.20 V (max.) at I_C = 15 A
    - V_{BE} (sat) = 1.80 V (max.) at I_C = 15 A
- High reliability and uniformity of characteristics
- High power dissipation
- Fast rise time at high collector current – 0.2 µs at 10 A (typical)

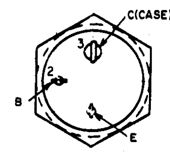
TERMINAL DESIGNATIONS



TOP VIEW

92CS-27523

2N3263, 2N3264 (RADIAL)



TOP VIEW

92CS-25530

2N3265, 2N3266 (JEDEC TO-63)

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3264 2N3266	2N3263 2N3265	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	150	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:				
With 1.5 volts (V_{BE}) of reverse bias	V_{CEX}(sus)	120	150	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	V_{CER}(sus)	80	110	V
* With base open	V_{CEO} (sus)	60	90	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	V
* COLLECTOR CURRENT	I_C	25	25	A
* BASE CURRENT	I_B	10	10	A
* TRANSISTOR DISSIPATION	P_T	*See Figs. 1 & 2*		
* TEMPERATURE RANGE:				
Storage and operating (Junction)		-65 to +200		°C
LEAD TEMPERATURE (During soldering):				
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230		°C

* In accordance with JEDEC registration data format.

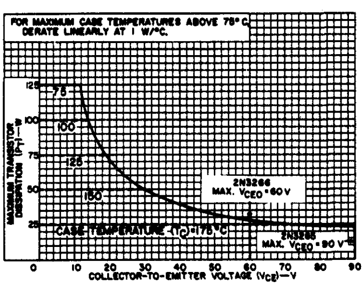


Fig. 1—Rating chart for 2N3265 and 2N3266.

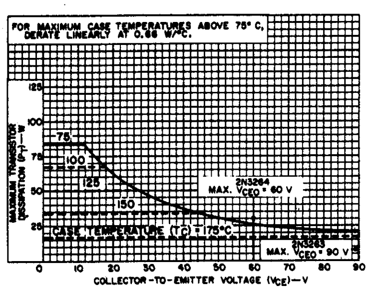


Fig. 2—Rating chart for 2N3263 and 2N3264.

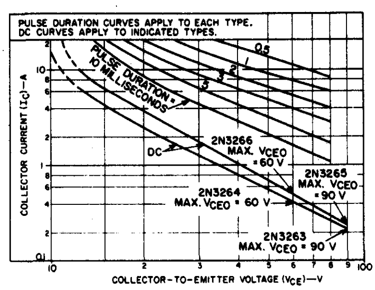


Fig. 3—Safe-operating region as a function of pulse width.

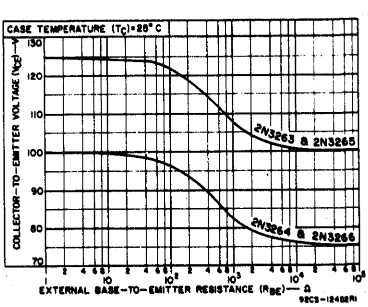


Fig. 4—Typical sustaining voltage vs. base-to-emitter resistance.

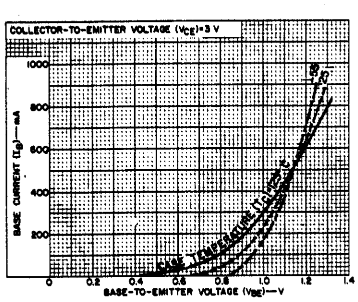


Fig. 5—Typical input characteristics.

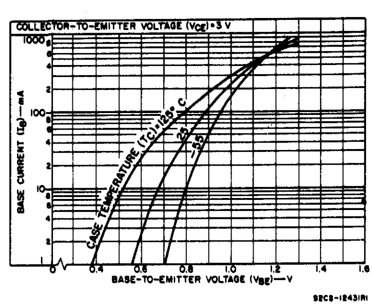


Fig. 6—Typical input characteristics.

2N3263-2N3266

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{EB}	CURRENT A dc I_E	I_B	I_C	LIMITS 2N3264 2N3266 MIN.	MAX.	2N3263 2N3265 MIN.	MAX.	UNITS
Collector Cutoff Current: With emitter open	I_{CBO}	60			0			–	10	–	–	mA
		80			0			–	–	–	4	
At T_C = 125°C		60			0			–	10	–	–	
		80			0			–	–	–	4	
* With base reverse-biased	I_{CEX}		120	1.5				–	20	–	–	
			150	1.5				–	–	–	20	
* Emitter Cutoff Current:	I_{EBO}			7			0	–	15	–	5	mA
* At T_C = 125°C				7			0	–	15	–	5	
Emitter-to-Base Voltage	V_{EBO}				0.02		0	7	–	7	–	V
Collector-to-Emitter Sustaining Voltage: * With base open	$V_{CEO}(sus)$●					0	0.2	60	–	90	–	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER}(sus)$●					0	0.2	80	–	110	–	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$●					2	20	–	1.6	–	1	V
						1.2	15	–	1.2	–	0.75	
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$●					2	20	–	2.2	–	1.8	V
						1.2	15	–	1.8	–	1.6	
* DC Forward Current Transfer Ratio	h_{FE}●		3				5	35	–	40	–	
			3				15	20	80	25	75	
			2				15	–	–	20	55	
* Second-Breakdown Collector Current: (See Fig. 3) DC forward-biased	$I_{S/b}$▲	50						700	–	–	–	mA
		75						–	–	350	–	
* Pulsed, forward-biased, t_p = 250 µs		75						13.3	–	13.3	–	A
* Second-Breakdown Energy With base reverse-biased, and R_{BE} = 20 Ω, L = 40 µH	$E_{S/b}$**			6			10	2	–	2	–	mJ
* Saturated Switching Time: Turn-on (t_d + t_r)	t_{ON}	V_{CC} = 30				1.2♦	15	–	0.5	–	0.5	µs
Storage	t_s					1.2♦	15	–	1.5	–	1.5	
Fall	t_f					1.2♦	15	–	0.5	–	0.5	
* Gain-Bandwidth Product (f = 1 MHz)	f_T		10				3	20	–	20	–	MHz
Collector-to-Base Feedback Capacitance (f = 1 MHz)	C_{ob}	10			0			–	500	–	500	pF
* Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$		10				10	2N3263 2N3264 –	1.5	2N3265 2N3266 –	1	°C/W

* In accordance with JEDEC registration data format.
● Pulsed; pulse duration ≤ 350 µs, duty factor ≤ 2%. CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of test circuit.
▲ $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage.
** $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b}$ = 1/2 LI^2, where L is a series load or leakage inductance and I is the collector current.
♦ I_{B_1} = I_{B_2}.

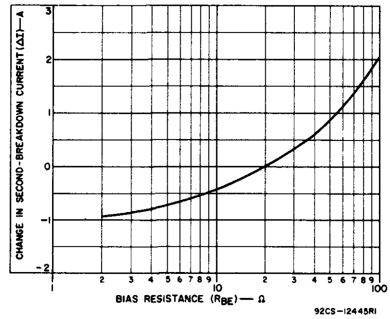


Fig.7—Typical change in $E_{S/b}$ as a function of base-to-emitter resistance.

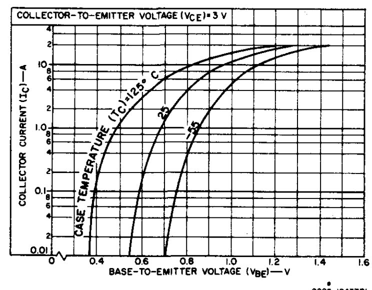


Fig.8—Typical transfer characteristics.

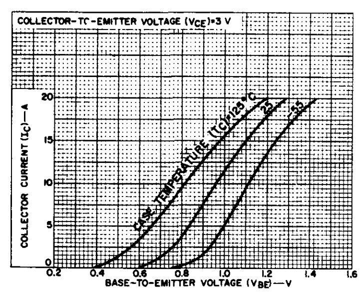


Fig.9—Typical transfer characteristics.

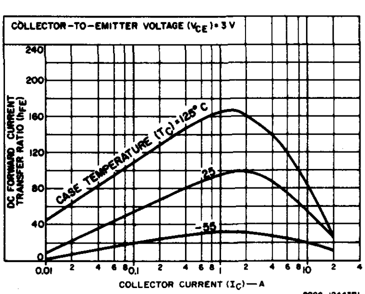


Fig.10—Typical dc beta characteristics (median values).

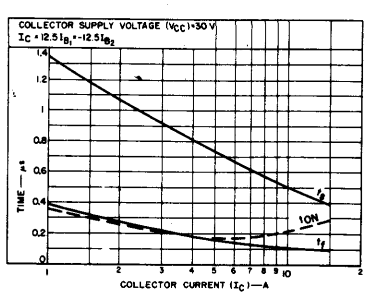


Fig.11—Typical saturated-switching characteristics.

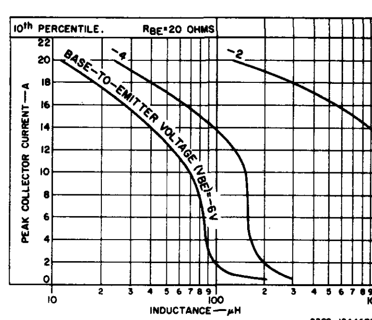


Fig.12—Collector current as a function of inductance (50th percentile).

2N3439; 2N3440; 2N4063; 2N4064; 40385; 40346, V1, V2; 40390; 40412, V1, V2

High-Voltage Silicon N-P-N Transistors

For High-Speed Switching and Linear-Amplifier Applications

These RCA types are epitaxial-base silicon n-p-n transistors with high breakdown voltages, high-frequency response, and fast switching speeds. These transistors are intended for industrial, commercial, and military equipment. Typical applications include high-voltage differential and operational amplifiers, high-voltage inverters, and high-voltage, low-current switching and series regulators.

Types 40346, 40346V1, and 40346V2 are especially useful in such devices as neon indicator and NIXIE● driver circuits and in differential and operational amplifiers. Types 40412, 40412V1, and 40412V2 are especially suited for class-A ac/dc audio-amplifier service.

These transistors are supplied in JEDEC TO-39 hermetic packages or in the TO-39 package with factory-attached mounting flange or heat radiator.

●Nixie is a Registered Trademark of Burroughs Corporation, Electronic Components Division, Plainfield, N.J.

Features:

- **High voltage ratings:**
  V_{CBO} = 450 V max. (2N3439, 2N4063)
  = 300 V max. (2N3440, 2N4064)
  $V_{CEO}(sus)$ = 350 V max. (2N3439, 2N4063)
  = 250 V max. (2N3440, 2N4064)
- **Maximum-area-of-operation curves**
- **Low saturation voltages**
- **Planar construction for low noise and low leakage**

Additional Features for 40385:

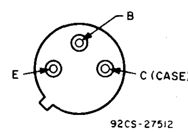
- **High reliability assured by five preconditioning steps**
- **Group A test data in data File 215**

MAXIMUM RATINGS, *Absolute-Maximum Values:*		2N3439 2N4063 40385	2N3440 2N4064 40390	40346 40346V1 40346V2	40412 40412V1 40412V2	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	450	300	–	–	V
COLLECTOR-TO-EMITTER VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 1,000 Ω	$V_{CER}(sus)$	–	–	175	–	V
= 10,000 Ω	$V_{CER}(sus)$	–	–	–	250	V
* With base open	$V_{CEO}(sus)$	350	250	–	–	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	–	–	V
*CONTINUOUS COLLECTOR CURRENT	I_C	1	1	1	1	A
*CONTINUOUS BASE CURRENT	I_B	0.5	0.5	0.5	0.5	A
TRANSISTOR DISSIPATION:	P_T					
At case temperature up to 25°C		10	10(2N3440) 10(2N4064)	10(40346) 10(40346V2)	10(40412) 10(40412V2)	W
At free-air temperatures up to 25°C		1(40385)	3.5(40390)	4(40346V1)	4(40412V1)	W
At free-air temperatures up to 50°C		1(2N3439)	1(2N3440)	1(40346)	1(40412)	W
At free-air temperatures above 25°C or 50°C		Derate linearly to 200°C				°C
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		–65 to 200				°C
*LEAD TEMPERATURE (During soldering): At distances ≥ 1/32 in (0.79 mm) from seating plane for 10 s max.		255				°C

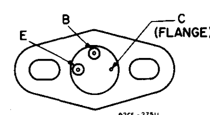
*2N-Series types in accordance with JEDEC registration data

NOTE: P_T value of 10 W at T_C = 25°C and lead temperature of 255°C are registered data for 2N4063 and 2N4064 only.

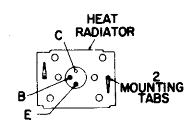
TERMINAL DESIGNATIONS



JEDEC TO-39
2N3439,2N3440,40346
40385,40412



JEDEC TO-39 with Flange
2N4063,2N4064,40346V2,
40412V2



JEDEC TO-39 with Heat Radiator
40390,40346V1,40412V1

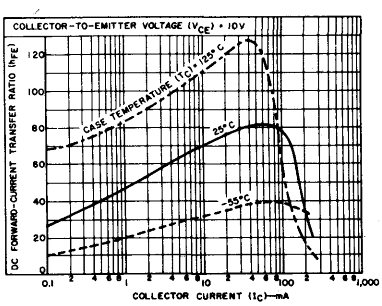


Fig. 1 – Typical dc-beta characteristics for 2N3439, 2N3440, 2N4063, 2N4064 and 40390.

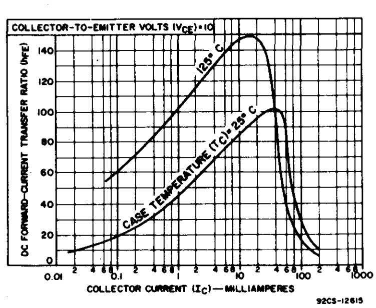


Fig. 2 – Typical dc-beta characteristics for 40346, 40346V1, 40346V2, 40412, 40412V1 and 40412V2.

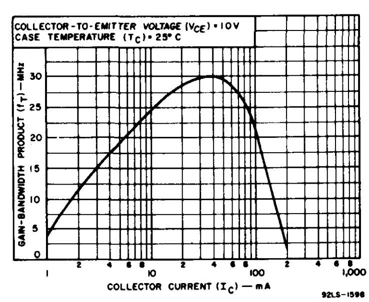


Fig.3—Typical gain-bandwidth product for all types.

2N3439; 2N3440; 2N4063; 2N4064; 40385; 40346, V1, V2; 40390; 40412, V1, V2

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

CHARACTERISTICS	SYMBOL	VOLTAGE V dc		CURRENT mA dc	LIMITS 2N3439 2N4063 40385		2N3440 2N4064 40390		40346 40346V1 40346V2		40412 40412V1 40412V2		UNITS
		V_{CE}	V_{BE}	I_C	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Collector-Cutoff Current: With base open	I_{CEO}	100	–		–	–	–	–	–	5	–	5	µA
		200			–	–	–	50	–	–	–	–	
		300			–	20	–	–	–	–	–	–	
With base reverse-biased:	I_{CEV}	200	−1.5		–	–	–	–	–	10	–	–	µA
		300	−1.5		–	–	–	500	–	–	–	–	
		450	−1.5		–	500	–	–	–	–	–	–	
At T_C = 150°C		150	−1.5		–	–	–	–	–	–	–	2	mA
		200	−1.5		–	–	–	–	–	1	–	–	
With R = 10,000 ohms	I_{CER}	100			–	–	–	–	–	—	–	1	mA
* Collector-Cutoff Current	I_{CBO}	250	–		–	–	–	20[c]	–	–	–	–	µA
		360	–		–	20[c]	–	–	–	–	–	–	
* Emitter-Cutoff Current	I_{EBO}		−3		–	–	–	–	–	–	–	100	µA
			−4		–	–	–	–	–	5	–	–	
			−6		–	20	–	20	–	–	–	–	
DC Forward-Current Transfer Ratio	h_{FE}	10		2	30	–	–	–	–	–	–	–	
		10		10	–	–	–	–	25	–	–	–	
		10		20	40	160	40	160	–	–	–	–	
		20		30	–	–	–	–	–	–	40	–	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			50	350[a]	–	250[a]	–	–	–	–	–	V
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance R_{BE} = 1,000 ohms	$V_{CER}(sus)$			50	–	–	–	–	175[a]	–	–	–	V
R_{BE} = 10,000 ohms	$V_{CER}(sus)$			50	–	–	–	–	–	–	250[a]	–	
Base-to-Emitter Voltage	V_{BE}	10		10	–	–	–	–	–	1	–	–	V
* Base-to-Emitter Saturation Voltage I_B = 4 mA	$V_{BE}(sat)$			50	–	1.3	–	1.3	–	–	–	–	V
Collector-to-Emitter Saturation Voltage I_B = 1 mA	$V_{CE}(sat)$			10	–	–	–	–	–	0.5	–	0.5	V
* I_B = 4 mA				50	–	0.5	–	0.5	–	–	–	–	
* Small-Signal Forward-Current Transfer Ratio: f= 5 MHz	h_{fe}	10		10	3	–	3	–	2	–	2	–	
* Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{ob}				–	10	–	10	–	10	–	10	pF
Second-Breakdown Current t_p = 0.4 s	$I_{S/b}$	200			–	50[b]	–	50[b]	–	–	50	–	mA
Thermal Resistance: Junction-to-case	$R_{\theta JC}$				–	17.5	–	17.5	15 max. (40346) (40346V2)		15 max. (40412) (40412V2)		°C/W
Junction-to-free air	$R_{\theta JFA}$				–	–	–	–	45 max. (40346V1)		45 max. (40412V1)		

[a]CAUTION: The sustaining voltages, $V_{CEO}(sus)$ and $V_{CER}(sus)$, MUST NOT be measured on a curve tracer. [b]2N-Series types.
[c]2N3439 and 2N3440 only. *2N-Series types in accordance with JEDEC registration data.

2N3439; 2N3440; 2N4063; 2N4064; 40385; 40346, V1, V2; 40390; 40412, V1, V2

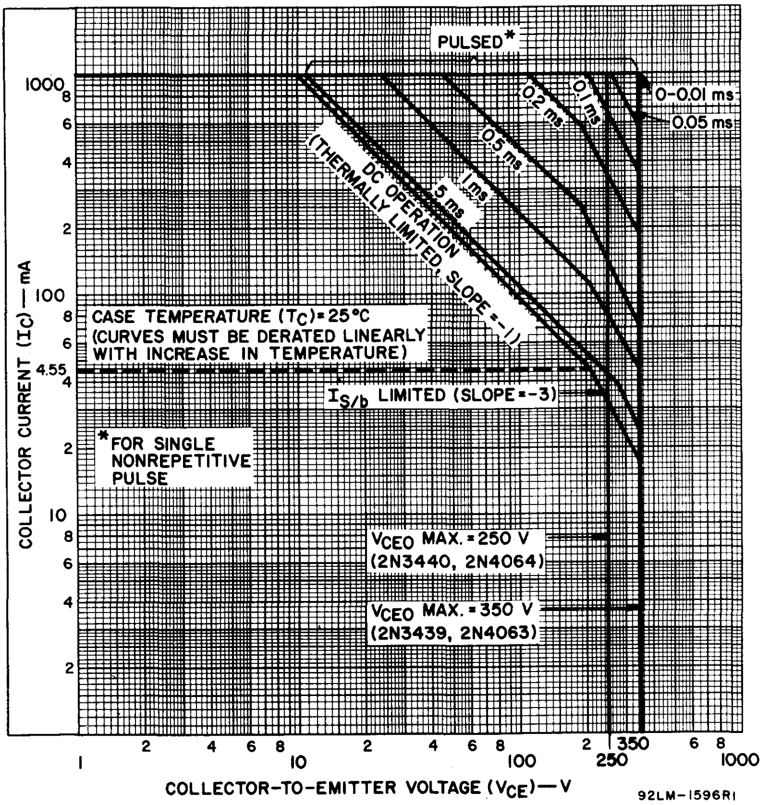


Fig.4—Maximum operating areas for 2N3439,2N3440,2N4063 and 2N4064.

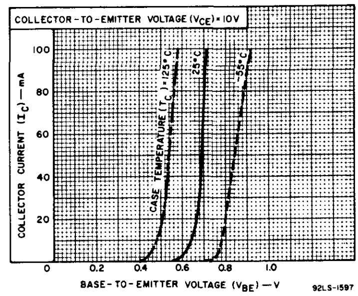


Fig. 5 — Typical transfer characteristics for 2N3439, 2N3440, 2N4063, 2N4064 and 40390.

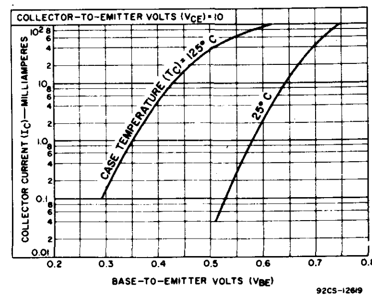


Fig. 6 — Typical transfer characteristics for 40346, 40346V1, 40346V2, 40412, 40412V1 and 40412V2.

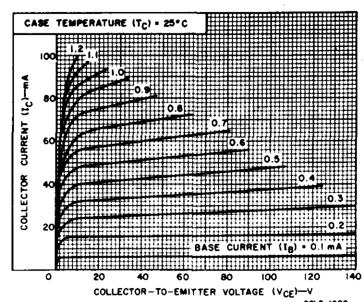


Fig. 7 — Typical output characteristics for 2N3439, 2N3440, 2N4063, 2N4064 and 40390.

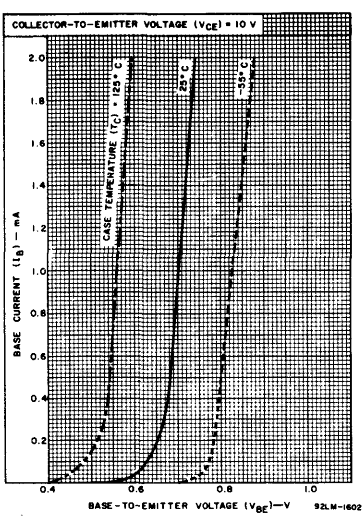


Fig. 8 — Typical input characteristics for 2N3439, 2N3440, 2N4063, 2N4064 and 40390.

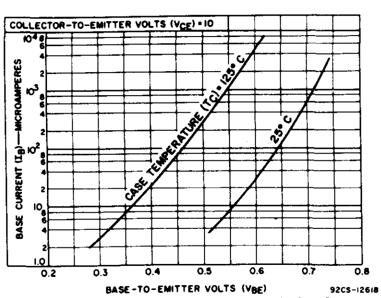


Fig. 9 — Typical input characteristics for 40346, 40346V1, 40346V2, 40412, 40412V1 and 40412V2.

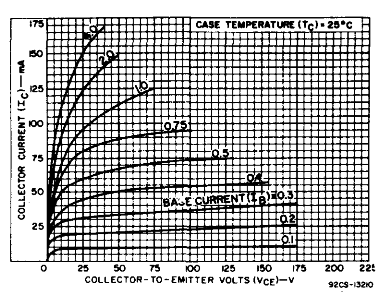


Fig. 10 — Typical output characteristics for 40346, 40346V1, 40346V2, 40412, 40412V1 and 40412V2.

2N3441, 2N6263, 2N6264, 40373, 40912, 40913

Hometaxial-Base, Medium-Power Silicon N-P-N Transistors

Rugged Devices for Intermediate, Power Applications in Industrial and Commercial Equipment

RCA 2N3441, 2N6263, and 2N6264 are hometaxial-base silicon n-p-n transistors intended for a wide variety of medium to-high power, high-voltage applications. These types are supplied in the JEDEC TO-66 hermetic package.

Types 40373, 40912, and 40913 are the 2N3441, 2N6263, and 2N6264 with factory-attached heat-radiators intended for printed-circuit-board applications.

Features:

- **2N6264: premium type from 2N3441 family**
- **Maximum safe-area-of-operation curves for dc and pulse operation**
- **High voltage ratings**
- **Low saturation voltages**
- **Thermal-cycling rating curves**

Applications:

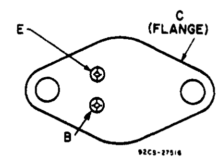
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power switching circuits**
- ***Solenoid drivers***

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

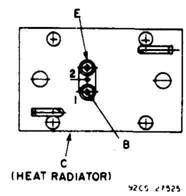
		2N6263 40912	2N3441 40373	2N6264 40913	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	140	160	170	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
* With base open	$V_{CEO}(sus)$	120	140	150	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$	130	150	160	V
With base reverse-biased (V_{BE} = -1.5 V)	$V_{CEV}(sus)$	140	160	170	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	3	3	3	A
PEAK COLLECTOR CURRENT		4	4	4	A
*CONTINUOUS BASE CURRENT	I_B	2	2	2	A
TRANSISTOR DISSIPATION:	P_T				
* At case temperature up to 25°C		20 (2N6263)	25 (2N3441)	50 (2N6264)	W
At ambient temperatures up to 25°C		5.8 (40912)	5.8 (40373)	5.8 (40913)	W
* At temperatures above 25°C		Derate linearly to 200°C			
*TEMPERATURE RANGE:					
Storage & Operating (Junction)		-65 to 200			°C
*PIN TEMPERATURE (During Soldering):					
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235			°C

*In accordance with JEDEC registration data format JS-6 RDF-2

TERMINAL DESIGNATIONS



JEDEC TO-66
2N3441,2N6263,2N6264



JEDEC TO-66 with Heat Radiator
40373,40912,40913

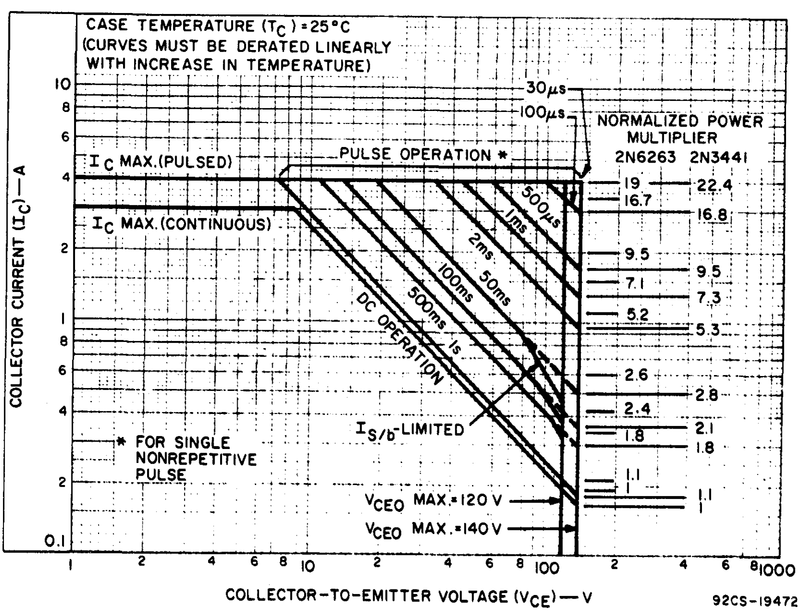


Fig. 1—Maximum operating areas for 2N3441 and 2N6263.

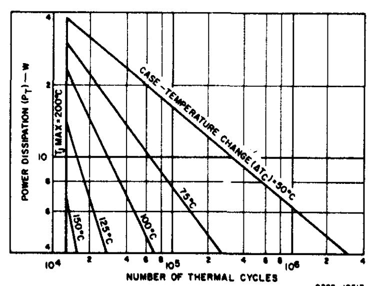


Fig. 2—Thermal-cycle rating chart for 2N6264.

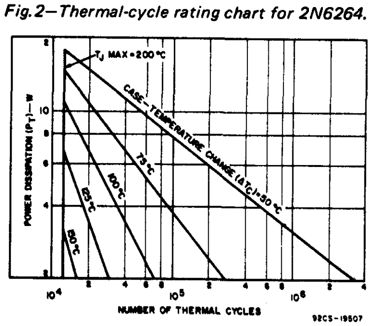


Fig. 3—Thermal-cycle rating chart for 2N3441.

2N3441, 2N6263, 2N6264, 40373, 40912, 40913

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6263 40912 Min.	Max.	2N3441 40373 Min.	Max.	2N6264 40913 Min.	Max.	UNITS
Collector-Cutoff Current:												
* With base open	I_{CEO}	100			0		5				-	mA
		130			0	-		-			1	
		140			0				100			
Collector-Cutoff Current: With base-emitter junction reversed biased	I_{CEX}	120	1.5				2*					mA
		140	-1.5						5*			
		140	1.5						1			
		150	1.5								0.05*	
	I_{CEX} (T_C 150°C)	120	1.5				10*					
		140	1.5						6*			
		140	1.5						5			
		150	1.5								1*	
* Emitter-Cutoff Current	I_{EBO}		-5				2					mA
			-7						1		0.2	
Collector-to-Emitter Sustaining Voltage:[a] * With base open	$V_{CEO}(sus)$			0.1[b]	0	120		140		150		V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1		130		150		160		V
With base-emitter junction reversed biased	$V_{CEV}(sus)$		1.5	0.1		140		160		170		V
* DC Forward-Current Transfer Ratio	h_{FE}	2		1[b]						20	60	
		2		3[b]		3				5		
		4		0.5[b]		20	100	25	100			
		4		2.7[b]				5				
Collector-to-Emitter Saturating Voltage	$V_{CE}(sat)$			0.5[b]	0.05		1.2*		1			V
				1[b]	0.1						0.5*	
				2.7[b]	0.9				6*			
Base-to-Emitter Voltage	V_{BE}	2		1[b]				-			1.5*	V
		4		0.5[b]			2*	-	1.7			
		4		2.7[b]		-		-	6*		-	
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 0.4 MHz)	$\|h_{fe}\|$	4		0.5		5	-	5	-	5	-	
Gain-Bandwidth Product	f_T	4		0.2		200	-	200	-	200	-	kHz
* Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		0.1		25	–	–	–	25	-	
		4		0.5		–	-	15	75	–	-	
Forward-Bias Second Breakdown Collector Current, Pulse Duration (non-repetitive) = 1 s	$I_{S/b}$	120				0.167	–	–	–	–	–	A
		120				–	–	–	–	0.417	–	
		120				–	–	0.21	–	–	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					8.75 (max.) 2N6263		7 (max.) 2N3441		3.5 (max.) 2N6264		°C/W
Junction-to-Ambient	$R_{\theta JA}$					30 (max.) 40912		30 (max.) 40373		30 (max.) 40913		

*In accordance with JEDEC registration data format (JS-6 RDF-2).

[a]**CAUTION:** The sustaining voltage $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ MUST NOT be measured on a curve tracer.

[b]Pulsed, pulse duration = 300 µs; duty factor ≤ 2 %.

2N3441, 2N6263, 2N6264, 40373, 40912, 40913

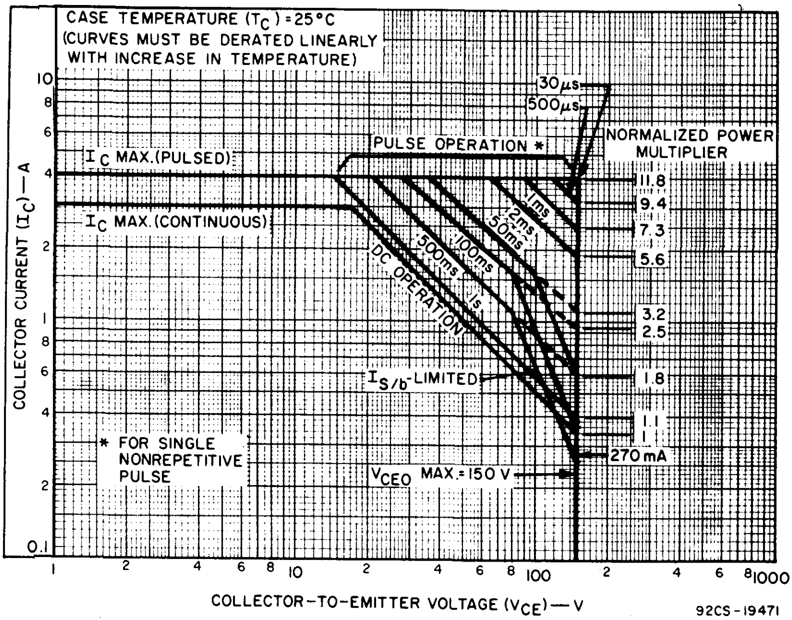


Fig. 4 — Maximum operating areas for 2N6264.

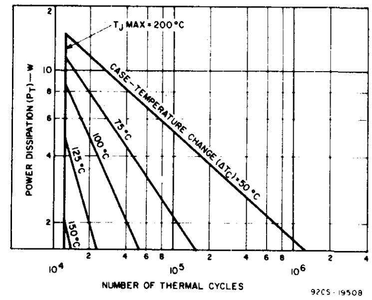


Fig. 5— Thermal-cycle rating chart for 2N6263.

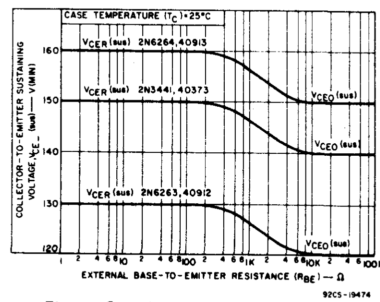


Fig. 6— Sustaining voltage vs. base-to-emitter resistance for all types.

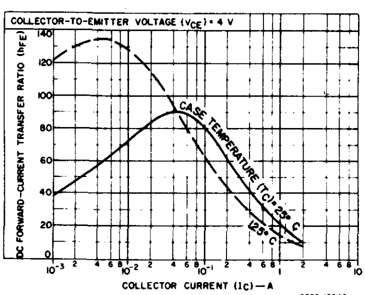


Fig. 7— Typical dc-beta characteristics for 2N3441 and 40373.

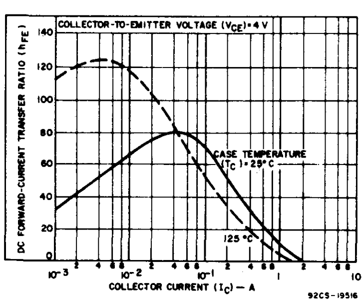


Fig. 8— Typical dc-beta characteristics for 2N6263 and 40912.

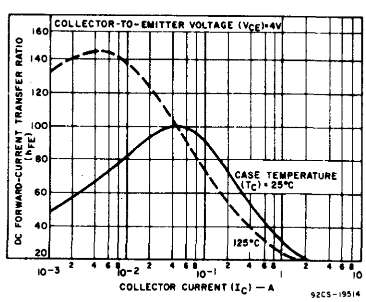


Fig. 9— Typical dc-beta characteristics for 2N6264 and 40913.

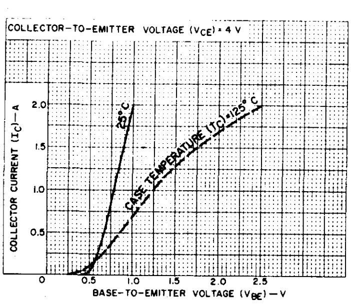


Fig. 10—Typical transfer characteristics for 2N3441 and 40373.

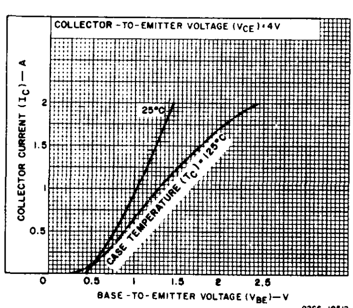


Fig. 11—Typical transfer characteristics for 2N6263 and 40912.

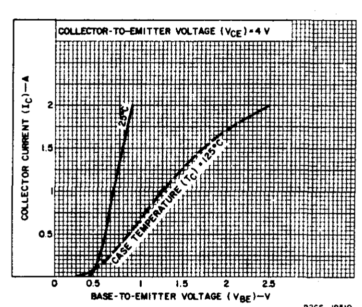


Fig. 12—Typical transfer characteristics for 2N6264 and 40913.

2N3441, 2N6263, 2N6264, 40373, 40912, 40913

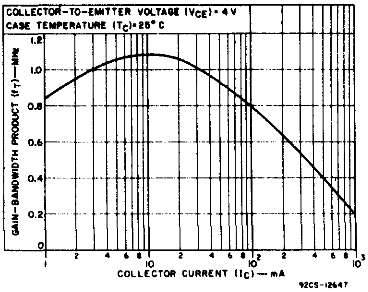


Fig. 13– Typical gain-bandwidth product for all types.

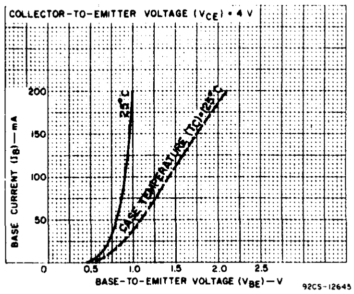


Fig. 14– Typical input characteristics for 2N3441 and 40373.

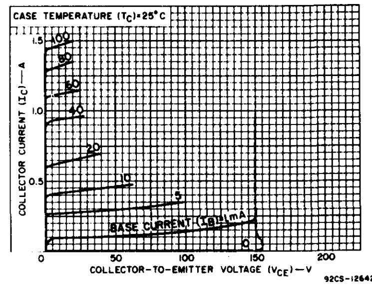


Fig. 15– Typical output characteristics for 2N3441 and 40373.

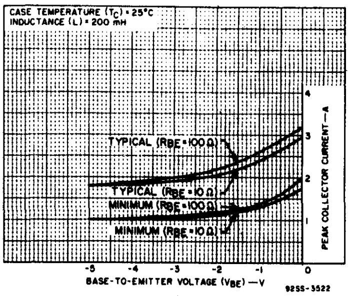


Fig. 16– Reverse-bias second-breakdown characteristics for all types.

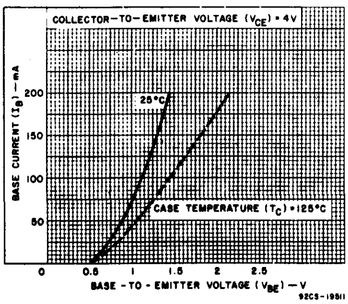


Fig. 17– Typical input characteristics for 2N6263 and 40912.

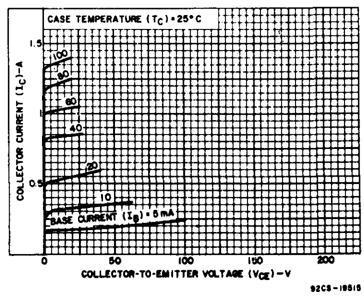


Fig. 18– Typical output characteristics for 2N6263 and 40912.

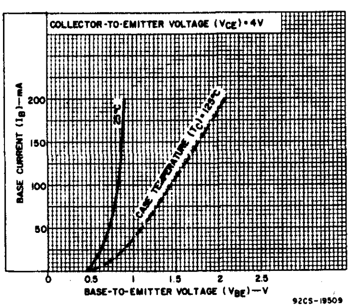


Fig. 19– Typical input characteristics for 2N6264 and 40913.

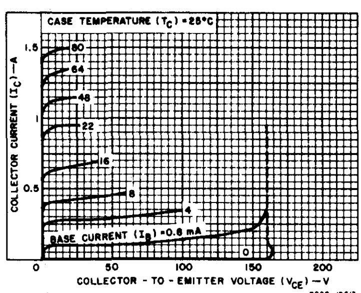


Fig. 20– Typical output characteristics for 2N6264 and 40913.

2N3442, 2N4347, 2N6262

Hometaxial-Base High-Voltage Silicon N-P-N Transistors

Rugged High-Power Devices for Applications in Industrial and Commercial Equipment

RCA 2N3442, 2N4347, and 2N6262 are hometaxial-base, silicon n-p-n transistors intended for a wide variety of high-power, high-voltage applications. Typical applications for these transistors include power-switching circuits, audio amplifiers, series- and shunt-regulator driver and output stages, dc-to-dc converters, inverters, and solenoid (hammer)/relay driver service.

These devices employ the popular JEDEC TO-3 package; they differ in maximum ratings for voltage, current, and power.

Features:
- Low saturation voltages
- Thermal-cycle rating charts
- High dissipation capability – 100 W (2N4347) – 117 W (2N3442) – 150 W (2N6262)
- Maximum area-of-operation curves for dc and pulse operation.

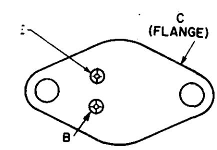
Applications:
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

		2N4347	2N3442	2N6262	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	140	160	170	V
COLLECTOR-TO-EMITTER VOLTAGE:					
* With base open	V_{CEO}	120	140	150	V
With reverse bias (V_{BE}) of −1.5 V	V_{CEV}	140*	160	170	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	V
*COLLECTOR CURRENT:	I_C				
Continuous		5	10	10	A
Peak		10*	15	15	A
*BASE CURRENT:	I_B				
Continuous		3	7	7	A
Peak		8*	–	–	A
*TRANSISTOR DISSIPATION:	P_T				
At case temperature up to 25°C		100	117	150	W
At case temperatures above 25°C			Derate linearly to 200°C		
*TEMPERATURE RANGE:					
Storage & Operating (Junction)		←	−65 to +200	→	°C
*PIN TEMPERATURE (During Soldering):					
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		235	235	235	°C

*In accordance with JEDEC registration data format (JS-6, RDF-2).

TERMINAL DESIGNATIONS



JEDEC TO-3

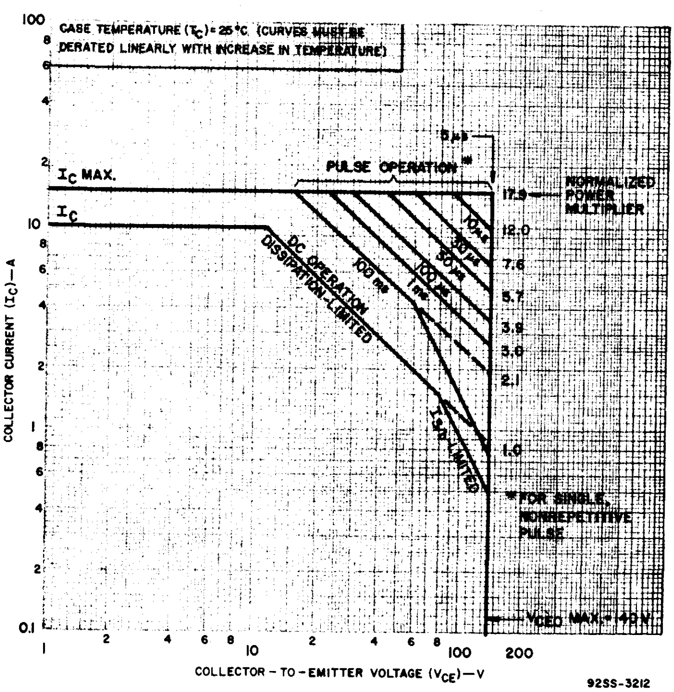


Fig. 1—Maximum operating areas for 2N3442.

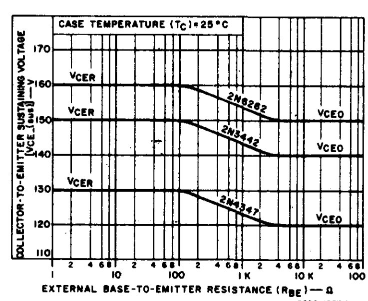


Fig. 2—Sustaining voltage vs. base-to-emitter resistance for all types.

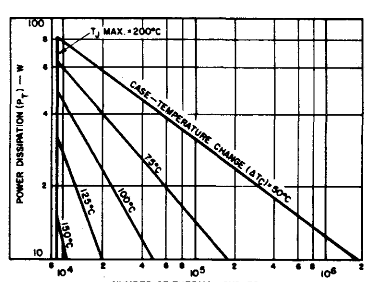


Fig. 3—Thermal-cycle rating chart for 2N3442.

2N3442, 2N4347, 2N6262

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS						UNITS
		VOLTAGE V dc		CURRENT A dc		2N4347		2N3442		2N6262		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
Collector Cutoff Current: With emitter open (V_{CB} = 140 V)	I_{CBO}					–	–	–	1*	–	1	mA
* With base-emitter junction reverse-biased	I_{CEX}	120	-1.5			–	2	–	–	–	–	mA
		140	-1.5			–	–	–	5	–	–	
		140	-1.5			–	–	–	1	–	–	
		150	-1.5			–	–	–	–	–	0.1	
* With base-emitter junction reverse-biased and T_C = 150°C	I_{CEX}	125	-1.5			–	10	–	–	–	–	mA
		140	-1.5			–	–	–	30	–	–	
		140	-1.5			–	–	–	10	–	–	
		150	-1.5			–	–	–	–	–	2	
* With base open	I_{CEO}	100				–	200	–	–	–	–	mA
		110				–	–	–	–	–	1	
		140				–	–	–	200	–	–	
* Emitter Cutoff Current	I_{EBO}		–7	0		–	5	–	5	–	0.2	mA
* DC Forward Current Transfer Ratio	h_{FE}	2		3[a]		–	–	–	–	20	70	
		2		10[a]		–	–	–	–	5	–	
		4		2[a]		15	60	–	–	–	–	
		4		3[a]		–	–	20	70	–	–	
		4		5[a]		10	–	–	–	–	–	
		4		10[a]		–	–	7.5	–	–	–	
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse-biased	V_{CEV}(sus)		–1.5	0.1		140	–	160	–	–	–	V
			–1.5	0.2		–	–	–	–	170	–	
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}(sus)			0.1		130	–	–	–	–	–	V
				0.2		–	–	150	–	160	–	
* With base open	V_{CEO}(sus)			0.2[a]	0	120	–	140	–	–	–	V
				0.2[a]	0	–	–	–	–	150	–	
* Base-to-Emitter Voltage	V_{BE}	2		3[a]		–	–	–	–	–	1	V
		4		3[a]		–	–	1.7	–	–	–	
		4		2[a]		–	2	–	–	–	–	
		4		5[a]		–	3	–	–	–	–	
		4		10[a]		–	–	–	5.7	–	–	
* Collector-to-Emitter Saturation Voltage	V_{CE}(sat)			2[a]	0.2	–	1	–	–	–	–	V
				3[a]	0.3	–	–	–	1	–	0.5	
				5[a]	0.63	–	2	–	–	–	–	
				10[a]	2	–	–	–	5	–	–	
Power Rating Test	PRT	67		1.5		1	–	–	–	–	–	s
		78		1.5		–	–	1	–	–	–	
		100		1.5		–	–	–	–	1	–	
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio: f = 50 kHz	$\|h_{fe}\|$	4		0.5		4	–	–	–	–	–	
f = 40 kHz	$\|h_{fe}\|$	4		1		–	–	–	–	2	–	
		4		2		–	–	2	–	–	–	
* Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		0.5		40	–	–	–	–	–	
		4		1		–	–	–	–	10	–	
		4		2		–	–	12	72	–	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	1.75	–	1.5	–	1.17	°C/W

*In accordance with JEDEC registration data format JS-6 RDF-2

[a]Pulse test; pulse duration = 300 μs, rep. rate = 60 Hz

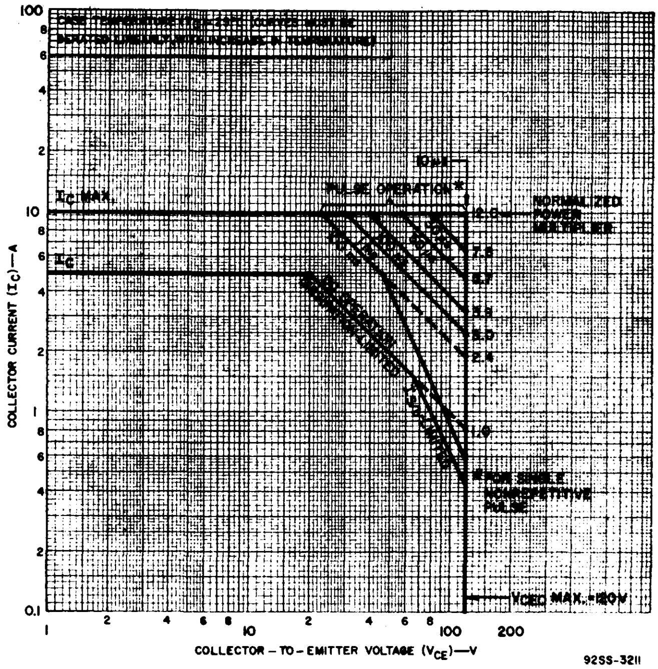


Fig. 4 — Maximum operating areas for 2N4347.

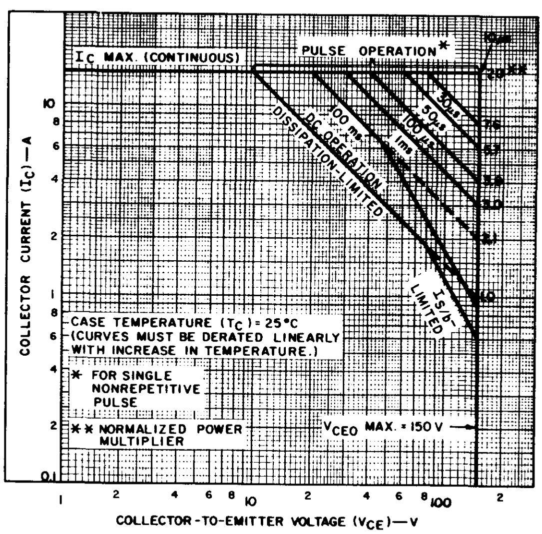


Fig. 5 — Maximum operating areas for 2N6262.

2N3442, 2N4347, 2N6262

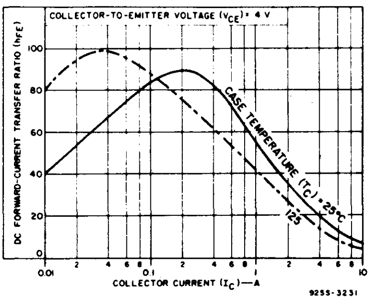


Fig. 6 – Typical dc beta characteristics for 2N3442.

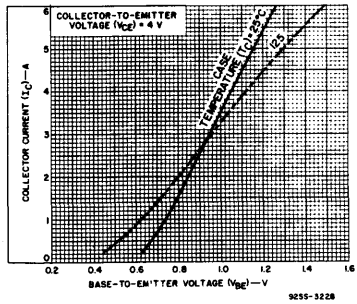


Fig. 7 – Typical transfer characteristics for 2N3442 and 2N4347.

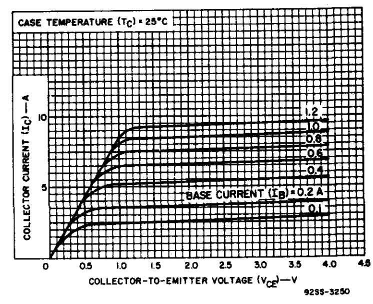


Fig. 8 – Typical small-signal output characteristics for 2N3442.

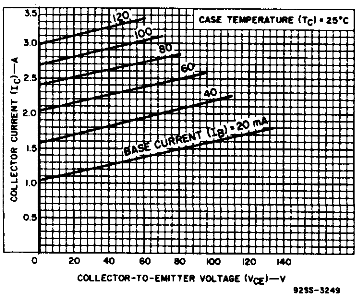


Fig. 9 – Typical large-signal output characteristics for 2N3442.

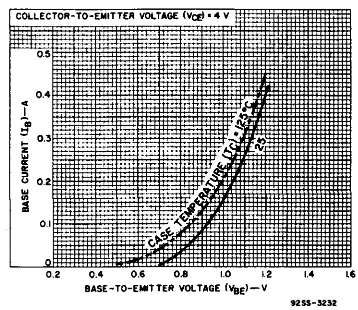


Fig. 10 – Typical input characteristics for 2N3442.

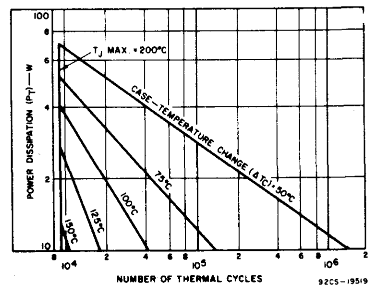


Fig. 11 – Thermal-cycle rating chart for 2N4347.

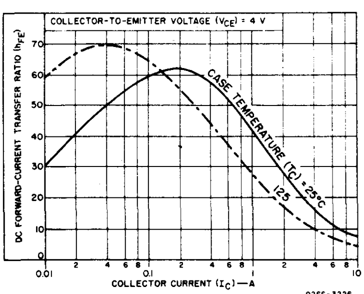


Fig. 12 – Typical dc beta characteristics for 2N4347.

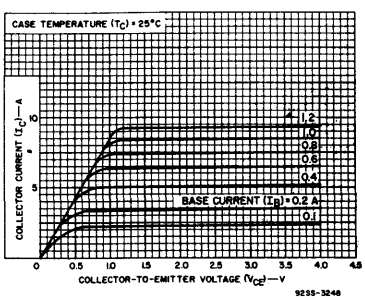


Fig. 13 – Typical small-signal output characteristics for 2N4347.

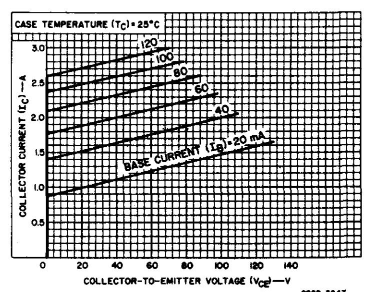


Fig. 14 – Typical large-signal output characteristics for 2N4347.

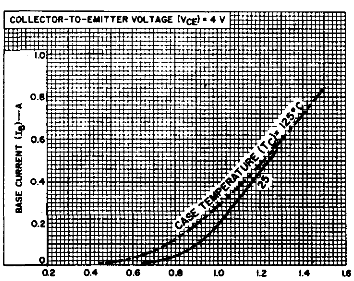


Fig. 15 – Typical input characteristics for 2N4347.

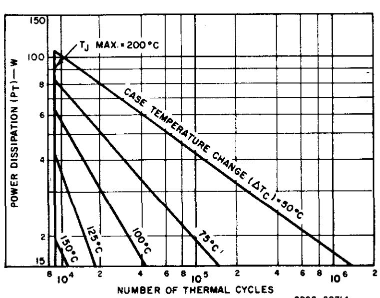


Fig. 16 – Thermal-cycle rating chart for 2N6262.

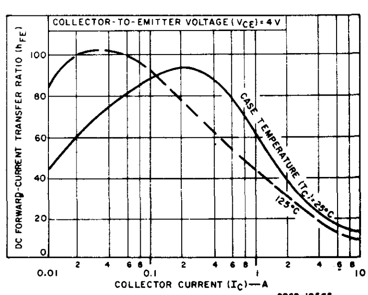


Fig. 17 – Typical dc beta characteristics for 2N6262.

2N3442, 2N4347, 2N6262

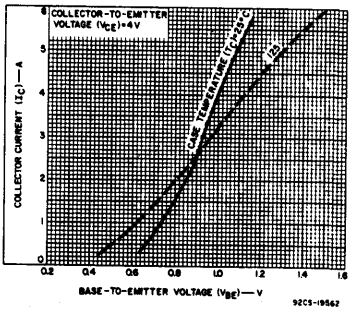


Fig. 18 – Typical transfer characteristics for 2N6262.

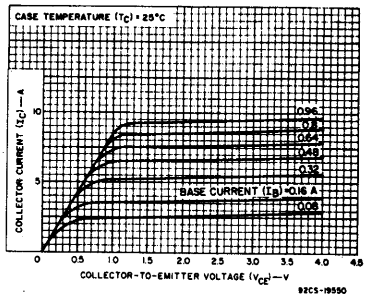


Fig. 19 – Typical small-signal output characteristics for 2N6262.

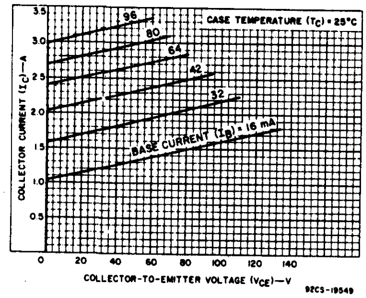


Fig. 20 – Typical large-signal output characteristics for 2N6262.

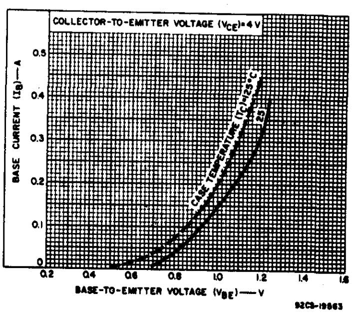


Fig. 21 – Typical input characteristics for 2N6262.

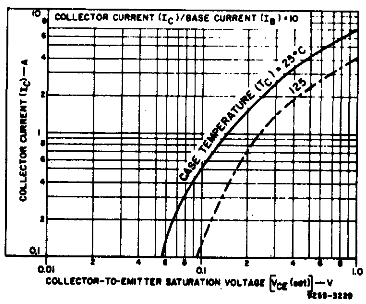


Fig. 22 – Typical saturation-voltage characteristics for all types.

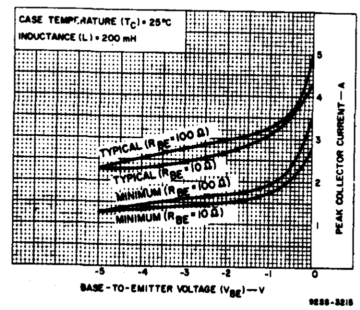


Fig. 23 – Reverse-bias, second-breakdown characteristics for all types.

2N3583-2N3585, 2N4240, 40374

High Voltage Silicon N-P-N Transistor

For High-Speed Switching, Linear-Amplifier Applications, and Off-Line Switching-Regulator Type Power-Supply Applications

These RCA types are silicon n-p-n transistors with high breakdown voltages and fast switching speeds.

Typical applications for these transistors include high-voltage operational amplifiers, high-voltage switches, switching regulators, converters, inverters, deflection- and hi-fi amplifiers.

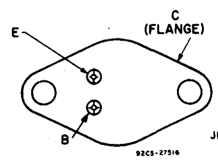
These transistors are also intended for a wide variety of applications in ac/dc commercial equipment.

Types 2N3583, 2N3584, 2N3585, and 2N4240 are supplied in hermetic JEDEC TO-66 packages. Type 40374 is a 2N3583 with a factory-attached heat radiator.

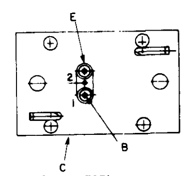
Features for JEDEC Types:

- **100-percent tested to assure freedom from second breakdown in both forward- and reverse-bias conditions when operated within specified limits**
- **Economy types for ac/dc circuits**
- **Fast turn-on time at high collector current**

TERMINAL DESIGNATIONS



JEDEC TO-66 2N3583, 2N3584, 2N3585, 2N4240, 40850



JEDEC TO-66 with Heat Radiator 40374

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3583	2N3584	2N3585 2N4240	40374	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	250	375	500	250	V
*COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With base open	$V_{CEO}(sus)$	175	250	300	175	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	V
*CONTINUOUS COLLECTOR CURRENT	I_C	1	2	2	2	A
*PEAK COLLECTOR CURRENT	I_{CM}	5	5	5	5	A
*CONTINUOUS BASE CURRENT	I_B	1	1	1	1	A
*TRANSISTOR DISSIPATION	P_T					
At case temperature (T_C) = 25°C		35	35	35	–	W
At ambient temperature (T_A) = 25°C		–	–	–	5.8	W
At case temperatures above 25°C		Derate linearly at 0.2 W/°C				
For other conditions		Derate linearly to 200°C				
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		–65 to 200				°C
*PIN TEMPERATURE:						
1/16 in. (1.58 mm) from seating plane for 10 s max.		235	235	235	235	°C

*In accordance with JEDEC registration data format JS-6 RDF-2 (2N3583), JS-6 RDF-1 (2N3584, 2N3585, 2N4240).

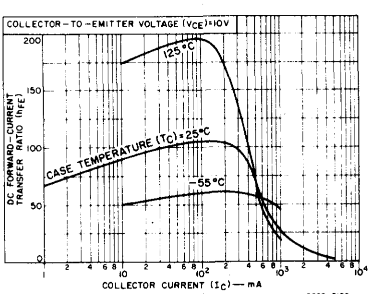


Fig.1—Typical dc beta vs. collector current for 2N3583, 2N4240 and 40374.

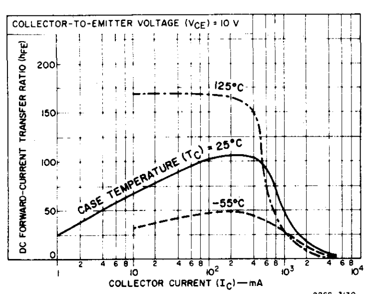


Fig.2—Typical dc beta vs. collector current for 2N3584 and 2N3585.

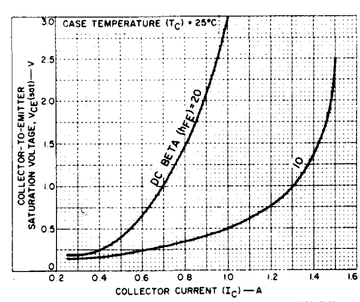


Fig.3—Typical collector-to-emitter saturation voltage vs. current for 2N3584 and 2N3585.

2N3583-2N3585, 2N4240, 40374

ELECTRICAL CHARACTERISTICS *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{BE}	CURRENT mA dc I_C	I_E	I_B	LIMITS 2N3583 40374 MIN.	MAX.	2N3584 MIN.	MAX.	2N3585 MIN.	MAX.	2N4240 MIN.	MAX.	UNITS
* Collector-Cutoff Current	I_{CEO}	150				0	–	10	–	5	–	5	–	5	mA
* Collector-Cutoff Current	I_{CEV}	225 340 450	–1.5 –1.5 –1.5				– – –	1.0 – –	– – –	– 1.0 –	– – –	– – 1.0	– – –	– – 2.0	mA
At T_C = 150°C	I_{CEV}	225 300	–1.5 –1.5				– –	3 –	– –	– 3	– –	– 3	– –	– 5.0	mA
* Emitter-Cutoff Current	I_{EBO}		–6	0			–	5.0	–	0.5	–	0.5	–	0.5	mA
* DC Forward-Current Transfer Ratio	h_{FE}	2 2 10 10 10 10		750• 1A• 100• 750• 750• 1A			– – 40 40 – 10	– – – 200 – –	– 8 40 – – 25	– 80 – – – 100	– 8 40 – – 25	– 80 – – – 100	10 – 40 – 30 –	100 – – – 150 –	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			200		0	175●	–	250●	–	300●	–	300●	–	V
With external base-to-emitter resistance (R_{BE})=50 Ω	I_{CER}	250 300 450		200			– – –	1.0 – –	– – –	– 1.0 –	– – –	– – 1.0	– – 1	– – 1.0	mA
Emitter-to-Base Voltage	V_{EBO}			0	5		–	–	–	–	–	–	–	–	V
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			750• 1A•		75 100	– –	– 1.4	– –	– 1.4	– –	– 1.4	– –	1.8 –	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			750• 1A•		75 125	– –	– 5	–	– 0.75	– –	– 0.75	– –	1.0 –	V
Small-Signal Forward Current Transfer Ratio f = 5 MHz * f = 1 kHz	h_{fe}	10 30		200 100			3 25	– 350	3 –	–	3 –	– –	3 –	– –	
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio f = 5 MHz	|h_{fe}|	10		200			2	-	2		2		3	–	
Output Capacitance: V_{CB}=10 V, f = 1 MHz	C_{obo}				0		-	120	–	120		120	–	120	pF
Second-Breakdown Collector Current With base forward-biased**	$I_{S/b}$	100					350	–	350	–	350	–	350		mA
Second-Breakdown Energy with base reverse-biased R_{BE} = 20Ω, L = 100 μH	$E_{S/b}$		–4	1A pk			50	–	–	–	–	–	50	–	μJ
R_{BE} = 20Ω; L = 100 μH			–4	2A pk			–	–	200	-	200	–	–	–	μJ
* Saturated Switching Time (V_{CC}=200 V): Rise Time (See Figs. 13 & 16)	t_r			1A 750		100 75	– –	– –	– –	3 –	– –	3 –	– –	– 0.5	μs
* Storage Time (See Figs. 14 & 16)	t_s			1A 750		100 75	– –	– –	– –	4 –	– –	4 –	– –	– 6	μs
Fall Time (See Figs. 15 & 16)	t_f			750 1A		75 100	– –	– –	– –	– 3	– –	– 3	– –	3 –	μs
* Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						5 (Max.) 2N3583		–	5	–	5	–	5	°C/W
Junction-to-Ambient	$R_{\theta JA}$						70 (Max.) 2N3583 30 (Max.) 40374		– –	70 –	– –	70 –	– –	70 –	°C/W

* In accordance with JEDEC registration data formal JS-6 RDF-2 (2N3583), JS-6 RDF-1 (2N3584, 2N3585, 2N4240)

● **CAUTION:** The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ **MUST NOT** be measured on a curve tracer.

** Specified value of $I_{S/b}$ for given value of V_{CE} as base voltage is increased from zero in a positive direction.

• Pulsed, pulse duration = 300 μs; duty factor ≤ 2%.

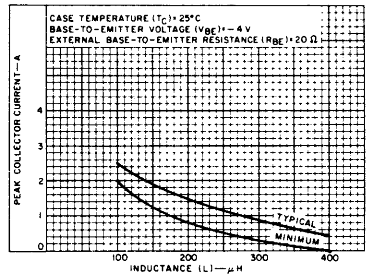


Fig.4—Reverse-bias second breakdown characteristics for 2N3584 and 2N3585.

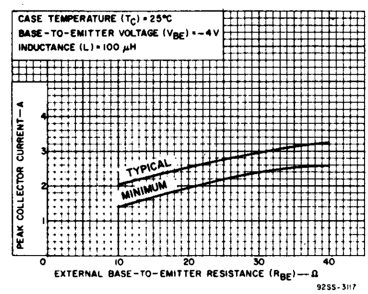


Fig.5—Reverse-bias second breakdown characteristics for 2N3584 and 2N3585.

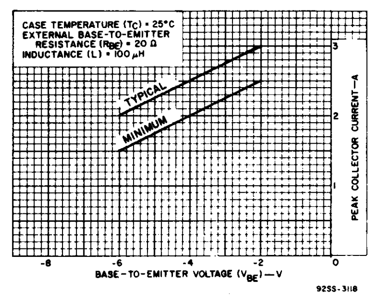


Fig.6—Reverse-bias second breakdown characteristics for 2N3584 and 2N3585.

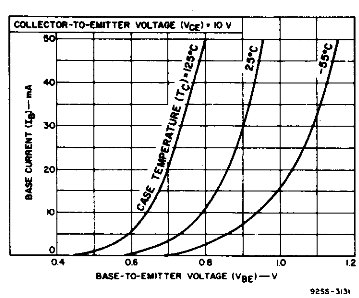


Fig.7—Typical input characteristics for all types.

2N3583-2N3585, 2N4240, 40374

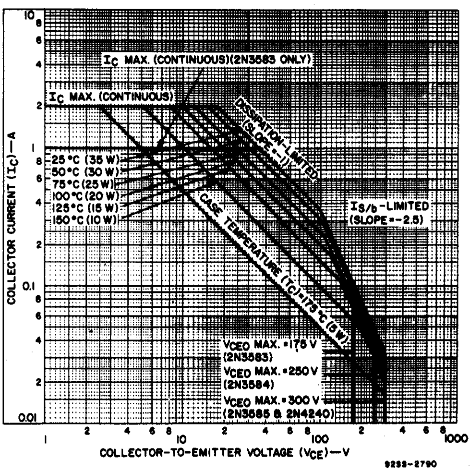


Fig.8—Maximum operating areas for 2N3583, 2N3584, 2N3585, and 2N4240 (pulse conditions).

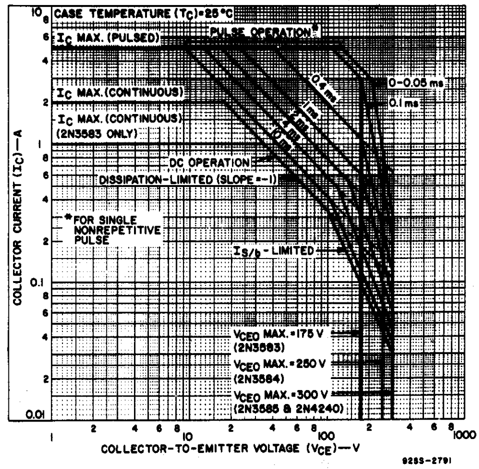


Fig.9—Maximum operating areas for 2N3583, 2N3584, 2N3585, and 2N4240 (dc conditions).

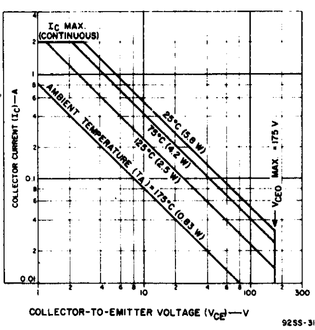


Fig.10—Maximum operating areas for 40374.

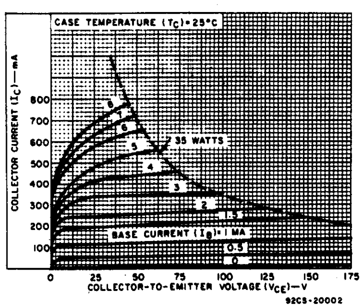


Fig.11—Typical output characteristics for 2N3583 and 40374.

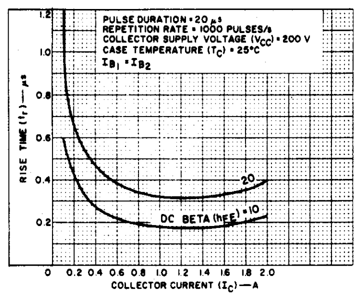


Fig.12—Typical rise time vs. collector current for 2N3584 and 2N3585.

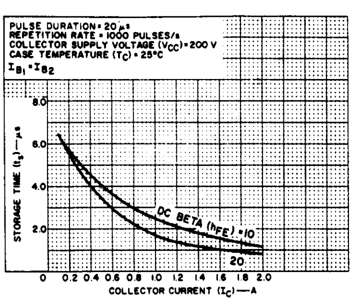


Fig.13—Typical storage time vs. collector current for 2N3584 and 2N3585.

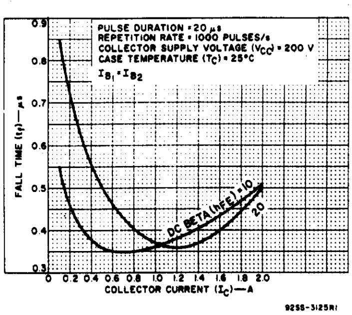


Fig.14—Typical fall time vs. collector current for 2N3584 and 2N3585.

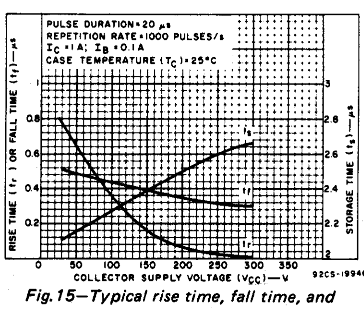


Fig.15—Typical rise time, fall time, and storage time vs. collector supply voltage for 2N3584 and 2N3585.

2N3715, 2N3716

Silicon N-P-N Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices
For Industrial and Commercial Use

The RCA-2N3715 and 2N3716 are epitaxial-base silicon n-p-n transistors featuring high gain and high current. They may be used as complements to the RCA-2N3791 and 2N3792 respectively. These devices have a dissipation capability of 150 watts at case temperature up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. Both are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- **High dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **Hermetically sealed JEDEC TO-3/TO-204MA package**
- **High gain at high current**
- **Thermal-cycling rating curve**

Applications:

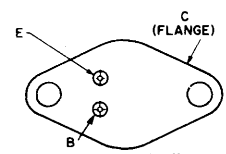
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3715	2N3716	
* V_{CBO}		80	100	V
* $V_{CEO}(sus)$		60	80	V
* V_{EBO}		7	7	V
* I_C		10	10	A
* I_B		4	4	A
* P_T				
At $T_C \leqslant 25°C$		150	150	W
At $T_C > 25°C$	Derate linearly	0.86		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distance ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

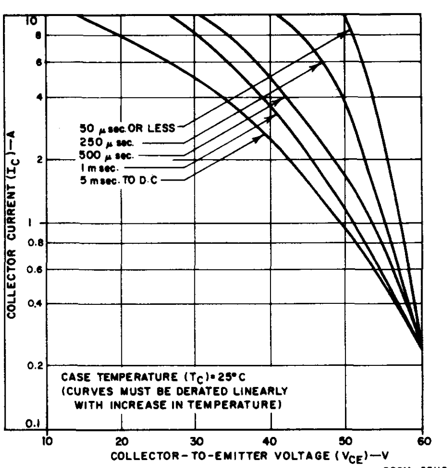


Fig. 1 — Maximum operating areas for 2N3715.

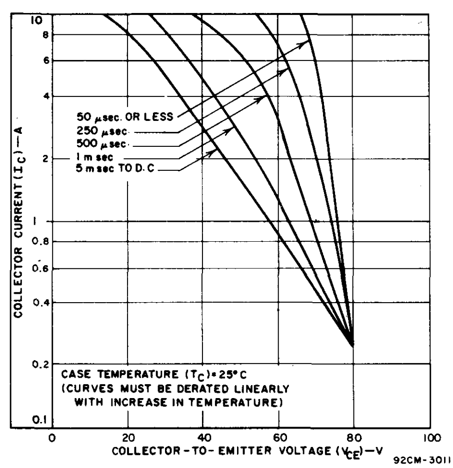


Fig. 2 — Maximum operating areas for 2N3716.

2N3715, 2N3716

ELECTRICAL CHARACTERISTICS,

at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		CURRENT A dc		LIMITS: 2N3715		2N3716		UNITS
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	80 100	−1.5 −1.5			– –	1 –	– –	– 1	mA
* I_{CEX}, T_C = 150°C	60 80	−1.5 −1.5			– –	10 –	– –	– 10	mA
* I_{CEO}	30 40			0 0	– –	0.7 –	– –	– 0.7	mA
* I_{EBO}		−7	0		–	1.0	–	1.0	mA
* $V_{CEO}(sus)$[b]			0.2	0	60	–	80	–	V
* h_{FE}	2 2 4		1[a] 3[a] 10		50 30 5	150 – –	50 30 5	150 – –	
* V_{BE}[a]	2		3		–	1.5	–	1.5	V
$V_{BE}(sat)$[a]			5	0.5	–	1.5	–	1.5	V
* $V_{CE}(sat)$[a]			5 10	0.5 2.0	– –	0.8 4	– –	0.8 4	V
* $\|h_{fe}\|$ f = 1 MHz	10		0.5		5	–	5	–	
* f_{hfe}	10		0.5		30	–	30	–	KHz
* h_{fe} f = 1 KHz	10		0.5		25	250	25	250	
* C_{ob} V_{CB} = 10 V f = 1 MHz			0		–	250	–	250	pF
$I_{S/b}$ tp = 1s	40				2.7	–	2.95	–	A
$R_{\theta JC}$					–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed; pulse duration = 200 μs, duty factor = 1.5%.

[b] **CAUTION:** Sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ ***MUST NOT*** be measured on a curve tracer.

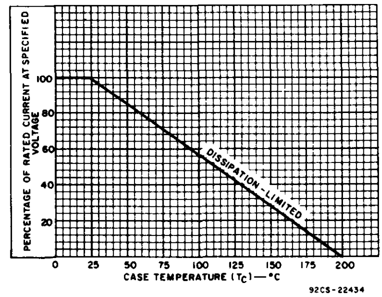


Fig. 3 – Derating curve.

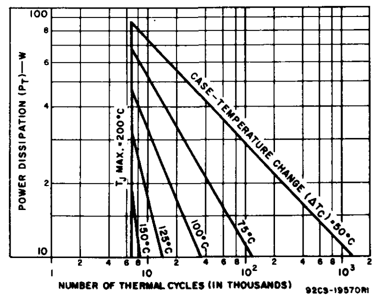


Fig. 4 – Thermal-cycling rating chart.

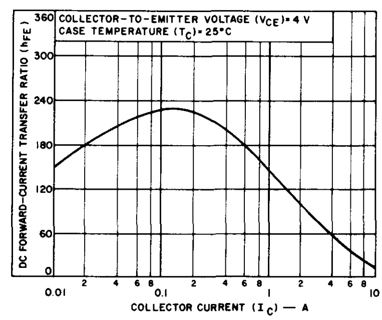


Fig. 5 – Typical dc beta characteristics for both types.

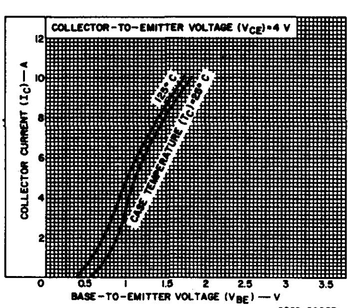


Fig. 6 – Typical transfer characteristics for both types.

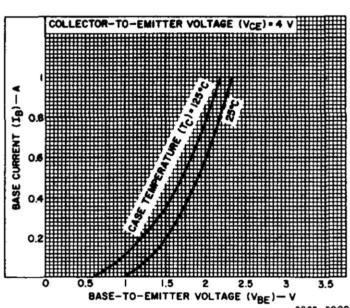


Fig. 7 – Typical input characteristics for both types.

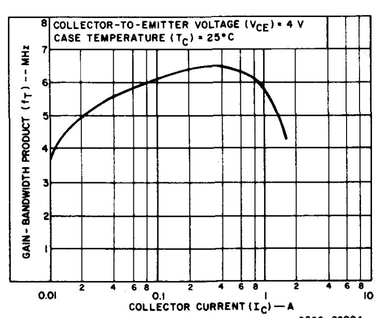


Fig. 8 – Typical gain-bandwidth product for both types.

2N3771, 2N3772, 2N6257, RCS258

Hometaxial-Base, High-Power N-P-N Transistors

Rugged Silicon N-P-N Devices for Applications in Industrial and Commercial Equipment

These RCA types are hometaxial base, silicon n-p-n transistors intended for a wide variety of high-power, high-current applications. Typical applications for these transistors include power-switching circuits, audio amplifiers, series- and shunt-regulator driver and output stages, dc-to-dc converters, inverters, and solenoid (hammer)/relay driver service.

All devices employ the popular JEDEC TO-3 package; they differ in maximum ratings for voltage, current, and power.

Features:

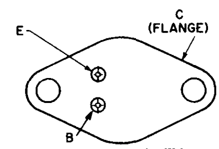
- **High dissipation capability**
- **V_{CEX}(sus) at 3 A = 50 V min. (2N3771, 2N6257) = 90 V min. (2N3772)**
- **15-A specification for: h_{FE}, V_{BE}, & V_{CE}(sat) (2N3771, 2N6257)**
- **10-A specification for: h_{FE}, V_{BE}, & V_{CE}(sat) (2N3772, RCS258)**
- **Low saturation voltage with high beta**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3771	2N3772	2N6257	RCS258	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	50	100	50	100	V
*COLLECTOR-TO-EMITTER VOLTAGE:						
With −1.5 V (V_{BE}) & R_{BE} = 100Ω	V_{CEX}	50	80	50	80	V
With base open	V_{CEO}	40	60	40	60	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	7	5	7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	30	20	20	20	A
*PEAK COLLECTOR CURRENT	I_{CM}	30	30	30	30	A
*CONTINUOUS BASE CURRENT	I_B	7.5	5	5	5	A
*PEAK BASE CURRENT	I_{BM}	15	15	15	15	A
*TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		150	150	150	250	W
At case temperatures above 25°C		Derate linearly to 200°C				
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		−65 to 200				°C
*PIN TEMPERATURE (During soldering):						
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230				

*In accordance with JEDEC registration data format JS-6 RDF-2.

TERMINAL DESIGNATIONS



JEDEC TO-3

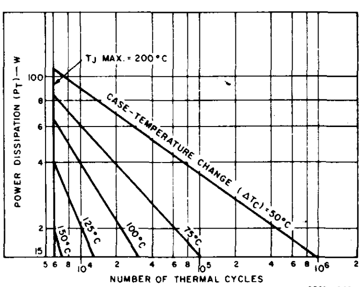


Fig. 1—Thermal-cycle rating chart for 2N3771, 2N3772, and 2N6257.

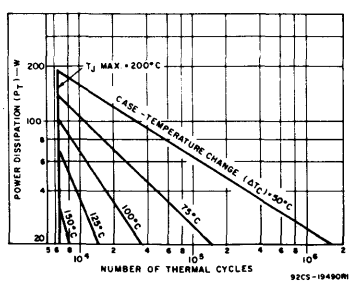


Fig. 2 — Thermal-cycle rating chart for RCS258.

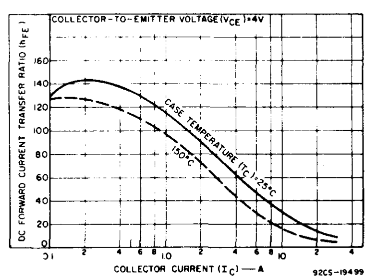


Fig. 3—Typical dc beta characteristics for 2N3771.

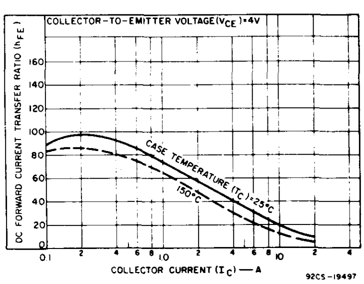


Fig. 4 — Typical dc beta characteristics for 2N3772, 2N6257 and RCS258.

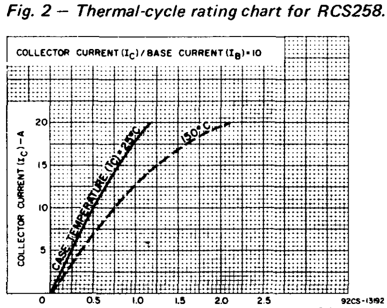


Fig. 5—Typical saturation-voltage characteristics for 2N3771.

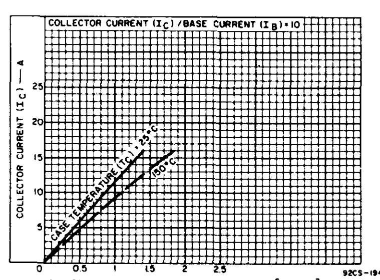


Fig. 6 — Typical saturation-voltage characteristics for 2N3772, 2N6257 and RCS258.

2N3771, 2N3772, 2N6257, RCS258

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25° Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc			CURRENT A dc		LIMITS: 2N3771		2N3772		2N6257		RCS258		UNITS
		V_{CB}	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* Collector-Cutoff Current With emitter open	I_{CBO}	50					–	2*	–	–	–	4	–	–	mA
		100					–	–	–	5*	–	–	–	5	
With base-emitter junction reverse-biased	I_{CEX}		45	−1.5			–	–	–	–	–	4	–	–	mA
			50	−1.5			–	2	–	–	–	–	–	–	
			100	−1.5			–	–	–	5	–	–	–	5	
With base-emitter junction reversed-biased, T_C=150°C	I_{CEX}		30	−1.5			–	10	–	10	–	–	–	–	mA
			45	−1.5			–	–	–	–	–	20	–	–	
			30	−1.5			–	–	–	–	–	–	–	10	
With base open	I_{CEO}		25			0	–	–	–	–	–	10	–	–	mA
			30			0	–	10	–	–	–	–	–	–	
			50			0	–	–	–	10	–	–	–	10	
* Emitter-Cutoff Current	I_{EBO}			−5	0		–	5	–	–	–	10	–	–	mA
				−7	0		–	–	–	5	–	–	–	5	
* DC Forward Current Transfer Ratio	h_{FE}		4		30[a]		5	–	–	–	–	–	–	–	
			4		20[a]		–	–	5	–	5	–	5	–	
			4		15[a]		15	60	–	–	–	–	–	–	
			4		10[a]		–	–	15	60	–	–	15	60	
			4		8[a]		–	–	–	–	15	75	–	–	
Collector-to-Emitter Sustaining Voltage With base-emitter Junction reversed-biased (R_{BE} = 100Ω)	$V_{CEX}(sus)$			−1.5	0.2[a]		50	–	80	–	50	–	80	–	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$				0.2[a]		45	–	70	–	45	–	70	–	V
* With base open	$V_{CEO}(sus)$				0.2[a]	0	40	–	60	–	40	–	60	–	V
* Base-to-Emitter Voltage	V_{BE}		4		15[a]		–	2.7	–	–	–	–	–	–	V
			4		10[a]		–	–	–	2.2	–	–	–	2.2	
			4		8[a]		–	–	–	–	–	2.2	–	–	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				30[a]	6	–	4	–	–	–	–	–	–	V
					20[a]	4	–	–	–	4	–	4	–	4	
					15[a]	1.5	–	2	–	–	–	–	–	–	
					10[a]	1	–	–	–	1.4	–	–	–	1.4	
					8[a]	0.8	–	–	–	–	–	1.5	–	–	
Second-Breakdown Collector Current With base forward-biased and 1−s nonrepetitive pulse	$I_{S/b}$[b]		60				–	–	2.5	–	–	–	4.2	–	A
			40				3.75	–	–	–	3.75	–	–	–	
Second-Breakdown Energy With base reverse biased and L=40mH, R_{BE}=100Ω	$E_{S/b}$[c]			−1.5	5		500	–	500	–	500	–	500	–	mJ
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 0.05 MHz)	$\|h_{fe}\|$		4		1		4*	16 (Typ)	4*	16 (Typ)	4*	16 (Typ)	4	16 (Typ)	
* Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}		4		1		40	–	40	–	40	–	40	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						–	1.17	–	1.17	–	1.17	–	0.7	°C/W

*In accordance with JEDEC registration data formal JS-6 RDF-2.

[a] Pulsed; pulse duration = 300 μs, rep. rate = 60 Hz, duty factor ≤ 2%.

[b] $I_{S/b}$ is defined at the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased for transistor operation in the active region.

[c] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = ½LI^2$, where L is a series load or leakage inductance and I is the peak collector current.

2N3771, 2N3772,2N6257, RCS258

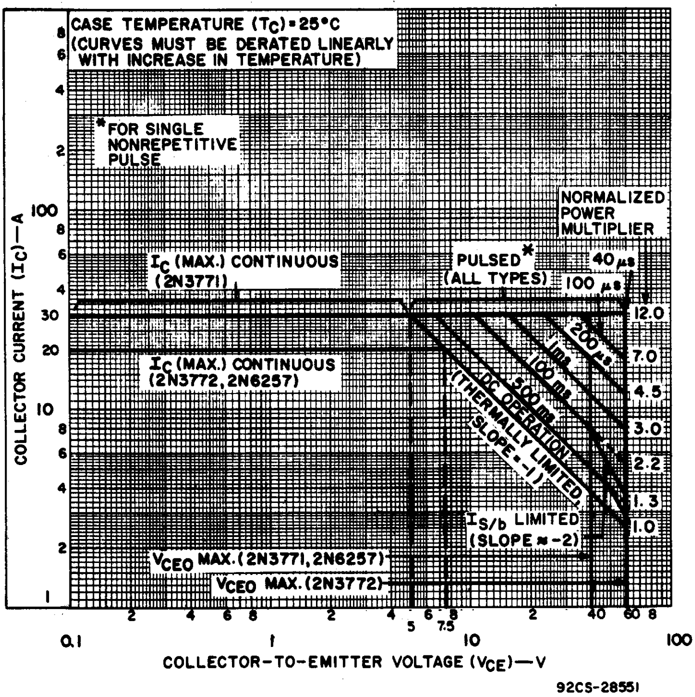


Fig. 7— Maximum operating areas for 2N3771, 2N3772, and 2N6257.

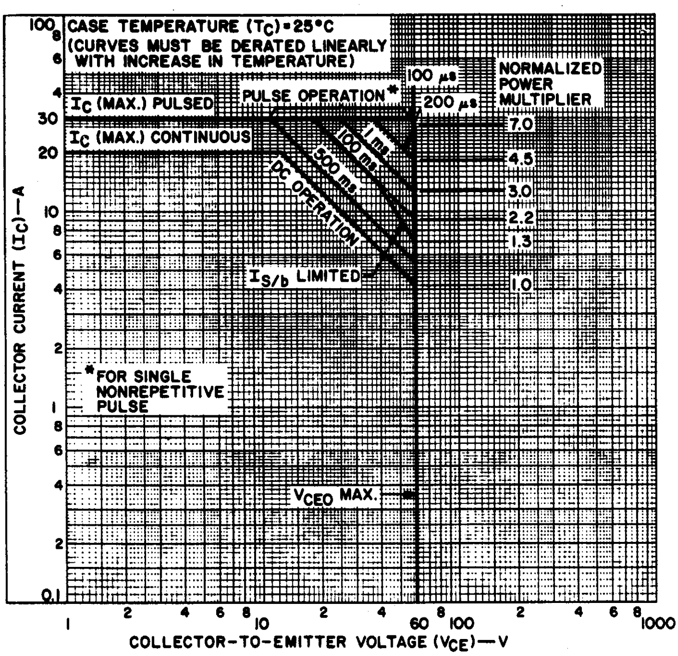


Fig. 8— Maximum operating areas for RCS258.

2N3771, 2N3772, 2N6257, RCS258

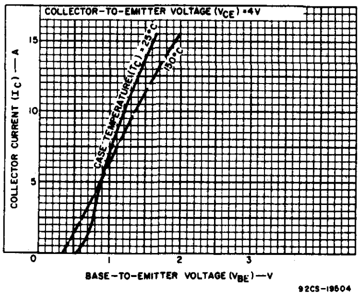


Fig. 9— Typical transfer characteristics for 2N3771.

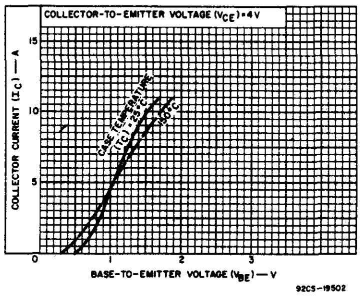


Fig. 10— Typical transfer characteristics for 2N3772, 2N6257 and RCS258.

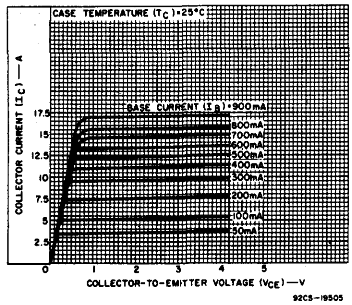


Fig. 11—Typical output characteristics for 2N3771.

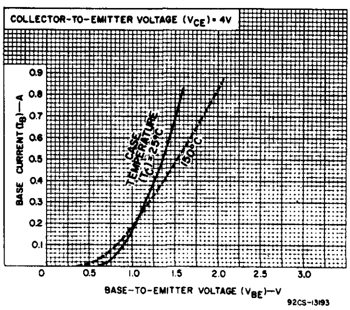


Fig. 12—Typical input characteristics for 2N3771 and 2N6257.

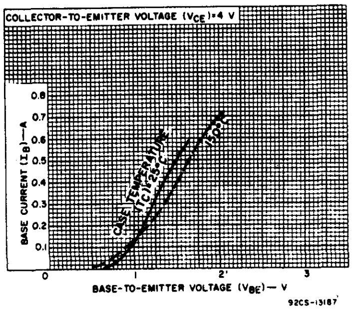


Fig. 13— Typical input characteristics for 2N3772 and RCS258.

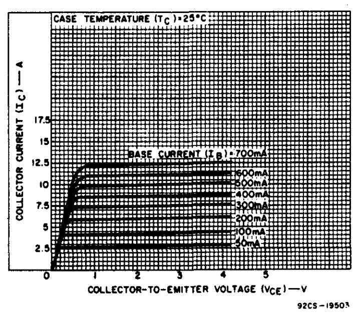


Fig. 14—Typical output characteristics for 2N3772, 2N6257 and RCS258.

2N3773, 2N4348, 2N6259

Hometaxial-Base, High Current Silicon N-P-N Transistors

Rugged High-Voltage Devices for Applications in Industrial and Commercial Equipment

These RCA types are hometaxial-base silicon n-p-n transistors intended for a wide variety of high-voltage high-current applications. Typical applications for these transistors include power-switching circuits, audio amplifiers, series- and shunt-regulator driver and output stages, dc-to-dc converters, inverters, and solenoid (hammer)/relay driver service.

These devices employ the popular JEDEC TO-3 package; they differ in maximum ratings for voltage, current, and power.

Features:

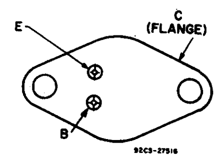
- High dissipation capability – 120 W (2N4348), 150 W (2N3773), 250 W (2N6259)
- 5-A specification for h_{FE}, V_{BE}, & $V_{CE}(sat)$ (2N4348)
- 8-A specification for h_{FE}, V_{BE}, & $V_{CE}(sat)$ (2N3773, 2N6259)
- V_{CEX} – 140 V min (2N4348), 160 V min (2N3773), 170 V min (2N6259)
- Low saturation voltage with high beta

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N4348	2N3773	2N6259	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	140	160	170	V
COLLECTOR-TO-EMITTER VOLTAGE:					
* With base open	V_{CEO}	120	140	150	V
With reverse bias (V_{BE}) of −1.5 V	V_{CEX}	140	160	170	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	V
*COLLECTOR CURRENT:	I_C				
Continuous		10	16	16	A
Peak		30	30	30	A
*BASE CURRENT:	I_B				
Continuous		4	4	4	A
Peak		15	15	15	A
*TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		120	150	250	W
At case temperatures above 25°C		Derate linearly to 200°C			
*TEMPERATURE RANGE:					
Storage & Operating (Junction)		← −65 to +200 →			°C
*PIN TEMPERATURE (During Soldering):					
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		← 230 →			°C

* In accordance with JEDEC registration data format (JS-6, RDF-2).

TERMINAL DESIGNATIONS



JEDEC TO-3

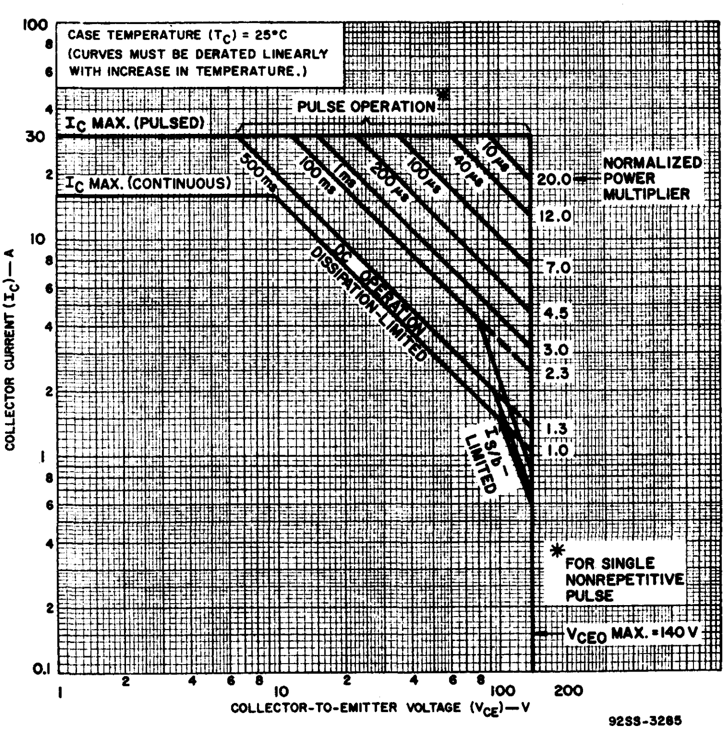


Fig. 1 - Maximum operating areas for 2N3773.

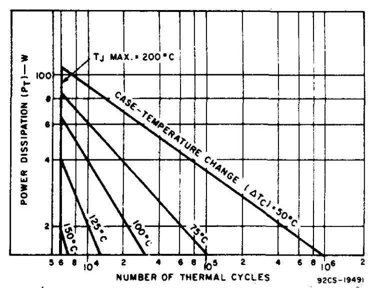


Fig. 2 - Thermal-cycle rating chart for 2N3773.

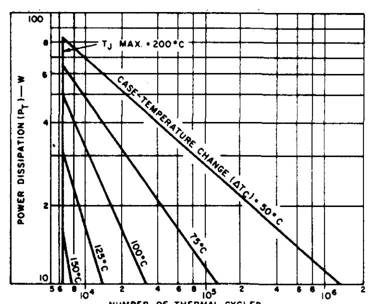


Fig. 3 - Thermal-cycle rating chart for 2N4348.

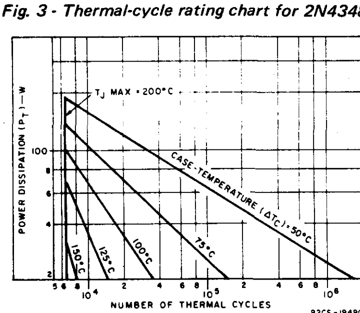


Fig. 4 - Thermal-cycle rating chart for 2N6259.

2N3773, 2N4348, 2N6259

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N4348 Min.	Max.	2N3773 Min.	Max.	2N6259 Min.	Max.	UNITS
* Collector-Cutoff Current: With emitter open, V_{CB}=140 V	I_{CBO}					–	–	–	2	–	–	mA
With base-emitter junction reverse-biased	I_{CEX}	120 140 150	−1.5 −1.5 −1.5			– – –	2 – –	– – –	– 2 –	– – –	– – 0.2	mA
With base-emitter junction reverse-biased and T_C = 150°C	I_{CEX}	120 140 150	−1.5 −1.5 −1.5			– – –	10 – –	– – –	– 10 –	– – –	– – 4	mA
With base open	I_{CEO}	100 120				– –	20 –	– –	– 10	– –	– 2	mA
* Emitter-Cutoff Current	I_{EBO}		−7	0		–	5	–	5	–	2	mA
* DC Forward Current Transfer Ratio	h_{FE}	4 4 2 4 4		5[a] 8[a] 8[a] 10[a] 16[a]		15 – – 10 –	60 – – – –	– 15 – – 5	– 60 – – –	– – 15 – 10	– – 60 – –	
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse-biased (R_{BE} = 100Ω)	$V_{CEX}(sus)$		−1.5	0.1		140	–	160	–	170		V
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$			0.2[a]		140	–	150	–	160	–	V
* With base open	$V_{CEO}(sus)$			0.2[a]	0	120	–	140	–	150	–	V
* Base-to-Emitter Voltage	V_{BE}	4 4 2 4		5[a] 8[a] 8[a] 10[a]		– – – –	2 – – 3	– – – –	– 2.2 – –	– – – –	– – 2 –	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			5[a] 8[a] 10[a] 16[a]	0.5 0.8 1.25 3.2	– – – –	1 – 2 –	– – – –	– 1.4 – 4	– – – –	– 1 – 2.5	V
Second-Breakdown Collector Current With base forward-biased and 1-s nonrepetitive pulse	$I_{S/b}$[b]	80 100				1.5 –	– –	– 1.5	– –	– 2.5	– –	A
Second-Breakdown Energy With base reverse-biased and L = 40 mH, R_{BE} = 100Ω	$E_{S/b}$[c]		−1.5	2.5		0.125	–	0.125	–	0.125	–	J
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 50 kHz)	$\|h_{fe}\|$	4		1		4	–	4	–	4	–	
* Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		1		40	–	40	–	40	–	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$					–	1.46	–	1.17	–	0.7	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

[a] Pulsed; pulse duration = 300μs, rep. rate = 60 Hz.

[b] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter base junction forward-biased for transistor operation in the active region.

[c] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b}$ = $1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

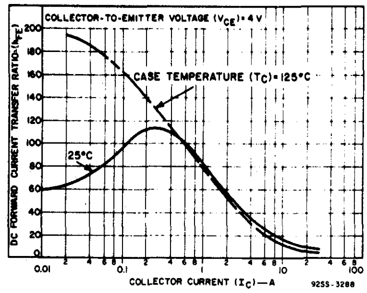


Fig. 5 - Typical dc beta characteristics for 2N3773.

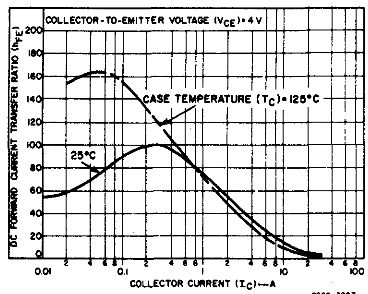


Fig. 6 - Typical dc beta characteristics for 2N4348.

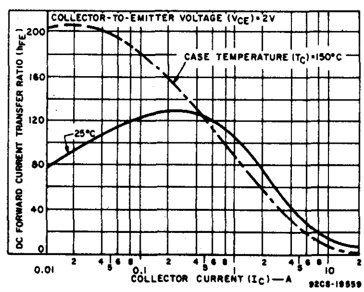


Fig. 7 - Typical dc beta characteristics for 2N6259.

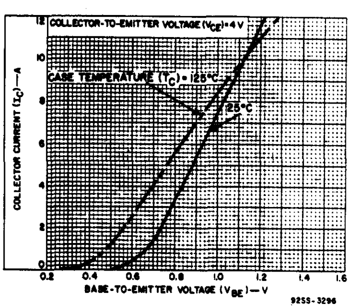


Fig. 8 - Typical transfer characteristics for 2N3773.

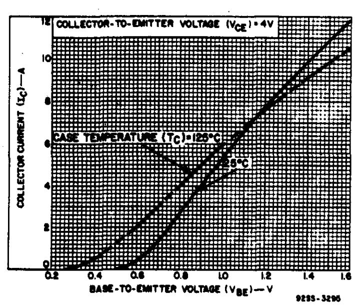


Fig. 9 - Typical transfer characteristics for 2N4348.

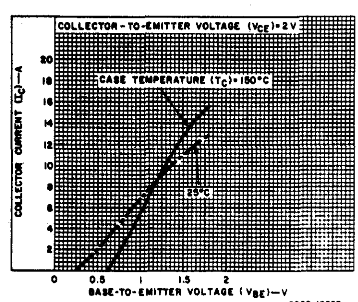


Fig. 10 - Typical transfer characteristics for 2N6259.

2N3773, 2N4348, 2N6259

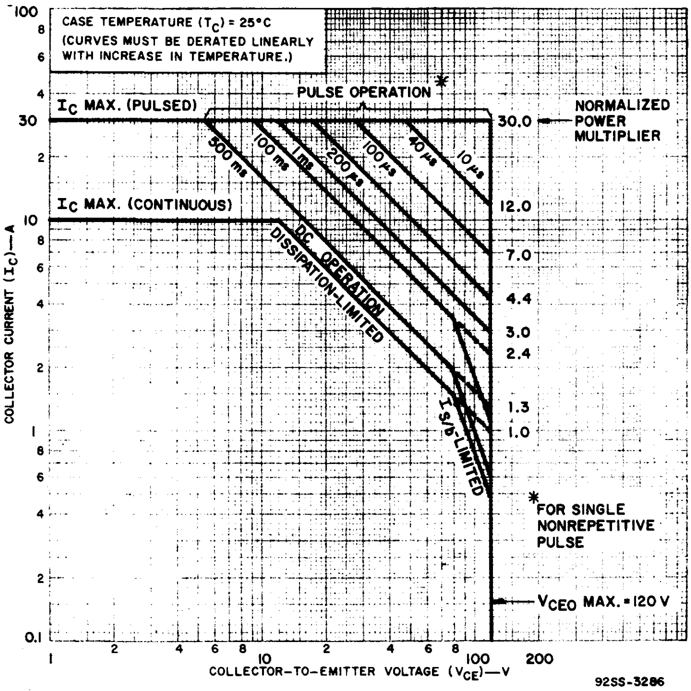


Fig. 11 - Maximum operating areas for 2N4348.

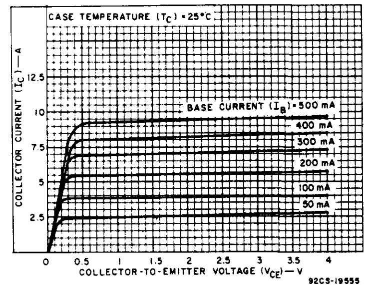


Fig. 12 - Typical output characteristics for 2N3773.

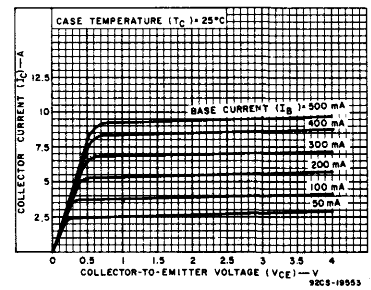


Fig. 13 - Typical output characteristics for 2N4348.

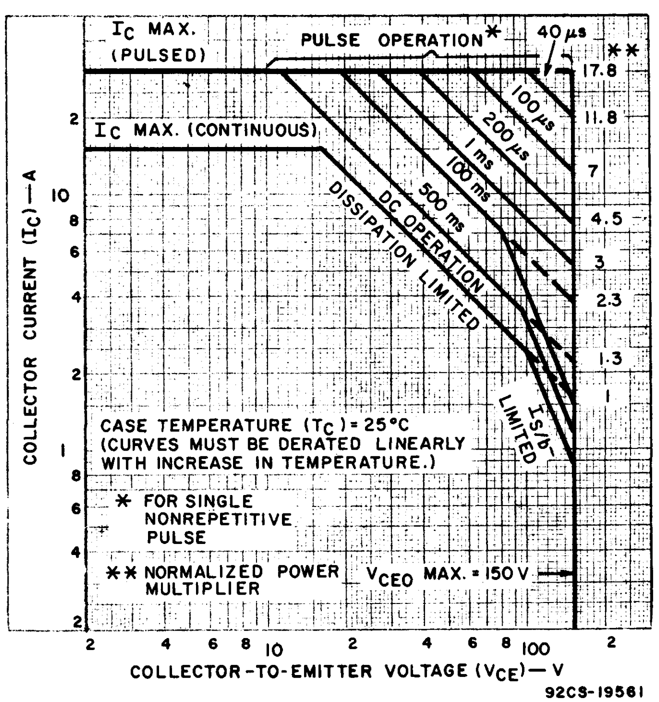


Fig. 14 - Maximum operating areas for 2N6259.

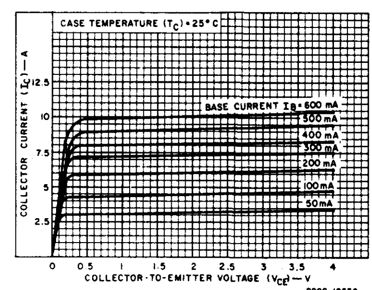


Fig. 15 - Typical output characteristics for 2N6259.

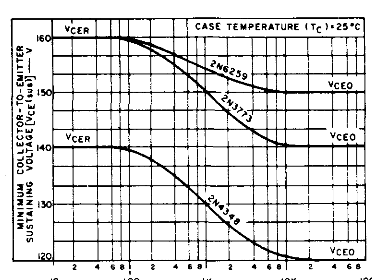


Fig. 16 - Sustaining voltage as a function of base-to-emitter resistance for all types.

2N3773, 2N4348, 2N6259

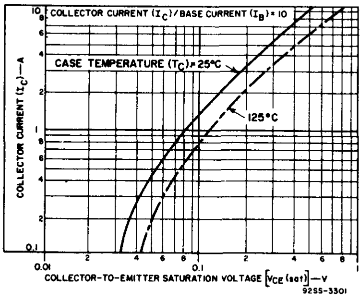


Fig. 17 - Typical saturation-voltage characteristics for 2N3773.

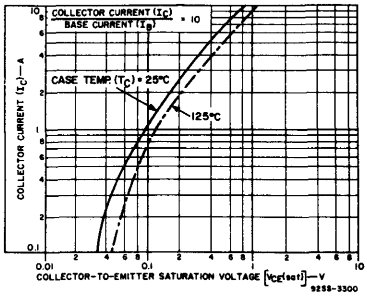


Fig. 18 - Typical saturation-voltage characteristics for 2N4348.

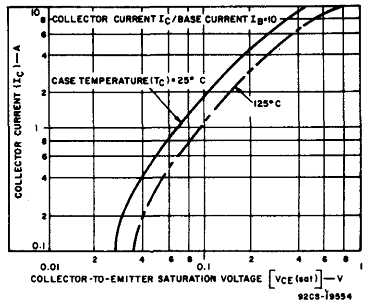


Fig. 19 - Typical saturation-voltage characteristics for 2N6259.

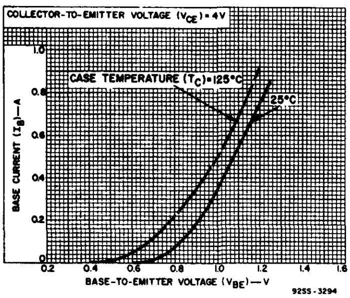


Fig. 20 - Typical input characteristics for 2N3773.

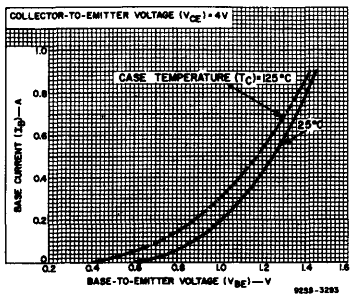


Fig. 21 - Typical input characteristics for 2N4348.

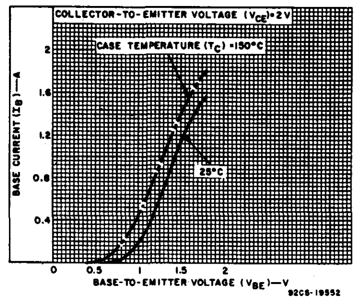


Fig. 22 - Typical input characteristics for 2N6259.

2N3791, 2N3792

Silicon P-N-P Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices
For Industrial and Commercial Use

The RCA-2N3791 and 2N3792 are epitaxial-base silicon p-n-p transistors featuring high-gain at high current. They may be used as complements to the n-p-n types 2N3715 and 2N3716, respectively. These devices are intended for medium-speed switching and amplifier applications and feature a dissipation capability of 150 watts at case temperatures up to 25°C

They differ in voltage ratings and in the currents at which the parameters are controlled. Both are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- **High dissipation capability**
- **Low saturation voltages**
- **Maximum safe-areas-of-operation curves**
- **Hermetically sealed JEDEC TO-204MA package**
- **High gain at high current**
- **Thermal-cycling rating curve**

APPLICATIONS:

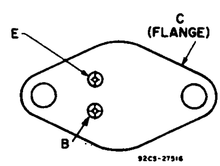
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

Maximum Ratings, *Absolute-Maximum Values:*

		2N3791	2N3792	
*	V_{CBO}	−60	−80	V
*	V_{CEO}	−60	−80	V
*	V_{EBO}	−7	−7	V
*	I_C	−10	−10	A
*	I_{CM}	−10	−10	A
*	I_B	−4	−4	A
*	P_T			
	$T_C \leq 25°C$	150	150	W
	$T_C > 25°C$ derate linearly	0.86		W/°C
*	T_J, T_{stg}	−65 to 200		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

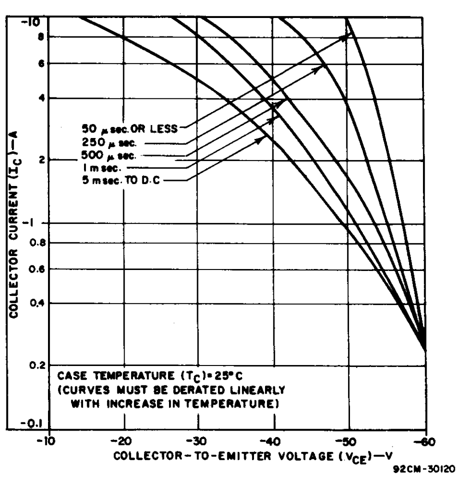


Fig. 1 — Maximum operating areas for 2N3791.

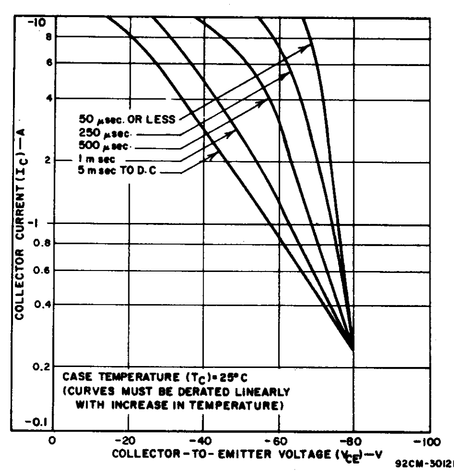


Fig. 2 — Maximum operating areas for 2N3792.

2N3791,2N3792

ELECTRICAL CHARACTERISTICS, at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTICS	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N3791		2N3792		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
* I_{CEX}	−60	1.5	–	–	–	−1	–	–	mA
	−80	1.5	–	–	–	–	–	−1	
T_C = 150°C	−60	1.5	–	–	–	−5	–	–	
	−80	1.5	–	–	–	–	–	−5	
* I_{CEO}	−30		–	–	–	−10	–	−10	mA
	−40		–	–	–	−10	–	−10	
* I_{EBO}		7	–	–	–	−5	–	−5	mA
* $V_{CEO}(sus)$[b]			−0.2	0	−60	–	−80	–	V
* h_{FE}[a]	−2		−1	–	50	150	50	150	
	−2		−3	–	30	–	30	–	
	−4		−10	–	4	–	4	–	
* V_{BE}	−2		−5	–	–	−1.8	–	−1.8	V
	−4		−10	–	–	−4.0	–	−4.0	
* $V_{BE}(sat)$[a]			−5	−0.5	–	−1.5	–	−1.5	V
* $V_{CE}(sat)$[a]			−5	−0.5	–	−1	–	−1	V
			−10	−2.0	–	−4	–	−4	
* f_{hfe}	−10		−0.5	–	30	–	30	–	KHz
* h_{fe} f = 1 KHz	−10		−0.5	–	25	250	25	250	
* $\|h_{fe}\|$ f = 1 MHz	−10		−0.5	–	4	–	4	–	
$I_{S/b}$ tp = 1s	40				2.7	–	2.95	–	A
* C_{ob} V_{CB} = 10 V f = 1 MHz			0		–	500	–	500	pF
* $R_{\theta JC}$					–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.
a Pulsed; pulse duration = 200 μs, duty factor = 1.5%.
b **CAUTION:** Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.

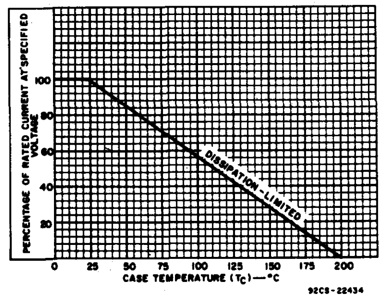


Fig. 3 — Derating curve.

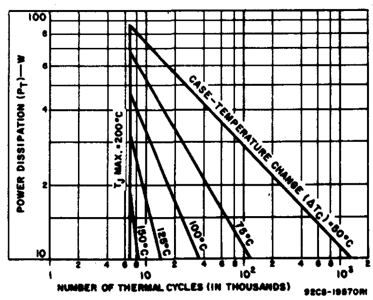


Fig. 4 — Thermal-cycling rating chart.

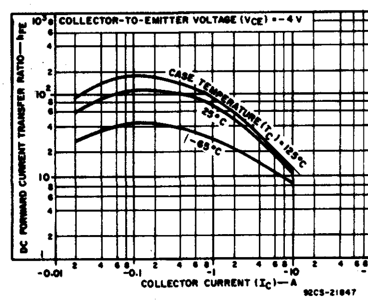


Fig. 5 — Typical dc beta characteristics for both types.

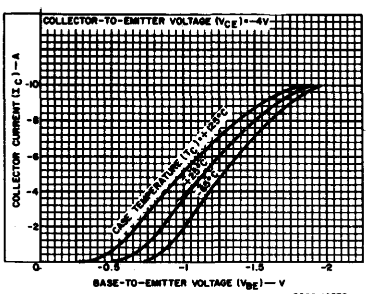


Fig. 6 — Typical transfer characteristics for both types.

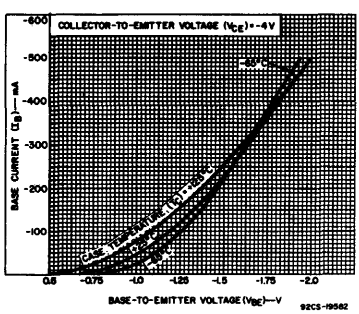


Fig. 7 — Typical input characteristics for both types.

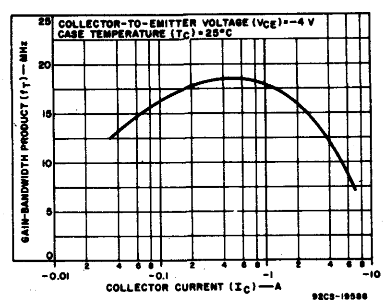


Fig. 8 — Typical gain-bandwidth product for both types.

2N3878, 2N3879, 2N5202, 2N6500, 40375

High-Speed, Epitaxial-Collector Silicon N-P-N Transistors

For High-Speed Switching and Linear-Amplifier Applications

Features:

- Maximum-area-of-operation curves for dc and pulse operation
- Rated for safe operation in both forward- and reverse-bias conditions
- High sustaining voltage
- Total saturated transition time less than 1 μs for 2N3879, 2N5202, and 2N6500

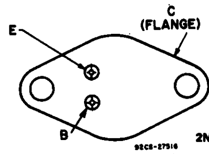
RCA-2N3878, 2N3879, 2N5202, and 2N6500● are epitaxial silicon n-p-n transistors. The 2N3878 is an amplifier type intended for audio-, ultrasonic-, and radio-frequency circuits. Types 2N3879, 2N5202, and 2N6500 are switching transistors intended for use in high-current, high-speed switching circuits.

Type 40375 is a 2N3878 with a factory-attached heat radiator; it is intended for printed circuit-board applications.

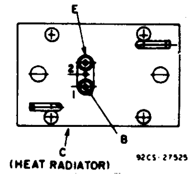
Typical applications for these transistors include: low-distortion power amplifiers, oscillators, switching regulators, series regulators, converters, and inverters.

● Formerly RCA Dev. Type Nos. TA2509, TA2509A, TA7285, and TA8932, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-66
2N3878, 2N3879, 2N5202, 2N6500

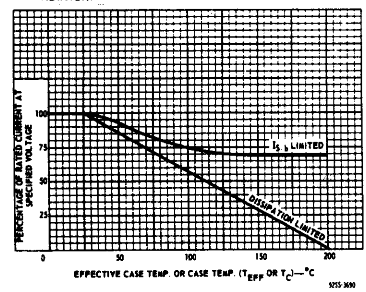


JEDEC TO-66 with Heat Radiator
40375

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3878 40375	2N3879	2N5202	2N6500	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	120	100	120	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$	65	90	75*	110*	V
With base open	$V_{CEO}(sus)$	50*	75*	50	90*	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	6	7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	4	7	4	4	A
PEAK COLLECTOR CURRENT	I_{CM}	10	10	5	5	A
*CONTINUOUS BASE CURRENT	I_B	4	5	2	3	A
*TRANSISTOR DISSIPATION	P_T					
At case temperature (T_C) = 25°C		35 (2N3878)	35	35	35	W
At case temperatures above 25°C		Derate linearly at 0.2 W/°C				
At ambient temperature (T_A) = 25°C		5.8 (40375)	–	–	–	W
For other conditions		See Figs. 1,2,3, and 5				
*TEMPERATURE RANGE:						
Storage & operating (Junction)		-65 to 200				°C
*PIN TEMPERATURE:						
1/32 in. (0.8 mm) from seating plane for 10 s max.		235	235	235	235	°C

* In accordance with JEDEC registration data format JS-6 RDF-2 (2N3878); JS-6 RDF-1 (2N3879, 2N5202, 2N6500).



Note: Use ambient temperature for derating 40375.

Fig. 2 - Dissipation derating for all types.

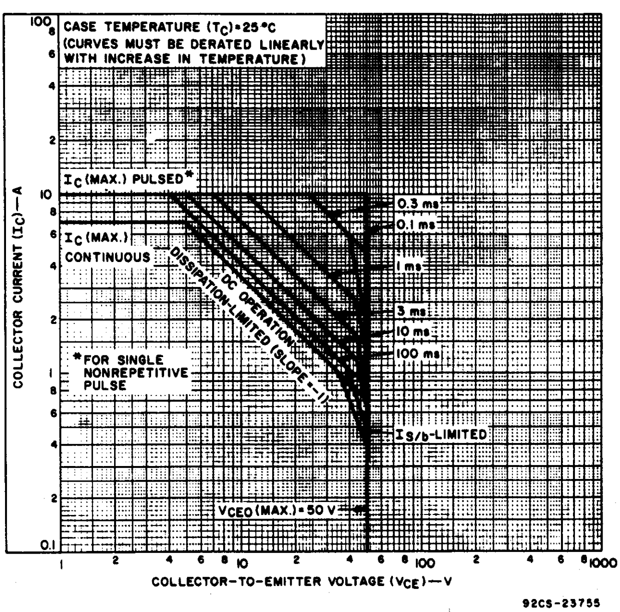


Fig. 1 - Maximum operating areas for 2N3878.

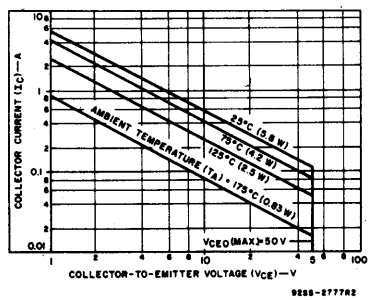


Fig. 3 - Maximum operating areas for 40375.

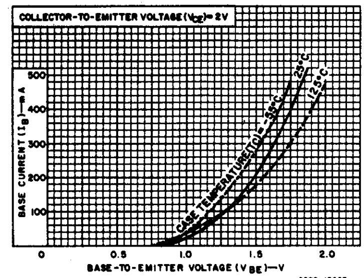


Fig. 4 - Typical input characteristics for all types.

2N3878, 2N3879, 2N5202, 2N6500, 40375

ELECTRICAL CHARACTERISTICS, ***At Case Temperature (T_C) = 25°C unless otherwise specified:***

		TEST CONDITIONS				LIMITS								
CHARACTERISTIC	SYMBOL	VOLTAGE V dc		CURRENT A dc		2N3878 40375		2N3879		2N5202		2N6500		UNITS
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector Cutoff Current: * With base-emitter junction reverse-biased	I_{CEV}	100	−1.5			–	–	–	–	–	10	–	–	mA
		110	0			–	–	–	–	–	–	–	5	
		120	−1.5			–	25	–	25	–	–	–	–	
* With base-emitter junction reverse-biased and T_C = 150°C	I_{CEV}	100	−1.5			–	4	–	4	–	10	–	–	mA
		110	0			–	–	–	–	–	–	–	10	
With base open	I_{CEO}	40			0	–	5*	–	5	–	–	–	–	mA
		70			0	–	–	–	–	–	–	–	5	
* Emitter Cutoff Current	I_{EBO}		−6			–	–	–	–	–	10	–	–	mA
			−7			–	10	–	10	–	–	–	25	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$			0.2	0	50[a]*		75[a]*		50[a]		90[a]*		V
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$			0.2	0	65[a]		90[a]		75[a]		110[a]		V
DC Forward-Current Transfer Ratio	h_{FE}	1.2		4[b]						10*	100*			
		2		0.5[b]		40*	200*							
		2		3[b]								15*	60*	
		2		4[b]		8*		12*	100*					
		5		4[b]		20*		20	80					
		5		0.5[b]		50*	200*	40						
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			3[b]	0.3								1.5	V
				4[b]	0.4		2		1.2		1.2			
* Base-to-Emitter Voltage	V_{BE}	2		4[b]			2.5							V
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			3[b]	0.3								2.5	V
				4[b]	0.4				2		2			
Collector-to-Base Output Capacitance: (f = 1 MHz, V_{CB} = 10 V)	C_{ob}						175*		175		175		175	pF
Second Breakdown Collector Current With base forward-biased and 1-s nonrepetitive pulse	$I_{S/b}$	40				750		500		400		400		mA
Second-Breakdown Energy: With base reverse-biased and R_{BE} = 50 Ω, V_{BB} = −4 V At L = 50 μH	$E_{S/b}$[c]									0.4				mJ
At L = 125 μH						1		1				0.5		
* Magnitude of Common Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio: (f = 10 MHz)	$\|h_{fe}\|$	10		0.5		4		4		6		6		
* Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio: (f = 1 kHz)	h_{fe}	30		0.1		40								
Thermal Resistance: Junction-to-case	$R_{\theta JC}$					2N3878	5		5		5		5	°C/W
Junction-to-ambient	$R_{\theta JA}$					40375	30							°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2 (2N3878); JS-6 RDF-1 (2N3879, 2N5202, 2N6500).

[a] CAUTION: Sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

[b] Pulsed, pulse duration = 300 μs, duty factor ≤ 2 %.

[c] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

TRANSITION AND STORAGE-TIME CHARACTERISTICS FOR SWITCHING TYPES, ***At Case Temperature (T_C) = 25°C:***

		TEST CONDITIONS			LIMITS						
CHARACTERISTIC	SYMBOL	VOLTAGE V dc	CURRENT A dc		2N3879		2N5202		2N6500		UNITS
		V_{CC}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
Saturated Switching Time Delay time	t_d	30	3	0.3[a]	–	–	–	–	–	40	ns
		30	4	0.4[a]	–	40	–	–	–	–	
		30	4	0.8[a]	–	–	–	40	–	–	
* Rise time	t_r	30	3	0.3[a]	–	–	–	–	–	400	ns
		30	4	0.4[a]	–	400	–	–	–	–	
		30	4	0.8[a]	–	–	–	400	–	–	
* Storage time	t_s	30	3	0.3[a]	–	–	–	–	–	1000	ns
		30	4	0.4[a]	–	800	–	–	–	–	
		30	4	0.8[a]	–	–	–	1200	–	–	
* Fall time	t_f	30	3	0.3[a]	–	–	–	–	–	500	ns
		30	4	0.4[a]	–	400	–	–	–	–	
		30	4	0.8[a]	–	–	–	400	–	–	

* In accordance with JEDEC registration data format (JS-6, RDF-1)

[a] $I_{B_1} = I_{B_2}$

2N3878, 2N3879, 2N5202, 2N6500, 40375

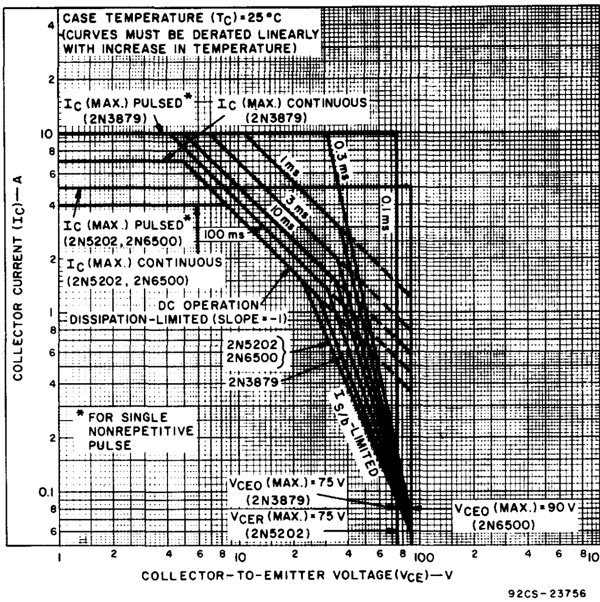


Fig. 5 - Maximum operating areas for 2N3879, 2N5202, and 2N6500.

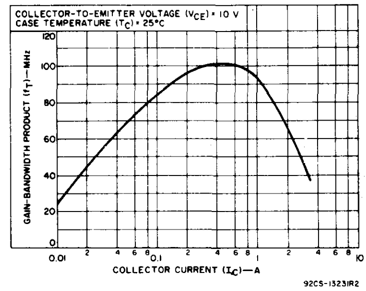


Fig. 6 - Typical gain-bandwidth product for all types.

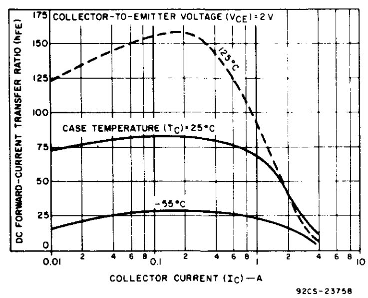


Fig. 7 - Typical dc beta characteristics for 2N6500.

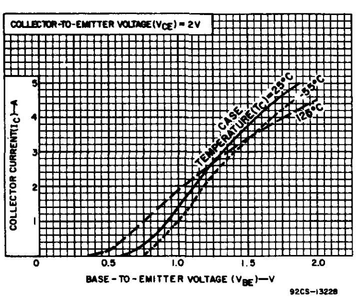


Fig. 8 - Typical transfer characteristics for all types.

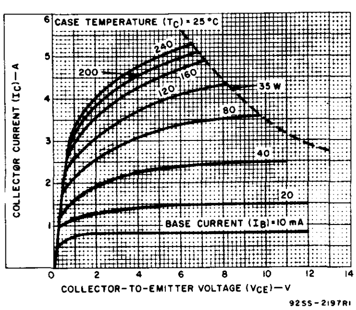


Fig. 9 - Typical output characteristics for 2N3878, 2N3879, 2N5202 and 40375.

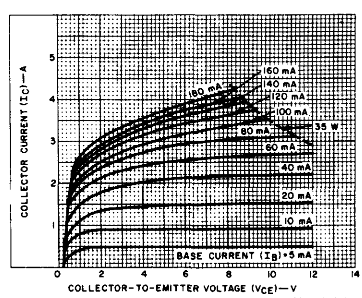


Fig. 10 - Typical output characteristics for 2N6500.

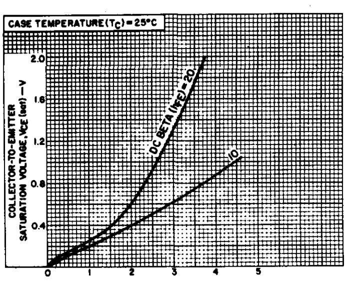


Fig. 11 - Typical saturation-voltage characteristics for 2N3878, and 2N3879.

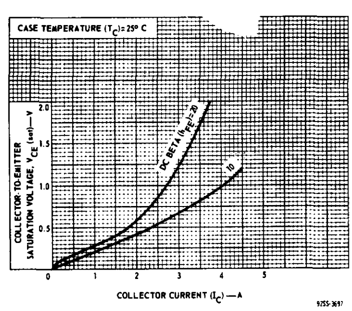


Fig. 12 - Typical saturation-voltage characteristics for 2N5202.

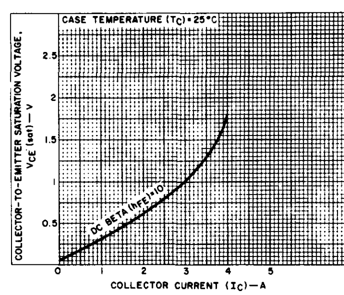


Fig. 13 - Typical saturation-voltage characteristics for 2N6500.

2N3878, 2N3879, 2N5202, 2N6500, 4305

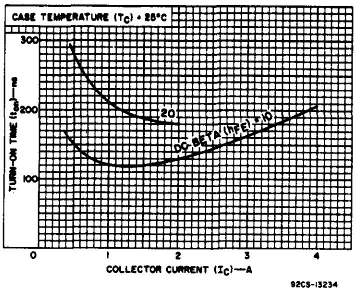


Fig. 14 - Typical turn-on time for 2N3879, 2N5202, and 2N6500.

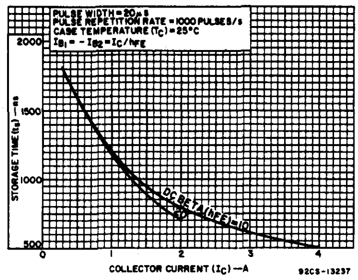


Fig. 15 - Typical storage time for 2N3879, 2N5202, and 2N6500.

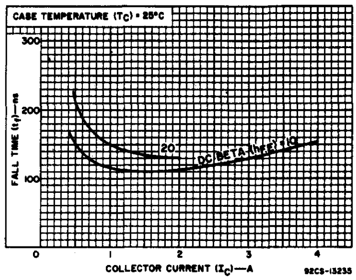


Fig. 16 - Typical fall time for 2N3879, 2N5202, and 2N6500.

2N4036, 2N4037, 2N4314, 40391, 40394, 41503

Medium-Power Silicon P-N-P Planar Transistors

General-Purpose Types for Industrial and Commercial Applications

These RCA types are double-diffused, epitaxial-planar, silicon p-n-p transistors; they differ in breakdown-voltage ratings, leakage-current, and saturation characteristics.

The 2N4036, 2N4037, 2N4314, 40391, and 40394 transistors are intended for a wide variety of small-signal medium-power applications. With a minimum gain-bandwidth product (f_T) of 60 MHz, these devices provide useful gain at high frequencies. In addition, the 2N4036 is useful in high-speed saturated switching applications.

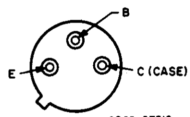
Type 41503 is suitable for low-power, low-cost industrial and audio uses, and may be employed as the p-n-p complement to RCA n-p-n type 41502.

Types 2N4036, 2N4037, 2N4314, and 41503 are supplied in the JEDEC TO-39 hermetic package. The 40391 is a 2N4037 with a factory attached heat radiator, intended for printed-circuit-board applications. Type 40394 is a 2N4037 with a factory-attached diamond-shaped mounting flange.

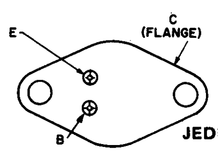
Features:

- 2N4036, 2N4037 are p-n-p complements of 2N2102, 2N3053
- Gain-bandwidth product (f_T) = 60 MHz min.
- High breakdown voltages
- Maximum-area-of-operation curves
- Planar construction provides low noise and low leakage
- Low saturation voltages
- High pulsed beta at high collector current
- Fast switching (2N4036)

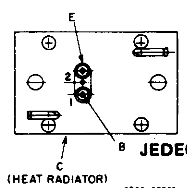
TERMINAL DESIGNATIONS



JEDEC TO-39
2N4036, 2N4037
2N4314, 41503



JEDEC TO-39 with Flange
40394



JEDEC TO-39 with Heat Radiator
40391

MAXIMUM RATINGS, *Absolute Maximum Values:*		**2N4036**	**2N4037 40391, 40394**	**2N4314**	**41503**	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−90	−60	−90	–	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With 1.5 volts (V_{BE}) of reverse bias	$V_{CEV}(sus)$	−85	−60	−85	–	V
With external base-to-emitter resistance (R_{BE}) ≤ 200Ω	$V_{CER}(sus)$	−85	−60	−85	–	V
* With base open	$V_{CEO}(sus)$	−65	−40	−65	−30	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	−7	−7	−7	−4	V
*COLLECTOR CURRENT	I_C	−1.0	−1.0	−1.0	−1	A
*BASE CURRENT	I_B	−0.5	−0.5	−0.5	−0.5	
*TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		7	7(2N4037)	7	7	W
		–	7(40394)	–	–	W
At free-air temperatures up to 25°C		1	3.5(40391)	1	1	W
		–	1(2N4037, 40394)	–	–	W
At temperatures above 25°C		Derate linearly to 200°C				
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		−65 to 200				°C
*LEAD TEMPERATURE (During soldering):						
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		230				°C

* In accordance with JEDEC registration data format (JS-6 RDF-1 2N4036; JS-9 RDF-2 2N4037, 2N4314).

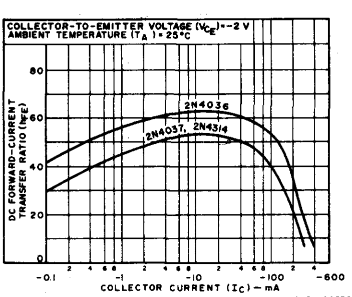


Fig.1—Typical dc-beta characteristics for 2N4036, 2N4037 and 2N4314.

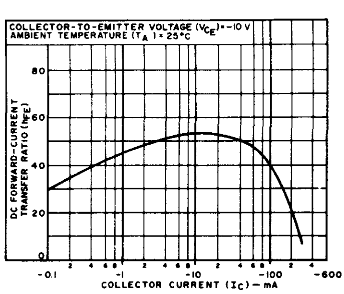


Fig.2—Typical dc-beta characteristic for 41503.

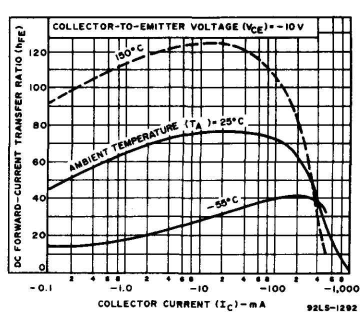


Fig.3—Typical dc beta characteristics for 2N4037 and 2N4314.

2N4036, 2N4037, 2N4314, 40391, 40394, 41503

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc			CURRENT mA dc	LIMITS: 2N4036		2N4037, 40391, 40394		2N4314		41503		UNITS
		V_{CB}	V_{CE}	V_{BE}	I_C	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
Collector Cutoff Current: With emitter open	I_{CBO}	−15 −90 −60				– – –	– -0.1● -0.02	– – –	– – -0.25●	– – –	– – -0.25●	– – –	−2 – –	μA mA μA
With base open	I_{CEO}		−30			–	-0.5●	–	-5●	–	-5●	–	–	μA
With base-emitter junction reverse biased	I_{CEX}		−85	1.5		–	-100●	–	–	–	–	–	–	mA
T_C = 150°C	I_{CEX}		−30	1.5		–	-0.1●	–	–	–	–	–	–	mA
Emitter Cutoff Current	I_{EBO}			7 5	0 0	– –	-0.1● -0.02	– –	– -1●	– –	– -1●	– –	– –	mA μA
Collector-to-Base Breakdown Voltage (I_E = 0)	$V_{(BR)CBO}$				-0.1	-90	–	-60●	–	-90●	–	–	–	V
Emitter-to-Base Breakdown Voltage (I_E = -0.1 mA)	$V_{(BR)EBO}$				0	-7	–	-7	–	-7	–	-4	–	V
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse biased	$V_{CEV}(sus)$			1.5	-100	-85[a]	–	-60[a]	–	-85[a]	–	–	–	V
With external base-to-emitter resistance (R_{BE}) ≤ 200Ω	$V_{CER}(sus)$				-100	-85[a]	–	-60[a]	–	-85[a]	–	–	–	V
● With base open	$V_{CEO}(sus)$				-30 -100	– -65[a]	– –	– -40[a]	– –	– -65[a]	– –	-30[a] –	– –	V
● Collector-to-Emitter Voltage (I_B = -15 mA)	$V_{CE}(sat)$				-150	–	-0.65	–	-1.4	–	-1.4	–	-1.5	V
Base-to-Emitter Voltage	V_{BE}		-10		-150	–	-1.1	–	-1.5●	–	-1.5●	–	-2.5	V
● Base-to-Emitter Voltage (I_B = -15mA)	$V_{BE}(sat)$				-150	–	-1.4	–	–	–	–	–	–	V
● DC Forward-Current Transfer Ratio	h_{FE}		-2 -10 -10 -10 -10		-150 -0.1 -1.0 -150[b] -500[b]	20 20 – 40 20	200 – – 140 –	– – 15 50 –	– – – 250 –	– – 15 50 –	– – – 250 –	– – – 20 –	– – – – –	
Common-Emitter, Small-Signal Short-Circuit, Forward-Current Transfer Ratio (at f = 20 MHz)	h_{fe}		-10		-50	3	–	3	–	3	–	–	–	
● Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (at f = 20 MHz)	$\|h_{fe}\|$		-10		-50	3	–	3	10	3	10	–	–	
Collector-Base Capacitance (at f = 1 MHz, I_E = 0)	C_{cb}	-10				–	30	–	30●	–	30●	–	30	pF
Input Capacitance	C_{ib}			0.5	0	–	90	–	90	–	90	–	90	pF
● Sat. Switching Time[c] Rise time Storage time Fall time Turn-on time Turn-off time	 t_r t_s t_f t_{on} t_{off}		 -30 -30 -30 -30 -30		 -150 -150 -150 -150 -150	 – – – – –	 70 600 100 110 700	 – – – – –	 – – – – –	 – – – – –	 – – – – –	 – – – – –	 – – – – –	ηs
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					– –	25● –	25 (max.) 2N4037 & 40394		– –	25 –	– –	25 –	°C/W
Junction-to-Ambient	$R_{\theta JA}$					– –	165 –	165 (max.) 2N4037 40394 50 (max.) 40391		– –	165 –	– –	165 –	°C/W

[a]CAUTION: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ MUST NOT be measured on a curve tracer.

[b] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

●In accordance with JEDEC registration data format (JS-6 RDF-1 2N4036; JS-9 RDF-2 2N4037, 2N4314).

[c]I_{B1} = I_{B2} = 15 mA

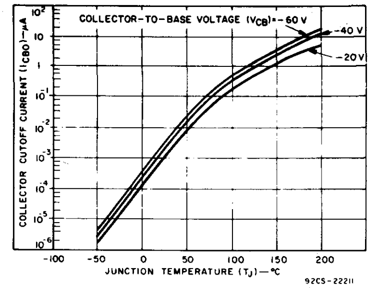


Fig.4—Typical collector-cutoff current vs. junction temperature for 2N4036.

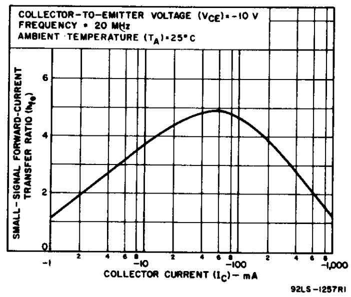


Fig.5—Typical small-signal beta characteristics for all types.

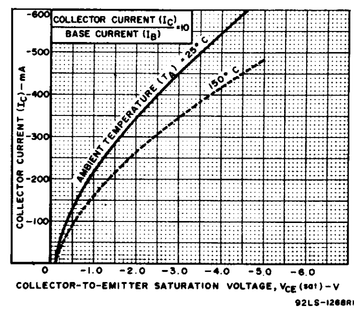


Fig.6—Typical saturation-voltage characteristics for 2N4036.

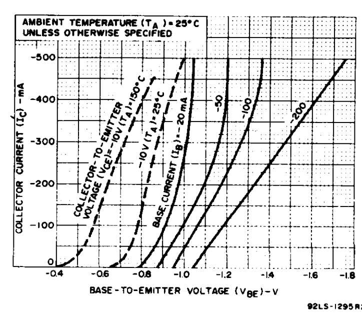


Fig.7—Typical transter characteristics for 2N4037 and 2N4314.

2N4036, 2N4037, 2N4314, 40391, 40394, 41503

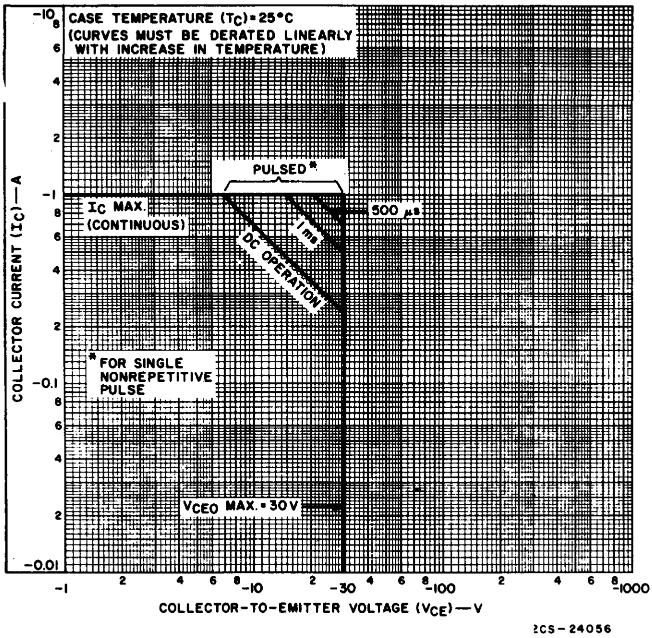


Fig.8—Maximum operating areas for 41503.

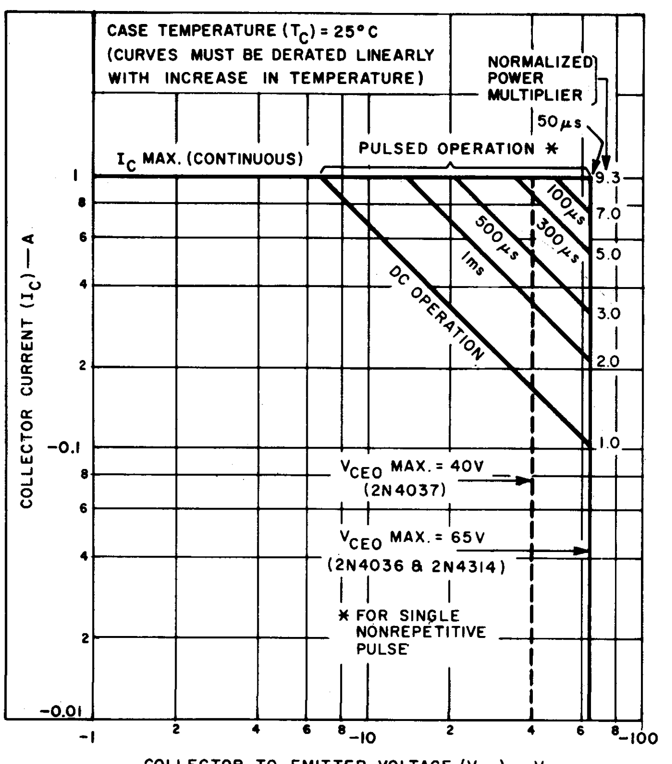


Fig.9—Maximum operating areas for 2N4036, 2N4037, and 2N4314.

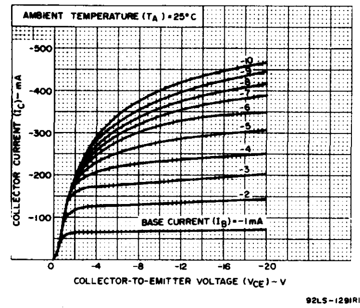


Fig.10—Typical large-signal output characteristics for 2N4037, 2N4314, 40391, and 40394.

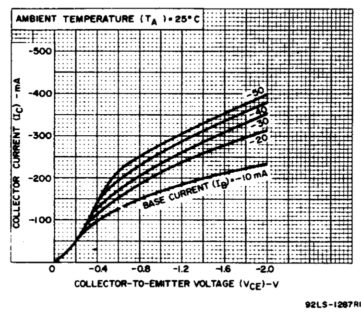


Fig.11—Typical small-signal output characteristics for 2N4037, 2N4314, 40391, and 40394.

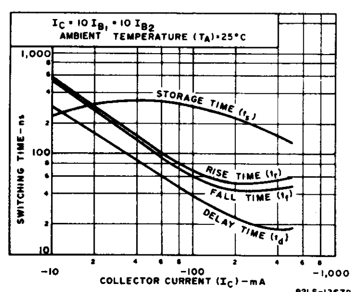


Fig.12—Typical saturated switching times for 2N4036.

2N4231A, 2N4232A, 2N4233A, 2N6312, 2N6313, 2N6314

Silicon N-P-N and P-N-P Medium-Power Transistors

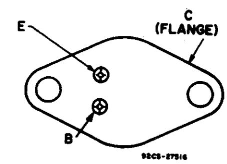
General-Purpose Types for Switching Applications

RCA-2N4231A, 2N4232A, and 2N4233A are multiple-epitaxial n-p-n transistors. The RCA-2N6312, 2N6313, and 2N6314 are multiple-epitaxial p-n-p transistors. They are complements to 2N4231A, 2N4232A, and 2N4233A. These types are supplied in steel JEDEC TO-213MA hermetic packages.

Features:

- 2N4231A–2N4233A complements of 2N6312–2N6314
- Low saturation voltages
- Maximum-safe-area-of-operation curves
- Thermal-cycle ratings
- High gain at high current

TERMINAL DESIGNATIONS



JEDEC TO-213MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	N-P-N 2N4231A P-N-P 2N6312♦	2N4232A 2N6313♦	2N4233A 2N6314♦	
* V_{CBO}	40	60	80	V
$V_{CEO}(sus)$	40	60	80	V
* V_{EBO}	5	5	5	V
* I_C (2N4231A, 2N4232A, 2N4233A)		3		A
(2N6312, 2N6313, 2N6314)		5		A
* I_{CM} (Registered for 2N6312, 13, 14 only)		10		A
* I_B (2N4231A, 2N4233A, 2N4233A)		1		A
(2N6312, 2N6313, 2N6314)		2		A
* P_T $T_C \leqslant 25°C$		75		W
$T_C > 25°C$ derate linearly		0.43		W/°C
* T_J, T_{stg} (2N4231A, 2N4232A, 2N4233A)		−55 to 200		°C
(2N6312, 2N6313, 2N6314)		−65 to 200		°C
* T_L (2N6312, 2N6313, 2N6314 only) At distances ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

♦ For p-n-p devices, voltage and current values are negative.

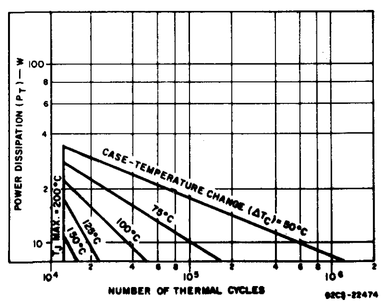


Fig. 2 — Thermal-cycling rating chart for all types.

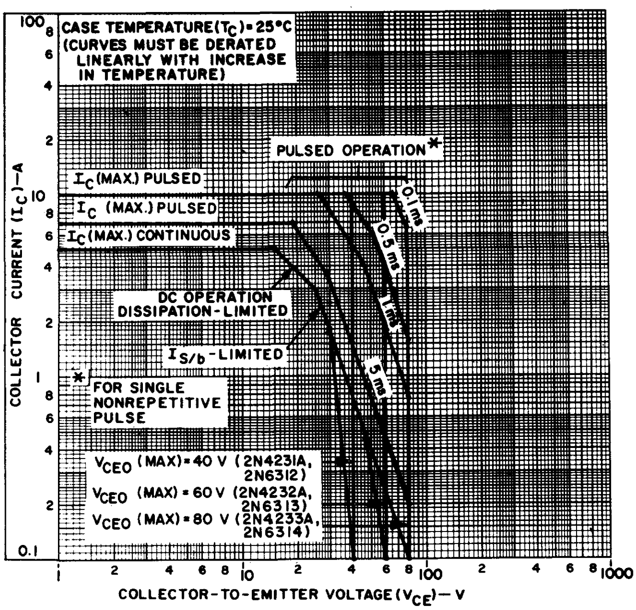


Fig. 1 — Maximum operating areas for all types.♦

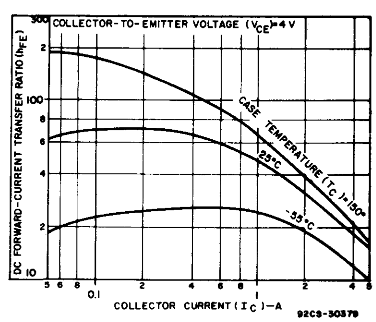


Fig. 3 — Typical dc beta characteristics for 2N4231A, 2N4232A, and 2N4233A.

♦ For p-n-p devices, voltage and current values are negative.

2N4231A, 2N4232A, 2N4233A, 2N6312, 2N6313, 2N6314

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	TEST CONDITIONS◆ VOLTAGE V dc V_{CE}	VOLTAGE V dc V_{BE}	CURRENT A dc I_C	CURRENT A dc I_B	LIMITS 2N4231A 2N6312◆ Min.	2N4231A 2N6312◆ Max.	2N4232A 2N6313◆ Min.	2N4232A 2N6313◆ Max.	2N4233A 2N6314◆ Min.	2N4233A 2N6314◆ Max.	UNITS
*	I_{CBO}	40[a]				–	50	–	–	–	–	µA
		60[a]				–	–	–	50	–	–	
		80[a]				–	–	–	–	–	50	
*	I_{CEX} R_{BE} = 100 Ω	40	−1.5			–	100	–	–	–	–	
		60	−1.5			–	–	–	100	–	–	
		80	−1.5			–	–	–	–	–	100	
*	R_{BE} = 100 Ω, T_C = 150°C	40	−1.5			–	1	–	–	–	–	mA
		60	−1.5			–	–	–	1	–	–	
		80	−1.5			–	–	–	–	–	1	
*	I_{CEO}	30			0	–	1	–	–	–	–	
		50			0	–	–	–	1	–	–	
		70			0	–	–	–	–	–	1	
*	I_{EBO}		−5			–	0.5	–	0.5	–	0.5	
*	h_{FE} 2N4231A, 2N4232A, 2N4233A	2		3[c]		10	–	10	–	10	–	
		2		1.5[c]		25	100	25	100	25	100	
		2		0.5[c]		40	–	40	–	40	–	
	2N6312, 2N6313, 2N6314	4		5[c]		4	–	4	–	4	–	
		4		3[c]		10	–	10	–	10	–	
		4		1.5[c]		25	100	25	100	25	100	
		4		0.5[c]		40	–	40	–	40	–	
*	V_{BE} 2N4231A, 2N4232A, 2N4233A	2		1.5[c]		–	1.4	–	1.4	–	1.4	V
	2N6312, 2N6313, 2N6314	4		1.5[c]		–	1.4	–	1.4	–	1.4	
*	V_{CE}(sat) 2N4231A, 2N4232A, 2N4233A			3[c]	0.3	–	2	–	2	–	2	
				1.5[c]	0.15	–	0.7	–	0.7	–	0.7	
	2N6312, 2N6313, 2N6314			5[c]	1.25	–	4	–	4	–	4	
				3[c]	0.3	–	2	–	2	–	2	
				1.5[c]	0.15	–	0.7	–	0.7	–	0.7	
*	V_{CEO}(sus)[b]			0.1[c]	0	40	–	60	–	80	–	
*	$\|h_{fe}\|$ f=1 MHz	10		0.5		4	–	4	–	4	–	
*	h_{fe} f=1 kHz	10		0.5		20	–	20	–	20	–	
	f_T	10		0.5		4	–	4	–	4	–	MHz
*	C_{obo} f = 0.1 MHz 2N4231A, 2N4233A, 2N4233A	10[a]				–	200	–	200	–	200	pF
	2N6312, 2N6313, 2N6314	10[a]				–	300	–	300	–	300	
	$R_{\theta JC}$					–	2.3	–	2.3	–	2.3	°C/W

* In accordance with JEDEC registration data format.
◆ For p-n-p devices, voltage and current values are negative.
a V_{CB} value.
b **CAUTION:** Sustaining voltages V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.
c Pulsed, pulse duration = 300 µs, duty factor = 1.8%.

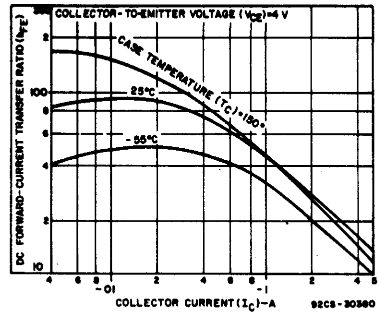


Fig. 4 — Typical dc beta characteristics for 2N6312, 2N6313, and 2N6314.

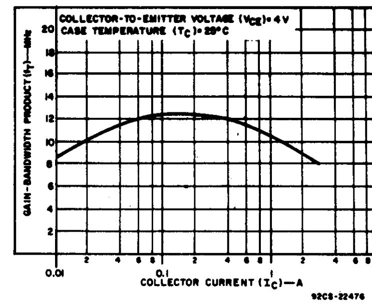


Fig. 5 — Typical gain-bandwidth product for all types.◆

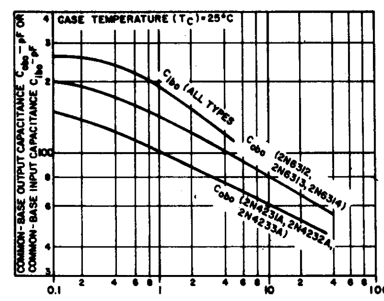


Fig. 6 — Typical common-base input or output capacitance characteristics as a function of reverse voltage for all types.◆

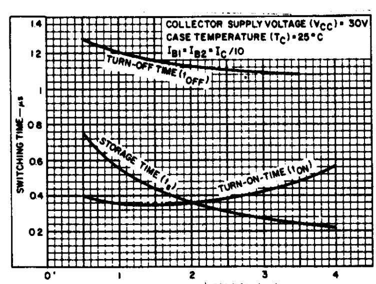


Fig. 7 — Typical saturated switching characteristics for 2N4231A, 2N4232A, and 2N4233A.

◆For p-n-p devices, voltage and current values are negative.

2N4231A, 2N4232A, 2N4233A, 2N6312, 2N6313, 2N6314

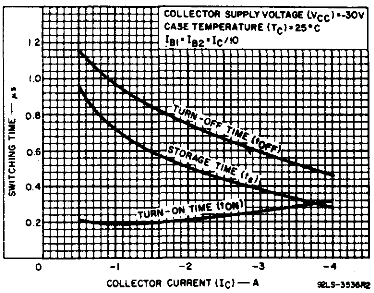


Fig. 8 — Typical saturated switching characteristics for 2N6312, 2N6313, and 2N6314.

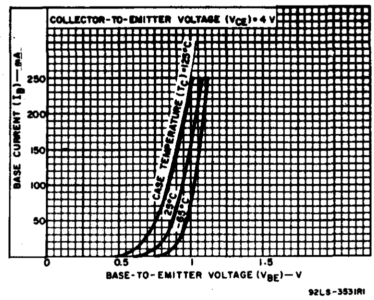


Fig. 9 — Typical input characteristics for all types.♦

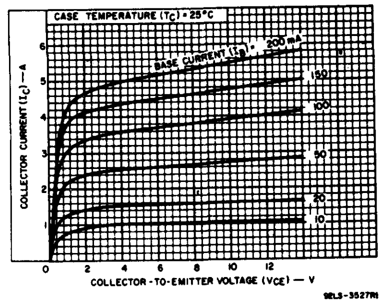


Fig. 10 — Typical output characteristics for all types.♦

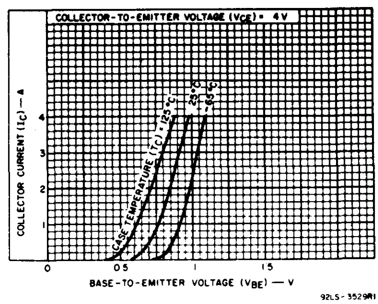


Fig. 11 — Typical transfer characteristics for all types.♦

♦For p-n-p devices, voltage and current values are negative.

2N4904, 2N4905, 2N4906

Silicon P-N-P Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices For Industrial and Commercial Use

The RCA-2N4904, 2N4905 and 2N4906 are epitaxial-base silicon p-n-p transistors featuring high-gain at high current. They may be used as complements to the 2N4913, 2N4914 and 2N4915 n-p-n types, respectively. These devices are intended for medium-speed switching and amplifier applications and feature a dissipation capability of 87.5 watts at case temperatures up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

Features:
- High dissipation capability
- Low saturation voltages
- Maximum safe-area-of-operation curves
- Hermetically sealed JEDEC TO-3/TO-204MA package
- High gain at high current
- Thermal-cycling rating curve

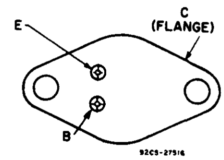
Applications:
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N4904	2N4905	2N4906	
* V_{CEO}	−40	−60	−80	V
* V_{CBO}	−40	−60	−80	V
* V_{EBO}	−5	−5	−5	V
* I_C	−5	−5	−5	A
* I_B	−1	−1	−1	A
* P_T				
At $T_C \leq 25°C$	87.5	87.5	87.5	W
At $T_C > 25°C$ ...... derate linearly		0.5		W/°C
* T_J, T_{stg}		−65 to 200		°C
* T_L at 1/16 ± 1/32 in. (1.58 ± 0.8 mm) from case for 10 s		235		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

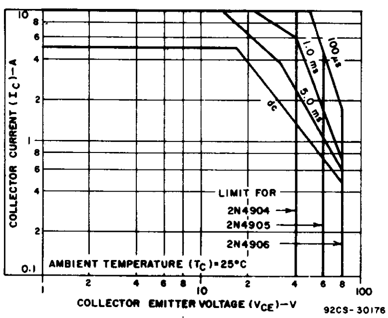


Fig. 1 — Maximum operating areas for all types.

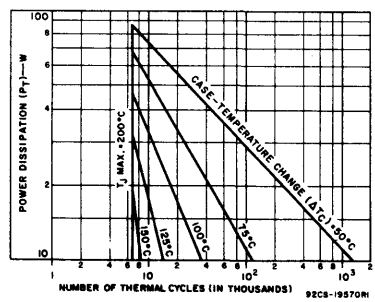


Fig. 2 — Thermal-cycling rating chart.

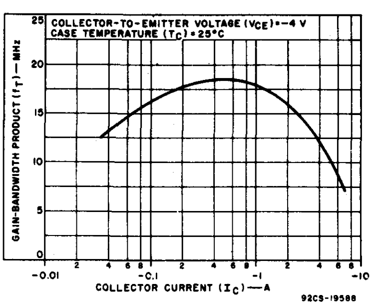


Fig. 3 — Typical gain-bandwidth product for all types.

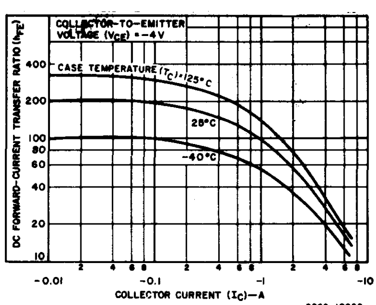


Fig. 4 — Typical dc beta characteristics for all types.

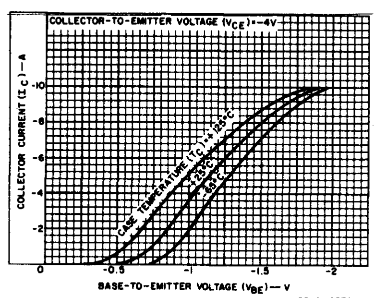


Fig. 5 — Typical transfer characteristics for all types.

2N4904, 2N4905, 2N4906

ELECTRICAL CHARACTERISTICS, At Case Temperature $T_C = 25^oC$ Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS Voltage V dc V_{CE}	V_{BE}	Current A dc I_C	I_B	LIMITS 2N4904 Min.	2N4904 Max.	2N4905 Min.	2N4905 Max.	2N4906 Min.	2N4906 Max.	UNITS
* I_{CEX}	–40	1.5	–	–	–	–0.1	–	–	–	–	mA
	–60	1.5	–	–	–	–	–	–0.1	–	–	
	–80	1.5	–	–	–	–	–	–	–	–0.1	
T_C=150°C	–40	1.5	–	–	–	–2	–	–	–	–	
	–60	1.5	–	–	–	–	–	–2	–	–	
	–80	1.5	–	–	–	–	–	–	–	–2	
* I_{CEO}	–40	–	–	0	–	–1	–	–	–	–	mA
	–60	–	–	0	–	–	–	–1	–	–	
	–80	–	–	0	–	–	–	–	–	–1	
I_{CBO}	40[c]	–	–	–	–	–0.1	–	–	–	–	mA
$I_E = 0$	60[c]	–	–	–	–	–	–	–0.1	–	–	
	80[c]	–	–	–	–	–	–	–	–	–0.1	
* I_{EBO}	–	5	0	–	–	–1	–	–1	–	–1	mA
* $V_{CEO}(sus)$[b]	–	–	–0.2	0	–40	–	–60	–	–80	–	V
* h_{FE}[a]	–2	–	–2.5	–	25	100	25	100	25	100	
	–2	–	–5	–	7	–	7	–	7	–	
* V_{BE}[a]	–2	–	–2.5	–	–	–1.4	–	–1.4	–	–1.4	V
* $V_{CE}(sat)$[a]	–	–	–2.5	–0.25	–	–1	–	–1	–	–1	V
	–	–	–5	–1	–	–1.5	–	–1.5	–	–1.5	
* f_T f=1 MHz	–10	–	–1	–	4	–	4	–	4	–	MHz
* h_{fe} f=1 kHz	–10	–	–0.5	–	40	–	40	–	40	–	
* $R_{\theta JC}$	–	–	–	–	–	2	–	2	–	2	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed; pulse duration = 300 μs, duty factor = 2%.

[b] *CAUTION:* Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.

[c] V_{CB}.

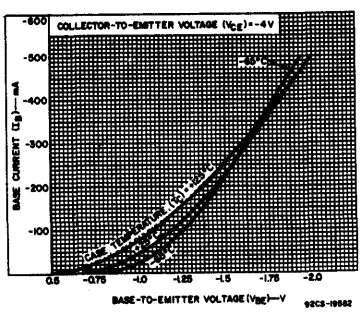


Fig. 6 – Typical input characteristics for all types.

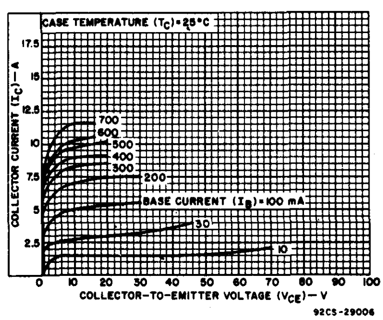


Fig. 7 – Typical output characteristics for all types.

2N4913, 2N4914, 2N4915

Silicon N-P-N Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices For Industrial and Commercial Use

The RCA-2N4913, 2N4914, and 2N4915 are epitaxial-base silicon n-p-n transistors featuring high-gain at high current. They may be used as complements to the 2N4904, 2N4905, and 2N4906 p-n-p types respectively. These devices are intended for medium-speed switching and feature a dissipation capability of 87.5 watts at case temperature up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- High dissipation capability
- Low saturation voltages
- Maximum safe-areas-of-operation curves
- Hermetically sealed JEDEC TO-3/TO-204MA package
- High gain at high current
- Thermal-cycling rating curve

Applications:

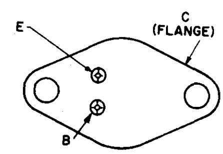
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N4913	2N4914	2N4915	
* V_{CEO}	40	60	80	V
* V_{CBO}	40	60	80	V
* V_{EBO}	5	5	5	V
* I_C	5	5	5	A
* I_B	1	1	1	A
* P_T				
At $T_C \leq 25°C$	87.5	87.5	87.5	W
At $T_C > 25°C$ derate linearly		0.5		W/°C
* T_L At 1/16 in. ± 1/32 in. (1.58 mm 0.8 mm) from case for 10 s		235		°C
* T_J, T_{stg}		−65 to 200		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

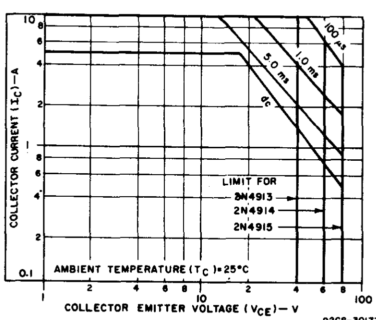


Fig. 1 — Maximum operating areas for all types.

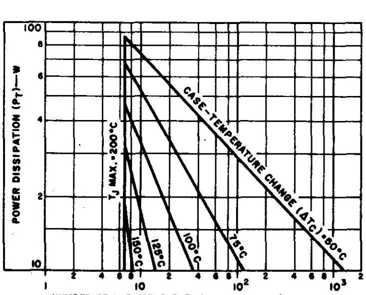


Fig. 2 — Thermal-cycling rating chart.

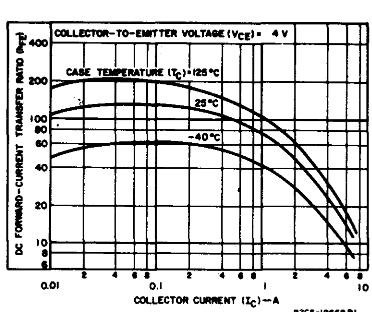


Fig. 3 — Typical dc beta characteristics for all types.

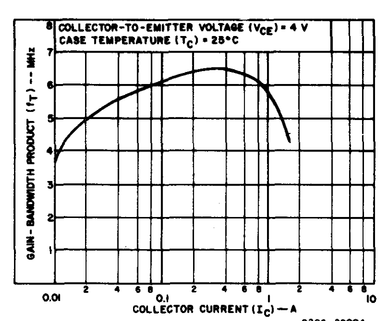


Fig. 4 — Typical gain bandwidth product for all types.

2N4913, 2N4914, 2N4915

ELECTRICAL CHARACTERISTICS, at Case Temperature T_C = 25°C Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N4913		2N4914		2N4915		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	40	−1.5	–	–	–	0.1	–	–	–	–	mA
	60	−1.5	–	–	–	–	–	0.1	–	–	
	80	−1.5	–	–	–	–	–	–	–	0.1	
T_C = 150°C	40	−1.5	–	–	–	2	–	–	–	–	
	60	−1.5	–	–	–	–	–	2	–	–	
	80	−1.5	–	–	–	–	–	–	–	2	
* I_{CEO}	40	–	–	0	–	1	–	–	–	–	mA
	60	–	–	0	–	–	–	1	–	–	
	80	–	–	0	–	–	–	–	–	1	
I_{CBO}	40[c]	–	–	–	–	1	–	–	–	–	mA
	60[c]	–	–	–	–	–	–	1	–	–	
	80[c]	–	–	–	–	–	–	–	–	1	
* I_{EBO}	–	5	–	–	–	1	–	1	–	1	mA
* $V_{CEO}(sus)$[b]	–	–	0.2	0	40	–	60	–	80	–	V
* h_{FE}[a]	2	–	2.5	–	25	100	25	100	25	100	
	2	–	5	–	7	–	7	–	7	–	
* V_{BE}[a]	2	–	2.5	–	–	1.4	–	1.4	–	1.4	V
* $V_{CE}(sat)$[a]	–	–	2.5	0.25	–	0.75	–	0.75	–	0.75	V
	–	–	5	1	–	1.5	–	1.5	–	1.5	
* f_T f = 1 MHz	10	–	1	–	4	–	4	–	4	–	MHz
* h_{fe} f = 1 kHz	10	–	0.5	–	20	–	20	–	20	–	
$R_{\theta JC}$	–	–	–	–	–	2	–	2	–	2	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed; pulse duration = 300 μs, Duty factor = 2%.

[b] **CAUTION:** Sustaining voltage, $BV_{CEO}(sus)$, ***MUST NOT BE*** measured on a curve tracer.

[c] V_{CB}

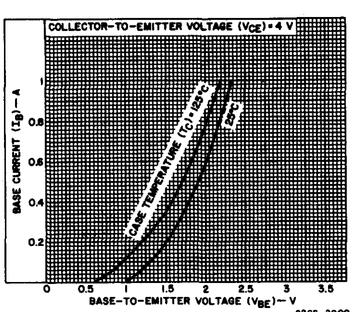


Fig. 5 — Typical input characteristics for all types.

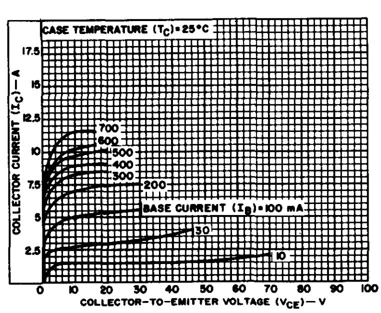


Fig. 6 — Typical output characteristics for all types.

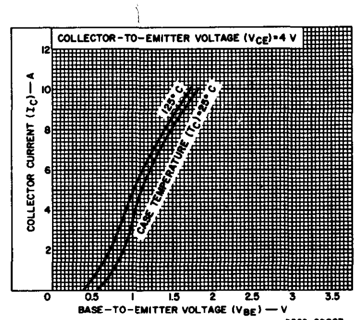


Fig. 7 — Typical transfer characteristics for all types.

2N5038, 2N5039, 2N6354, 2N6496

High-Current, High-Power, High-Speed Silicon N-P-N Power Transistors

Devices for Switching and Amplifier Circuits in Industrial and Commercial Applications

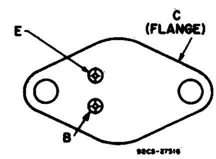
RCA-2N5038, 2N5039, 2N6354, and 2N6496 are epitaxial silicon n-p-n power transistors. They differ in breakdown-voltage ratings, leakage-current, and dc-beta values

The high current-handling capability of these transistors in conjunction with fast switching speeds make these devices especially sutted for switching-control amplifiers, power gates, switching regulators, converters, and inverters. Other recommended applications include dc-rf amplifiers and power oscillators. These transistors are supplied in the JEDEC TO-3 package.

Features:

- **Maximum operating area curves for dc and pulse operation**
- **$I_{S/b}$-limit line beginning at 28 V**
- **High collector current ratings**
- **High-dissipation capability**
- **Fast switching speeds — Measured at: 5 A, 8 A, 10 A, 12 A levels**

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute Maximum Values:*		2N5038	2N5039	2N6354	2N6496	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	150	120	150	150	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With −1.5 volts (V_{BE}) of reverse bias and external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CEX}(sus)$	150	120	–	–	V
* With external base-to-emitter resistance (R_{BE}) = 500Ω, L = 7mH	V_{CEX}	–	–	130	–	V
With $R_{BE} < 50\Omega$	$V_{CER}(sus)$	110	95	–	130	V
With base open	$V_{CEO}(sus)$	90	75	120	110	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	6.5	7	V
*CONTINUOUS COLLECTOR CURRENT	I_C	20	20	10	15	A
*PEAK COLLECTOR CURRENT	I_{CM}	30	30	12	–	A
*CONTINUOUS BASE CURRENT	I_B	5	5	5	5	A
*TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C and V_{CE} up to 28 V		140	140	140	140	W
At case temperature of 100°C and V_{CB} of 20 V		80	80	80	80	W
At case temperatures above 25°C		Derate linearly to 200°C				
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		−65 to 200				°C
PIN TEMPERATURE (During soldering) At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230				

* In accordance with JEDEC registration data format (JS-6, RDF-1)

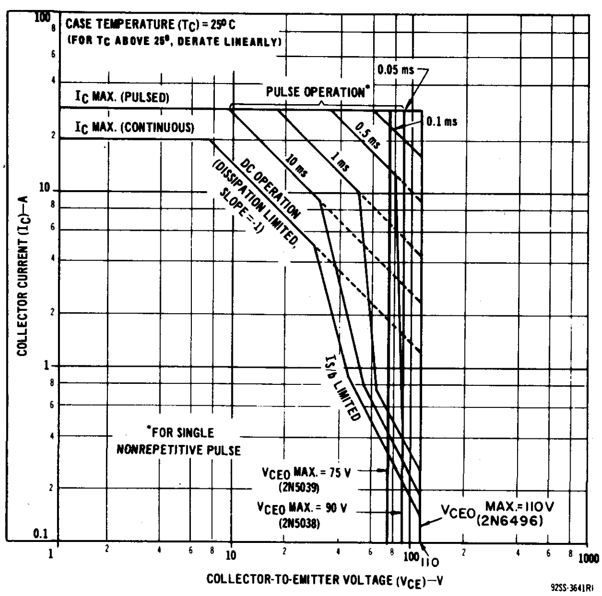


Fig. 1 — Maximum operating areas for 2N5038, 2N5039, 2N6496.

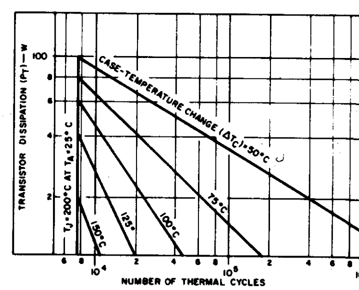


Fig. 2 — Thermal-cycling rating chart for all types.

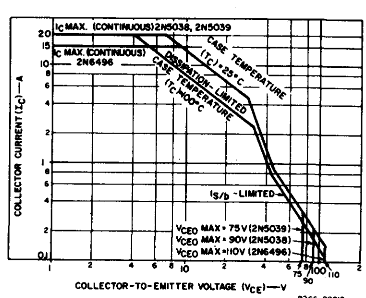


Fig. 3 — Maximum operating areas for 2N5038, 2N5039, 2N6496.

2N5038, 2N5039, 2N6354, 2N6496

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N5038		2N5039		2N6354		2N6496		UNITS
		V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* Collector-Cutoff Current: With emitter open V_{CB} = 150 V	I_{CBO}					–	–	–	–	–	5	–	–	mA
With base open	I_{CEO}	55			0	–	–	–	20	–	–	–	–	mA
		70			0	–	20	–	–	–	–	–	–	
		100				–	–	–	–	–	20	–	–	
* With base-emitter junction reverse-biased	I_{CEV}	110	-1.5			–	–	–	50	–	–	–	–	mA
		130	0			–	–	–	–	–	–	–	20	
		140	-1.5			–	50	–	–	–	–	–	–	
		140	0			–	–	–	–	–	10	–	–	
* At T_C = 150°C		85	-1.5			–	–	–	10	–	–	–	–	
		100	-1.5			–	10	–	–	–	–	–	–	
		130	0			–	–	–	–	–	–	–	25	
* At T_C = 125°C		140	0			–	–	–	–	–	20	–	–	
* Emitter Cutoff Current	I_{EBO}		-5	0		–	5	–	15	–	–	–	–	mA
			-6.5	0		–	–	–	–	–	5	–	–	
			-7	0		–	50	–	50	–	–	–	50	
* DC Forward-Current Transfer Ratio	h_{FE}	2		5[a]		–	–	–	–	20	150	–	–	
*		2		8[a]		–	–	–	–	–	–	12	100	
*		2		10[a]		–	–	–	–	10	100	–	–	
		5		2[a]		50	250	30	250	–	–	–	–	
*		5		10[a]		–	–	20	100	–	–	–	–	
*		5		12[a]		20	100	–	–	–	–	–	–	
* Magnitude of Small-Signal Forward-Current Transfer Ratio: f = 5 MHz	$\|h_{fe}\|$	10		2		12	–	12	–	–	–	12	–	
f = 10 MHz		10		1		–	–	–	–	8	–	–	–	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$			0.2[a]	0	90[b]	–	75[b]	–	120[b]	–	100[b]	–	V
With base-emitter junction reverse biased and external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CEX}(sus)$		-1.5	0.2	0	150[b]	–	120[b]	–	–	–	–	–	
With R_{BE} ⩽ 50Ω	V_{CER}			0.2	0	110[b]	–	95[b]	–	–	–	130[b]	–	
⩽ 100Ω				0.2		–	–	–	–	130[b]	–	–	–	
Emitter-to-Base Voltage: I_E = 0.05 A	V_{EBO}			0		7	–	7	–	–	–	7	–	V
* = 0.005 A				0		–	–	–	–	6.5	–	–	–	
Base-to-Emitter Voltage	V_{BE}	2		8[a]		–	–	–	–	–	–	–	1.6	V
		5		10[a]		–	–	–	1.8	–	–	–	–	
		5		12[a]		–	1.8	–	–	–	–	–	–	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			8[a]	0.8	–	–	–	–	–	–	–	1.0	V
*				5[a]	0.5	–	–	–	–	–	0.5	–	–	
				10[a]	1.0	–	–	–	1.0	–	1	–	–	
				12[a]	1.2	–	1.0	–	–	–	–	–	–	
*				20[a]	5	–	2.5	–	2.5	–	–	–	–	
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			5[a]	0.5	–	–	–	–	–	1.3	–	–	V
				8[a]	0.8	–	–	–	–	–	–	–	2.0	
*				10[a]	1	–	–	–	–	–	2	–	–	
*				20[a]	5	–	3.3	–	3.3	–	–	–	–	
Output Capacitance: V_{CB} = 10V, f = 1 MHz	C_{ob}					–	400	–	400	–	400	–	400	pF
Forward-Bias Second Breakdown Collector Current: t = 1s, nonrepetitive	$I_{S/b}$	25				–	–	–	–	5.5	–	–	–	A
		28				5.0	–	5.0	–	–	–	5.0	–	
		45				0.9	–	0.9	–	–	–	0.9	–	
Second-Breakdown Energy: With base reverse biased, R_{BE} = 51Ω, L = 25μH	$E_{S/b}$		-1	5		–	–	–	–	0:3	–	–	–	mJ
R_B = 20Ω, L = 180μH			-4	13		13	–	13	–	–	–	–	–	
			-4	8		–	–	–	–	–	–	5.7	–	
* Saturated Switching Time (V_{CC} = 30 V, I_{B_1} = I_{B_2}): Rise Time	t_r			5	0.5	–	–	–	–	–	0.3	–	–	μs
				8	0.8	–	–	–	–	–	–	–	0.5	
				10	1.0	–	–	–	0.5	–	1	–	–	
				12	1.2	–	0.5	–	–	–	–	–	–	
* Storage Time	t_{s_1}			5	0.5	–	–	–	–	–	1	–	–	
				8	0.8	–	–	–	–	–	–	–	1.5	
				10	1.0	–	–	–	1.5	–	–	–	–	
				12	1.2	–	1.5	–	–	–	–	–	–	
Storage Time (No Load)	t_{s_2}			0.5	0.5	–	–	–	–	–	2	–	–	
* Fall Time	t_f			5	0.5	–	–	–	–	–	0.2	–	–	
				8	0.8	–	–	–	–	–	–	–	0.5	
				10	1.0	–	–	–	0.5	–	–	–	–	
				12	1.2	–	0.5	–	–	–	–	–	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	10		10		–	1.25	–	1.25	–	–	–	1.25	°C/W
		20		1		–	–	–	–	–	1.25	–	–	

* In accordance with JEDEC registration data format (JS-6, RDF-1).

[a] Pulsed; pulse duration ⩽ 350μs, duty factor = 2%.

[b] CAUTION: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer.

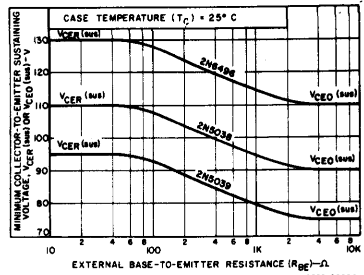


Fig. 4 — Collector-to-emitter sustaining voltage characteristics for 2N5038, 2N5039 and 2N6496.

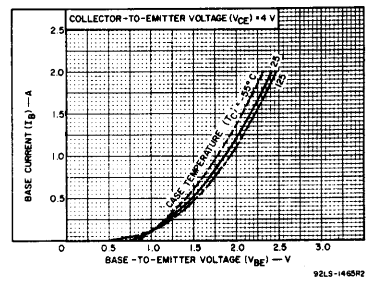


Fig. 5 — Typical input characteristics for 2N5038 and 2N5039.

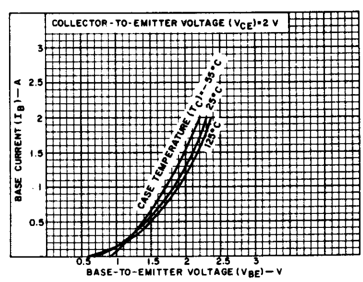


Fig. 6 — Typical input characteristic for 2N6496.

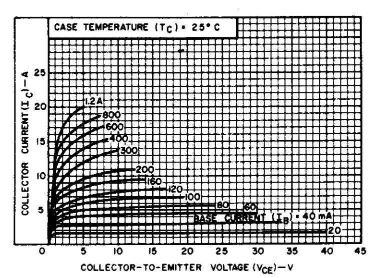


Fig. 7 — Typical output characteristics for 2N5038.

2N5038, 2N5039, 2N6354, 2N6496

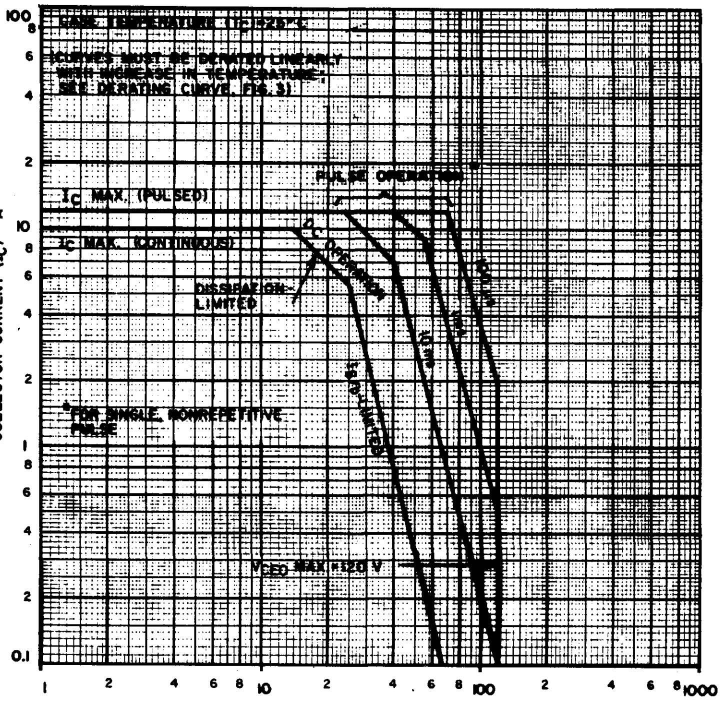


Fig. 8 – Maximum operating areas for 2N6354.

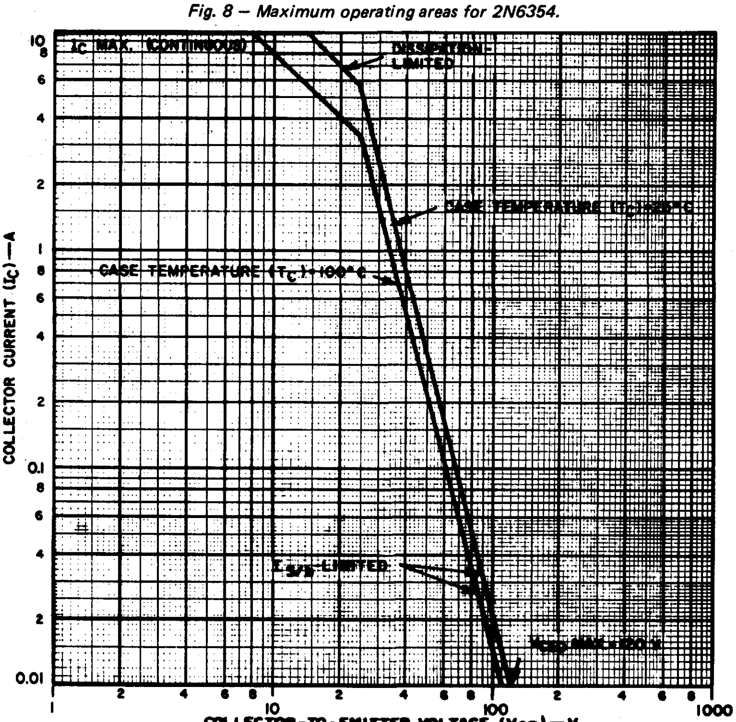


Fig. 11 – Maximum operating areas for 2N6354.

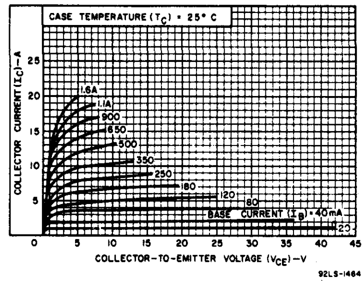


Fig. 9 – Typical output characteristics for 2N5039.

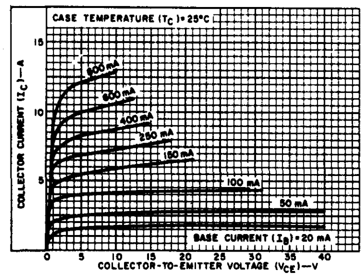


Fig. 10 – Typical output characteristics for 2N6496.

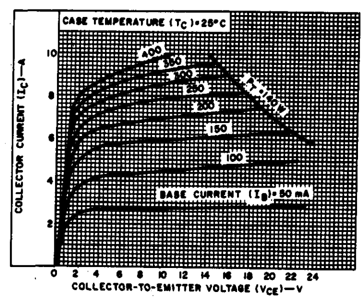


Fig. 12 – Typical output characteristics for 2N6354.

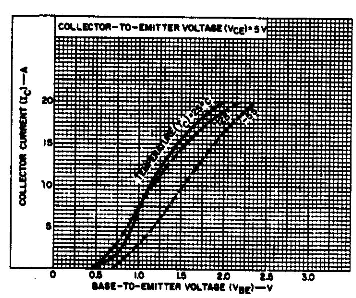


Fig. 13 – Typical transfer characteristics for 2N5038.

2N5038, 2N5039, 2N6354, 2N6496

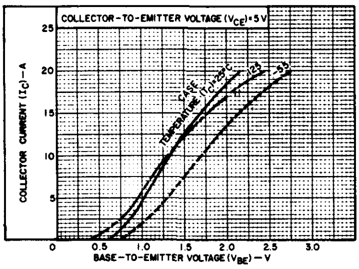


Fig. 14 — Typical transfer characteristics for 2N5039.

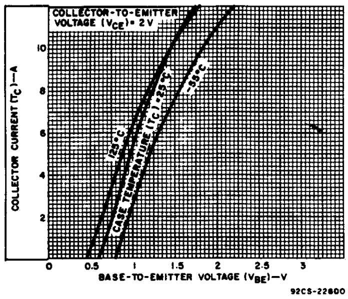


Fig. 15 — Typical transfer characteristics for 2N6496.

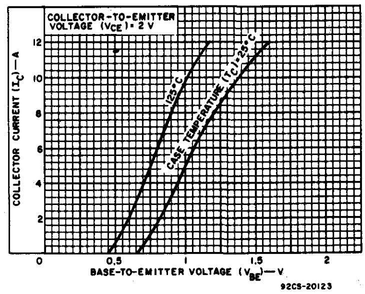


Fig. 16 — Typical transfer characteristics for 2N6354.

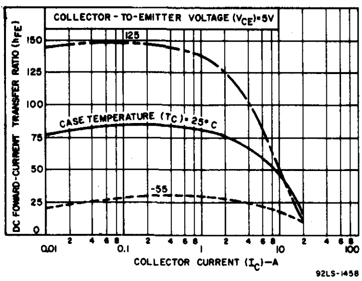


Fig. 17 — Typical dc beta characteristics for 2N5038.

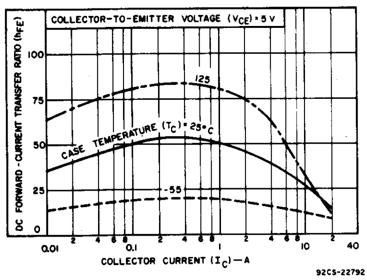


Fig. 18 — Typical dc beta characteristics for 2N5039.

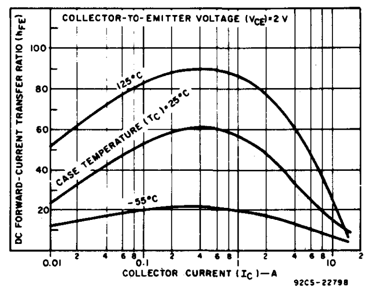


Fig. 19 — Typical dc beta characteristics for 2N6496.

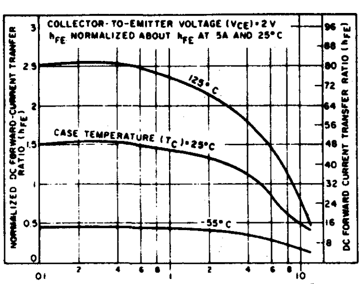


Fig. 20 — Typical normalized dc beta characteristics for 2N6354.

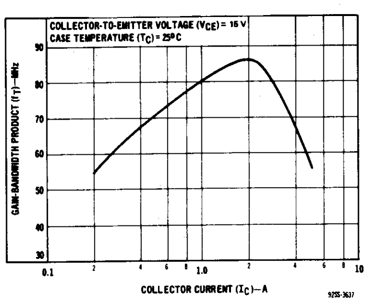


Fig. 21 — Typical gain-bandwidth product for 2N5038, 2N5039, 2N6496.

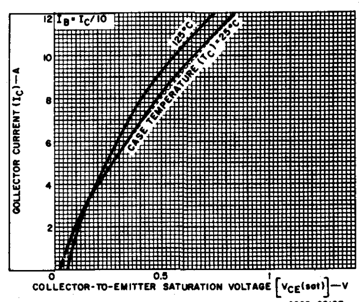


Fig. 22 — Typical saturation voltage characteristics for 2N6354.

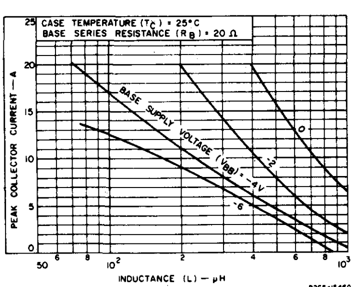


Fig. 23 — Maximum reverse-bias, second-breakdown characteristics for 2N5038 and 2N5039.

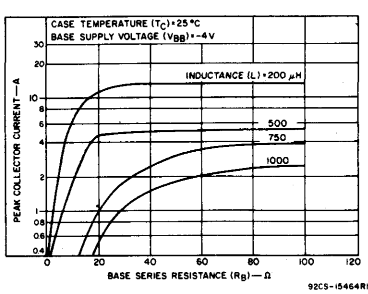


Fig. 24 — Maximum reverse-bias, second-breakdown characteristics for 2N5038 and 2N5039.

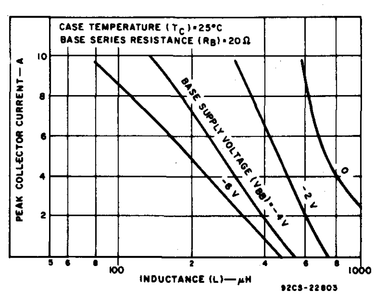


Fig. 25 — Maximum reverse-bias, second-breakdown characteristics for 2N6496.

2N5038, 2N5039, 2N6354, 2N6496

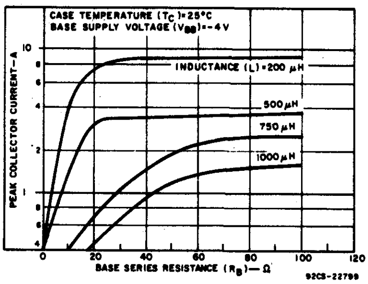


Fig. 26 — Maximum reverse-bias, second-breakdown characteristics for 2N6496.

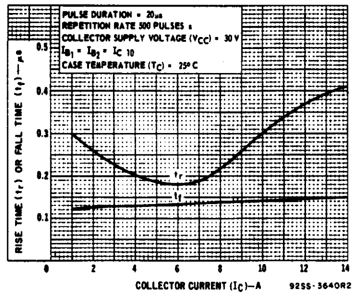


Fig. 27 — Typical rise-time and fall-time characteristics for 2N5038, 2N5039, 2N6496.

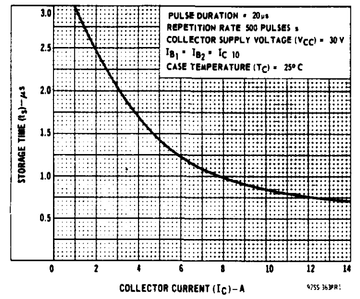


Fig. 28 — Typical storage time characteristics for 2N5038, 2N5039, 2N6496.

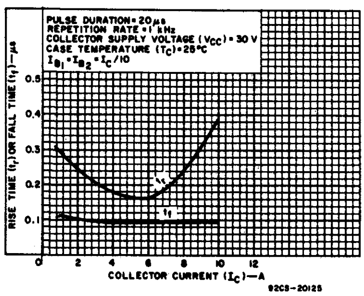


Fig. 29 — Typical rise- and fall-time characteristics for 2N6354.

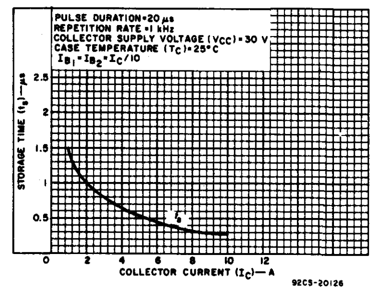


Fig. 30 — Typical storage-time characteristics for 2N6354.

2N5050, 2N5051, 2N5052

High-Voltage Silicon N-P-N Transistors

For High-Speed Switching and Linear-Amplifier Applications

Features:

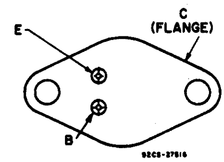
- Economy types for ac/dc circuits
- Fast turn-on time at high collector current

The RCA-2N5050, 2N5051, and 2N5052 are silicon n-p-n transistors with high breakdown voltages and fast switching speeds.

Typical applications for these transistors include high-voltage operational amplifiers, high-voltage switches, switching regulators, converters, inverters, deflection- and hi-fi amplifiers.

The 2N5050, 2N5051, and 2N5052 transistors are supplied in steel JEDEC TO-213MA hermetic packages.

TERMINAL DESIGNATIONS



JEDEC TO-213MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5050	2N5051	2N5052	
*	V_{CBO}	125	150	200	V
*	V_{CEO}	125	150	200	V
*	V_{EBO}		6		V
*	I_C		2		A
	I_{CM}		4		A
*	I_B		1		A
*	P_T				
	T_C up to 25°C		40		W
	T_C above 25°C, derate linearly		0.266		W/°C
*	T_{stg}		−65 to 200		°C
*	T_C		−65 to 175		°C
*	T_L At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

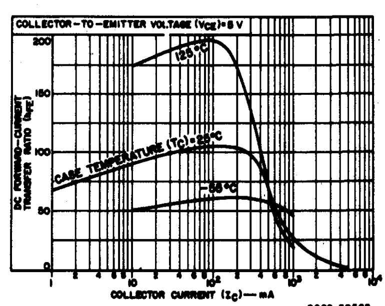


Fig. 2 — Typical dc beta characteristics for all types.

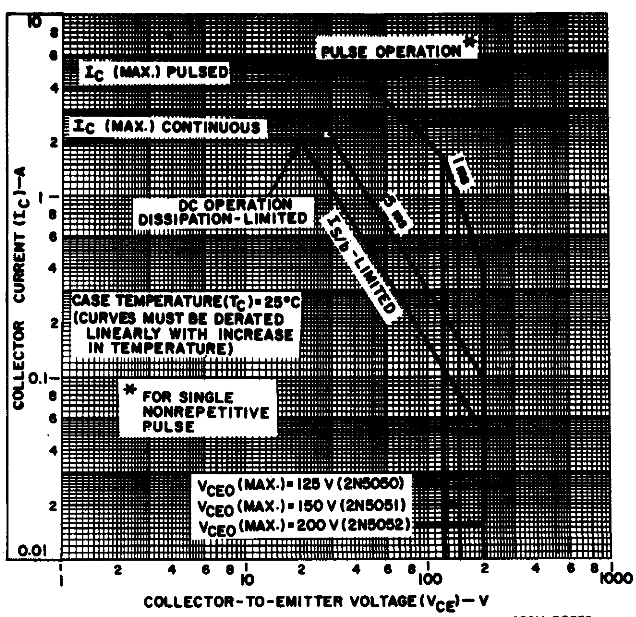


Fig. 1 — Maximum operating areas for all types.

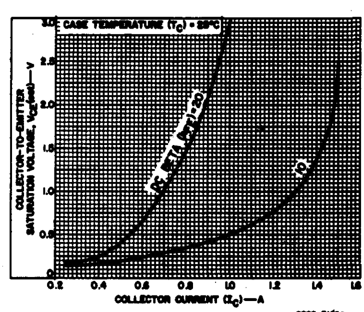


Fig. 3 — Typical collector-to-emitter saturation voltage as a function of collector current.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

	CHARACTERISTIC	TEST CONDITIONS				LIMITS						Units
		VOLTAGE V dc		CURRENT A dc		2N5050		2N5051		2N5052		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
*	I_{CEX}	125	−1.5			–	0.5	–	–	–	–	mA
		150	−1.5			–	–	–	0.5	–	–	
		200	−1.5			–	–	–	–	–	0.5	
	At T_C = 150°C	125	−1.5			–	5	–	–	–	–	
		150	−1.5			–	–	–	5	–	–	
		200	−1.5			–	–	–	–	–	5	
*	I_{CEO}	62.5				–	0.1	–	–	–	–	
		75				–	–	–	0.1	–	–	
		100				–	–	–	–	–	0.1	
*	I_{EBO}		−6	0		–	0.1	–	0.1	–	0.1	
*	$V_{CEO}(sus)$[b]			0.2[a]	0	125	–	150	–	200	–	V
*	h_{FE}	5		0.75[a]		25	100	25	100	25	100	
		5		1[a]		25	–	25	–	25	–	
		5		2[a]		5	–	5	–	5	–	
*	V_{BE}	5		0.75[a]		–	1.2	–	1.2	–	1.2	
*	$V_{CE}(sat)$			0.75[a]	0.1	–	1	–	1	–	1	V
				2[a]	0.4	–	5	–	5	–	5	
	$I_{S/b}$	100				0.15	–	0.15	–	0.15	–	mA
*	$\lvert h_{fe} \rvert$ f = 5 MHz	10		0.25		5	–	2	–	2	–	
*	h_{fe} f = 1 kHz	10		0.25		25	–	25	–	25	–	
*	C_{obo} f = 1 MHz	10[c]		0		–	250	–	250	–	250	pF
*	t_r	120[d]		0.75	0.1	–	0.3	–	0.3	–	0.3	µs
*	t_s	120[d]		0.75	0.1	–	3.5	–	3.5	–	3.5	
*	t_f	120[d]		0.75	0.1	–	1.2	–	1.2	–	1.2	
	$R_{\theta JC}$					–	3.7	–	3.7	–	3.7	°C/W

* In accordance with JEDEC registration data.
a Pulsed: pulse duration = 300 µs, duty factor ≤ 2%.
b CAUTION: The sustaining voltage $V_{CEO}(sus)$ *MUST NOT* be measured on a curve tracer. See circuit, Fig. 9, or equivalent, to measure $V_{CEO}(sus)$.
c V_{CB} value
d V_{CC} value

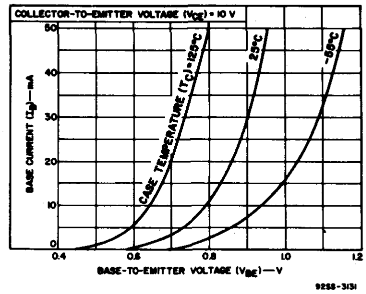


Fig. 4 – Typical input characteristics for all types.

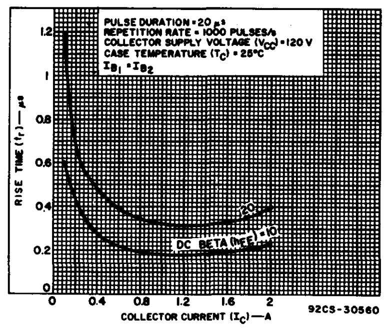


Fig. 5 – Typical rise time as a function of collector current.

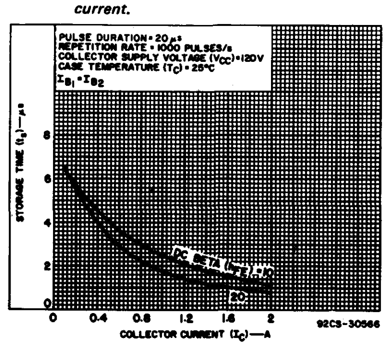


Fig. 6 – Typical storage time as a function of collector current.

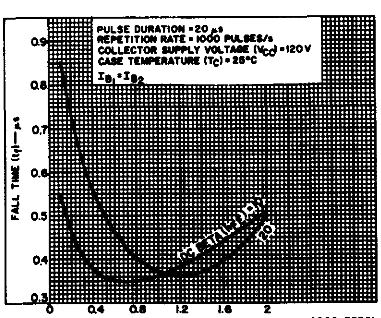


Fig. 7 – Typical fall time as a function of collector current.

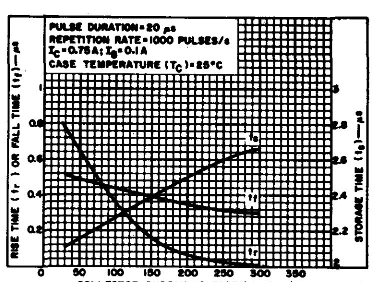


Fig. 8 – Typical rise, fall, and storage time as a function of collector supply voltage.

2N5239, 2N5240

High-Voltage Silicon N-P-N Transistors

For High-Speed Switching and Linear-Amplifier Applications in Industrial and Commercial Service

The RCA-2N5239 and 2N5240• are multiple epitaxial silicon n-p-n power transistors employing a new overlay construction with several emitter sites.

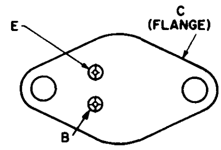
The high breakdown voltage ratings and exceptional second-breakdown capabilities of these transistors make them especially suitable for use in series regulators, power amplifiers, inverters, deflection circuits, switching regulators, and high-voltage bridge amplifiers.

These types differ in breakdown voltage and leakage current values. The 2N5239 and 2N5240 are supplied in steel JEDEC TO-204MA hermetic packages.

•RCA Dev. Nos. TA2765 and TA2765A, respectively.

Features:
- High voltage ratings: $V_{CER}(sus)$ = 350 V, $R_{BE} \leq 50\ \Omega$ (2N5240) = 250 V, $R_{BE} \leq 50\ \Omega$ (2N5239)
- High power dissipation rating: P_T = 100 W at V_{CE} = 150 V, T_C = 25°C
- For switching applications where circuit values and operating conditions require a transistor with a high second breakdown rating ($I_{S/b}$) (limit line begins at 150 V)
- Exceptional second-breakdown: 0.67A at V_{CE} = 150 V
- Maximum area-of-operation curves for dc and pulse operation

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values*

	2N5239	2N5240	
* V_{CBO}	300	375	V
$V_{CER}(sus)$ $R_{BE} \leq 50\Omega$	250	350	V
* $V_{CEO}(sus)$	225	300	V
* V_{EBO}	6		V
* I_C	5		A
* I_B	2		A
* P_T			
$T_C \leq 25$°C and $V_{CE} \leq 150$ V	100		W
$T_C \leq 25$°C and $V_{CE} > 150$ V	See Fig. 1		
$T_C > 25$°C and $V_{CE} > 150$ V	See Fig. 1 and 2		
* T_{stg}, T_J	−65 to 100		°C
T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230		°C

*In accordance with JEDEC registration data

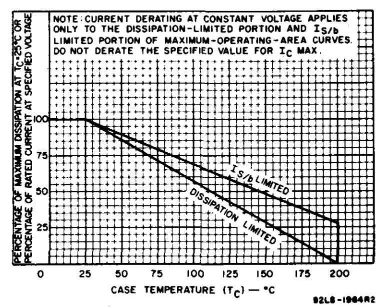


Fig. 1 -Derating curves for both types.

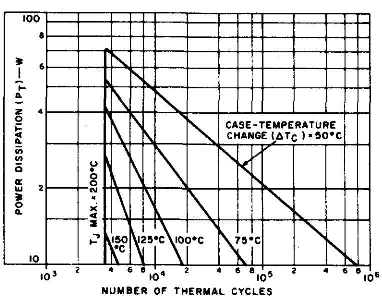


Fig. 2 -Thermal-cycling rating chart for both types.

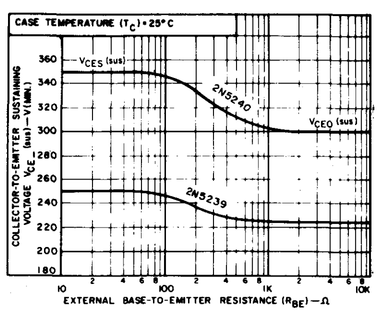


Fig. 3 -Sustaining voltages as a function of base-to-emitter resistance for both types.

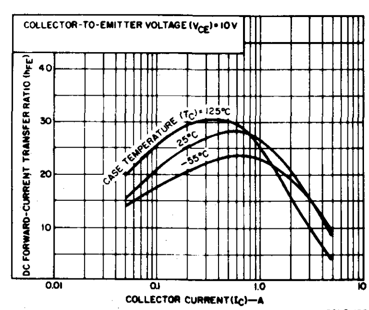


Fig. 4 - Typical dc beta characteristics for both types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N5239		2N5240		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
* I_{CEO}	200			0	—	5	—	2	mA
* I_{CEV}	300 375	−1.5 −1.5			— —	4 —	— —	— 2	mA
(T_C = 150°C)	300	−1.5			—	5	—	3	mA
I_{EBO} (V_{EB} = 5 V) * (V_{EB} = 6 V)			0 0		— —	5 20	— —	1 20	mA
V_{EBO}				0.02	6	—	6	—	V
* $V_{CEO}(sus)^a$			0.2^b		225	—	300	—	V
$V_{CER}(sus)^a$ ($R_{BE} \leq 50\ \Omega$)			0.2^b		250	—	350	—	V
h_{FE} * *	10 10 10		0.4^b 2^b 4.5^b		20 20 5	80 80 —	20 20 5	80 80 —	
* V_{BE}	10		2^b		—	3	—	3	V
* $V_{CE}(sat)$			2^b 4.5^b	0.25 1.125	— —	2.5 5	— —	2.5 5	V
* $I_{S/b}$ (t = 1 s)	150				0.67	—	0.67	—	A
$E_{S/b}$ (R_{BE} = 50 Ω, L = 0.2 mH, V_{EB} = 4 V)			4		1.6	—	1.6	—	mJ
* $\|h_{fe}\|$ (f = 1 MHz)	10		0.2		2	—	2	—	
* h_{fe} (f = 1 kHz)	10		4		20	—	20	—	
f_T	10		0.2		2	—	2	—	MHz
C_{obo} (f = 1 MHz)	10^c		0		—	150	—	150	pF
$R_{\theta JC}$					—	1.75	—	1.75	°C/W

* In accordance with JEDEC registration data.

[a] CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig.14

[b] Pulsed; pulse duration ≤ 350 μs, duty factor ≤ 2%.

[c] V_{CB} value

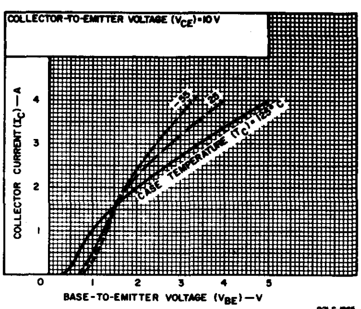


Fig. 5 - Typical transfer characteristics for both types.

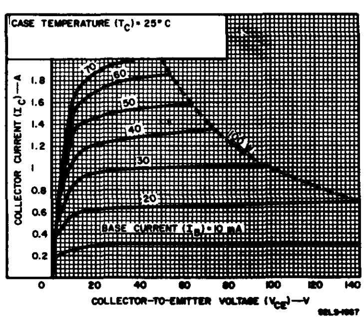


Fig. 6 - Typical output characteristics for both types.

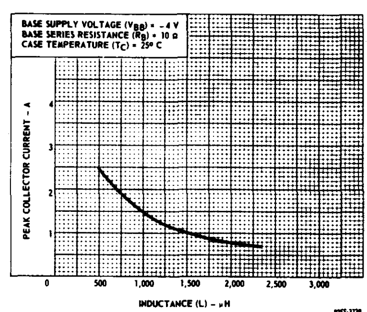


Fig. 7 - Typical reverse-bias, second-breakdown characteristic for both types.

2N5239, 2N5240

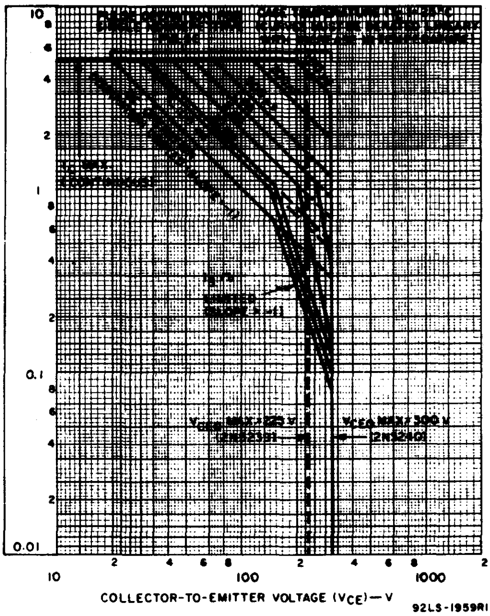


Fig. 8 - Maximum operating areas for both types.

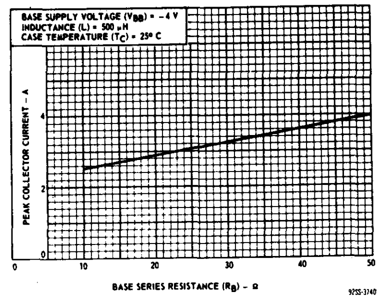


Fig. 9 - Typical reverse-bias, second-breakdown characteristic for both types.

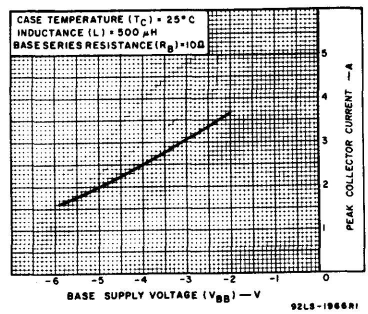


Fig. 10 - Typical reverse-bias, second-breakdown characteristic for both types.

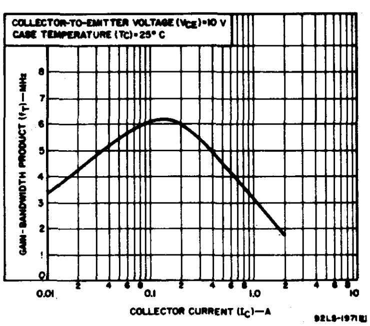


Fig. 11 - Typical gain-bandwidth product as a function of collector current for both types.

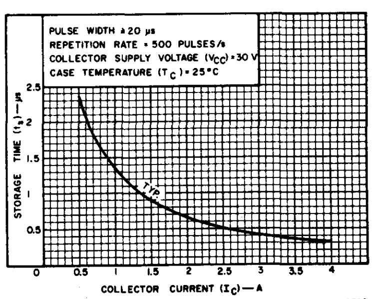


Fig. 12 - Typical saturated-switching time (storage) as a function of collector current for both types.

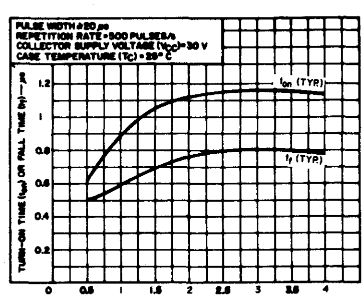


Fig. 13 - Typical saturated-time (turn-on or fall) as a function of collector current for both types.

2N5293-2N5298, RCA3054
Hometaxial-Base, Silicon N-P-N VERSAWATT Transistors

General-Purpose Types for Medium-Power Switching and Amplifier Applications in Military, Industrial, and Commercial Equipment

Features:

- Low saturation voltage—
  $V_{CE}(sat)$ = 1 V max. at I_C = 0.5 A (2N5293, 2N5294)
  = 1 V max. at I_C = 1 A (2N5295, 2N5296)
  = 1 V max. at I_C = 1.5 A (2N5297, 2N5298)
- VERSAWATT package (molded-silicone plastic)
- Maximum safe-area-of-operation curves

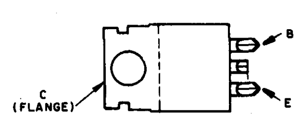
RCA-2N5293, 2N5294, 2N5295, 2N5296, 2N5297, 2N5298, and RCA3054 are hometaxial-base silicon n-p-n transistors. They are intended for a wide variety of medium-power switching and amplifier applications such as series and shunt regulators, and in driver and output stages of high-fidelity amplifiers. Types 2N5293, 2N5295, and 2N5297 have formed emitter and base leads for easy insertion into TO-66 sockets. Types 2N5294, 2N5296, and 2N5298 are electrically identical to the 2N5293, 2N5295, and 2N5297, respectively, but have straight leads. The RCA3054 is supplied with straight leads.

These plastic power transistors differ in voltage ratings and in the currents at which the parameters are controlled.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5293 2N5294	2N5295 2N5296	2N5297 2N5298	RCA3054	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	80	60	80	90	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With −1.5 volts (V_{BE}) of reverse bias	$V_{CEV}(sus)$	80	60	80	90	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	75	50	70	60	V
With base open	$V_{CEO}(sus)$	70	40	60	55	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	5	5	7	V
COLLECTOR CURRENT	I_C	4	4	4	4	A
BASE CURRENT	I_B	2	2	2	2	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		36	36	36	36	W
At case temperatures above 25°C		Derate linearly at 0.288				W/°C
At ambient temperatures up to 25°C		1.8	1.8	1.8	1.8	W
At ambient temperatures above 25°C		Derate linearly at 0.0144				W/°C
TEMPERATURE RANGE:						
Storage and Operating (Junction)		−65 to +150				°C
LEAD TEMPERATURE (During soldering):						
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235				°C

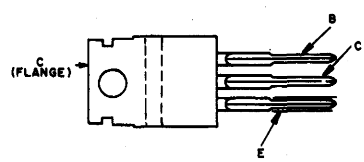
TERMINAL DESIGNATIONS



92CS-27520

BOTTOM VIEW

JEDEC TO-220AA
2N5293, 2N5295, 2N5297



92CS-27519

BOTTOM VIEW

JEDEC TO-220AB
2N5294, 2N5296, 2N5298, RCA3054

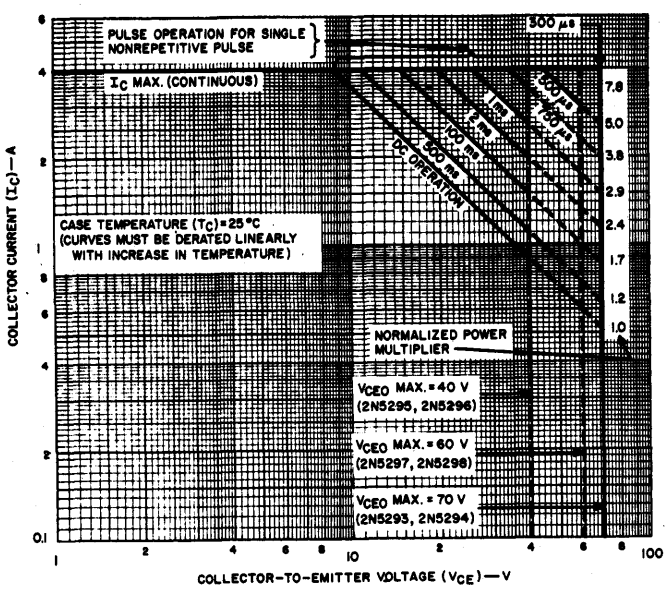


Fig. 1 – Maximum operating areas for 2N5293–2N5298.

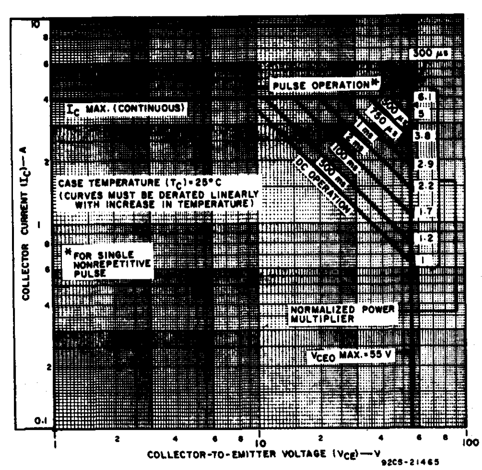


Fig. 2 – Maximum operating areas for RCA3054.

2N5293-2N5298, RCA3054

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, unless otherwise specified.*

CHARACTERISTIC SYMBOL	TEST CONDITIONS				LIMITS								UNITS
	VOLTAGE V dc		CURRENT A dc		2N5293 2N5294		2N5295 2N5296		2N5297 2N5298		RCA3054		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CEV} •	90	-1.5			–	–	–	–	–	–	–	1	mA
	65	-1.5			–	0.5	–	–	–	0.5	–	–	
	35	-1.5			–	–	–	2	–	–	–	–	
I_{CEV} • (T_C = 150°C)	90	-1.5			–	–	–	–	–	–	–	6	
	65	-1.5			–	3	–	–	–	3	–	–	
	35	-1.5			–	–	–	5	–	–	–	–	
I_{CER} (R_{BE} = 100 Ω)	50				–	0.5	–	–	–	0.5	–	–	mA
	20				–	–	–	–	–	–	–	–	
I_{CER} (T_C = 150°C)	50				–	2	–	–	–	2	–	–	mA
I_{EBO}		-7	0		–	1	–	–	–	–	–	1	mA
		-5	0		–	–	–	1	–	1	–	–	
		-4	0		–	–	–	–	–	–	–	–	
h_{FE}[c]	4		0.5		30	120	–	–	–	–	25	100	
	4		1		–	–	30	120	–	–	–	–	
	4		1.5		–	–	–	–	20	80	–	–	
$V_{CEO}(sus)$[c]			0.1	0	70	–	–	–	–	–	55	–	V
			0.1	0	–	–	40	–	–	–	–	–	
			0.1	0	–	–	–	–	60	–	–	–	
$V_{CER}(sus)$[c] (R_{BE} = 100 Ω)			0.1		75	–	–	–	–	–	–	–	V
			0.1		–	–	50	–	–	–	–	–	
			0.1		–	–	–	–	70	–	60	–	
$V_{CEV}(sus)$[c]		-1.5	0.1		80	–	–	–	–	–	–	–	V
		-1.5	0.1		–	–	60	–	–	–	–	–	
		-1.5	0.1		–	–	–	–	80	–	90	–	
V_{BE}[c]	4		0.5		–	1.1	–	–	–	–	–	1.7	V
	4		1		–	–	–	1.3	–	–	–	–	
	4		1.5		–	–	–	–	–	1.5	–	–	
$V_{CE}(sat)$[c]			0.5	0.05	–	1	–	–	–	–	–	1	V
			1	0.05	–	–	–	–	–	–	–	–	
			1	0.1	–	–	–	1	–	–	–	–	
			1.5	0.15	–	–	–	–	–	1	–	–	
f_T	4		0.2		0.8	–	0.8	–	0.8	–	0.8	–	MHz
t_{ON}	V_{CC} = 30		0.5	0.05[a]	–	5	–	–	–	–	–	–	μs
			1	0.1[a]	–	–	–	5	–	–	–	–	
			1.5	0.15[a]	–	–	–	–	–	5	–	–	
t_{OFF}	V_{CC} = 30		0.5	-0.5[a]	–	15	–	–	–	–	–	–	μs
			1	-0.1[b]	–	–	–	15	–	–	–	–	
			1.5	-0.15[b]	–	–	–	–	–	15	–	–	
$R_{\theta JC}$					–	3.5	–	3.5	–	3.5	–	3.5	°C/W
$R_{\theta JA}$					–	70	–	70	–	70	–	70	°C/W

[a] I_{B1} value (turn-on base current). [b] I_{B2} value (turn-off base current). [c] Pulsed, pulse duration = 300 μs, duty factor = .018.

• I_{CEX} for RCA3054.

2N5293-2N5298, RCA3054

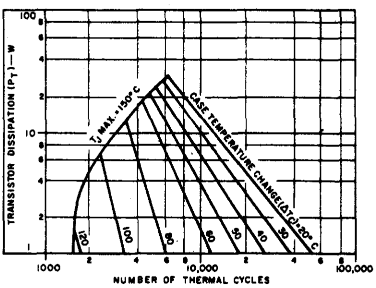


Fig. 3 — Thermal-cycling rating chart for all types.

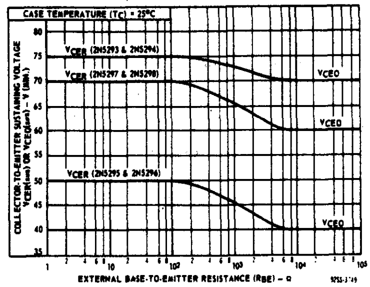


Fig. 4 — Sustaining voltage vs. base-to-emitter resistance for 2N5293—2N5298.

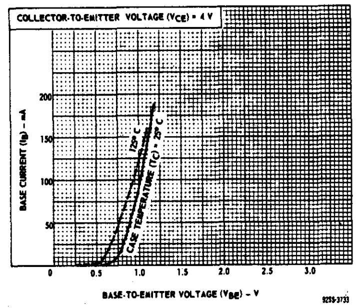


Fig. 5 — Typical input characteristics for 2N5293, 2N5294, and RCA3054.

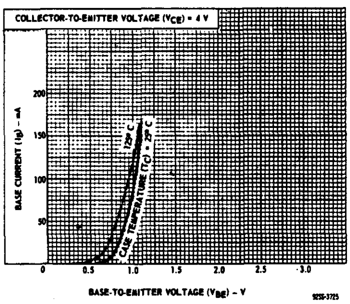


Fig. 6 — Typical input characteristics for 2N5295 and 2N5296.

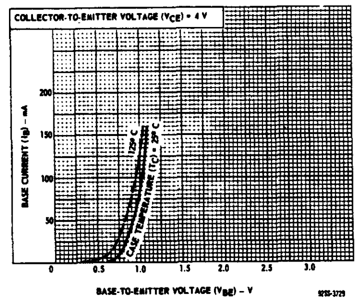


Fig. 7 — Typical input characteristics for types 2N5297 and 2N5298.

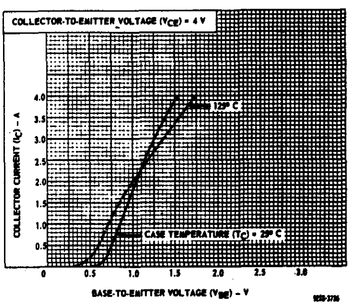


Fig. 8 — Typical transfer characteristics for 2N5293, 2N5294, and RCA3054.

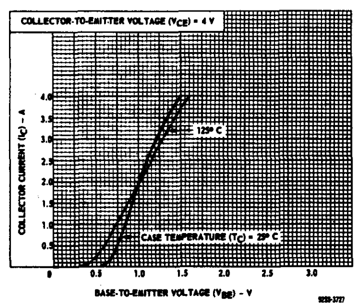


Fig. 9 — Typical transfer characteristics for 2N5295 and 2N5296.

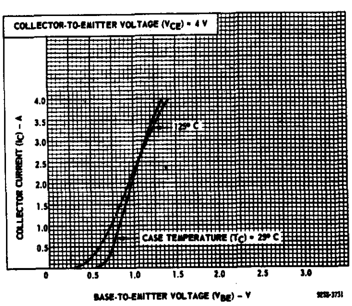


Fig. 10 — Typical transfer characteristics for 2N5297 and 2N5298.

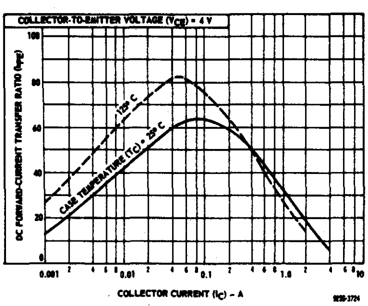


Fig. 11 — Typical dc beta for 2N5293, 2N5294, and RCA3054.

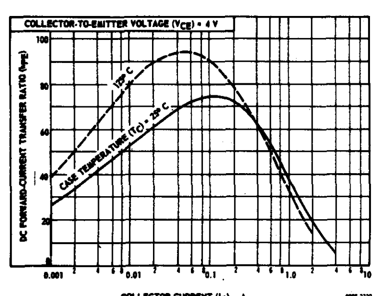


Fig. 12 — Typical dc beta for 2N5295, and 2N5296.

2N5293-2N5298, RCA3054

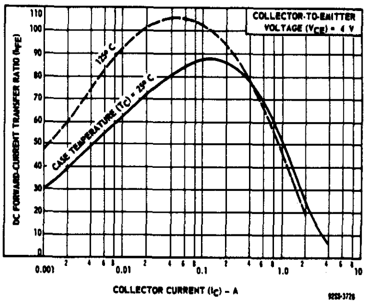


Fig. 13—Typical dc beta for 2N5297 and 2N5298.

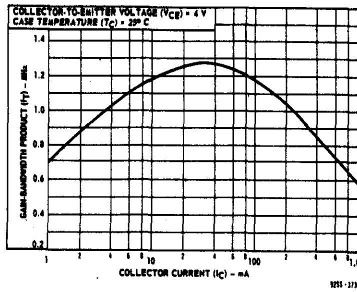


Fig. 14—Typical gain-bandwidth product for 2N5293, 2N5294, and RCA3054.

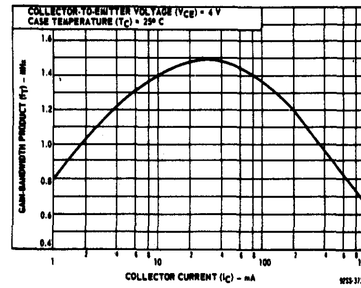


Fig. 15—Typical gain-bandwidth product for 2N5295 and 2N5296.

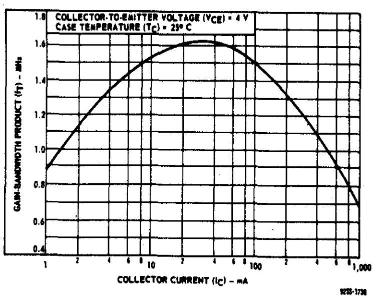


Fig. 16—Typical gain-bandwidth product for 2N5297 and 2N5298.

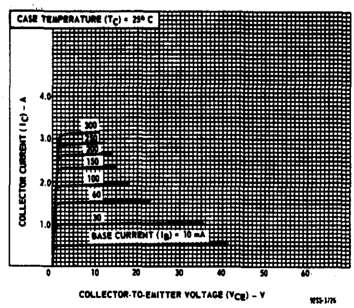


Fig. 17—Typical output characteristics for 2N5293, 2N5294, and RCA3054.

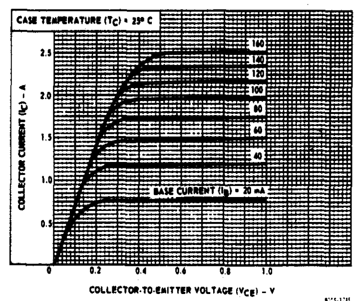


Fig. 18—Typical output characteristics for 2N5295 and 2N5296.

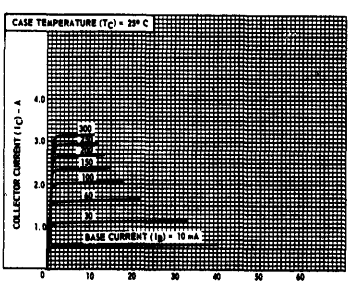


Fig. 19—Typical output characteristics for 2N5295 and 2N5296.

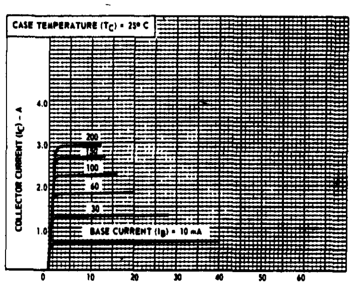


Fig. 20—Typical output characteristics for 2N5297 and 2N5298.

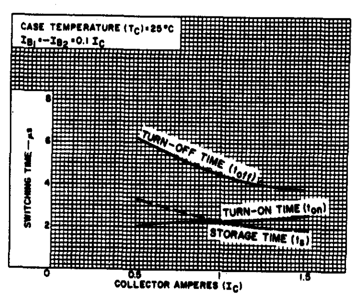


Fig. 21—Typical saturated switching characteristics for 2N5295, 2N5296, and RCA3054.

2N5301, 2N5302, 2N5303

High-Current High-Power High-Speed N-P-N Power Transistors

The RCA-2N5301, 2N5302 and 2N5303 are epitaxial-base silicon n-p-n transistors intended for a wide variety of high-power, high-current applications, such as power-switching circuits, driver and output stages for series and shunt regulstors, dc-to-dc converters, inverters, and solenoid (hammer) /relay drivers.

These devices differ in maximum voltage ratings and V_{CE}(sat), V_{BE}(sat), and V_{BE} characteristics. All are supplied in JEDEC TO-204MA hermetic steel packages.

Features:

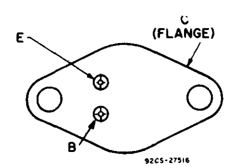
- **Specification for h_{FE} and V_{CE}(sat) up to 30A**
- **Current gain-bandwidth product f_T = 2 MHz min. at 1A**
- **Low saturation voltage with high beta**
- **High dissipation capability**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5301	2N5302	2N5303	
* V_{CBO}		40	60	80	V
* V_{CEO}(sus)		40	60	80	V
* V_{EBO}			5		V
* I_C			30		A
* I_{CM}			50		A
* I_B			7.5		A
I_{BM}			15		A
* P_T					
At $T_C \leq 25°C$			200		W
At $T_C > 25°C$	Derate linearly		1.15 *See Fig. 1 and 2*		W/°C
* T_{stg}, T_J			−65 to 200		°C
T_L					
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.			230		°C

* In accordance with JEDEC registration data format JS-6 RDF-2.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

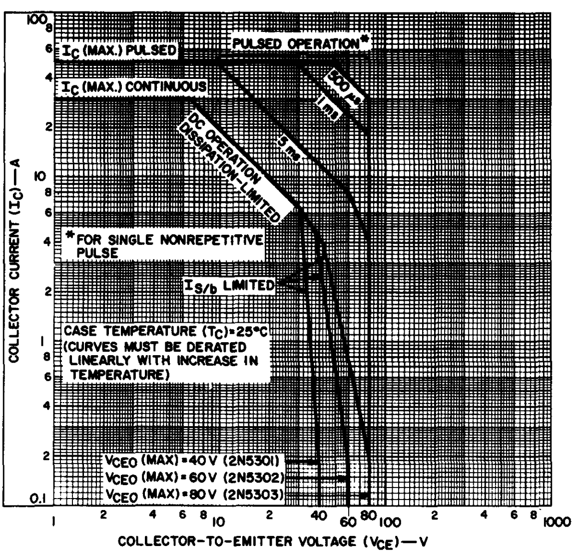


Fig. 1 – Maximum operating areas for 2N5301, 2N5302, and 2N5303.

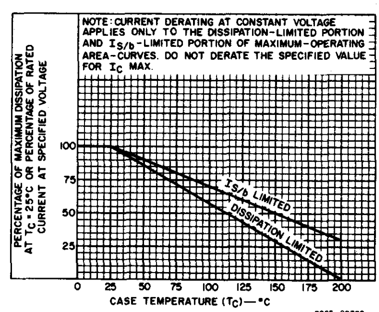


Fig. 2 – Derating curves for 2N5301, 2N5302, and 2N5303.

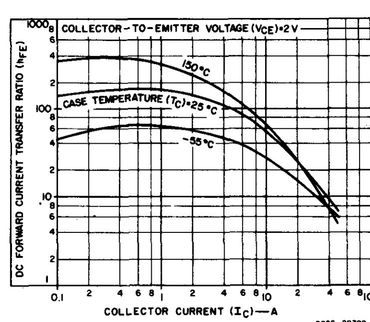


Fig. 3 – Typical dc beta characteristics as a function of collector current for 2N5301, 2N5302, and 2N5303.

2N5301, 2N5302, 2N5303

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		CURRENT A dc		LIMITS: 2N5301		2N5302		2N5303		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
* I_{CBO}	40[a]				–	1	–	–	–	–	mA
	60[a]				–	–	–	1	–	–	
	80[a]				–	–	–	–	–	1	
* I_{CEX}	40	−1.5			–	1	–	–	–	–	
	60	−1.5			–	–	–	1	–	–	
	80	−1.5			–	–	–	–	–	1	
* I_{CEX} T_C = 150°C	40	−1.5			–	10	–	–	–	–	
	60	−1.5			–	–	–	10	–	–	
	80	−1.5			–	–	–	–	–	10	
* I_{CEO}	40				–	5	–	–	–	–	
	60				–	–	–	5	–	–	
	80				–	–	–	–	–	5	
* I_{EBO}		−5			–	5	–	5	–	5	
* h_{FE}	2		1[b]		40	–	40	–	40	–	
	2		10[b]		–	–	–	–	15	60	
	3		15[b]		15	60	15	60	–	–	
	2		20[b]		–	–	–	–	5	–	
	3		30[b]		5	–	5	–	–	–	
* V_{CEO}(sus)			0.2		40	–	60	–	80	–	V
* V_{BE}	2		10[b]		–	–	–	–	–	1.5	
	2		15[b]		–	1.7	–	1.7	–	–	
	4		20[b]		–	–	–	–	–	2.5	
	4		30[b]		–	3	–	3	–	–	
* V_{BE}(sat)			10[b]	1	–	1.7	–	1.7	–	1.7	
			15[b]	1.5	–	1.8	–	1.8	–	2	
			20[b]	2	–	2.5	–	2.5	–	–	
			20[b]	4	–	–	–	–	–	2.5	
* V_{CE}(sat)			10[b]	1	–	0.75	–	0.75	–	1	
			15[b]	1.5	–	–	–	–	–	1.5	
			20[b]	2	–	2	–	2	–	–	
			20[b]	4	–	–	–	–	–	2	
			30[b]	6	–	3	–	3	–	–	
$I_{S/b}$ tp = 1 s nonrep.	20				10	–	10	–	10	–	A
$E_{S/b}$ L = 125 µH, R_{BE} = 51 Ω		−1.5	10	–	6.25	–	6.25	–	6.25	–	mJ
* $\|h_{fe}\|$ f = 1 MHz	10		1	–	2	–	2	–	2	–	
* h_{fe} f = 1 kHz	10		1	–	40	–	40	–	40	–	
* t_r (See Fig.8)	V_{CC} = 30		10	1	–	1	–	1	–	1	µs
* t_s			10	1[c]	–	2	–	2	–	2	
* t_f			10	1[c]	–	1	–	1	–	1	
$R_{\theta JC}$	20		5	–	–	0.875	–	0.875	–	0.875	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-1. [a] V_{CB} [b] Pulsed; pulse duration = 300 µs, duty factor = 1.8%
[c] $I_{B_1} = -I_{B_2}$

2N5301, 2N5302, 2N5303

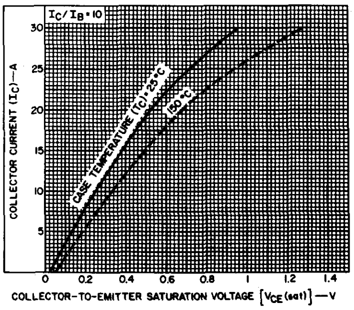


Fig. 4 — Typical saturation voltage characteristics for 2N5301, 2N5302, and 2N5303.

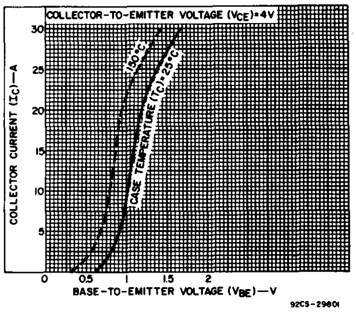


Fig. 5 — Typical transfer characreristics for 2N5301, 2N5302, and 2N5303.

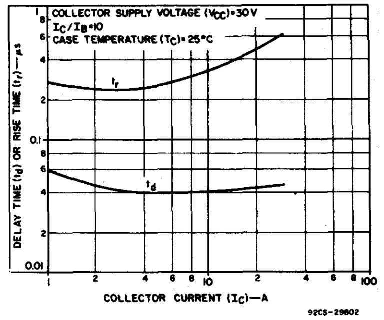


Fig. 6 — Typical delay-time and rise-time characteristics as a function of collector current for 2N5301, 2N5302, and 2N5303.

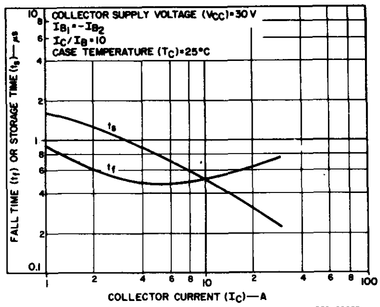


Fig. 7 — Typical storage-time and fall-time characteristics as a function of collector current for 2N5301, 2N5302, and 2N5303.

2N5320-2N5323

Complementary N-P-N & P-N-P Silicon Power Transistors

General-Purpose Types for Small-Signal, Medium-Power Applications

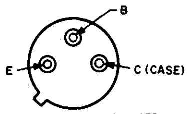
RCA-2N5320, 2N5321, 2N5322 and 2N5323 are double-diffused epitaxial-planar silicon power transistors intended for small-signal medium-power applications. The 2N5320 and 2N5321 n-p-n types are actually high-current, high-dissipation versions of the 2N2102 with all of the salinet features of that device. The 2N5322 and 2N5323, p-n-p complements of the 2N5320 and 2N5321, are actually high-current, high-power versions of the 2N4036 with all of its additional outstanding features. (Technical data on the 2N2102 and 2N4036 are shown on pages 29 and 71, respectively).

The devices are supplied in the JEDEC TO-39 hermetic package.

Features:

- 2N5322, 2N5323 P–N–P Complements of: 2N5320, 2N5321
- Maximum safe-area-of-operation curves
- Planar construction for low-noise and low-leakage characteristics
- Low saturation voltage
- High beta at high collector current

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*		2N5321	2N5323•	2N5320	2N5322•	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	75	-75	100	-100	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With 1.5 volts (V_{BE}) of reverse bias	$V_{CEV}(sus)$	75	-75	100	-100	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	65	-65	90	-90	V
* With base open	$V_{CEO}(sus)$	50	-50	75	-75	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	-5	7	-7	V
* COLLECTOR CURRENT	I_C	2	-2	2	-2	A
* BASE CURRENT	I_B	1	-1	1	-1	A
* TRANSISTOR DISSIPATION:	P_T	10	10	10	10	W
At case temperatures up to 25° C						
At case temperatures above 25° C		Figs. 2 & 5 Derate linearly at 0.057 W/°C				
* TEMPERATURE RANGE:						
Storage and operating (Junction)		-65 to +200				°C
* LEAD TEMPERATURE (During soldering): At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max		230				°C

* In accordance with JEDEC registration data format (JS-6-RDF-1)

• For p-n-p devices, voltage and current values are negative.

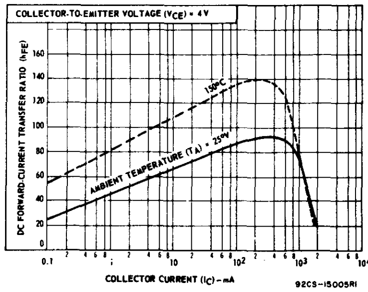


Fig. 1 - Typical static beta characteristics for types 2N5320 and 2N5321.

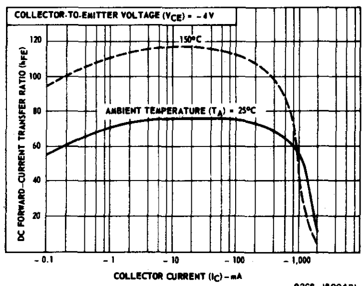


Fig. 3 - Typical static beta characteristics for 2N5322 and 2N5223.

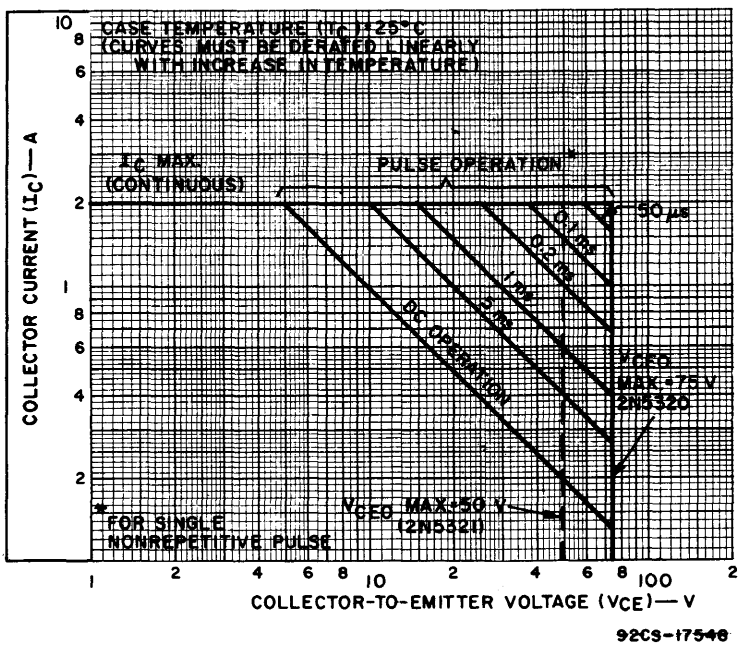


Fig. 2 - Maximum operating areas for 2N5320 and 2N5321.

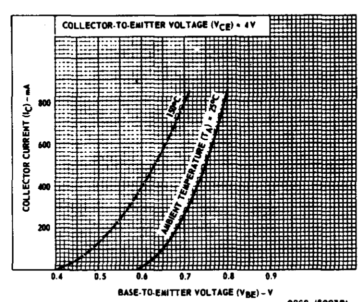


Fig. 4 - Typical transfer characteristics for 2N5320 and 2N5321.

2N5320-2N5323

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25° C Unless Otherwise Specified*

CHARACTERISTIC	Symbol	TEST CONDITIONS DC Voltage V			DC Current mA		LIMITS Type 2N5320		Type 2N5321		Type 2N5322		Type 2N5323		Units
		V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current: With base open (I_E = 0)	I_{CBO}	80					-	0.5	-	-	-	-	-	-	μA
		60					-	-	-	5	-	-	-	-	
		-80					-	-	-	-	-	-0.5	-	-	
		-60					-	-	-	-	-	-	-	-5	
• With base-emitter junction reverse biased	I_{CEX}		100	-1.5			-	0.1	-	-	-	-	-	-	mA
			75	-1.5			-	-	-	0.1	-	-	-	-	
			-100	1.5			-	-	-	-	-	-0.1	-	-	
			-75	1.5			-	-	-	-	-	-	-	-0.1	
T_C=150°C			70	-1.5			-	5	-	-	-	-	-	-	mA
			45	-1.5			-	-	-	5	-	-	-	-	
			-70	1.5			-	-	-	-	-	-5	-	-	
			-45	1.5			-	-	-	-	-	-	-	-5	
• Emitter-Cutoff Current	I_{EBO}			-7	0		-	0.1	-	-	-	-	-	-	mA
				-5	0		-	-	-	0.1	-	-	-	-	
				7	0		-	-	-	-	-	-0.1	-	-	
				5	0		-	-	-	-	-	-	-	-0.1	
				-5	0		-	0.1	-	-	-	-	-	-	μA
				-4	0		-	-	-	0.5	-	-	-	-	
				5	0		-	-	-	-	-	-0.1	-	-	
				4	0		-	-	-	-	-	-	-	-0.5	
Collector-to-Emitter Breakdown Voltage With base-emitter junction reverse biased	$V_{(BR)CEV}$			-1.5	0.1		100		75	-		-	-	-	V
				1.5	-0.1				-		-100	-	-75		
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$[a]				100		90	-	65	-	-	-	-	-	V
					-100		-	-	-	-	-90	-	-65	-	
• With base open	$V_{CEO}(sus)$[a]				100	0	75		50	-	-	-	-	-	V
					-100	0	-			-	-75	-	-50	-	
• Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				500	50	-	0.5	-	0.8	-	-	-	-	V
					-500	-50	-	-	-	-		-0.7	-	-1.2	
• Base-to-Emitter Voltage	V_{BE}		4		500		-	1.1	-	1.4	-	-	-	-	V
			-4		-500		-	-	-	-	-	-1.1	-	-1.4	
• DC Forward Current Transfer Ratio	h_{FE}[b] See NOTE		4		500		30	130	40	250	-	-	-	-	
			-4		-500		-	-	-	-	30	130	40	250	
			2		1000		10	-	-	-	-	-	-	-	
			-2		-1000		-	-	-	-	10	-	-	-	
Gain-Bandwidth Product	f_T		4		50		50	-	50	-	-	-	-	-	MHz
			-4		-50		-	-	-	-	50	-	50	-	
• Magnitude of common-emitter, small-signal, short circuit, forward current transfer ratio (f=10 MHz)	$\|h_{fe}\|$		4		50		5	-	5	-	-	-	-	-	
			-4		-50		-	-	-	-	5	-	5	-	
Second Breakdown Collector Current[c] (With base forward biased)	$I_{S/b}$		50				200	-	200	-	-	-	-	-	mA
			-35				-	-	-	-	-285	-	285	-	
• Sat. Switching Time: Turn-on Time	t_{on}		30		500	50	-	80	-	80	-	-	-	-	ns
			-30		-500	-50	-	-	-	-	-	100	-	100	
Turn-off Time	t_{off}		30		500	50	-	800	-	800	-	-	-	-	ns
			-30		-500	-50	-	-	-	-	-	1000	-	1000	
• Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						-	17.5	-	17.5	-	17.5	-	17.5	°C/W
Junction-to-Ambient	$R_{\theta JA}$						-	150	-	150	-	150	-	150	°C/W

* In accordance with JEDEC registration data format (JS-6-RDF-1)

● For p-n-p devices, voltage and current values are negative.

[a] CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

[b] Pulsed; pulse duration < 300 μs, duty factor ≤ 0.02.

[c] Pulsed; 0.4s non-repetitive pulse.

[d] $I_{S/b}$ is defined as the current at which second breakdown occurs at junction forward biased for transistor operation in the active region.

2N5320-2N5323

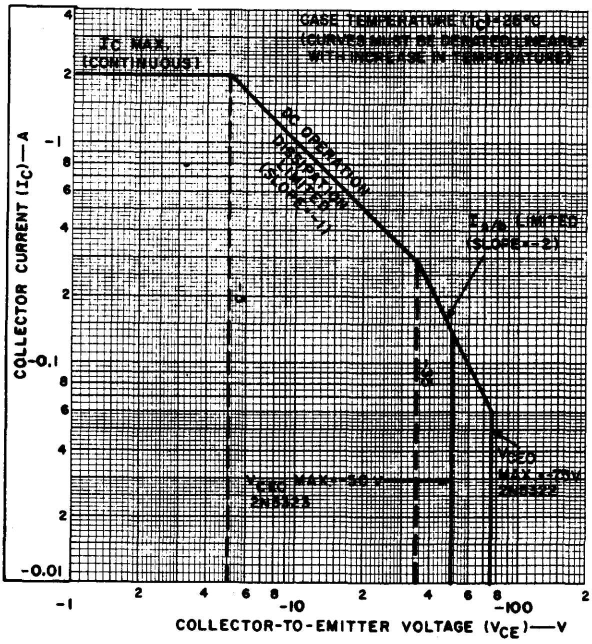


Fig. 5 – Maximum operating areas for 2N5322 and 2N5323.

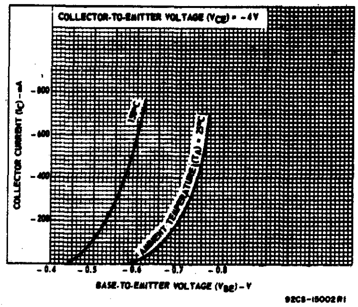


Fig. 6 – Typical transfer characteristics for 2N5322 and 2N5323.

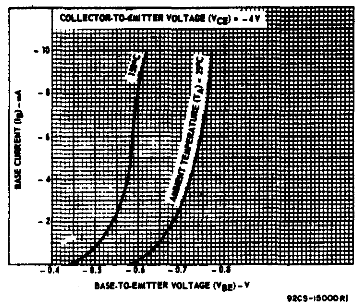


Fig. 7 – Typical input characterisitcs for 2N5322 and 2N5323.

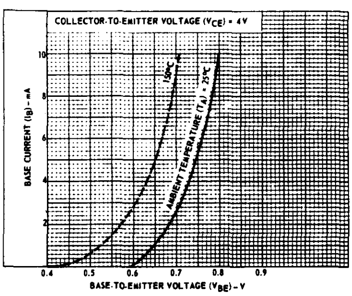


Fig. 8 – Typical input characteristics for 2N5320 and 2N5321.

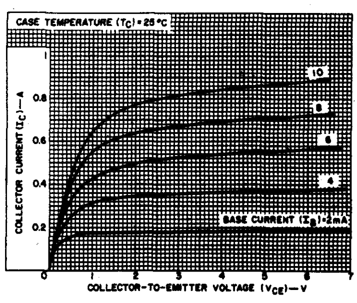


Fig. 9 – Typical output characteristics for 2N5320 and 2N5321.

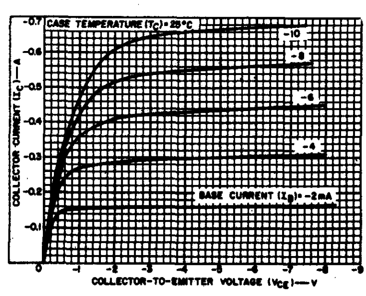


Fig. 10 – Typical output characteristics for 2N5322 and 2N5323.

2N5415, 2N5416, RCS880-RCS882

Silicon P-N-P High-Voltage Transistors

For High-Speed Switching and Linear-Amplifier Applications in Military, Industrial and Commercial Equipment

The RCA-2N5415, 2N5416 and RCS880, RCS881, and RCS882 are silicon p-n-p transistors with high breakdown voltages, high frequency response, and fast switching speeds. All of these types are supplied in the JEDEC TO-39 hermetic package.

These transistors differ primarily in their voltage ratings. Typical applications include high-voltage differential and operational amplifiers; high-voltage inverters; and high-voltage, low-current switching and series regulators.

Features:

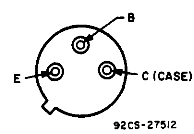
- 2N5415: p-n-p complement of 2N3440
- 2N5415: p-n-p complement of 2N3439
- Maximum safe-area-of-operation curves
- High voltage ratings:
  V_{CBO} = −350 V max. (2N5416)
  $V_{CEO}(sus)$ = −300 V max. (2N5416, RCS882)
  −250 V max. (RCS881)
  −200 V max. (2N5415)
  −150 V max. (RCS880)

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5415	2N5416	RCS880	RCS881	RCS882	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−200	−350	–	−250	−350	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:							
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$	–	−350	–	–	−350	V
* With base open	$V_{CEO}(sus)$	−200	−300	−150	−250	−300	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	−4	−6	–	−4	−6	V
*COLLECTOR CURRENT	I_C	−1	−1	−1	−1	−1	A
*BASE CURRENT	I_B	−0.5	−0.5	−0.5	−0.5	−0.5	A
*TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C		10	10	7.5	7.5	7.5	W
At case temperatures above 25°C		Derate linearly to 200°C					
At ambient temperatures up to 50°C		1	1	0.75	0.75	0.75	W
At ambient temperatures above 50°C	Derate linearly at	6.7	6.7	5	5	5	mW/°C
*TEMPERATURE RANGE:							
Storage and Operating (Junction)		−65 to +200					°C
*LEAD TEMPERATURE (During soldering):							
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		255					°C

*2N-Series types in accordance with JEDEC registration data format (JS-9 RDF-8)

TERMINAL DESIGNATIONS



JEDEC TO-39

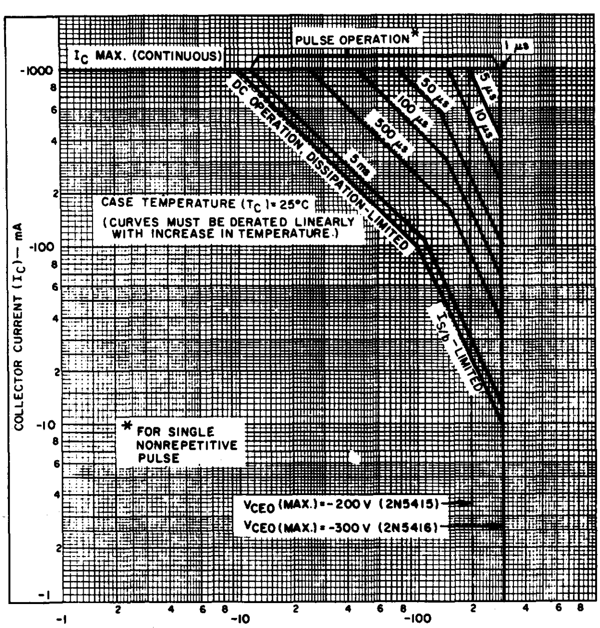


Fig. 1—Maximum safe operating areas for 2N5415 and 2N5416.

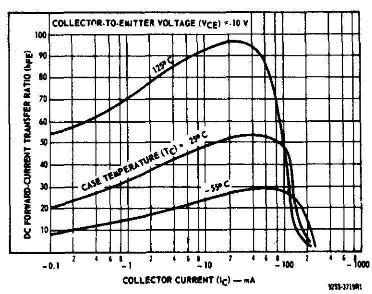


Fig. 2—Typical dc beta characteristics for all types.

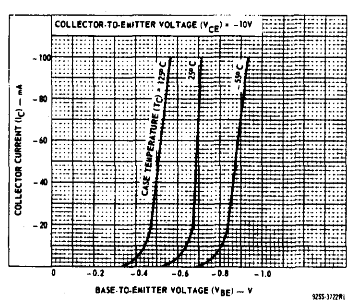


Fig. 3—Typical transfer characteristics for all types.

2N5415, 2N5416, RCS880-RCS882

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc			CURRENT mA dc		LIMITS 2N5415		2N5416		RCS880		RCS881		RCS882		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CEO}		−250			0	–	–	–	−50	–	–	–	–	–	−50	μA
		−150			0	–	−50	–	–	–	–	–	−50	–	–	
		−100			0	–	–	–	–	–	−50	–	–	–	–	
* I_{CBO}	−280					–	–	–	−50	–	–	–	–	–	−50	μA
	−175					–	−50	–	–	–	–	–	−50	–	–	
I_{CEV}		−300	1.5			–	–	–	−50	–	–	–	–	–	−50	μA
		−200	1.5			–	−50	–	–	–	–	–	−50	–	–	
		−150	1.5							–	−100	–	–	–	–	
* I_{EBO}			6	0		–	–	–	−20	–	–	–	–	–	−20	μA
			4	0		–	−20	–	–	–	−30	–	−20	–	–	
* h_{FE}		−10		−50[b]		–	–	30	120	20	150	–	–	–	–	
		−10		−50[b]		30	150	–	–	–	–	–	–	–	–	
		−10		−35[b]		–	–	–	–	–	–	20	–	20	–	
$V_{CEO}(sus)$				−50	0	−200[a]	–	−300[a]	–	−150[a]	–	−250[a]	–	−300[a]	–	V
$V_{CER}(sus)$ (R_{BE}) = 50 Ω				−50		–	–	−350[a]	–	–	–	–	–	−350[a]	–	V
$V_{BE}(sat)$		−10		−50[b]		–	−1.5	–	−1.5	–	−2.5	–	−1.5	–	−1.5	V
$V_{CE}(sat)$				−50[b]	−5	–	−2.5	–	−2	–	−3.5	–	−3	–	−3	V
* h_{fe}, (at 1 kHz)		−10		−5		25	–	25	–	–	–	–	–	–	–	
* $\|h_{fe}\|$ (at 5 MHz)		−10		−10		3	–	3	–	3	–	3	–	3	–	
* $Re(h_{ie})$ (at 1 MHz)		−10		−5		–	300	–	300	–	–	–	300	–	300	Ω
* C_{ib} (at 1 MHz)			5	0		–	75	–	75	–	–	–	75	–	75	pF
* C_{ob} (at 1 MHz)	−10					–	15	–	15	–	–	–	15	–	15	pF
$I_{S/b}$ t_p = 0.4 s nonrep.		−100				−100	–	−100	–	–	–	–	–	–	–	mA
		−75				–	–	–	–	–	–	−100	–	−100	–	
t_p = 0.2 s nonrep.		−75				–	–	–	–	−100	–	–	–	–	–	
$R\theta_{JC}$						–	17.5	–	17.5	–	23.3	–	23.3	–	23.3	°C/W

* 2N-Series types in accordance with JEDEC registration data format (JS-9 RDF-8).

[a] CAUTION: The sustaining voltages V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer.

[b] Pulsed: Pulse = 300 μs; duty factor ≤ 2%.

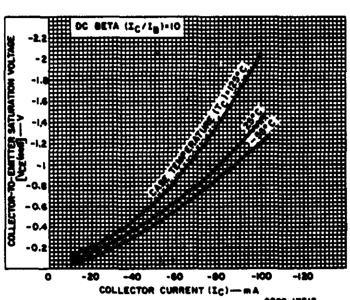


Fig. 4—Typical collector-to-emitter saturation voltage for all types.

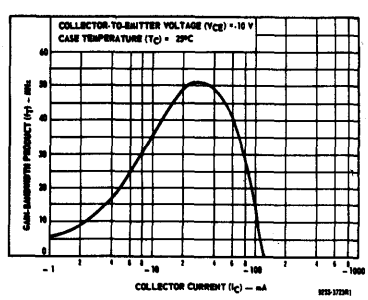


Fig. 5—Typical gain-bandwidth product for all types.

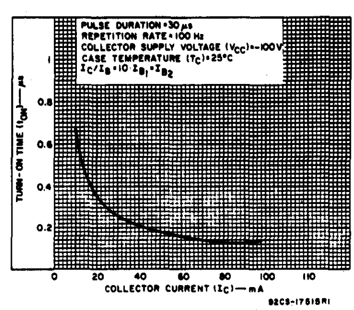


Fig. 6—Typical turn-on time characteristic for 2N5415 and 2N5416.

2N5415, 2N5416, RCS880-RCS882

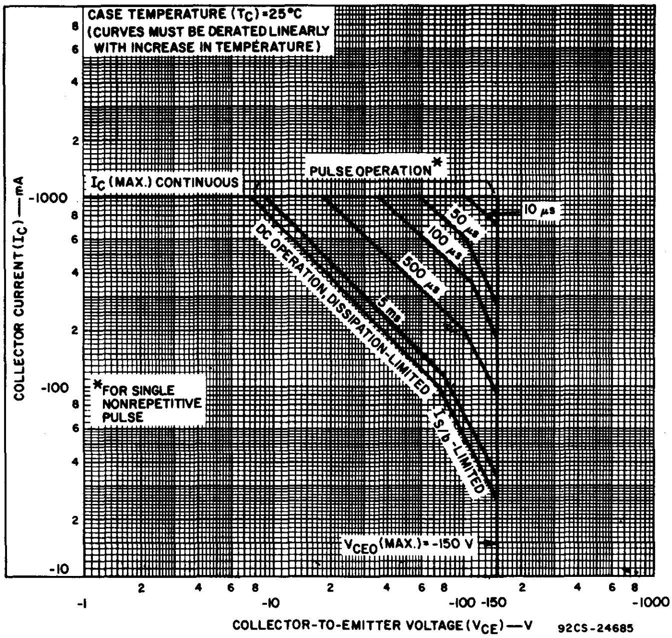


Fig. 7—Maximum safe operating areas for RCS880.

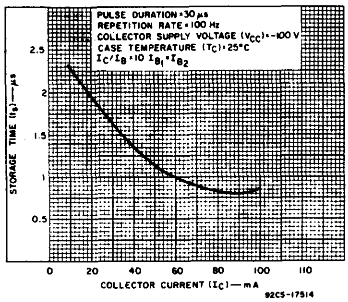


Fig. 8—Typical storage-time characteristic for 2N5415 and 2N5416.

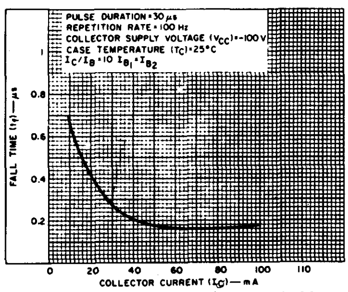


Fig. 10—Typical fall-time characteristic for 2N5415 and 2N5416

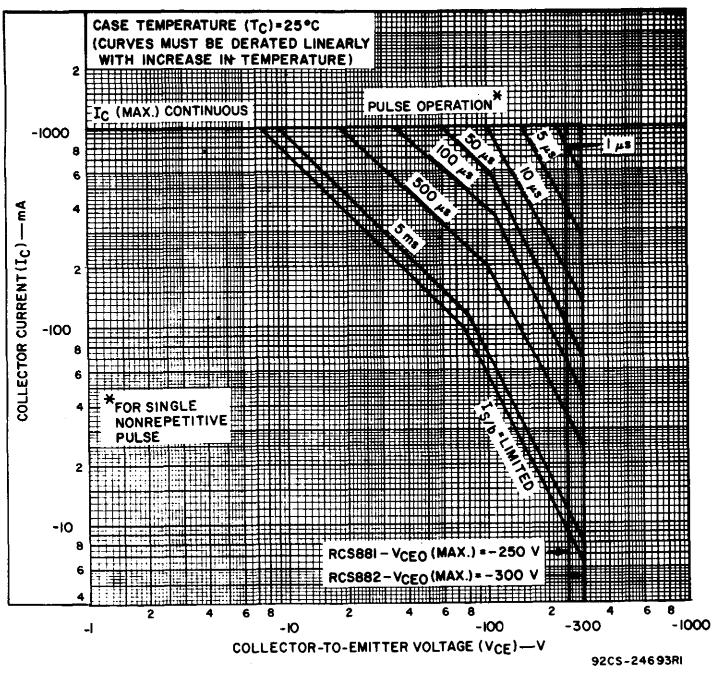


Fig. 9—Maximum safe operating areas for RCS881 and RCS882.

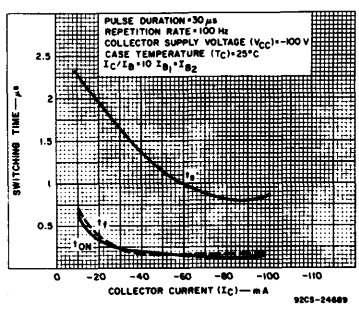


Fig. 11—Typical saturated switching times for RCS880, RCS881 and RCS882.

2N5490, 2N5491, 2N5492, 2N5493, 2N5494, 2N5495, 2N5496, 2N5497

Hometaxial-Base, Silicon N-P-N VERSAWATT Transistors

General-Purpose Types for Medium-Power Switching and Amplifier Applications in Military, Industrial, and Commercial Equipment

FEATURES

- Low saturation voltage—
  $V_{CE}(sat)$ = 1 V max. at I_C = 2 A (2N5490, 2N5491)
  = 1 V max. at I_C = 2.5 A (2N5492, 2N5493)
  = 1 V max. at I_C = 3 A (2N5494, 2N5495)
  = 1 V max. at I_C = 3.5 A (2N5496, 2N5497)
- VERSAWATT package (molded silicone plastic)
- Maximum safe-area-of-operation curves specified for DC and pulse operation

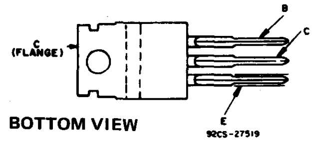
RCA-2N5490, 2N5491, 2N5492, 2N5493, 2N5494, 2N5495, 2N5496 and 2N5497* are hometaxial-base silicon n-p-n transistors. They are intended for a wide variety of medium-power switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers.

Types 2N5491, 2N5493, 2N5495, and 2N5497 have formed emitter and base leads for insertion into TO-66 sockets. Types 2N5490, 2N5492, 2N5494, and 2N5496 are electrically identical to the 2N5491, 2N5493, 2N5495, and 2N5497 but have straight leads.

These plastic-package power transistors differ in voltage ratings and in the currents at which the parameters are controlled.

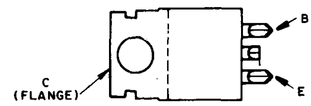
*Formerly RCA Dev. Nos. TA7317, TA7318, TA7315, TA7316, TA7313, TA7314, TA7311, TA7312, respectively.

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB
2N5490 2N5494
2N5492 2N5496



BOTTOM VIEW 92CS-27520

JEDEC TO-220AA
2N5491 2N5495
2N5493 2N5497

Maximum Ratings, *Absolute-Maximum Values:*

		2N5490 2N5491 2N5494 2N5495	2N5492 2N5493	2N5496 2N5497	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	75	90	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
With -1.5 volts (V_{BE}) of reverse bias	$V_{CEV}(sus)$	60	75	90	V
With external base-to-emitter resistance (R_{BE}) 100 Ω	$V_{CER}(sus)$	50	65	80	V
With base open	$V_{CEO}(sus)$	40	55	70	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	V
COLLECTOR CURRENT	I_C	7	7	7	A
BASE CURRENT	I_B	3	3	3	A
TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		50	50	50	W
At ambient temperatures up to 25°C		1.8	1.8	1.8	W
At case temperatures above 25°C		Derate linearly at 0.4 W/°C or see Figs. 1 & 2			
At ambient temperatures above 25°C		Derate linearly at 0.0144 W/°C			
TEMPERATURE RANGE:					
Storage & Operating (Junction)		← -65 to 150 →			°C
LEAD TEMPERATURE (During Soldering):					
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max		← 235 →			°C

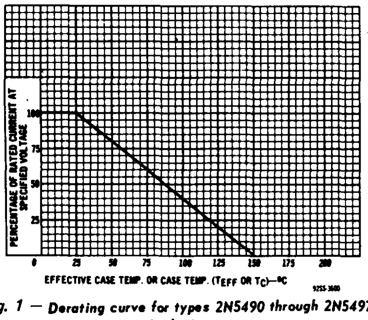


Fig. 1 — Derating curve for types 2N5490 through 2N5497 inclusive.

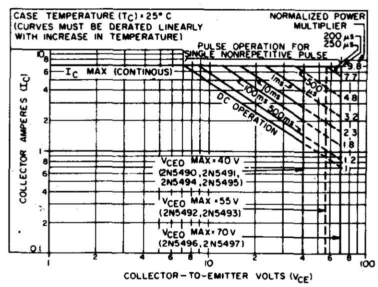


Fig. 2 — Maximum operating areas for types 2N5490 through 2N5497 inclusive.

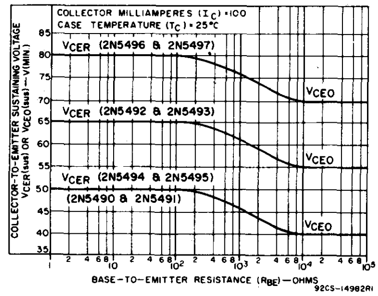


Fig. 3 — Collector-to-emitter sustaining voltage characteristics for types 2N5490 through 2N5497 inclusive.

2N5490, 2N5491, 2N5492, 2N5493, 2N5494, 2N5495, 2N5496, 2N5497

ELECTRICAL CHARACTERISTICS, ***Case Temperature (T_C) = 25°C Unless Otherwise Specified***

Characteristic	Symbol	TEST CONDITIONS: DC Voltage (V) V_{CE}	V_{BE}	DC Current (A) I_C	I_B	LIMITS: Types 2N5496 2N5497 Min.	Max.	Types 2N5494 2N5495 Min.	Max.	Types 2N5492 2N5493 Min.	Max.	Types 2N5490 2N5491 Min.	Max.	Units
Collector-Cutoff Current With base-emitter junction reverse biased	I_{CEV}	85	-1.5			-	1	-	-	-	-	-	-	mA
		55	-1.5			-	-	-	1	-	-	-	-	
		70	-1.5			-	-	-	-	-	1	-	-	
	I_{CEV} (T_C = 150°C)	85	-1.5			-	5	-	-	-	-	-	-	mA
		55	-1.5			-	-	-	5	-	-	-	-	
		70	-1.5			-	-	-	-	-	5	-	-	
Collector-Cutoff Current With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	70				-	0.5	-	-	-	-	-	-	mA
		40				-	-	-	0.5	-	-	-	2	
		55				-	-	-	-	-	0.5	-	-	
	I_{CER} (T_C = 150°C)	70				-	3.5	-	-	-	-	-	-	mA
		40				-	-	-	3.5	-	-	-	5	
		55				-	-	-	-	-	3.5	-	-	
Emitter-Cutoff Current	I_{EBO}		-5			-	1	-	1	-	1	-	1	mA
DC Forward-Current Transfer Ratio	h_{FE}[c]	4		3.5		20	100	-	-	-	-	-	-	
		4		3		-	-	20	100	-	-	-	-	
		4		2.5		-	-	-	-	20	100	-	-	
		4		2		-	-	-	-	-	-	20	100	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$[c]			0.1	0	70	-	40	-	55	-	40	-	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$[c]			0.1		80	-	50	-	65	-	50	-	V
With base-emitter junction reverse biased	$V_{CEV}(sus)$[c]		-1.5	0.1		90	-	60	-	75	-	60	-	V
Base-to-Emitter Voltage	V_{BE}[c]	4		3.5		-	1.7	-	-	-	-	-	-	V
		4		3		-	-	-	1.5	-	-	-	-	
		4		2.5		-	-	-	-	-	1.3	-	-	
		4		2		-	-	-	-	-	-	-	1.1	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$[c]			3.5	0.35	-	1	-	-	-	-	-	-	V
				3	0.3	-	-	-	1	-	-	-	-	
				2.5	0.25	-	-	-	-	-	1	-	-	
				2	0.2	-	-	-	-	-	-	-	1	
Gain-Bandwidth Product	f_T	4		0.5		0.8	-	0.8	-	0.8	-	0.8	-	MHz
Sat. Switching Time: Turn-On	t_{on}	V_{CC} = 30		3.5	0.35[a]	-	5	-	-	-	-	-	-	μs
				3	0.3[a]	-	-	-	5	-	-	-	-	
				2.5	0.25[a]	-	-	-	-	-	5	-	-	
				2	0.2	-	-	-	-	-	-	-	5	
Turn-Off	t_{off}	V_{CC} = 30		3.5	0.35[b]	-	15	-	-	-	-	-	-	μs
				3	0.3[b]	-	-	-	15	-	-	-	-	
				2.5	0.25[b]	-	-	-	-	-	15	-	-	
				2	0.2	-	-	-	-	-	-	-	15	
Thermal Resistance: Junction-to-Case	θ_{J-C}					-	2.5	-	2.5	-	2.5	-	2.5	°C/W
Junction-to-Ambient	θ_{J-A}					-	70	-	70	-	70	-	70	°C/W

[a] I_{B1} value (turn-on base current). [b] I_{B2} value (turn-off base current). [c] Pulsed, pulse duration = 300 μs, duty factor = .018.

2N5490, 2N5491, 2N5492, 2N5493, 2N5494, 2N5495, 2N5496, 2N5497

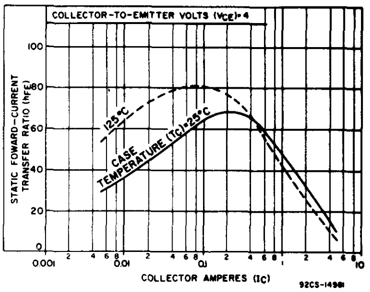


Fig.4 - Typical static beta characteristics for types 2N5490 through 2N5493 inclusive.

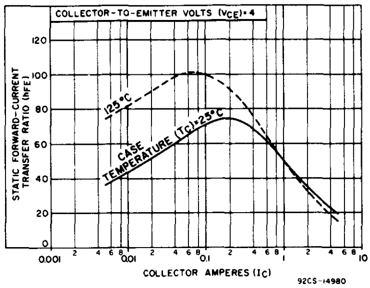


Fig.5 - Typical static beta characteristics for types 2N5494 and 2N5495.

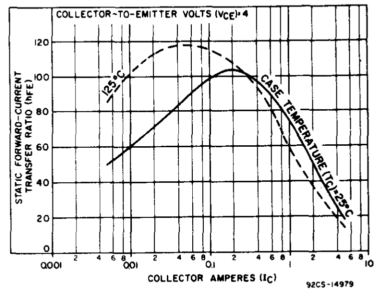


Fig.6 - Typical static beta characteristics for types 2N5496 and 2N5497.

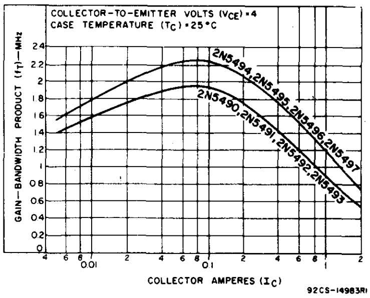


Fig.7 - Typical gain-bandwidth product for types 2N5490 through 2N5497 inclusive.

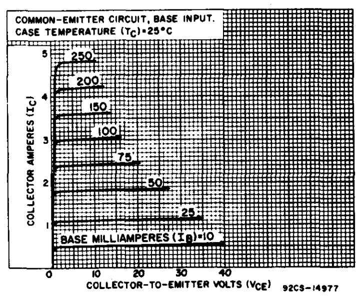


Fig.8 - Typical output characteristics for types 2N5494 through 2N5497 inclusive.

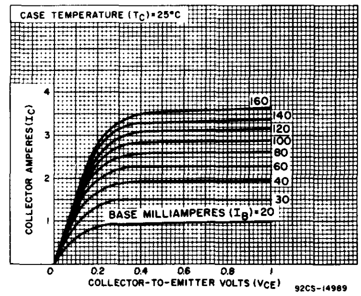


Fig.9 - Typical output characteristics for types 2N5494 and 2N5495.

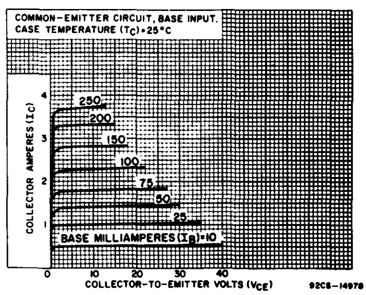


Fig.10 - Typical output characteristics for types 2N5490 through 2N5493 inclusive.

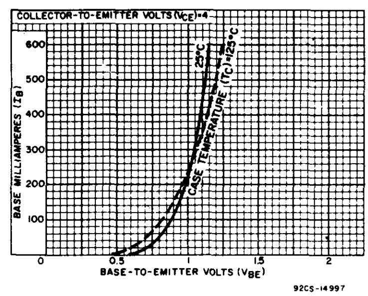


Fig.11 - Typical input characteristics for types 2N5494 through 2N5497 inclusive.

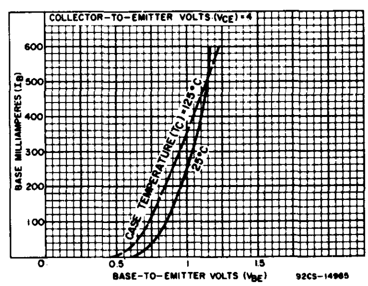


Fig.12 - Typical input characteristics for types 2N5490 through 2N5493 inclusive.

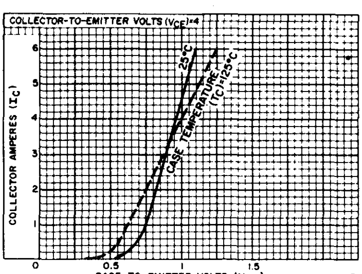


Fig.13 - Typical transfer characteristics for types 2N5494 through 2N5497 inclusive.

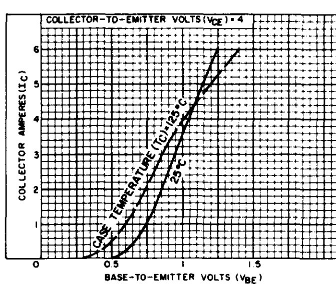


Fig.14 - Typical transfer characteristics for types 2N5490 through 2N5493 inclusive.

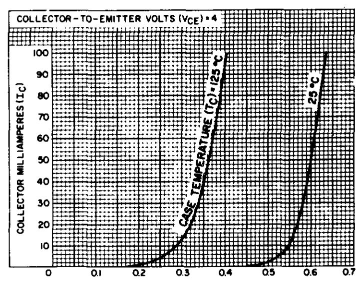


Fig.15 - Typical transfer characteristics for types 2N5490 through 2N5497 inclusive.

2N5575, 2N5578

High-Current, High-Power, Hometaxial-Base Silicon N-P-N Transistors

For Linear and Switching Applications in Military, Commercial, and Industrial Equipment

RCA-2N5575 and 2N5578● are high-current, high-power, hometaxial-base silicon n-p-n transistors. They differ in maximum voltage and current ratings.

These power transistors are intended for a wide variety of high-current, high-power linear and switching applications such as low- to medium-frequency amplifiers, switching and linear regulators, power-switching circuits, series- or shunt-regulator driver and output stages, dc-to-dc converters, inverters, control circuits, and solenoid (hammer)/relay drivers.

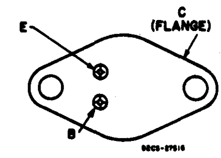
The high-current capability (100-A peak) makes these types particularly suitable for circuit designs that now require several low-current types connected in parallel.

They are supplied in the Modified JEDEC TO-3 package with 0.060-In. Dia. Pins.

● Formerly RCA Dev. Nos. TA7016 and TA7017, respectively.

Features:
- Maximum safe-area-of operation curves
- $I_{S/b}$-limit line beginning at 25 V
- High-current capability
- Low saturation voltage at high beta
- High-dissipation capability
- Low thermal resistance

TERMINAL DESIGNATIONS



Modified JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5575	2N5578	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	70	90	V
*COLLECTOR-TO-EMITTER VOLTAGE:				
With base open, sustaining	$V_{CEO}(sus)$	50	70	V
With external base-to-emitter resistance (R_{BE}) = 10 Ω & V_{BE} = −1.5 V	V_{CEX}	70	90	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	8	8	V
*COLLECTOR CURRENT (Continuous)	I_C	80	60	A
*COLLECTOR CURRENT (Peak)		100	80	A
*BASE CURRENT (Continuous)	I_B	20	15	A
*TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C and V_{CE} up to 25 V		300	300	W
At case temperatures of 100°C and V_{CB} of 25 V		150	150	W
At case temperatures up to 25°C and V_{CE} above 25 V		See Fig. 2		
At case temperatures above 25°C and V_{CE} above 25 V		See Figs. 1 & 2		
*TEMPERATURE RANGE:				
Operating (Junction)		−65 to 175		°C
Storage		−65 to 200		°C
*PIN TEMPERATURE (During Soldering):				
At distance ≥ 1/32 in. (0.8 mm) from case for 10 s max.		230		°C

* In accordance with JEDEC registration data format JS-6 RDF-1.

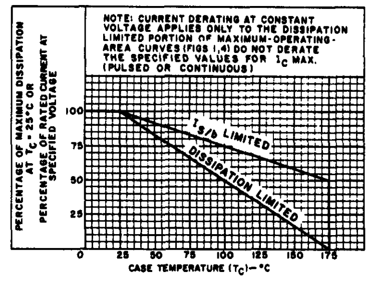


Fig. 1 - Dissipation derating curves for both types.

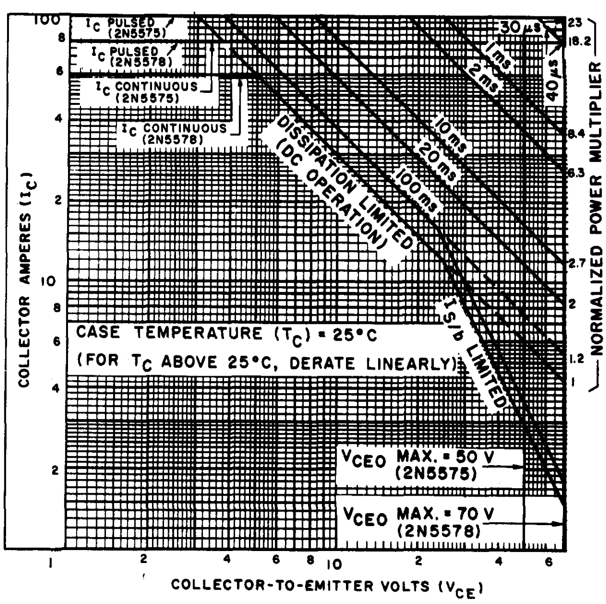


Fig. 2 — Maximum operating areas for both types.

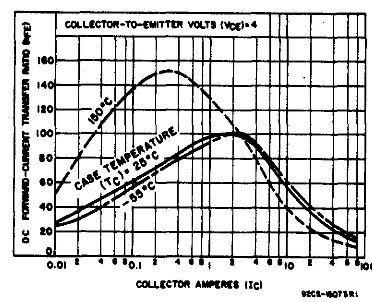


Fig. 3 - Typical dc beta characteristics for 2N5575.

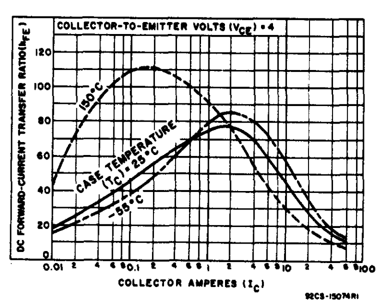


Fig. 4 - Typical dc beta characteristics for 2N5578.

2N5575, 2N5578

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS				UNITS
		Voltage V dc		Current A dc		2N5575		2N5578		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
Collector Cutoff Current:										
* With base-emitter junction reverse-biased	I_{CEV}	60 80	−1.5 −1.5			– –	10 –	– –	– 10	mA
With external base-emitter resistance (R_{BE})=10 Ω	I_{CER}	50 70				– –	10 –	– –	– 10	mA
* With base-emitter junction reverse-biased	I_{CEV} (T_C=150°C)	60 80	−1.5 −1.5			– –	20 –	– –	– 20	mA
* Emitter Cutoff Current	I_{EBO}		−8			–	10	–	10	mA
* Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$			0.2	0	50	–	70	–	V
* DC Forward Current Transfer Ratio	h_{FE}[a]	3 4		40[a] 60[a]		– 10	– 40	10 –	40 –	
Collector-to-Emitter Sustaining Voltage: (See Figs. 5 and 6) With base open	$V_{CEO}(sus)$			0.2		50[b]	–	70[b]	–	V
With base-emitter junction reverse-biased, R_{BE}=10 Ω	$V_{CEX}(sus)$		−1.5	7		70[b]	–	90[b]	–	V
Base-to-Emitter Voltage	V_{BE}[a]	4 4		40[a] 60[a]		– –	– 3	– –	2.5 –	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$[a]			40[a] 60[a]	4 6	– –	– 2	– –	1.5 –	V
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$[a]			40[a] 60[a]	4 6	– –	– 3	– –	2.5 –	V
Output Capacitance: (V_{CB} = 10 V)	C_{ob}					–	2000	–	2000	pF
Input Capacitance	C_{ib}		−0.5	0		–	4000	–	4000	pF
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f=0.2 MHz)	$\|h_{fe}\|$	4		10		2	–	2	–	
* Saturated Switching Time (V_{CC} = 30 V): Turn-on time	t_{ON}			40 60	4 6	– –	– 15	– –	10 –	μs
Turn-off time	t_{OFF}			40 60	4 6	– –	– 15	– –	10 –	μs
Forward-Bias Second-Breakdown Collector Current (t = 1 s)	$I_{S/b}$	25				12	–	12	–	A
Second Breakdown Energy (With base reverse-biased, R_{BE}=10 Ω, L=33 mH)	$E_{S/b}$		−1.5	7		0.8	–	0.8	–	J
Thermal Resistance: (Junction-to-Case)	$R_{\theta JC}$					–	0.5	–	0.5	°C/W

*In accordance with JEDEC registration data format JS-6 RDF-1.

[a]Pulsed; pulse duration ≤ 350 μs, duty factor=0.02.

[b]CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer.

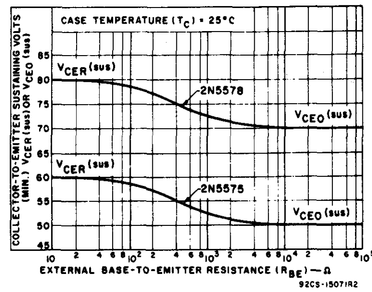


Fig.5 - Collector-to-emitter sustaining voltage characteristics for both types.

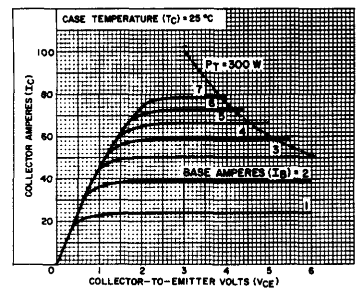


Fig. 6 - Typical output characteristics for 2N5575.

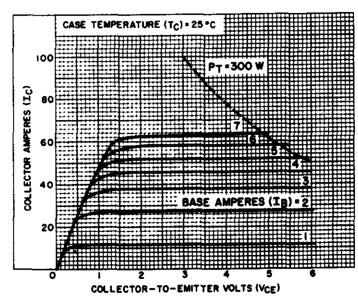


Fig. 7 - Typical output characteristics for 2N5578.

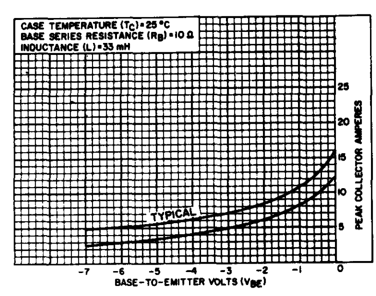


Fig. 8 - Reverse-bias second-breakdown characteristics for both types.

2N5575, 2N5578

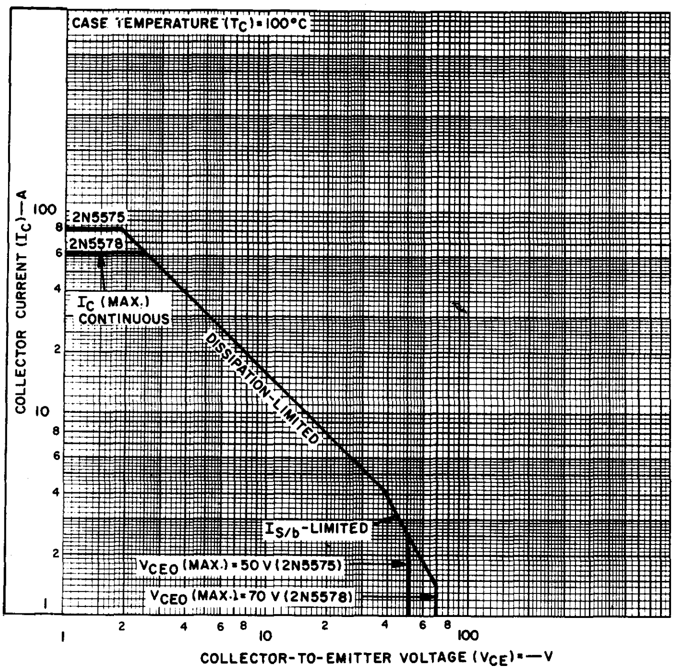


Fig. 9 – Maximum operating areas for both types at $T_C = 100°C$.

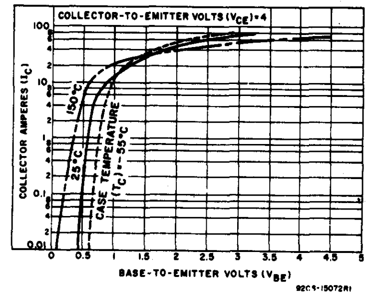


Fig. 10 – Typical transfer characteristics for 2N5575.

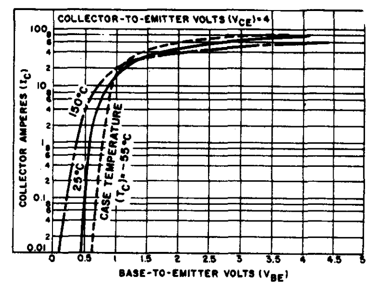


Fig. 11 – Typical transfer characteristics for 2N5578.

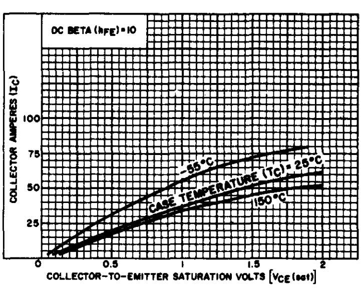


Fig. 12 – Typical saturation voltage characteristics for 2N5575.

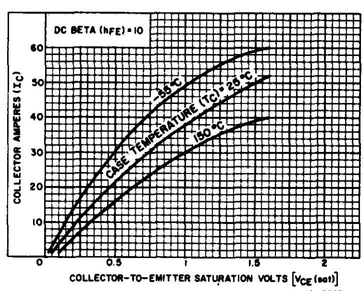


Fig. 13 – Typical saturation voltage characteristics for 2N5578.

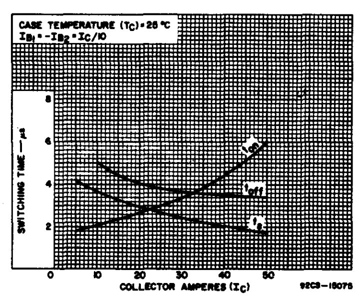


Fig. 14 – Typical saturated switching characteristics for both types.

2N5632, 2N5633, 2N5634

Silicon N-P-N Epitaxial-Base High-Power Transistors

Rugged, Broadly Applicable Devices
For Industrial and Commercial Use

The RCA-2N5632, 2N5633 and 2N5634 are epitaxial-base silicon n-p-n transistors intended for a wide variety of high-power, high-current applications, such as power-switching circuits, driver and output stages for series and shunt regulators, dc-to-dc converters, inverters, and solenoid (hammer)/relay drivers.

These devices differ in maximum voltage ratings. They are supplied in JEDEC TO-204MA hermetic steel packages.

Features:

- **High dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **Hermetically sealed JEDEC TO-3/TO-204MA package**
- **High gain at high current**

Applications:

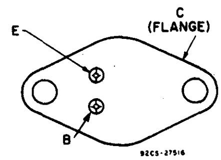
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N5632	2N5633	2N5634	
* V_{CEO}	100	120	140	V
* V_{CBO}	100	120	140	V
* V_{EBO}		7		V
* I_C		10		A
* I_{CM}		15		A
* I_B		5		A
* P_T				
At $T_C \leq 25°C$		150		W
At $T_C > 25°C$ derate linearly		0.857		W/°C
* T_J, T_{stg}		−65 to 200		°C
* T_L at 1/16 ± 1/32 in. (1.58 ± 0.8 mm) from case for 10 s		235		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

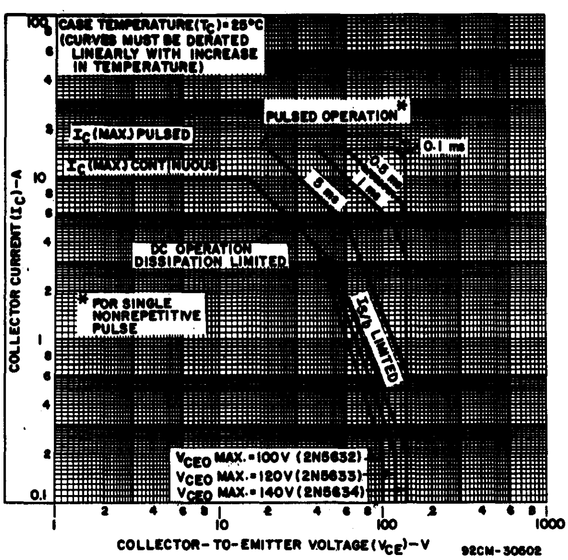


Fig. 1 — Maximum operating areas for all types.

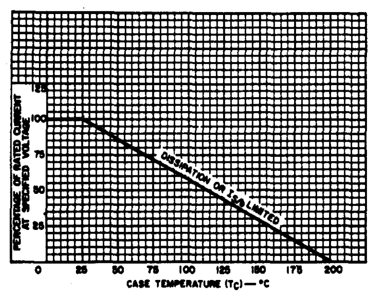


Fig. 2 — Current derating curve for all types.

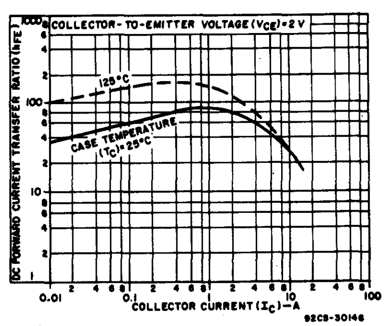


Fig. 3 — Typical dc beta characteristics as a function of collector current for all types.

2N5632, 2N5633, 2N5634

ELECTRICAL CHARACTERISTICS, At Case Temperature $T_C = 25^oC$
Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N5632 Min.	Max.	2N5633 Min.	Max.	2N5634 Min.	Max.	UNITS
* I_{CEX}	100	−1.5	–	–	–	1.0	–	–	–	–	mA
	120	−1.5	–	–	–	–	–	1.0	–	–	
	140	−1.5	–	–	–	–	–	–	–	1.0	
$T_C = 150^oC$	100	−1.5	–	–	–	5.0	–	–	–	–	
	120	−1.5	–	–	–	–	–	5.0	–	–	
	140	−1.5	–	–	–	–	–	–	–	5.0	
* I_{CEO}	50	–	–	0	–	1.0	–	–	–	–	mA
	60	–	–	0	–	–	–	1.0	–	–	
	70	–	–	0	–	–	–	–	–	1.0	
I_{CBO} $I_E = 0$ V_{CB}=Rated V_{CB}	100	–	–	–	–	1.0	–	–	–	–	mA
	120	–	–	–	–	–	–	1.0	–	–	
	140	–	–	–	–	–	–	–	–	1.0	
* I_{EBO}	–	7	–	–	–	1.0	–	1.0	–	1.0	mA
* $V_{CEO}(sus)$[b]	–	–	0.2	0	100	–	120	–	140	–	V
* h_{FE}[a]	2	–	5	–	25	100	20	80	15	60	
	2	–	10	–	5	–	5	–	5	–	
* V_{BE}[a]	2	–	5	–	–	1.5	–	1.5	–	1.5	V
* $V_{CE}(sat)$[a]	–	–	7.5	0.75	–	1.0	–	1.0	–	1.0	V
	–	–	10	2.0	–	2.0	–	2.0	–	2.0	
* f_T f = 0.5 MHz	20	–	1	–	1	–	1	–	1	–	MHz
* h_{fe} f = 1 kHz	10	–	2.0	–	15	–	15	–	15	–	
* $V_{BE}(sat)$			7.5	0.75	–	2.0	–	2.0	–	2.0	V
* C_{obo} f = 0.1 MHz $I_E = 0$	10[c]				–	300	–	300	–	300	pF
$I_{S/b}$ t_p = 1 s nonrep.	50				3.0	–	–	–	–	–	A
	45				–	–	3.33	–	–	–	
	40				–	–	–	–	3.75	–	
$R_{\theta JC}$	–	–	–	–	–	1.17	–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed; pulse duration ≤ 300 μs. Duty factor ≤ 2%.
[b] CAUTION: Sustaining voltage, $V_{CEO}(sus)$ MUST NOT BE measured on a curve tracer.
[c] V_{CB}.

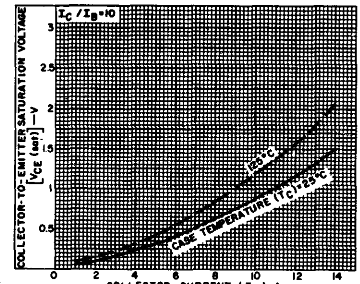


Fig. 4 — Typical saturation voltage characteristics for all types.

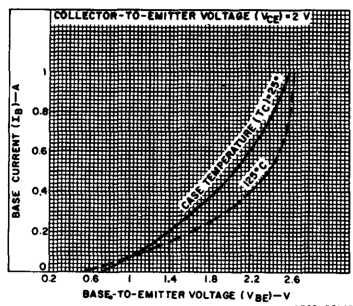


Fig. 5 — Typical input characteristics for all types.

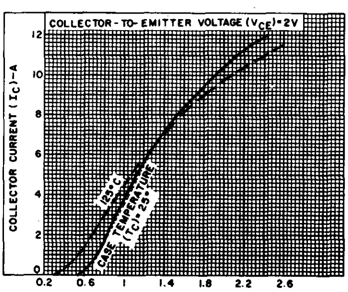


Fig. 6 — Typical transfer characteristics for all types.

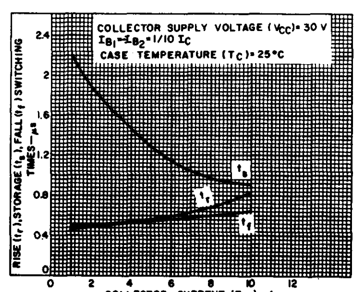


Fig. 7 — Typical saturated-switching times for all types.

2N5671, 2N5672
Silicon N-P-N Power Transistors

High-Current, High-Speed, High-Power Types for Switching and Amplifier Applications

RCA Types 2N5671 and 2N5672▲ are epitaxial silicon n-p-n transistors having high current and high power handling capability and fast switching speed. The 2N5672 is similar to the 2N5671 except that it has higher voltage ratings and lower leakage currents. These devices are especially suitable for switching-control amplifiers, power gates, switching regulators, power-switching circuits, converters, inverters, control circuits. Other recommended applications included DC-RF amplifiers and power oscillators.

They are supplied in the JEDEC TO-3 hermetic steel package.

▲Formerly Dev. Types TA7323 and TA7323A, respectively

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

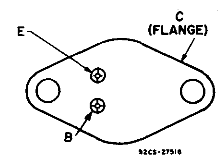
	2N5671	2N5672	
*COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	120	150	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With base open, $V_{CEO}(sus)$	90	120	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω, $V_{CER}(sus)$	110	140	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω & V_{BE} = -1.5, $V_{CEX}(sus)$	120	150	V
*EMITTER-TO-BASE VOLTAGE, V_{EBO}	7	7	V
*COLLECTOR CURRENT, I_C	30	30	A
*BASE CURRENT, I_B	10	10	A
*TRANSISTOR DISSIPATION, P_T:			
At case temperatures up to 25° C and V_{CE} up to 24 V	140	140	W
At case temperatures up to 25° C and V_{CE} above 24 V	See Fig. 1		
At case temperatures above 25° C and V_{CE} above 24 V	See Figs. 1&2.		
*TEMPERATURE RANGE:			
Storage & Operating (Junction)	-65 to +200		°C
*PIN TEMPERATURE (During Soldering)			
At distances ≥ 1/32 in. from seating plane for 10 s max		230	°C

*In accordance with JEDEC registration data format (JS-6, RFD-1)

Features:

- **Maximum Safe-Area-of-Operation Curves . . . $I_{S/b}$ limit line beginning at 24 V**
- **Fast Turn-On Time . . . t_{on} = 0.5μs max. at I_C = 15 A**
- **High-Current Capability . . . h_{FE}, $V_{CE}(sat)$, $V_{BE}(sat)$, & V_{BE} measured at I_C = 15 A**
- **Low $V_{CE}(sat)$ = 0.75 V max.**
- **High P_T = 140 W max. at T_C = 25° C**

TERMINAL DESIGNATIONS



JEDEC TO-3

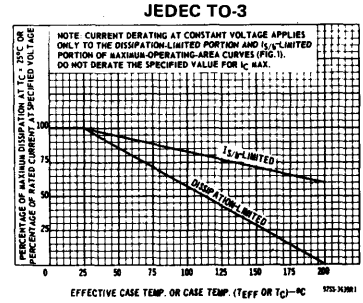


Fig. 2 - Dissipation derating curves for types 2N5671 and 2N5672.

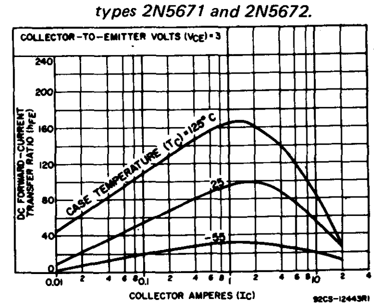


Fig. 3 - Typical dc beta characteristics for types 2N5671 and 2N5672.

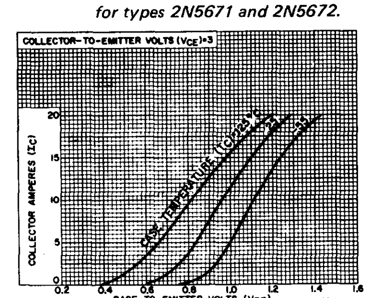


Fig. 4 - Typical transfer characteristics for types 2N5671 and 2N5672.

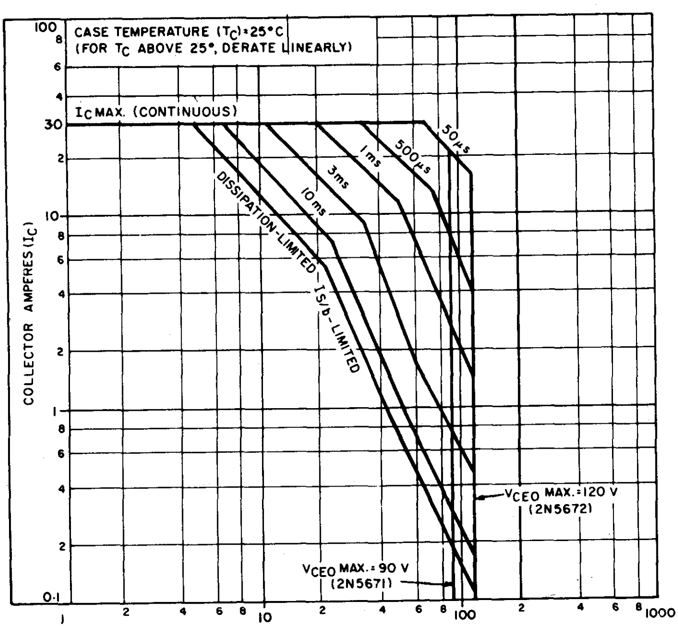


Fig. 1 - Maximum operating areas for types 2N5671 and 2N5672.

2N5671, 2N5672

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS DC Voltage (V) V_{CB}	V_{CE}	V_{BE}	DC Current (A) I_C	I_B	LIMITS Type 2N5671 Min.	Max.	Type 2N5672 Min.	Max.	UNITS
Collector-Cutoff Current	I_{CEO}	-	80	-	-	0	-	10	-	10	mA
*	I_{CEV}	-	110	-1.5	-	-	-	12	-	-	mA
*	I_{CEV}	-	135	-1.5	-	-	-	-	-	10	mA
	I_{CEV} (T_C=150° C)	-	100	-1.5	-	-	-	15	-	10	mA
* Emitter-Cutoff Current	I_{EBO}	-	-	-7	0	-	-	10	-	10	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$	-	-	-	0.2	0	90[a]	-	120[a]	-	V
With external base-to-emitter resistance (R_{BE}) ≤50 Ω	$V_{CER}(sus)$	-	-	-	0.2	0	110[a]	-	140[a]	-	V
With base-emitter junction reverse biased & R_{BE} ≤ 50 Ω	$V_{CEX}(sus)$	-	-	-1.5	0.2	-	120[a]	-	150[a]	-	V
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$	-	-	-	15	1.2	-	1.5	-	1.5	V
Base-to-Emitter Voltage	V_{BE}	-	5	-	15	-	-	1.6	-	1.6	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	-	-	-	15	1.2	-	0.75	-	0.75	V
* DC Forward-Current Transfer Ratio	h_{FE}	-	2	-	15	-	20	100	20	100	
		-	5	-	20	-	20	-	20	-	
Second-Breakdown Collector Current[c] With base forward biased	$I_{S/b}$[b]	-	24	-	-	-	5.8[c]	-	5.8[c]	-	A
		-	45	-	-	-	0.9[c]	-	0.9[c]	-	A
Second-Breakdown Energy With base reverse biased R_{BE} = 20 Ω, L = 180 µH	$E_{S/b}$[d]	-	-	-4	15	-	20	-	20	-	mJ
Gain-Bandwidth Product	f_T	-	10	-	2	-	50	-	50	-	MHz
Output Capacitance (At 1 MHz, I_E=0)	C_{ob}	10	-	-	-	-	-	900	-	900	pF
* Saturated Switching Turn-On Time (Delay Time + Rise Time)	t_{on}	V_{CC}= 30 V	-	-	15	I_{B1}=I_{B2}= 1.2	-	0.5	-	0.5	µs
* Saturated Switching Storage Time	t_s	V_{CC}= 30 V	-	-	15	I_{B1}=I_{B2}= 1.2	-	1.5	-	1.5	µs
* Saturated Switching Fall Time	t_f	V_{CC}= 30 V	-	-	15	I_{B1}=I_{B2}= 1.2	-	0.5	-	0.5	µs
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	-	10	-	5	-	-	1.25	-	1.25	°C/W

[a]Pulsed; pulse duration ≤ 350 µs, duty factor=0.02.

[b]CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer.

[c]$I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

[d]Pulsed; 1-s, non-repetitive pulse.

[e]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

*In accordance with JEDEC registration data format JS-6 RDF-1.

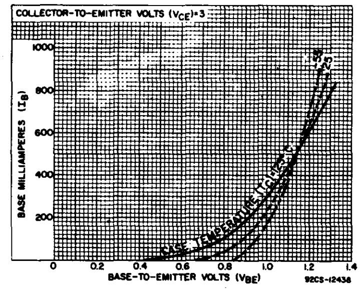


Fig. 5 - Typical input characteristics for types 2N5671 and 2N5672.

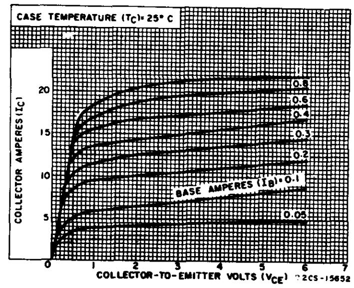


Fig. 6 - Typical output characteristics for types 2N5671 and 2N5672.

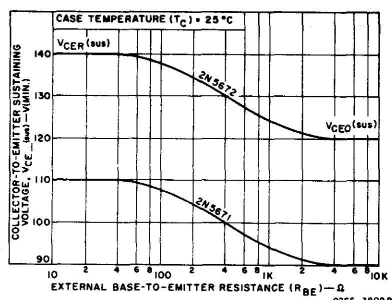


Fig. 7 - Collector-to-emitter sustaining voltage characteristics for types 2N5671 and 2N5672.

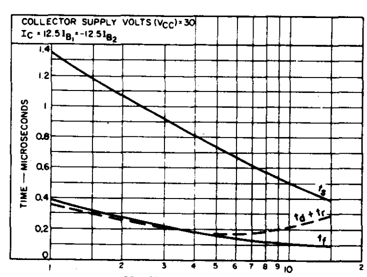


Fig. 8 - Typical saturated switching characteristics for types 2N5671 and 2N5672.

2N5781-2N5786

Silicon N-P-N and P-N-P Epitaxial-Base Complementary-Symmetry Transistors

General-Purpose Types for Switching and Linear-Amplifier Applications

Features:

- Low saturation voltages
- Maximum safe-area-of-operation curves
- Hermetically sealed package
- High gain at high current
- High breakdown voltages

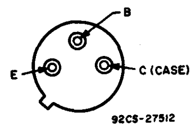
RCA-2N5781, 2N5782, and 2N5783 are epitaxial-base silicon p-n-p transistors - - complements of the hometaxial-base silicon n-p-n types 2N5784, 2N5785, and 2N5786,● respectively.

The three types in each family differ primarily in voltage ratings and saturation characteristics.

These transistors are intended for medium-power switching and complementary-symmetry audio amplifier applications.

● Formerly RCA Dev. Types TA7270, TA7271, TA7272, TA7289, TA7290, and TA7291 respectively.

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		P-N-P: 2N5781◆ / N-P-N: 2N5784	P-N-P: 2N5782◆ / N-P-N: 2N5785	P-N-P: 2N5783◆ / N-P-N: 2N5786	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	80	65	45	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
* With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	80	65	45	V
With base open	$V_{CEO}(sus)$	65	50	40	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	3.5	V
*CONTINUOUS COLLECTOR CURRENT	I_C	3.5	3.5	3.5	A
*CONTINUOUS BASE CURRENT	I_B	1	1	1	A
*TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		10	10	10	W
At ambient temperatures up to 25°C		1	1	1	W
At case temperatures above 25°C ... Derate linearly		0.057 W/°C, or see Fig. 1			
At ambient temperatures above 25°C ... Derate linearly		0.0057			W/°C
*TEMPERATURE RANGE:					
Storage and operating (Junction)		−65 to +200			°C
*LEAD TEMPERATURE (During soldering):					
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230			°C

*In accordance with JEDEC registration data format JS-6 RDF-2.

◆For p-n-p devices, voltage and current values are negative.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS◆ VOLTAGE V dc		CURRENT A dc		LIMITS 2N5781 p-n-p		2N5784 n-p-n		UNITS
			V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
	Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	65				–	−10	–	10	µA
	At T_C = 150°C	I_{CER}	65				–	−1	–	1	mA
*	With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	−75 75	1.5 −1.5			– –	−10 –	– –	– 10	µA
*	At T_C = 150°C	I_{CEX}	−75 75	1.5 −1.5			– –	−1 –	– –	– 1	mA
*	With base open	I_{CEO}	50			0	–	−100	–	100	µA
*	Emitter Cutoff Current	I_{EBO}		−5	0		–	−10	–	10	µA
*	DC Forward-Current Transfer Ratio	h_{FE}	2 2		1[a] 3.2[a]		20 4	100 –	20 4	100 –	
*	Collector-to-Emitter Sustaining Voltage (see Figs, 2 and 3): With base open	$V_{CEO}(sus)$			0.1[a]	0	−65[b]	–	65[b]	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1[a]		−80[b]	–	80[b]	–	V
*	Base-to-Emitter Voltage	V_{BE}	2		1[a]		–	−1.5	–	1.5	V
*	Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE}(sat)$			1[a]	0.1	–	−0.5	–	0.5	V
*	Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\|h_{fe}\|$	−2		−0.1		2	15	–	–	
	f = 200 kHz	$\|h_{fe}\|$	2		0.1			–	5	20	
*	Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	

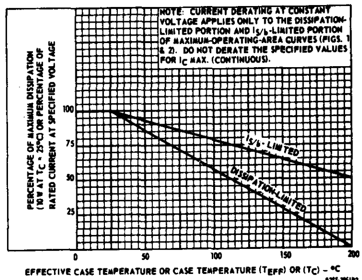


Fig. 1 - Dissipation derating curve for all types.

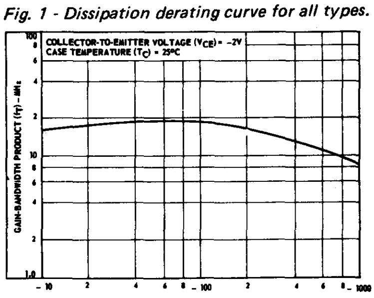


Fig. 2 - Typical gain-bandwidth product for 2N5781, 2N5782, & 2N5783.

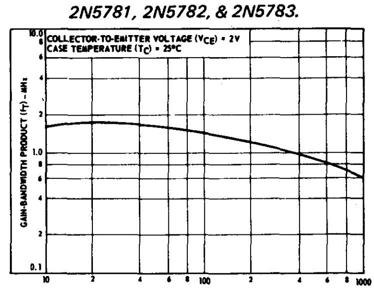


Fig. 3 - Typical gain-bandwidth product for 2N5784, 2N5785, & 2N5786.

2N5781-2N5786

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N5781 p-n-p Min.	Max.	2N5784 n-p-n Min.	Max.	UNITS
Saturated Switching Time (V_{CC} = 30 V, I_{B1} = I_{B2}): Turn-on ($t_d + t_r$)	t_{ON}			−1 1	−0.1 0.1	– –	0.5 –	– –	– 5	µs
Turn-off ($t_s + t_f$)	t_{OFF}			−1 1	−0.1 0.1	– –	2.5 –	– –	– 15	µs
Thermal Resistance: Junction-to-case	$R_{\theta JC}$					–	17.5	–	17.5	°C/W
Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	°C/W

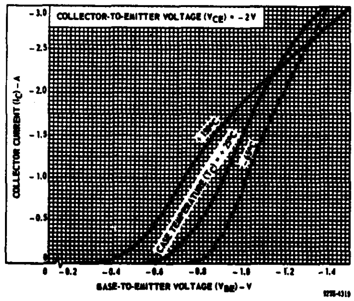


Fig. 4 - Typical transfer characteristics for types 2N5781, 2N5782, 2N5783.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N5782 p-n-p Min.	Max.	2N5785 n-p-n Min.	Max.	UNITS
Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	50				–	−10	–	10	µA
At T_C = 150°C	I_{CER}	50				–	−1	–	1	mA
• With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	−60 60	1.5 −1.5			– –	−10 –	– –	– 10	µA
• At T_C = 150°C	I_{CEX}	−60 60	1.5 −1.5			– –	−1 –	– –	– 1	mA
• With base open	I_{CEO}	35			0	–	−100	–	100	µA
• Emitter Cutoff Current	I_{EBO}		−5	0		–	−10	–	10	µA
• DC Forward-Current Transfer Ratio	h_{FE}	2 2		1.2[a] 3.2[a]		20 4	100 –	20 4	100 –	
• Collector-to-Emitter Sustaining Voltage (see Figs. 2 and 3): With base open	$V_{CEO}(sus)$			0.1[a]	0	−50[b]	–	50[b]	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1[a]		−65[b]	–	65[b]	–	V
• Base-to-Emitter Voltage	V_{BE}	2		1.2[a]		–	−1.5	–	1.5	V
• Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE}(sat)$			1.2[a] 3.2[a]	0.12 0.8	– –	−0.75 −2	– –	0.75 2	V
• Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\|h_{fe}\|$	−2		−0.1		2	15	–	–	
f = 200 kHz	$\|h_{fe}\|$	2		0.1		–	–	5	20	
• Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	
Saturated Switching Time (V_{CC} = 30 V, I_{B1} = I_{B2}): Turn-on ($t_d + t_r$)	t_{ON}			−1 1	−0.1 0.1	– –	0.5 –	– –	– 5	µs
Turn-off ($t_s + t_f$)	t_{OFF}			−1 1	−0.1 0.1	– –	2.5 –	– –	– 15	µs
Thermal Resistance: Junction-to-case	$R_{\theta JC}$						17.5	–	17.5	°C/W
Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	°C/W

• In accordance with JEDEC registration data format JS-6 RDF-2.

[a] Pulsed, pulse duration = 300 µs, duty factor = 1.8%.

[b] *CAUTION: Sustaining voltages $V_{CEO}(sus)$, and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.*

♦ For p-n-p devices, voltage and current values are negative.

[c] Lead resistance is critical in this test.

[d] Measured at a frequency where $|h_{fe}|$ is decreasing at approximately 6 dB per octave.

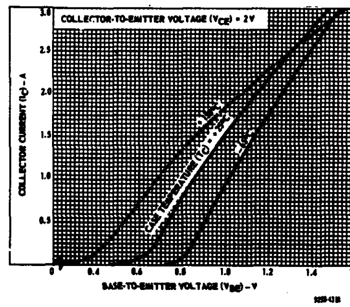


Fig. 5 - Typical transfer characteristics for types 2N5784, 2N5785, 2N5786.

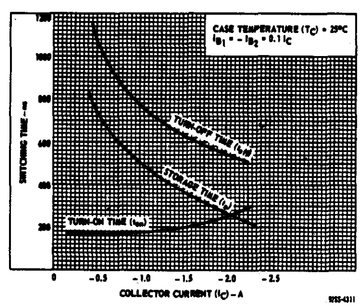


Fig. 6 - Typical saturated switching characteristics for types 2N5781, 2N5782, 2N5783.

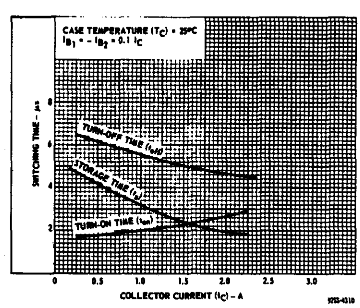


Fig. 7 - Typical saturated switching characteristics for types 2N5784, 2N5785, & 2N5786.

2N5781-2N5786

ELECTRICAL CHARACTERISTICS, *At Case Temperature, (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N5783 p-n-p Min.	Max.	2N5786 n-p-n Min.	Max.	UNITS
Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	40				–	–10	–	10	µA
At T_C = 150°C		40.				–	–1	–	1	mA
* With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CEX}	–45 45	1.5 –1.5			– –	–10 –	– –	– 10	µA
* At T_C = 150°C		–45 45	1.5 –1.5			– –	–1 –	– –	– 1	mA
* With base open	I_{CEO}	25			0	–	–100	–	100	µA
* Emitter Cutoff Current	I_{EBO}		–3.5	0		–	–10	–	10	µA
* DC Forward-Current Transfer Ratio	h_{FE}	2 2		1.6[a] 3.2[a]		20 4	100 –	20 4	100 –	
* Collector-to-Emitter Sustaining Voltage (see Figs. 2 and 3): With base open	$V_{CEO}(sus)$			0.1[a]	0	–40[b]	–	40[b]	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1[a]		–45[b]	–	45[b]	–	V
* Base-to-Emitter Voltage	V_{BE}	2		1.6[a]		–	–1.5	–	1.5	V
* Collector-to-Emitter Saturation Voltage (measured 0.25 in (6.35 mm) from case)[c]	$V_{CE}(sat)$			1.6[a] 3.2[a]	0.16 0.8	– –	–1 –2	– –	1 2	V
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[d] f = 4 MHz	$\|h_{fe}\|$	–2		–0.1		2	15	–	–	
f = 200 kHz		2		0.1		–	–	5	20	
* Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	2		0.1		25	–	25	–	
Saturated Switching Time (V_{CC} = 30 V, $I_{B1} = I_{B2}$): Turn-on ($t_d + t_r$)	t_{ON}			–1 1	–0.1 0.1	– –	0.5 –	– –	– 5	µs
Turn-off ($t_s + t_f$)	t_{OFF}			–1 1	–0.1 0.1	– –	2.5 –	– –	– 15	µs
Thermal Resistance: Junction-to-case	$R_{\theta JC}$						17.5	–	17.5	°C/W
Junction-to-ambient	$R_{\theta JA}$					–	175	–	175	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

[a] Pulsed, pulse duration = 300 µs, duty factor = 1.8%.

[b] *CAUTION: Sustaining voltages $V_{CEO}(sus)$, and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.*

♦ For p-n-p devices, voltage and current values are negative.

[c] Lead resistance is critical in this test.

[d] Measured at a frequency where $|h_{fe}|$ is decreasing at approximately 6 dB per octave.

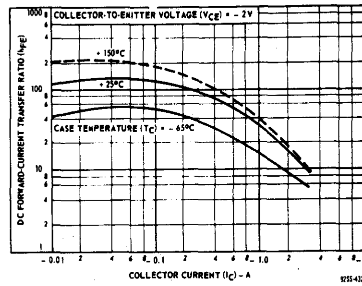


Fig. 8 - Typical dc-beta characteristics for type 2N5781.

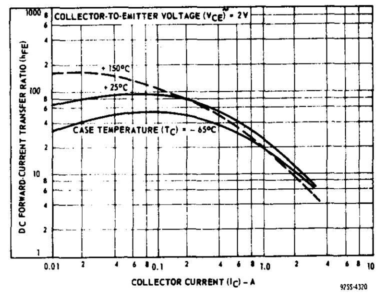


Fig. 9 - Typical dc-beta characteristics for type 2N5784.

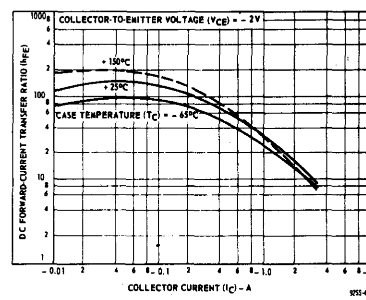


Fig. 10 - Typical dc-beta characteristics for type 2N5782.

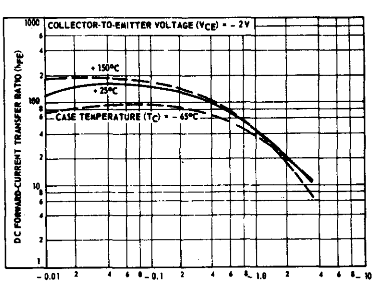


Fig. 11 - Typical dc-beta characteristics for type 2N5783.

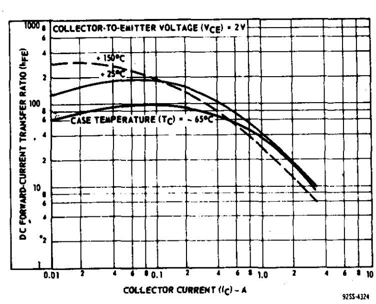


Fig. 12 - Typical dc-beta characteristics for type 2N5786.

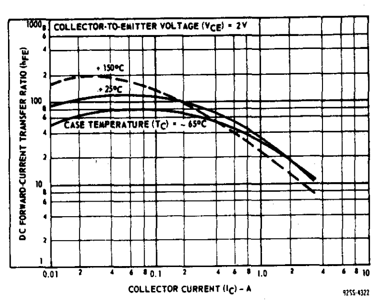


Fig. 13 - Typical dc-beta characteristics for type 2N5785.

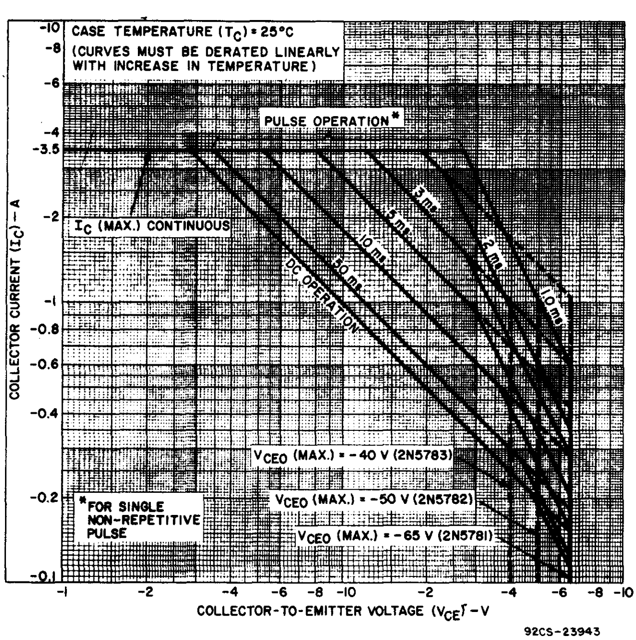


Fig. 14 - Maximum operating areas for types 2N5781, 2N5782, and 2N5783.

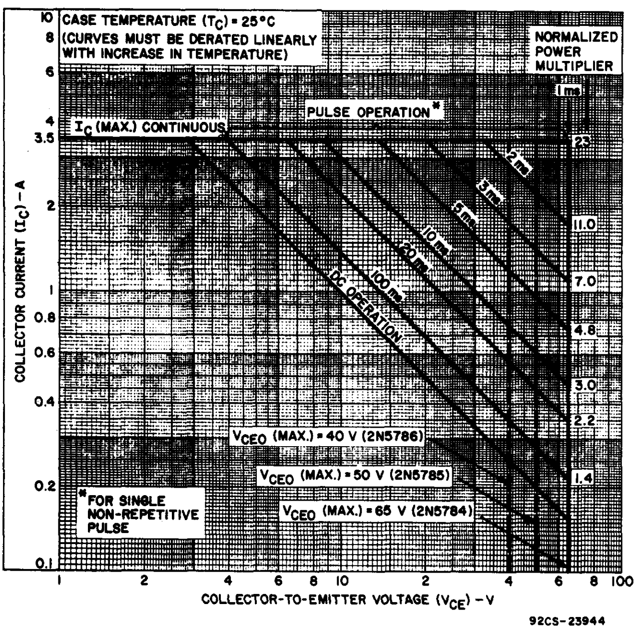


Fig. 15 - Maximum operating areas for types 2N5784, 2N5785, and 2N5786.

2N5838-2N5840

High-Voltage, High-Power Silicon N-P-N Power Transistor

For Switching and Linear Applications in Military, Industrial and Commercial Equipment

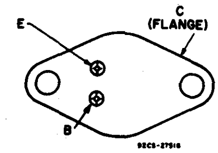
Features:
- **Maximum safe-area-of-operation curves**
- **Low saturation voltages**
- **High voltage ratings**
  $V_{CER(sus)}$ = 375 V (2N5840)
  300 V (2N5839)
  275 V (2N5838)
- **High dissipation rating**
  P_T = 100 W

RCA 2N5838, 2N5839 and 2N5840** are epitaxial silicon n-p-n power transistors utilizing a multiple-emitter-site structure. These devices employ the popular JEDEC TO-3 package; they differ mainly in voltage, current-gain, and V_{CE}(sat) ratings.

Featuring high breakdown voltage ratings and low-saturation voltage values, the 2N5838, 2N5839 and 2N5840 are especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

** Formerly RCA Dev. types TA7513, TA7530, and TA7420 respectively.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

	2N5838	2N5839	2N5840	
*COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	275	300	375	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:				
With base open, V_{CEO}(sus)	250	275	350	V
* With reverse bias (V_{BE}) of -1.5 V, V_{CEV}(sus)▲	275	300	375	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω, V_{CER}(sus)	275	300	375	V
*EMITTER-TO-BASE VOLTAGE, V_{EBO}	6	6	6	V
*COLLECTOR CURRENT, I_C				
Continuous	3	3	3	A
Peak	5	5	5	A
*CONTINUOUS BASE CURRENT, I_B	1.5	1.5	1.5	A
*TRANSISTOR DISSIPATION, P_T:				
At case temperature up to 25° C and V_{CE} up to 40 V	100	100	100	W
At case temperatures up to 25° C and V_{CE} above 40 V	See Fig. 5			
At case temperatures above 25° C and V_{CE} above 40 V	See Figs. 1 & 5			
*TEMPERATURE RANGE:				
Storage & Operating (Junction)	-65 to +200			°C
*PIN TEMPERATURE (During Soldering):				
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max	230			°C

* In accordance with JEDEC registration data format (JS-6, RDF-1).
▲ Shown as V_{CEX}(sus) in JEDEC Registration Data.

ELECTRICAL CHARACTERISTICS, *Case Temperature* (T_C) = 25°C

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N5838		2N5839		2N5840		UNITS
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current: With base open	I_{CEO}	200 250				· ·	2	·	· 2	· ·	· 2	mA
* With base-emitter junction reverse biased	I_{CEV}	265 290 360	-1.5 -1.5 -1.5			· · ·	5 ·	· ·	· 2 ·	· · ·	· · 2	mA
* With base-emitter junction reverse biased, T_C=100°C	I_{CEV} T_C 100 °C	265 290 360	-1.5 -1.5 -1.5			·	8 ·	·	· 5	·	· · 5	mA
* Emitter-Cutoff Current	I_{EBO}		-6			·	1	·	1	·	1	mA
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.2[a]		250[b]		275[b]	·	350[b]	·	V
* With base-emitter junction reverse biased	$V_{CEX}(sus)$		-1.5	0.1[a]		275[b]	·	300[b]	·	375[b]	·	V
With external base-to-emitter resistance (R_{BE}) - 50 Ω	$V_{CER}(sus)$			0.2[a]		275[b]	·	300[b]	·	375[b]	·	V
* Emitter-to-Base Voltage I_E = 0.02 A	V_{EBO}					6	·	6	·	6	·	V
* DC Forward-Current Transfer Ratio	h_{FE}	5 3 2		0.5[a] 2[a] 3[a]		20 · 8	· · 40	20 10 ·	· 50 ·	20 10 ·	· 50 ·	
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			2[a] 3[a]	0.2 0.375	· ·	2	·	2	·	2	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			2[a] 3[a]	0.2 0.375	·	1	·	1.5	·	1.5	V
Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}					·	150		150		150	pF
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f - 1 MHz)	$\|h_{fe}\|$	10		0.2		5		5	·	5	·	
Forward-Bias, Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	40				2.5		2.5		2.5	·	A
Second Breakdown[c] Energy (With base reverse biased) R_B = 50 Ω, L = 100 µH	$E_{S/b}$		-4			0.45	·	0.45	·	0.45	·	mJ
Thermal Resistance: (Junction-to-Case)	$R_{\theta JC}$	10		5			1.75	·	1.75	·	1.75	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-1)
a Pulsed; pulse duration = 350 µs, Duty factor ≤ 2%.
b CAUTION: The sustaining voltages V_{CEO}(sus), V_{CEX}(sus) and V_{CER}(sus), MUST NOT be measured on a curve tracer.

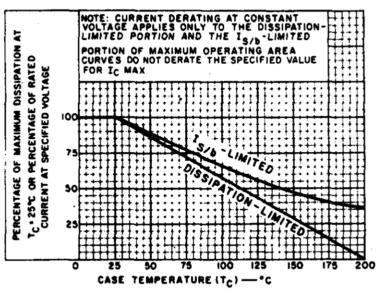


Fig. 1 - Derating curves for all types.

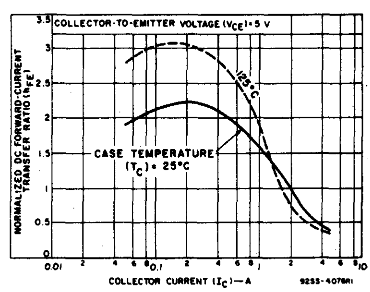


Fig. 2 - Typical normalized dc beta characteristics for all types.

2N5838-2N5840

SWITCHING-TIME CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CC}	TEST CONDITIONS: CURRENT A dc I_C	TEST CONDITIONS: CURRENT A dc I_B●	2N5838 Max.	2N5838 Typ.	2N5839 Max.	2N5839 Typ.	2N5840 Max.	2N5840 Typ.	UNITS
Switching Times: Delay	t_d	200	2	0.2	-	-	-	0.07	-	0.07	μs
			3	0.375	-	0.06	-		-	-	
* Rise	t_r	200	2	0.2	-	-	1.5	0.6	1.75	0.6	
			3	0.375	1.5	0.8	-	-	-	-	
* Storage	t_s	200	2	0.2	-	-	3.75	1.75	3.0	1.75	
			3	0.375	3.0	1.0	-	-	-	-	
* Fall	t_f	200	2	0.2	-	-	1.5	0.35	1.5	0.35	
			3	0.375	1.5	0.4	-	-	-	-	

* In accordance with JEDEC registration data format (JS-6 RDF-1). ● $I_{B1} = I_{B2}$ = value shown.

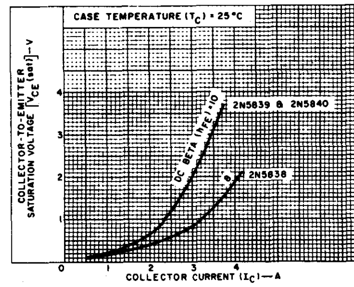


Fig. 3 - Typical saturation voltage characteristics for all types.

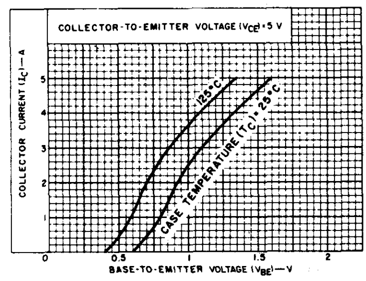


Fig. 4 - Typical transfer characteristics for all types.

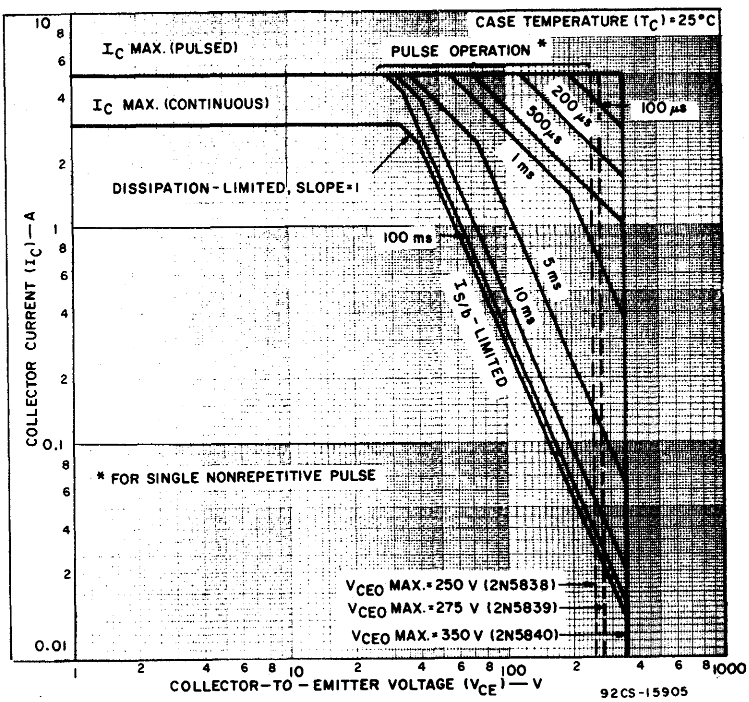


Fig. 5 - Maximum operating areas for all types.

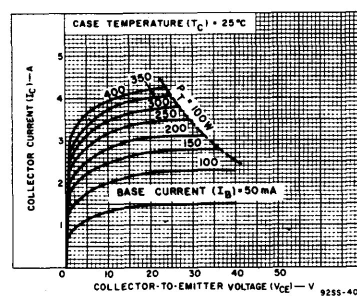


Fig. 6 - Typical output characteristics for all types.

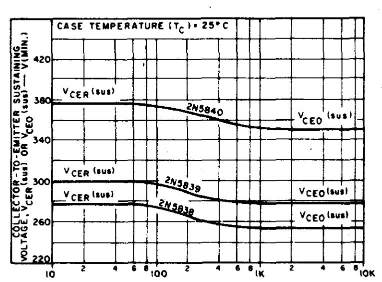


Fig. 7 - Collector-to-emitter sustaining voltage characteristics for all types.

2N5838-2N5840

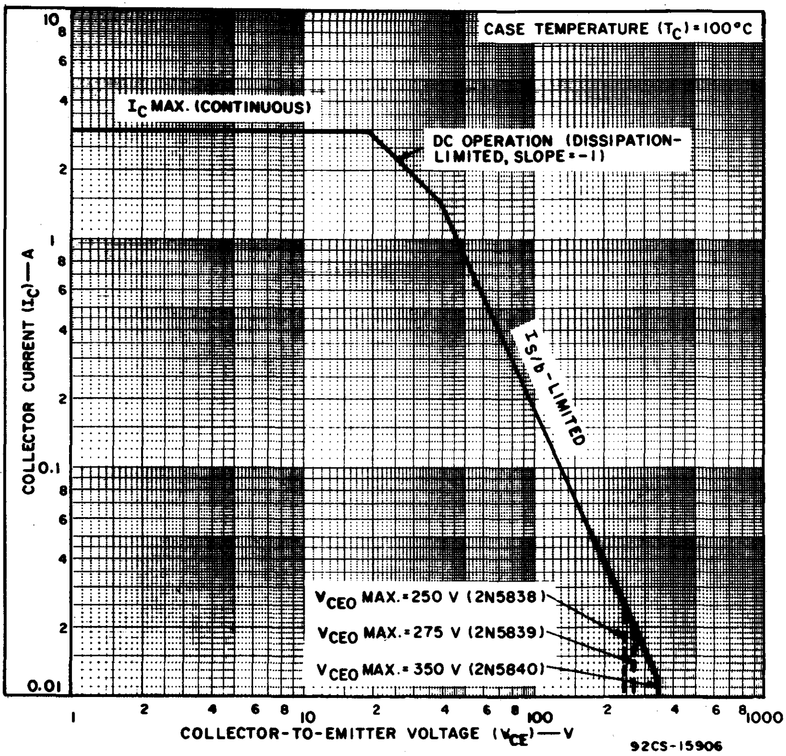


Fig. 8 - Maximum operating areas for all types.

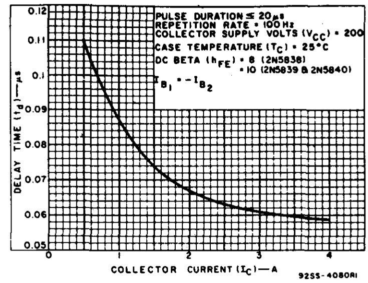


Fig. 9 - Typical delay-time characteristic for all types.

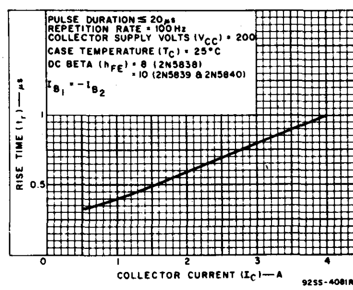


Fig. 10 - Typical rise-time characteristic for all types.

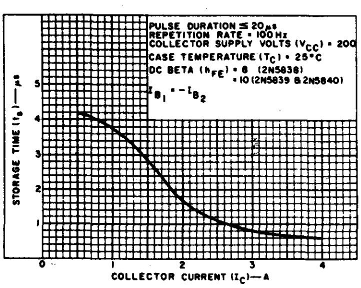


Fig. 11 - Typical storage-time characteristic for all types.

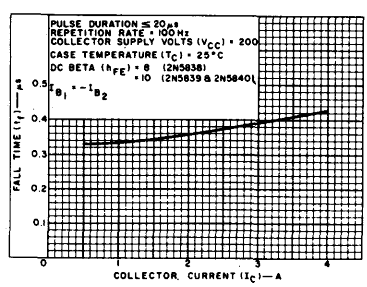


Fig. 12 - Typical fall-time characteristic for all types.

2N5869, 2N5870

Silicon N-P-N Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable
For Industrial and Commercial Use

The RCA-2N5869 and 2N5870 are epitaxial-base silicon n-p-n transistors featuring high gain at high current. These devices have a dissipation capability of 87.5 watts at case temperatures up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled.

Both of these devices are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- High dissipation capability
- Low saturation voltages.
- Maximum safe-areas-of-operation curves
- Hermetically sealed JEDEC TO-204MA package
- High gain at high current
- Thermal-cycling rating curve

Applications:

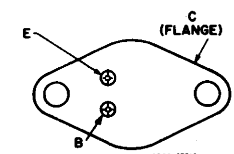
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5869	2N5870	
* V_{CEO}		60	80	V
* V_{CBO}		60	80	V
* V_{EBO}		5	5	V
* I_C		5	5	A
* I_{CM}		10	10	A
* I_B		2	2	A
* P_T				
At $T_C \leq 25°C$		87.5	87.5	W
At $T_C > 25°C$	derate linearly	0.5		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distance 1/16 in. (1.58 mm) from case for 10 s		250		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

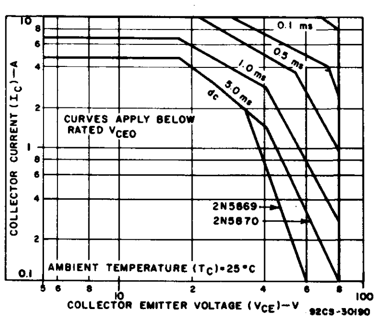


Fig. 1 — Maximum operating areas.

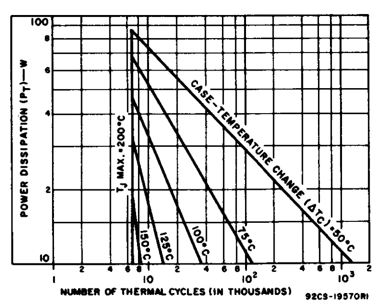


Fig. 2 — Thermal-cycling rating chart.

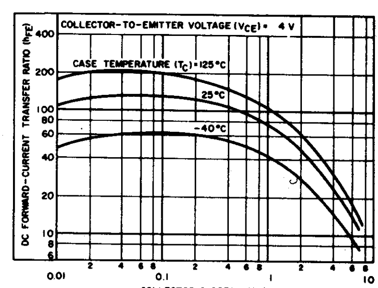


Fig. 3 — Typical dc beta characteristics for both types.

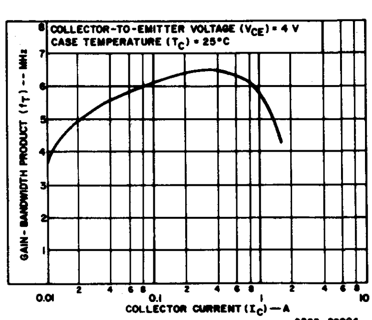


Fig. 4 — Typical gain-bandwidth characteristics for both types.

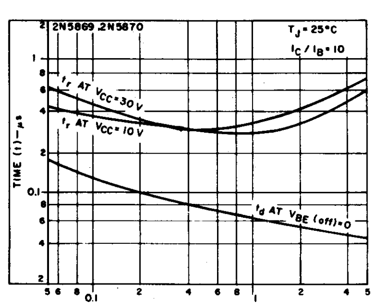


Fig. 5 — Turn-on-time characteristics.

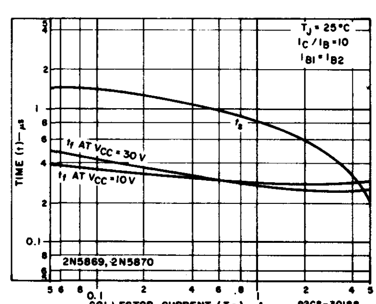


Fig. 6 — Turn-off-time characteristics.

2N5869, 2N5870

ELECTRICAL CHARACTERISTICS, at Case Temperature T_C = 25°C Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNIT
	VOLTAGE V dc		CURRENT A dc		2N5869		2N5870		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	60	1.5	–	–	–	0.1	–	–	mA
	80	1.5	–	–	–	–	–	0.1	mA
T_C = 150°C	60	1.5	–	–	–	2	–	–	mA
	80	1.5	–	–	–	–	–	2	mA
* I_{CEO}	30	–	–	0	–	0.5	–	–	mA
	40	–	–	0	–	–	–	0.5	mA
* I_{CBO} I_E = 0	60●	–	–	–	–	0.1	–	–	mA
	80●	–	–	–	–	–	–	0.1	mA
* I_{EBO}	–	–5	0	–	–	1	–	1	mA
* $V_{CEO}(sus)$[b]	–	–	0.1	0	60	–	80	–	V
* h_{FE}[a]	4	–	0.3	–	35	–	35	–	
	4	–	1.5	–	20	100	20	100	
	4	–	5	–	4	–	4	–	
* V_{BE}[a]	4	–	1.5	–	–	1.5	–	1.5	V
* $V_{BE}(sat)$[a]	–	–	5	1.25	–	2.5	–	2.5	V
* $V_{CE}(sat)$[a]	–	–	2	0.2	–	1	–	1	V
	–	–	5	1.25	–	2	–	2	V
* f_T f = 1 MHz	10	–	0.25	–	4	–	4	–	MHz
* h_{fe} f = 1.0 kHz	4	–	0.25	–	20	–	20	–	
* C_{ob} V_{CB} = 10 V f = 1 kHz	–	–	–	–	–	150	–	150	pF
* t_r	–	–	1.5	0.15[c]	–	0.7	–	0.7	μs
* t_s V_{CC} = 30 V	–	–	1.5	0.15[c]	–	1	–	1	μs
* t_f	–	–	1.5	0.15[c]	–	0.8	–	0.8	μs
$R_{\theta JC}$	–	–	–	–	–	2	–	2	°C/W

* In accordance with JEDEC registration data.
● V_{CB}
[a] Pulsed; pulse width ≤ 300 μs, duty factor ≤ 2%.
[b] **CAUTION:** Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.
[c] $I_{B1} = -I_{B2}$

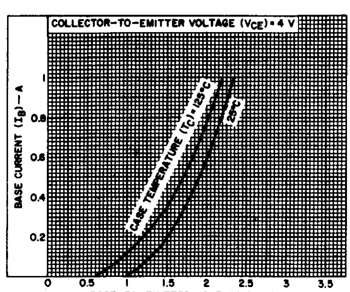


Fig. 7 — Typical input characteristics for both types.

2N5871,2N5872, 2N5873, 2N5874

Silicon N-P-N and P-N-P Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable
For Industrial and Commercial Use

The RCA-2N5871 and 2N5872 are epitaxial-base silicon p-n-p transistors featuring high gain at high current. The RCA-2N5873 and 2N5874 are epitaxial-base silicon n-p-n transistors. They may be used as complements to 2N5871 and 2N5872, respectively. These devices have a dissipation capability of 115 watts at case temperature up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- High dissipation capability
- Low saturation voltages
- Maximum safe-areas-of-operation curves
- Hermetically sealed JEDEC TO-3/ TO-204MA package
- High gain at high current
- Thermal-cycling rating curve

Applications:

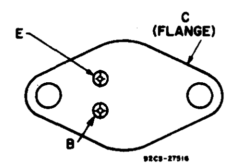
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N5871• 2N5873	2N5872• 2N5874	
* V_{CEO}	60	80	V
* V_{CBO}	60	80	V
* V_{EBO}	5	5	V
* I_C	7	7	A
* I_{CM}	15	15	A
* I_B	2	2	A
* P_T			
At $T_C \leq 25°C$	115	115	W
At $T_C > 25°C$ derate linearly	0.658		W/°C
* T_L			
At distance 1/16 in. (1.58 mm) from case for 10 s	250		°C
* T_J, T_{stg}	−65 to 200		°C

* In accordance with JEDEC registration data.
• For p-n-p devices, voltage and current values are negative.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

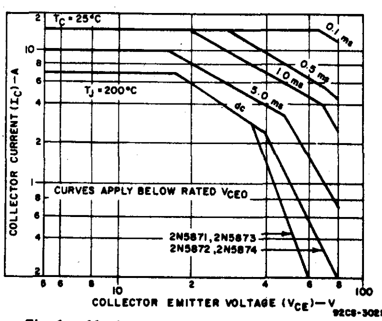


Fig. 1 – Maximum operating areas for all types.

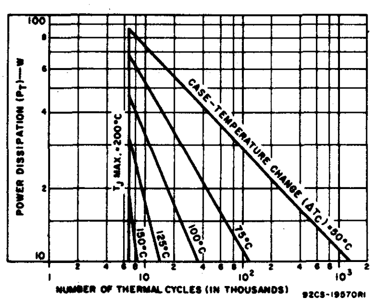


Fig. 2 – Thermal-cycling rating chart.

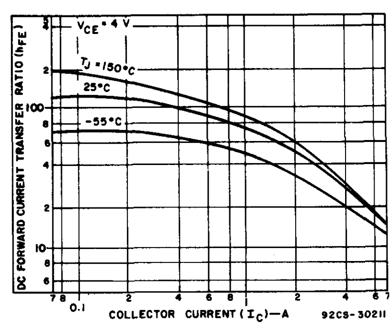


Fig. 3 – Typical dc beta characteristics for 2N5871 and 2N5872.

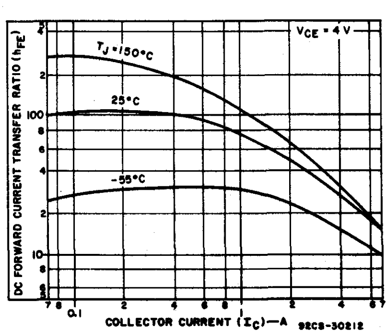


Fig. 4 – Typical dc beta characteristics for 2N5873 and 2N5874.

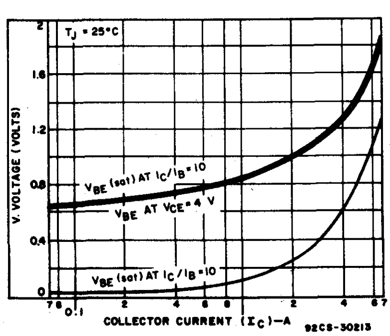


Fig. 5 – Typical voltage characteristics for 2N5871 and 2N5872.

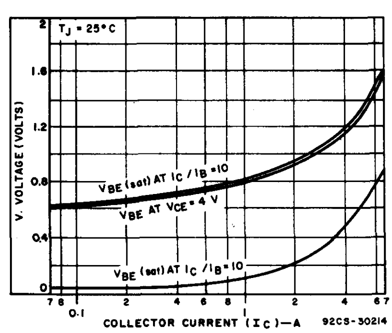


Fig. 6 – Typical voltage characteristics for 2N5873 and 2N5874.

2N5871, 2N5872, 2N5873, 2N5874

ELECTRICAL CHARACTERISTICS, at Case Temperature T_C = 25°C Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNIT
	VOLTAGE V dc		CURRENT A dc		2N5871● 2N5873		2N5872● 2N5874		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	60	1.5	–	–	–	0.25	–	–	mA
	80	1.5	–	–	–	–	–	0.25	
T_C = 150°C	60	1.5	–	–	–	2	–	–	
	80	1.5	–	–	–	–	–	2	
* I_{CEO}	30	–	–	0	–	0.5	–	–	mA
	40	–	–	0	–	–	–	0.5	
* I_{CBO} $I_E = 0$	60[c]	–	–	–	–	0.25	–	–	mA
	80[c]	–	–	–	–	–	–	0.25	
* I_{EBO}	–	–5	0	–	–	1	–	1	mA
* $V_{CEO}(sus)$[b]	–	–	0.1	0	60	–	80	–	V
* h_{FE}[a]	4	–	0.5	–	35	–	35	–	
	4	–	2.5	–	20	100	20	100	
	4	–	7.0	–	4	–	4	–	
* V_{BE}[a]	4	–	2.5	–	–	1.5	–	1.5	V
* $V_{BE}(sat)$[a]	–	–	7	1.75	–	2.5	–	2.5	V
* $V_{CE}(sat)$[a]	–	–	4	0.4	–	1	–	1	V
	–	–	7	1.75	–	2	–	2	
* f_T f = 1 MHz	10	–	0.25	–	4	–	4	–	MHz
* h_{fe} f = 1.0 kHz	4	–	0.5	–	20	–	20	–	
* C_{ob} f = 1 MHz 2N5871-72	10[c]	–	–	–	–	300	–	300	pF
2N5873-74						250	–	250	
* t_r V_{CC} = 30 V	–	–	2.5	0.25[d]	–	0.7	–	0.7	µs
* t_s V_{CC} = 30 V	–	–	2.5	0.25[d]	–	1	–	1	µs
* t_f V_{CC} = 30 V	–	–	2.5	0.25[d]	–	0.8	–	0.8	µs
$R_{\theta JC}$	–	–	–	–	–	1.52	–	1.52	°C/W

● For p-n-p devices, voltage and current values are negative.
* In accordance with JEDEC registration data.
a Pulsed; pulse width ≤ 300 µs, duty factor ≤ 2%.
b **CAUTION:** Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.
c V_{CB}
d $I_{B1} = -I_{B2}$

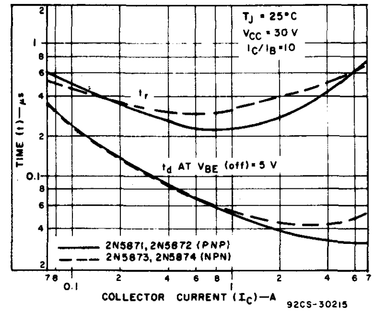


Fig. 7 — Typical turn-on-time for all types.

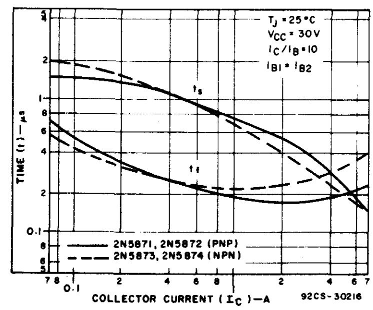


Fig. 8 — Typical turn-off-time for all types.

2N5875, 2N5876, 2N5877, 2N5878

Silicon N-P-N and P-N-P Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable
For Industrial and Commercial Use

The RCA-2N5875 and 2N5876 are epitaxial-base silicon p-n-p transistors featuring high gain at high current. The RCA-2N5877 and 2N5878 are epitaxial-base silicon n-p-n transistors. They may be used as complements to 2N5875 and 2N5876, respectively. These devices have a compability of 150 watts at case temperatures up to 25°C.

They differ in voltage ratings and in currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

Features:

- High dissipation capability
- Low saturation voltages
- Maximum safe-areas-of-operation curves
- Hermetically sealed JEDEC TO-3/TO-204MA package
- High gain at high current
- Thermal-cycling rating curve

Applications:

- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

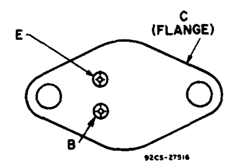
MAXIMUM RATINGS, *Absolute Values:*

	2N5875• 2N5877	2N5876• 2N5878	
* V_{CEO}	60	80	V
* V_{CBO}	60	80	V
* V_{EBO}	5	5	V
* I_C	10	10	A
* I_{CM}	20	20	A
* I_B	4	4	A
* P_T			
At $T_C \leq 25°C$	150	150	W
At $T_C > 25°C$ derate linearly	0.857		W/°C
* T_J, T_{stg}	−65 to 200		°C
* T_L			
At 1/16 in. (1.58 mm) from case for 10 s	250		°C

*In accordance with JEDEC registration data.

•For p-n-p devices, voltage & current values are negative.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

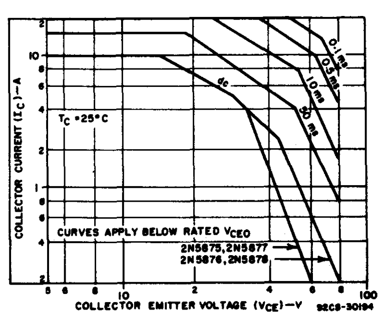


Fig. 1 – Collector-emitter voltage (V_{CE})-V.

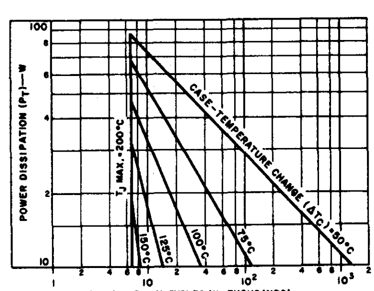


Fig. 2 – Thermal-cycling rating chart.

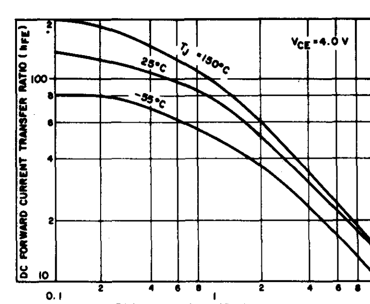


Fig. 3 – Typical dc beta characteristics for 2N5875 and 2N5876.

2N5875, 2N5876, 2N5877, 2N5878

ELECTRICAL CHARACTERISTICS, at Case Temperature $T_C = 25°C$ Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N5875● 2N5877		2N5876● 2N5878		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEX}	60	1.5	–	–	–	0.5	–	–	mA
	80	1.5	–	–	–	–	–	0.5	
$T_C = 150°C$	60	1.5	–	–	–	5	–	–	
	80	1.5	–	–	–	–	–	5	
* I_{CEO}	30	–	–	0	–	1	–	–	mA
	40	–	–	0	–	–	–	1	
* I_{CBO} $I_E = 0$	60c	–	–	–	–	0.5	–	–	mA
	80c	–	–	–	–	–	–	0.5	
* I_{EBO} $I_E = 0$	–	−5	–	–	–	1	–	1	mA
* $V_{CEO}(sus)$b	–	–	0.2	0	60	–	80	–	V
* h_{FE}a	4	–	1	–	35	–	35	–	
	4	–	4	–	20	100	20	100	
	4	–	10	–	4	–	4	–	
* V_{BE}a	4	–	4	–	–	1.5	–	1.5	V
* $V_{BE}(sat)$a	–	–	10	2.5	–	2.5	–	2.5	V
* $V_{CE}(sat)$a	–	–	5	0.5	–	1	–	1	V
	–	–	10	2.5	–	3	–	3	
* f_Tc f = 1 MHz	10	–	0.5	–	4	–	4	–	MHz
* h_{fe} f = 1 kHz	4	–	1	–	20	–	20	–	
* C_{ob} V_{CB} = 10 V 2N5875-76	–	–	–	–	–	500	–	500	pF
f = 1 MHz 2N5877-78	–	–	–	–	–	300	–	300	
* t_r V_{CC} = 30 V	–	–	4	0.4d	–	0.7	–	0.7	µs
* t_s	–	–	4	0.4d	–	1.0	–	1.0	µs
* t_f	–	–	4	0.4d	–	0.8	–	0.8	µs
$R_{\theta JC}$	–	–	–	–	–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.
a Pulsed; pulse width ≤300 µs, duty cycle ≤2%.
c V_{CB}

● For p-n-p devices, voltages and current values are negative.
b **CAUTION:** Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.
d $I_{B1} = -I_{B2}$

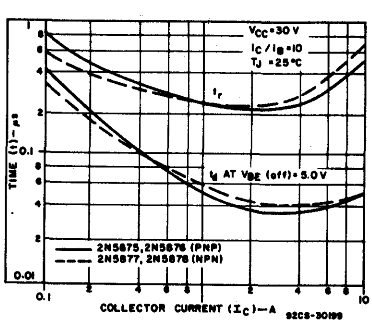


Fig. 7 — Typical turn-on-time for all types.

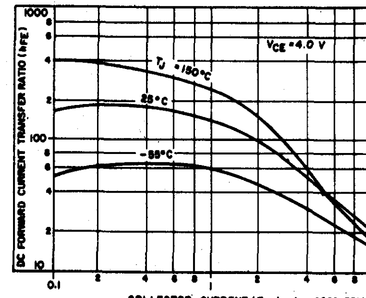


Fig. 4 — Typical dc beta characteristics for 2N5877 and 2N5878.

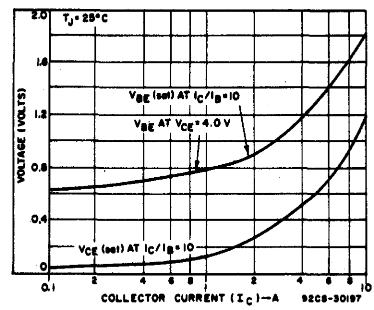


Fig. 5 — Typical voltages for 2N5875 and 2N5876.

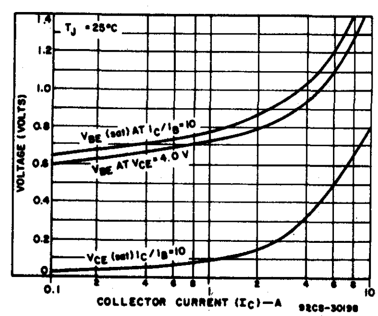


Fig. 6 — Typical voltages for 2N5877 and 2N5878.

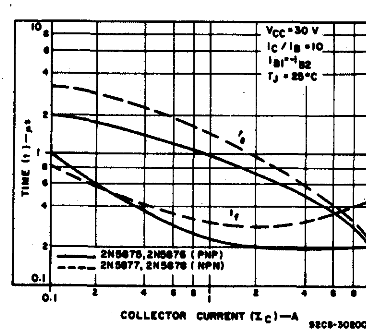


Fig. 8 — Typical turn-off-time for all types.

2N5879, 2N5880, 2N5881, 2N5882

Silicon N-P-N and P-N-P Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable For Industrial and Commercial Use

The RCA-2N5879 and 2N5880 are epitaxial-base silicon p-n-p transistors featuring high gain at high current. The RCA-2N5881 and 2N5882 are epitaxial-base silicon n-p-n transistors. They may be used as complements to 2N5879 and 2N5880, respectively. These devices have a dissipation capability of 160 watts at case temperatures up to 25°C.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA hermetic package.

Features:
- **High dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **Hermetically sealed JEDEC TO-3/ TO-204MA package**
- **High gain at high current**
- **Thermal-cycling rating curve**

Applications:
- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

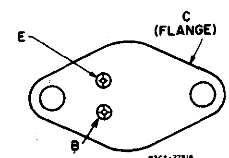
MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N5879• 2N5881	2N5880• 2N5882	
* V_{CEO}	60	80	V
* V_{CBO}	60	80	V
* V_{EBO}	5	5	V
* I_C	15	15	A
* I_{CM}	30	30	A
* I_B	5	5	A
* P_T			
At $T_C \leq 25°C$	160	160	W
At $T_C > 25°C$ ...... derate linearly	0.915		W/°C
* T_J, T_{stg}	–65 to 200		°C
* T_L			
At 1/16 in. (1.58 mm) from case for 10 s	250		°C

* In accordance with JEDEC registration data.

• For p-n-p devices, voltage and current values are negative.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

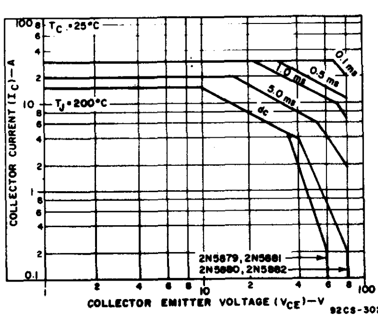


Fig. 1 – Maximum operating areas for all types.

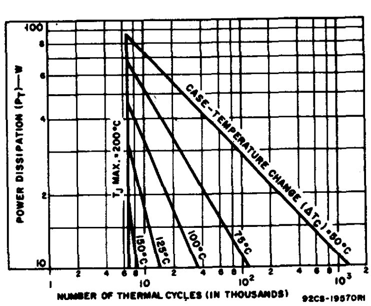


Fig. 2 – Thermal-cycling rating chart.

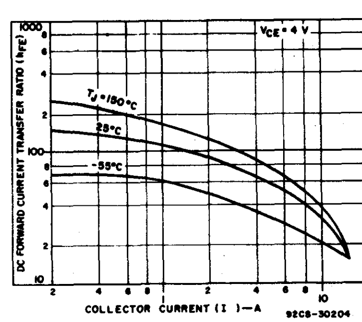


Fig. 3 – Typical dc beta characteristics for 2N5879 and 2N5880.

2N5879, 2N5880, 2N5881, 2N5882

ELECTRICAL CHARACTERISTICS, At Case Temperature
T_C = 25°C Unless Otherwise Specified

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N5879• 2N5881		2N5880• 2N5882		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
* I_{CEX}	60	1.5	–	–	–	0.5	–	–	mA
	80	1.5	–	–	–	–	–	0.5	
T_C = 150°C	60	1.5	–	–	–	5	–	–	
	80	1.5	–	–	–	–	–	5	
* I_{CEO}	30	–	–	0	–	1	–	–	mA
	40	–	–	0	–	–	–	1	
* I_{CBO} $I_E = 0$	60[c]	–	–	–	–	0.5	–	–	mA
	80[c]	–	–	–	–	–	–	0.5	
* I_{EBO}	–	−5	0	–	–	1	–	1	mA
* $V_{CEO}(sus)$[b]	–	–	0.2	0	60	–	80	–	V
* h_{FE}[a]	4	–	2	–	35	–	35	–	
	4	–	6	–	20	100	20	100	
	4	–	15	–	4	–	4	–	
* V_{BE}[a]	4	–	6	–	–	1.5	–	1.5	V
* $V_{BE}(sat)$[a]	–	–	15	3.75	–	2.5	–	2.5	V
* $V_{CE}(sat)$[a]	–	–	7	0.7	–	1	–	1	V
	–	–	15	3.75	–	4	–	4	
* f_T, f = 1 MHz	10	–	1	–	4	–	4	–	MHz
* h_{fe}, f = 1 kHz	4	–	2	–	20	–	20	–	
* C_{ob}, f = 1 MHz 2N5879-80	10[c]	–	–	–	–	600	–	600	pF
2N5881-82	10[c]	–	–	–	–	400	–	400	
* t_r	–	–	6	0.6[d]	–	0.7	–	0.7	µs
* t_s V_{CC} = 30 V	–	–	6	0.6[d]	–	1	–	1	µs
* t_f	–	–	6	0.6[d]	–	0.8	–	0.8	µs
$R_{\theta JC}$	–	–	–	–	–	1.1	–	1.1	°C/W

*In accordance with JEDEC registration data.
•For p-n-p devices, voltage and current values are negative.
[a]Pulsed; pulse duration ≤ 300 µs, duty factor = 2%.
[b]CAUTION: Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.
[c]V_{CB}.
[d]$I_{B1} = I_{B2}$.

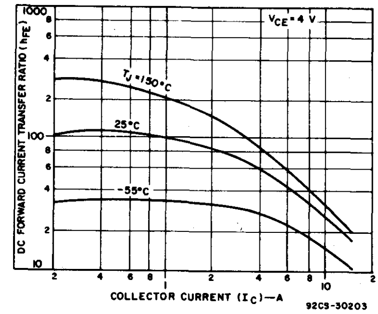


Fig. 4 — Typical dc beta characteristics for 2N5881 and 2N5882.

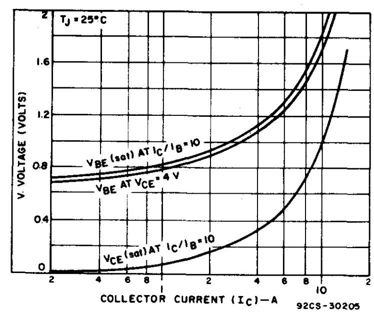


Fig. 5 — Typical voltage characteristics for 2N5879 and 2N5880.

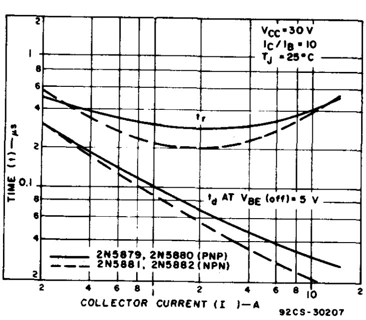


Fig. 6 — Typical turn-on time for all types.

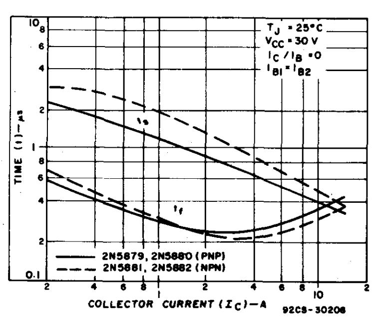


Fig. 7 — Typical turn-off time for all types.

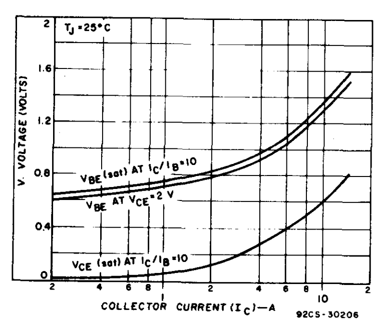


Fig. 8 — Typical voltage characteristics for 2N5881 and 2N5882.

2N5885, 2N5886

High-Current, High-Power, High-Speed N-P-N Power Transistors

The RCA-2N5885 and 2N5886 are epitaxial-base silicon n-p-n transistors intended for a wide variety of high-power, high-current applications, such as power-switching circuits, driver and output stages for series and shunt regulators, dc-to-dc converters, inverters, and solenoid (hammer)/relay drivers.

These devices differ in maximum voltage ratings. They are supplied in JEDEC TO-204MA hermetic steel packages.

Features:

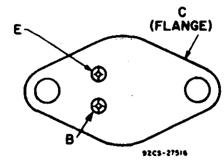
- **Specification for h_{FE} and V_{CE}(sat) up to 25 A**
- **Current gain bandwidth product f_T = 4 MHz (min.) at 1 A**
- **Low saturation voltage with high beta**
- **High dissipation capability**
- **90 mJ $E_{S/b}$ characteristic**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N5885	2N5886	
* V_{CBO}		60	80	V
* V_{CEO}(sus)		60	80	V
* V_{EBO}		5		V
* I_C		25		A
* I_{CM}		50		A
* I_B		7.5		A
I_{BM}		15		A
* P_T				
At $T_C \leqslant 25°C$		200		W
At $T_C > 25°C$	Derate linearly	1.15		W/°C
		See Figs. 1 and 2		
* T_{stg}, T_J		-65 to 200		°C
T_L				
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230		°C

* In accordance with JEDEC registration data format JS-6 RDF-1.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

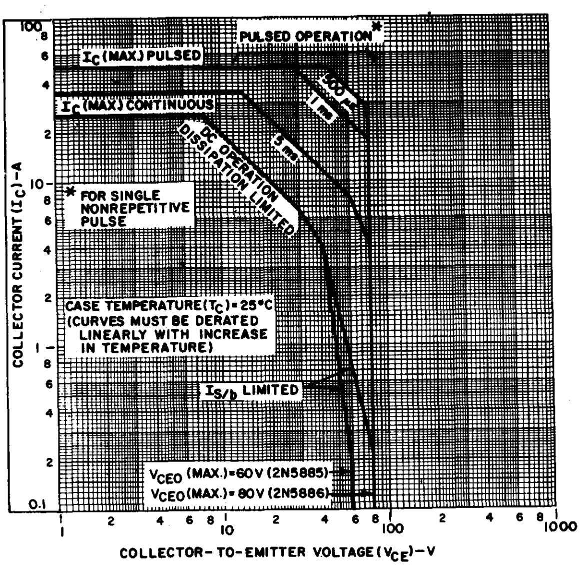


Fig. 1 – Maximum operating areas for 2N5885 and 2N5886.

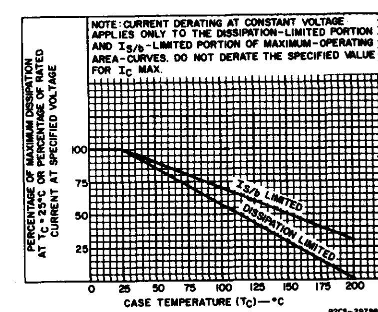


Fig. 2 – Derating curves for 2N5885 and 2N5886.

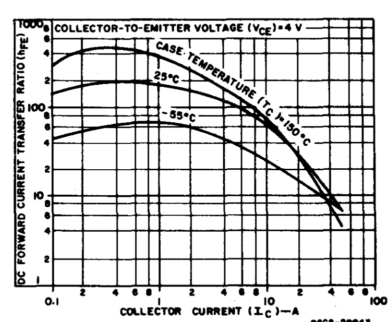


Fig. 3 – Typical dc beta characteristics as a function of collector current for 2N5885 and 2N5886.

2N5885, 2N5886

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N5885 Min.	Max.	2N5886 Min.	Max.	UNITS
* I_{CBO}	60[a]				–	1	–	–	mA
	80[a]				–	–	–	1	
* I_{CEX}	60	−1.5			–	1	–	–	
	80	−1.5			–	–	–	1	
* I_{CEX} T_C = 150°C	60	−1.5			–	10	–	–	
	80	−1.5			–	–	–	10	
* I_{CEO}	30				–	2	–	–	
	40				–	–	–	2	
* I_{EBO}		−5			–	1	–	1	
* h_{FE}	4		3[b]		35	–	35	–	
	4		10[b]		20	100	20	100	
	4		25[b]		4	–	4	–	
* $V_{CEO}(sus)$			0.2		60	–	80	–	V
* V_{BE}	4		10		–	1.5	–	1.5	
* $V_{BE}(sat)$			25[b]	6.25	–	2.5	–	2.5	
* $V_{CE}(sat)$			15[b]	1.5	–	1	–	1	
			25[b]	6.25	–	4	–	4	
$I_{S/b}$ t_p = 1 s nonrep.	20				10	–	10	–	A
$E_{S/b}$ L = 125 µH, R_{BE} = 51 Ω		−1.5	10		6.25	–	6.25	–	mJ
L = 20 mH, R_{BE} = 100 Ω		0	3		90	–	90	–	
* $\|h_{fe}\|$ f = 1 MHz	10		1		4	–	4	–	
* h_{fe} f = 1 kHz	4		3		20	–	20	–	
* C_{obo} f = 1 MHz	10[a]				–	500	–	500	pF
* t_r	V_{CC} = 30		10	1	–	0.7	–	0.7	µs
* t_s			10	1[c]	–	1	–	1	
* t_f			10	1[c]	–	0.8	–	0.8	
$R_{\theta JC}$	20		5		–	0.875	–	0.875	°C/W

*In accordance with JEDEC registration data format JS-6 RDF-1.

[a] V_{CB}.

[b] Pulsed; pulse duration = 300 µs, duty factor = 1.8%.

[c] $I_{B_1} = -I_{B_2}$.

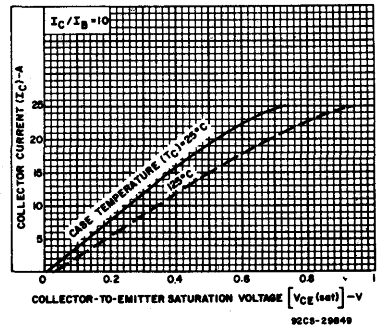


Fig. 4 — Typical saturation voltage characteristics for 2N5885 and 2N5886.

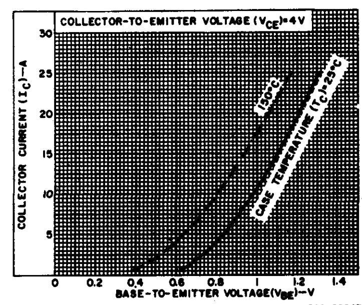


Fig. 5 — Typical transfer characteristics for 2N5885 and 2N5886.

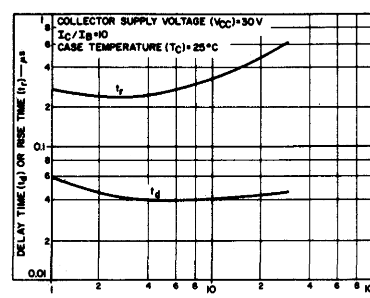


Fig. 6 — Typical delay-time and rise-time characteristics as a function of collector current for 2N5885 and 2N5886.

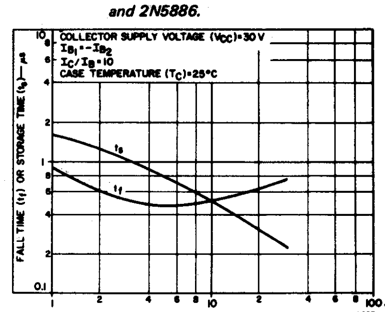


Fig. 7 — Typical storage-time and fall-time characteristics as a function of collector current for 2N5885 and 2N5886.

2N5954-2N5956, 2N6372-2N6374, 2N6465-2N6468, 40829-40831

Silicon N-P-N and P-N-P Medium-Power Transistors

General-Purpose Types for Switching Applications

Features:
- 2N5954-2N5956 complements to 2N6372-2N6374
- 2N6465, 2N6466 complements to 2N6467, 2N6468
- Low saturation voltages
- Maximum-safe-area-of-operation curves
- Thermal-cycle ratings
- Hermetically-sealed JEDEC TO-66 package

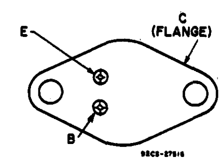
RCA-2N5954, -2N5955, and -2N5956 are multiple-epitaxial p-n-p transistors. RCA-2N6372, -2N6373, and -2N6374 are multiple-epitaxial n-p-n transistors. They are complements to 2N5954, 2N5955, and 2N5956.

The RCA-2N6465 and 2N6466 are multiple-epitaxial n-p-n transistors. They are complements to the 2N6467, and 2N6468, multiple-epitaxial p-n-p transistors. These devices differ in voltage ratings and in the currents at which the parameters are controlled.

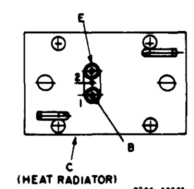
All are supplied in the JEDEC TO-66 package.

Types 2N5954, 2N5955, and 2N5956 are available with factory-attached heat radiators as RCA types 40829, 40830, and 40831, respectively. The other devices may be obtained with heat radiators on special order. Radiator versions are intended for printed-circuit-board applications, and differ electrically from their basic counterparts only in device dissipation (5.8 W up to 25°C ambient) and thermal resistance (30°C/W max. at T_A = 25°C).

TERMINAL DESIGNATIONS



JEDEC TO-66
2N5954-2N5956 2N6372-2N6374, 2N6465-2N6468



JEDEC TO-66 with Heat Raidator
40829, 40830, 40831

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

	N-P-N 2N6374 / P-N-P 2N5956♦ 40831♦	2N6373 / 2N5955♦ 40830♦	2N6372 / 2N5954♦ 40829♦	2N6465 / 2N6467♦	2N6466 / 2N6468♦	
*V_{CBO}	50	70	90	110	130	V
*V_{CEX}(sus) V_{BE} = −1.5 V, R_{BE} = 100 Ω	50	70	90	110	130	V
V_{CER}(sus) R_{BE} = 100 Ω	45	65	85	105	125	V
V_{CEO}(sus)	40	60	80	100	120	V
*V_{EBO}	5	5	5	5	5	V
*I_C	6	6	6	4	4	A
*I_B	2	2	2	2	2	A
*P_T						
At T_C up to 25°C	40 (2N6374) (2N5956)	40 (2N6373) (2N5955)	40 (2N6372) (2N5954)	40	40	W
At T_A up to 25°C	5.8 (40831)	5.8 (40830)	5.8 (40829)	–	–	W
At T_C above 25°C	Derate linearly to 200°C					
*T_J, T_{stg}	−65 to +200					°C
*T_L						
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	+235					°C

*JEDEC types in accordance with JEDEC registration data format JS-6-RDF-2.
♦For p-n-p devices, voltage and current values are negative.

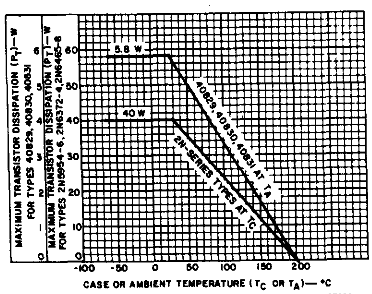


Fig. 1 - Dissipation derating chart for all types.

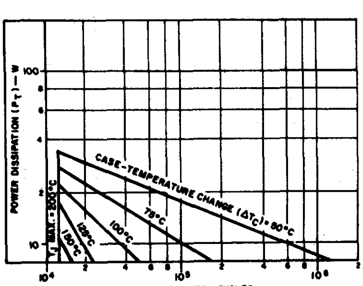


Fig. 2 - Thermal-cycling rating chart for all types.

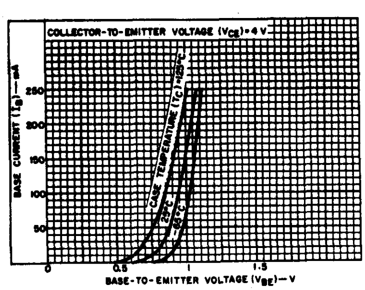


Fig. 3 - Typical input characteristics for 2N5954-56, 2N6372-74 and 40829-31.♦

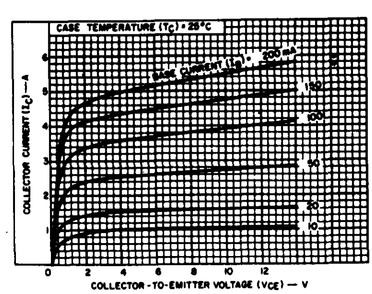


Fig. 4 - Typical output characteristics for 2N5954-56, 2N6372-74 and 40829-31.♦

♦For p-n-p devices, voltage and current values are negative.

2N5954-2N5956, 2N6372-2N6374, 2N6465-2N6468, 40829-40831

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS◆ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6374 2N5956◆ 40831◆ Min.	Max.	2N6373 2N5955◆ 40830◆ Min.	Max.	2N6372 2N5954◆ 40829◆ Min.	Max.	UNITS
* I_{CER} R_{BE}=100 Ω	35 55 75				– – –	100 – –	– – –	– 100 –	– – –	– – 100	μA
* I_{CEX} R_{BE}=100 Ω	45 65 85	–1.5 –1.5 –1.5			– – –	100 – –	– – –	– 100 –	– – –	– – 100	μA
* R_{BE}=100 Ω, T_C=150°C	45 65 85	–1.5 –1.5 –1.5			– – –	2 – –	– – –	– 2 –	– – –	– – 2	mA
* I_{CEO}	25 45 65				– – –	1 – –	– – –	– 1 –	– – –	– – 1	mA
* I_{EBO}		–5			–	0.1	–	0.1	–	0.1	mA
* h_{FE}	4 4 4 4		3ª 2.5ª 2ª 6ª		20 – – 5	100 – – –	– 20 – 5	– 100 – –	– – 20 5	– – 100 –	
* V_{CEO}(sus)			0.1ª		40ᵇ	–	60ᵇ	–	80ᵇ	–	V
V_{CER}(sus) R_{BE}=100 Ω			0.1ª		45ᵇ	–	65ᵇ	–	85ᵇ	–	V
V_{CEX}(sus) R_{BE}=100 Ω		–1.5	0.1ª		50ᵇ	–	70ᵇ	–	90ᵇ	–	V
* V_{BE} All types All types All types 2N6372-2N6374	4 4 4 4		3ª 2.5ª 2ª 6ª		– – – –	2 – – 3	– – – –	– 2 – 3	– – – –	– – 2 3	V
* V_{CE}(sat) 2N5954–2N5956			3ª 2.5ª 2ª 6	0.3 0.25 0.2 1.2	– – – –	1 – – 2	– – – –	– 1 – 2	– – – –	– – 1 2	V
* $\|h_{fe}\|$ f=1 MHz 2N6372-2N6374 2N5954-56,40829-31	4 –4		1 –1		4 5	– –	4 5	– –	4 5	– –	
* h_{fe} f=1 kHz	4		0.5		25	–	25	–	25	–	
$R_{\theta JC}$ 2N5954-56, 2N6372-74					–	4.3	–	4.3	–	4.3	°C/W
$R_{\theta JA}$ 40829-40831					–	30	–	30	–	30	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2 for JEDEC (2N5954-2N5956 2N6372-2N6374 2N6465-2N6468 40829-40931) types.

◆ For p-n-p devices, voltage and current values are negative.

ª Pulsed, pulse duration = 300 μs, duty factor = 1.8%.

ᵇ *CAUTION: Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEX}(sus) MUST NOT be measured on a curve tracer.*

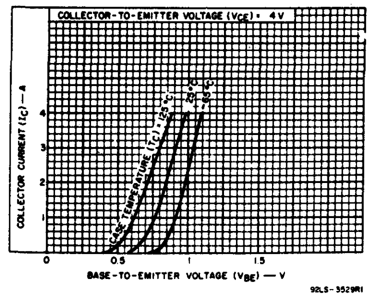


Fig. 5 - Typical transfer characteristics for 2N5954-56, 2N6372-74 and 40829-31.◆

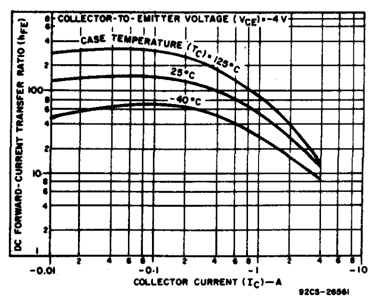


Fig. 6 - Typical dc beta characteristics for 2N6467 and 2N6468.

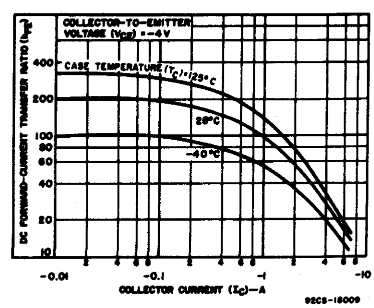


Fig. 7 - Typical dc beta characteristics for 2N5954-2N5956 and 40829-40831.

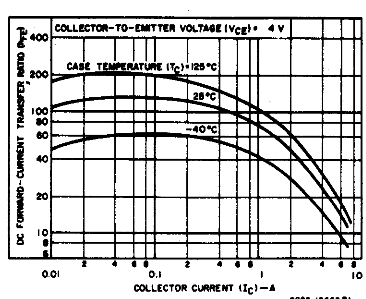


Fig. 8 - Typical dc beta characteristics for 2N6372-2N6374.

◆For p-n-p devices, voltage and current values are negative.

2N5954-2N5956, 2N6372-2N6374, 2N6465-2N6468, 40829-40831

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6465 2N6467♦ Min.	Max.	2N6486 2N6468♦ Min.	Max.	UNITS
I_{CER} R_{BE} = 100 Ω	95				–	100	–	–	μA
	100				–	–	–	100	
* I_{CEX} R_{BE} = 100 Ω	100	−1.5			–	100	–	–	μA
	120	−1.5			–	–	–	100	
R_{BE} = 100 Ω, T_C = 150°C	100	−1.5			–	2	–	–	mA
	120	−1.5			–	–	–	2	
* I_{CEO}	50				–	1	–	–	mA
	60				–	–	–	1	
* I_{EBO}		−5			–	0.1	–	0.1	mA
* h_{FE}	4		1.5a		15	150	15	150	
	4		4a		5	–	5	–	
* $V_{CEO}(sus)$			0.1a		100b	–	120b	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω			0.1a		105b	–	125b	–	V
* $V_{CEX}(sus)$ R_{BE} = 100 Ω		−1.5	0.1a		110b	–	130b	–	V
* V_{BE}	4		1.5a		–	2	–	2	V
	4		4a		–	3.5	–	3.5	
$V_{CE}(sat)$ All types			1.5a	0.15	–	1.2	–	1.2	V
2N6465–2N6466			4a	0.8		3*	–	3*	
2N6467–2N6468			−4a	−0.8	–	−4*	–	−4*	
* $\|h_{fe}\|$ f = 1 MHz	4		1		5	–	5	–	
* h_{fe} f = 1 kHz	4		0.5		25	–	25	–	
$R_{\theta JC}$					–	4.3	–	4.3	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

♦ For p-n-p devices, voltage and current values are negative.

a Pulsed, pulse duration = 300 μs, duty factor = 1.8%

b *CAUTION: Sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer.*

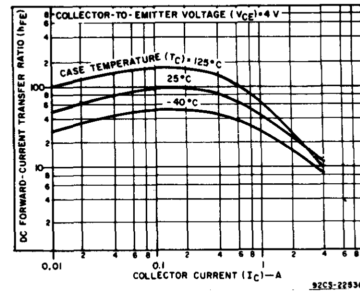


Fig. 9 - Typical dc beta characteristics for 2N6465 and 2N6466.

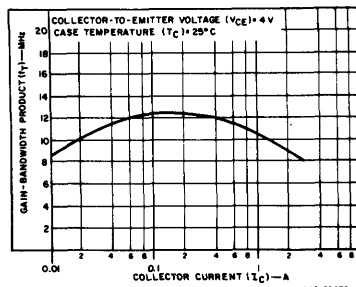


Fig. 10 - Typical gain-bandwidth product for 2N5954-56, 2N6372-74, 2N6467-68, and 40829-31. (For p-n-p devices, voltage and current values are negative.)

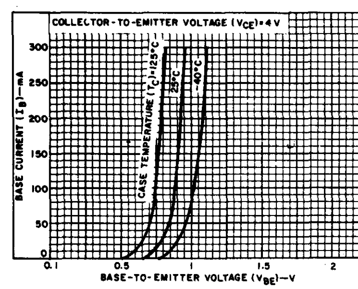


Fig. 11 - Typical input characteristics for 2N6465 and 2N6466.

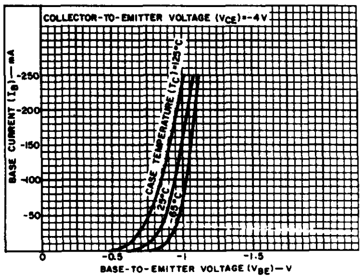


Fig. 12 - Typical input characteristics for 2N6467 and 2N6468.

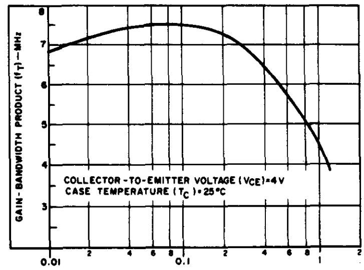


Fig. 13 - Typical gain-bandwidth product for 2N6465 and 2N6466.

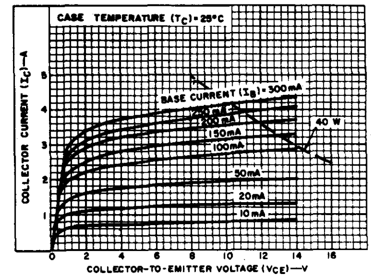


Fig. 14 - Typical output characteristics for 2N6465 and 2N6466.

2N5954-2N5956, 2N6372-2N6374, 2N6465-2N6468, 40829-40831

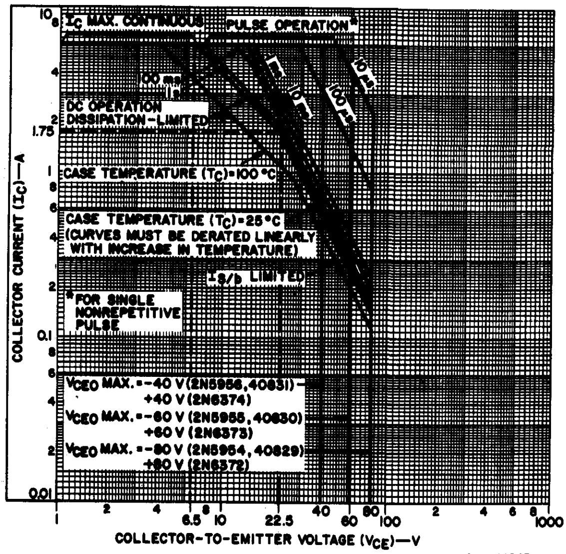


Fig. 15 - Maximum operating areas for 2N5954-56, 2N6372-74, and 40829-31.♦

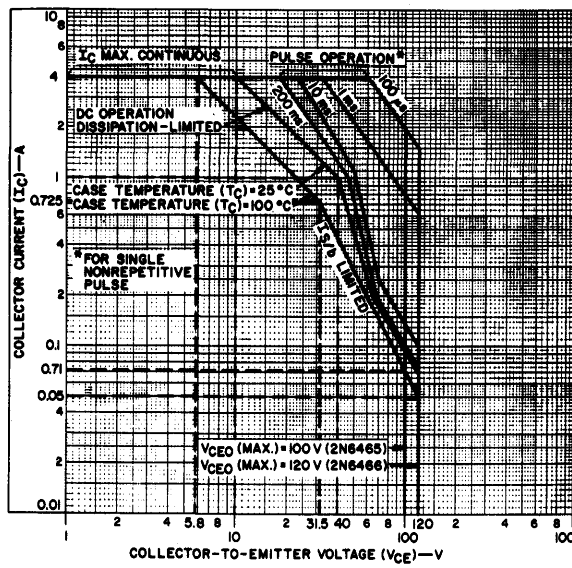


Fig. 16 - Maximum operating areas for 2N6465 and 2N6466.

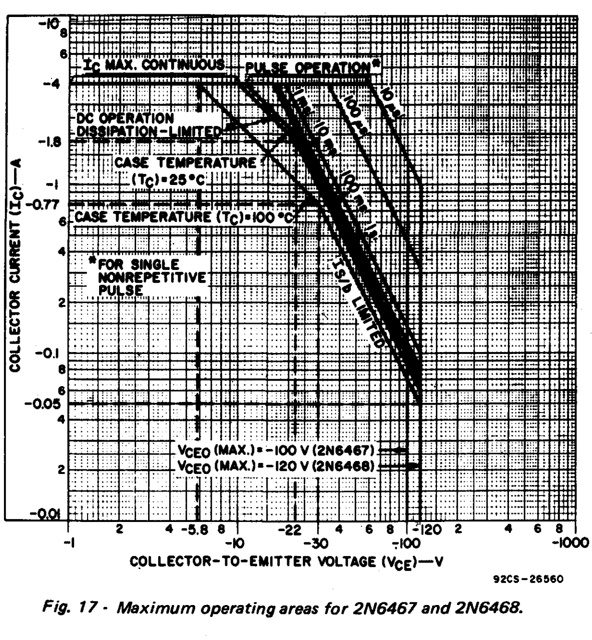


Fig. 17 - Maximum operating areas for 2N6467 and 2N6468.

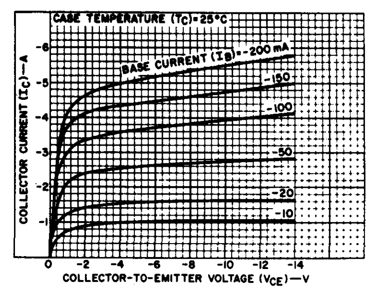


Fig. 18 - Typical output characteristics for 2N6467 and 2N6468.

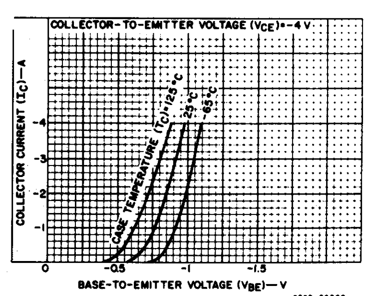


Fig. 19 - Typical transfer characteristics for 2N6467 and 2N6468.

♦For p-n-p devices, voltage and current values are negative.

2N5954-2N5956, 2N6372-2N6374, 2N6465-2N6468, 40829-40831

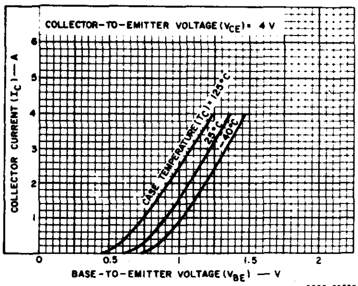


Fig. 20 - Typical transfer characteristics for 2N6465 and 2N6466.

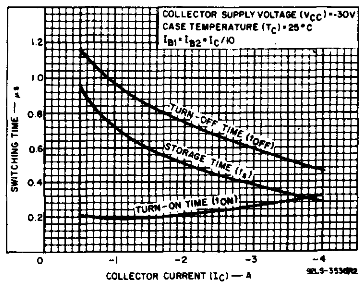


Fig. 21 - Typical saturated switching characteristics for 2N5954-56 and 40829-31.

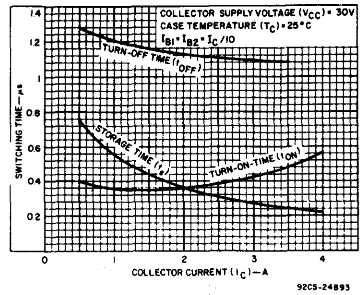


Fig. 22 - Typical saturated switching characteristics for 2N6372-2N6374.

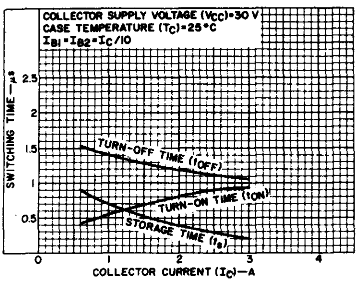


Fig. 23 - Typical saturated switching characteristics for 2N6465 and 2N6466.

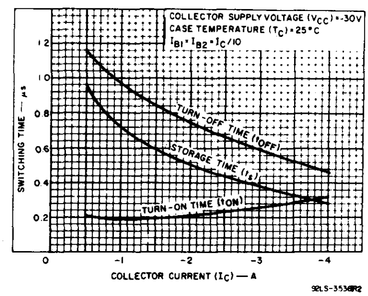


Fig. 24 - Typical saturated switching characteristics for 2N6467 and 2N6468.

2N6032, 2N6033

High-Current, High-Speed, High-Power Transistors

Silicon N-P-N Types

For Switching and Amplifier Applications in Military, Industrial, and Commercial Equipment

RCA Types 2N6032 and 2N6033* are epitaxial silicon n-p-n transistors having high-current and high-power handling capability and fast switching speed. The 2N6033 is similar to the 2N6032; they differ in maximum values for continuous collector current and sustaining voltage.

They are supplied in modified TO-3 hermetic steel packages with 0.60-in. diameter pins.

*Formerly RCA Dev. Types TA7337 and TA7337A, respectively.

Applications:

- Switching-control amplifiers
- Power gates
- Switching regulators
- Power-switching circuits
- Power oscillators
- DC-RF amplifiers
- Converters
- Inverters
- Control circuits

Features:

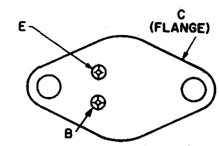
- Low $V_{CE}(sat)$ = 1.0 V max. at 40 A, 1.3 V max. at 50 A
- Maximum Safe-Area-of-Operation Curve... $I_{S/b}$ limit line beginning at 24 V
- Fast Storage Time... t_s = 1.5 μs max at I_C = 40 A (2N6033) 50A (2N6032)
- High-Current Capability... $V_{CE}(sat)$ & V_{BE} measured at I_C = 40 A (2N6033) = 50 A (2N6032)
- High P_T (140 W max. at T_C = 25°C)

MAXIMUM RATINGS, *Absolute Maximum Values:*

		2N6032	2N6033	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	150	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:				
With base open	$V_{CEO}(sus)$	90	120	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER}(sus)$	110	140	V
* With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω & V_{BE} = -1.5 V	$V_{CEX}(sus)$	120	150	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	V
* CONTINUOUS COLLECTOR CURRENT	I_C	50	40	A
* BASE CURRENT	I_B	10	10	A
* EMITTER CURRENT	I_E	50	40	A
* TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C and V_{CE} up to 24 V		140	140	W
At case temperatures above 25°C		Derate linearly to 200°C		
* TEMPERATURE RANGE:				
Storage & Operating (Junction)		-65 to +200		°C
* PIN TEMPERATURE (During Soldering): At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max		230		°C

*In accordance with JEDEC registration data format JS-6 RDF-1.

TERMINAL DESIGNATIONS



Modified JEDEC TO-3

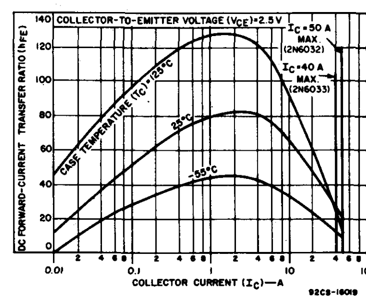


Fig. 2 - Typical dc-beta characteristics for both types.

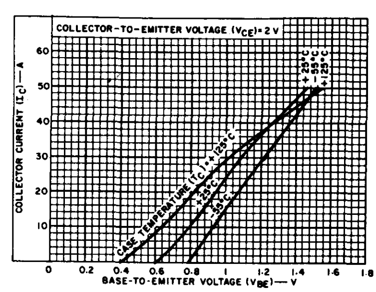


Fig. 3 - Typical transfer characteristics for both types.

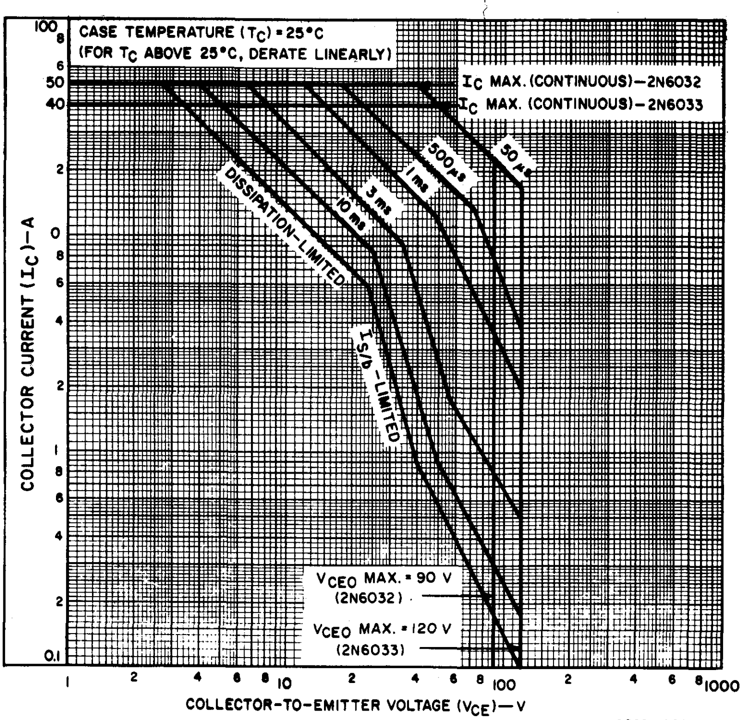


Fig. 1 - Maximum operating areas for both types.

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS				UNITS
		VOLTAGE V dc		CURRENT A dc		2N6032		2N6033		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
Collector-Cutoff Current: With base open	I_{CEO}	80	–	–	0	–	10	–	10	mA
* With base-emitter junction reverse biased	I_{CEV}	110	-1.5	–	–	–	12	–	–	mA
		135	-1.5	–	–	–		–	10	
T_C = 150°C		100	-1.5	–	–	–	15	–	10	mA
* Emitter-Cutoff Current	I_{EBO}	–	-7	0	–	–	10	–	10	mA
Collector-to-Emitter Sustaining Voltage: *(See Figs. 12 & 13)* * With base open	$V_{CEO}(sus)$	–	–	0.2[b]	0	90[a]	–	120[a]	–	V
With external base to emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER}(sus)$	–	–	0.2[b]	0	110[a]	–	140[a]	–	
With base-emitter junction reverse biased & R_{BE} ≤ 50 Ω	$V_{CEX}(sus)$	–	-1.5	0.2[b]	0	120[a]	–	150[a]	–	
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$	–	–	50[b]	5	–	2	–	–	V
		–	–	40[b]	4	–	–	–	2	
Base-to-Emitter Voltage	V_{BE}	2	–	50[b]	–	–	2	–	–	V
		2	–	40[b]	–	–	–	–	2	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	–	–	50[b]	5	–	1.3	–	–	V
		–	–	40[b]	4	–	–	–	1	
* DC Forward-Current Transfer Ratio	h_{FE}	2.6	–	50[b]	–	10	50	–	–	
		2	–	40[b]	–	–	–	10	50	
Second-Breakdown Collector Current With base forward biased, t = 1 s nonrepetitive	$I_{S/b}$	24	–	–	–	5.8[c]	–	5.8[c]	–	A
		40	–	–	–	0.9[c]	–	0.9[c]	–	
Second-Breakdown Energy With base reverse biased (L = 310 μH, R_{BE} = 5 Ω)	$E_{S/b}$	–	-4	20	–	62	–	62	–	mJ
* Magnitude of common-emitter small-signal, short-circuit, forward-current transfer ratio f = 5 MHz	$\|h_{fe}\|$	10		2		10	–	10	–	
* Gain-Bandwidth Product f = 5 MHz	f_T	10	–	2	–	50	–	50	–	MHz
Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}	–	–	–	–	–	800	–	800	pF
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10	–	10	–	–	1.25	–	1.25	°C/W

*In accordance with JEDEC registration format JS-6 RDF-1.

[a] CAUTION: The sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer.

[b] Pulsed: Pulse duration 300 μs; duty factor ≤ 2%.

SWITCHING TIME CHARACTERISTICS, *Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS				UNITS
		VOLTAGE V dc		CURRENT A dc		2N6032		2N6033		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
Saturated Switching Time: (V_{CC}=30 V, I_{B1} = I_{B2}):										
* Rise Time	t_r	–	–	50	5	–	1	–	–	μs
		–	–	40	4	–	–	–	1	
* Storage Time	t_s	–	–	50	5	–	1.5	–	–	μs
		–	–	40	4	–	–	–	1.5	
* Fall Time	t_f	–	–	50	5	–	0.5	–	–	μs
		–	–	40	4	–	–	–	0.5	

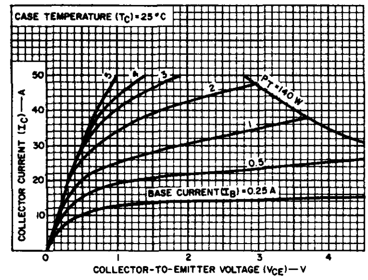


Fig. 4 - Typical output characteristics for both types.

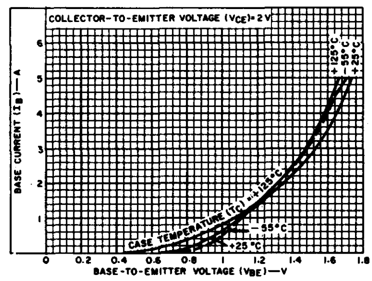


Fig. 5 - Typical input characteristics for both types.

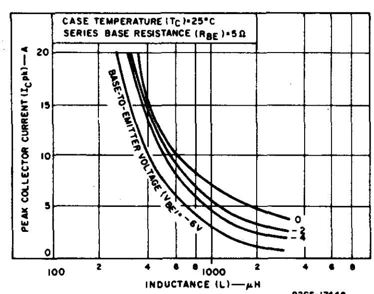


Fig. 6 - Maximum reverse-bias second-breakdown characteristics for both types.

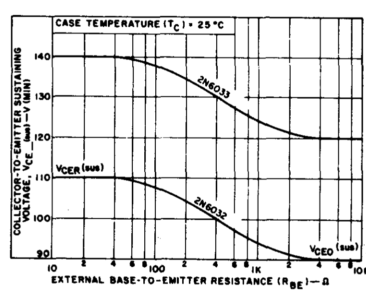


Fig. 7 - Collector-to-emitter sustaining voltage characteristics for both types.

2N6032, 2N6033

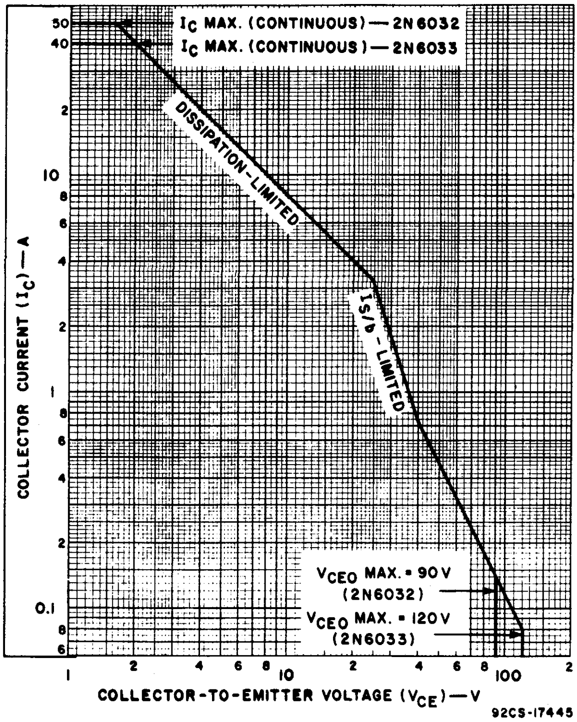


Fig. 8 - Maximum operating areas for both types at case temperature (T_C) = 100°C.

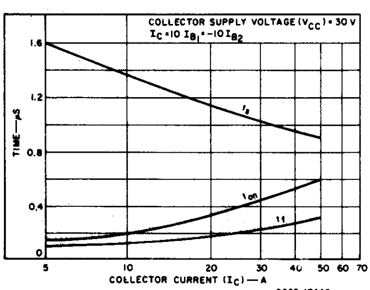


Fig. 9 - Typical saturated switching characteristics for both types.

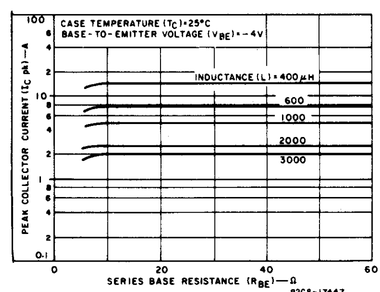


Fig. 10 - Maximum reverse-bias second-breakdown characteristics for both types.

2N6077-2N6079

High-Voltage, High-Power Silicon N-P-N Transistors

For Switching and Linear Applications

RCA 2N6077, 2N6078 and 2N6079 are multiple epitaxial silicon n-p-n power transistors utilizing a multiple-emitter-site structure. Multiple-epitaxial construction maximizes the volt-ampere characteristic of the device and provides fast switching speeds. Multiple-emitter-site design ensures uniform current flow throughout the structure, which produces a high $I_{S/b}$ and a large safe-operation area.

These devices use the popular JEDEC TO-66 package; they differ mainly in voltage ratings, leakage-current limits, and V_{CE}(sat) ratings.

The 2N6077 is characterized for switching applications with load lines in the active region. These applications include sweep circuits and all circuits using the transistor as an active voltage clamp.

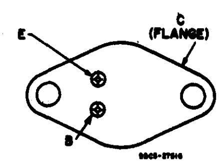
Type 2N6078 is characterized for switching applications with the load line extending into the reverse-bias region. Its voltage ratings make this device useful for switching regulators operating directly from a rectified 110-V or 220-V power line. The unit is rated to take surge currents up to 5 A and maintain saturation.

The 2N6079 is characterized for use in inverters operating directly from a rectified 110-V power line. The leakage current is specified at 450 volts; therefore the device can also be used in a series bridge configuration on a 220-V line. The V_{EBO} rating of 9 volts eases requirements on the drive transformer in inverter applications. Storage time, an important factor in the frequency stability of an inverter, is specified in Fig. 11, which shows variation in storage time with variation in load current from zero to maximum (4 A).

Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltages**
- **High voltage ratings:**
  V_{CER}(sus) = 300 V (2N6077)
  275 V (2N6078)
  375 V (2N6079)
- **High dissipation rating: P_T = 45 W**

TERMINAL DESIGNATIONS



JEDEC TO-66

MAXIMUM RATINGS, ***Absolute-Maximum Values:***		**2N6077**	**2N6078**	**2N6079**	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	300	275	375	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
With base open	V_{CEO}(sus)	275	250 1	350	V
* With reverse bias (V_{BE}) of −1.5 V	V_{CEX}(sus)	300	275	375	V
With external base-to-emitter resistance (R_{BE}) ≤ 500 Ω	V_{CER}(sus)	300	275	375	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	9	V
*COLLECTOR CURRENT:	I_C				
Continuous		7	7	7	A
Peak		10	10	10	A
*CONTINUOUS BASE CURRENT	I_B	4	4	4	A
*TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		45	45	45	W
At case temperatures above 25°C			Derate linearly to 200°C		
*TEMPERATURE RANGE:					
Storage & Operating (Junction)			−65 to +200		°C
*PIN TEMPERATURE (During Soldering):					
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.			230		°C

* 2N-Series types in accordance with JEDEC registration data format (JS-6, RDF-1).

2N6077-2N6079

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N6077			2N6078			2N6079			UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
I_{CEO}	250			0	–	–	2	–	–	–	–	–	–	mA
* I_{CEV}	250 450	–1.5 –1.5			– –	– –	5 –	– –	– –	0.05 –	– –	– –	– 0.5	mA
(T_C = 125°C)	250 450	–1.5 –1.5			– –	– –	8 –	– –	– –	0.2 –	– –	– –	– 5	mA
* I_{EBO}		–6 –9	0 0		– –	– –	1 –	– –	– –	1 –	– –	– –	– 1	mA
* $V_{CEO}(sus)$			0.2[a]		275[b]	–	–	250[b]	–	–	350[b]	–	–	V
$V_{CER}(sus)$ (R_{BE} = 500 Ω)			0.2[a]		300[b]	–	–	275[b]	–	–	375[b]	–	–	V
* V V_{EBO} (I_E = 1 mA)			0		6	–	–	6	–	–	9	–	–	V
* h_{FE}	1		1.2[a]		12	28	70	12	28	70	12	28	50	
* $V_{BE}(sat)$			1.2[a] 3[a] 4[a] 5[a]	0.2 0.6 0.8 1	– – – –	1.0 1.2 – –	1.6 1.9 – –	– – – –	1.0 – – 1.5	1.6 – – 2	– – – –	1.0 – 1.3 –	1.6 – 2 –	V
* $V_{CE}(sat)$			1.2[a] 3[a] 4[a] 5[a]	0.2 0.6 0.8 1	– – – –	0.15 0.25 – –	0.5 1 – –	– – – –	0.15 – – 0.8	0.5 – – 3	– – – –	0.15 – 0.5 –	0.5 – 3 –	V
C_{obo} (V_{CB}=10 V, f = 1 MHz)					–	–	150	–	–	150	–	–	150	pF
* $\|h_{fe}\|$ (f = 1 MHz)	10		0.2		1	7	–	1	7	–	1	7	–	
$I_{S/b}$ (Pulse duration (non-repetitive) = 1 s)	50				0.9	–	–	0.9	–	–	0.9	–	–	A
$E_{S/b}$ (R_B = 50Ω, L=100μH)		–4	3●		0.45	–	–	0.45	–	–	0.45	–	–	mj
t_d[c]			1.2	0.2	–	0.02	–	–	0.02	–	–	0.02	–	μs
* t_r[c]			1.2	0.2	–	0.3	0.75	–	0.3	0.75	–	0.3	0.75	μs
* t_s[c]			1.2	0.2	–	2.8	5	–	2.8	5	–	2.8	5	μs
* t_f[c]			1.2	0.2	–	0.3	0.75	–	0.3	0.75	–	0.3	0.75	μs
$R_{\theta JC}$	20		2.25		–	–	3.9	–	–	3.9	–	–	3.9	°C/W

*2N-series types in accordance with JEDEC registration data format (JS-6, RDF-1).

[a] Pulsed; pulse duration ≤ 350 μs, Duty factor = 2%.

[b] CAUTION: The sustaining voltages $V_{CEO}(sus)$, and $V_{CER}(sus)$, MUST NOT be measured on a curve tracer.

[c] V_{CC} = 250 V, I_{B1} = I_{B2}.

2N6077-2N6079

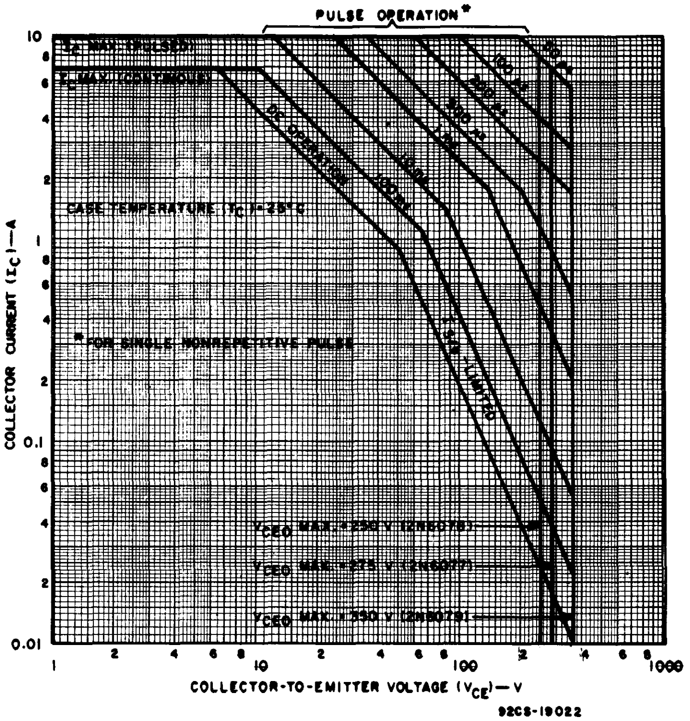


Fig. 1 - Maximum operating areas for all types.

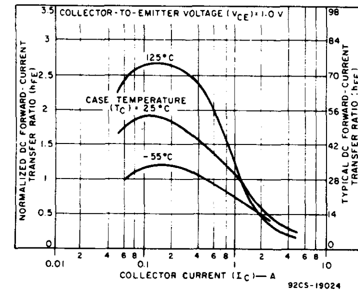


Fig. 2 - Typical normalized dc beta characteristics for all types.

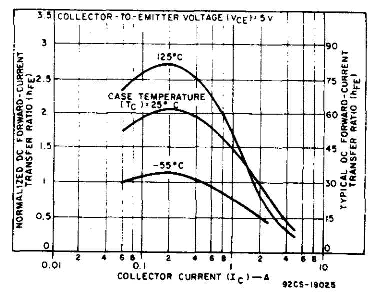


Fig. 3 - Typical normalized dc beta characteristics for all types.

Note (Figs. 2 & 3): To estimate min., max. h_{FE} at any current and temperature, read normalized dc forward-current transfer ratio and multiply by min., max. specifications given in Electrical Characteristics Chart.

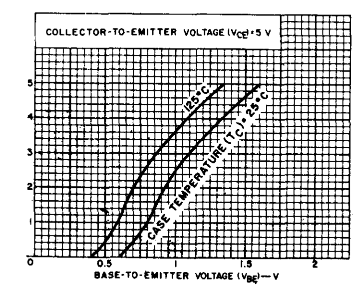


Fig. 5 - Typical transfer characteristics for all types.

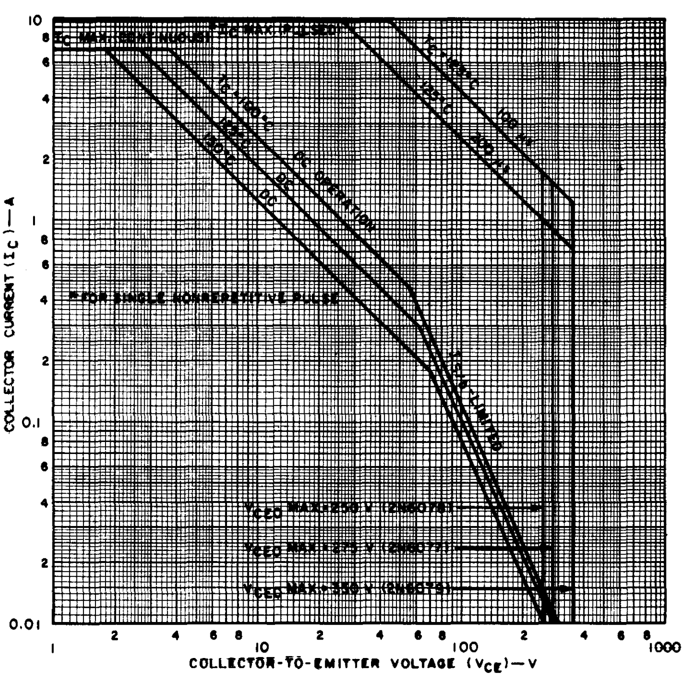


Fig. 4 - Maximum operating areas for all types.

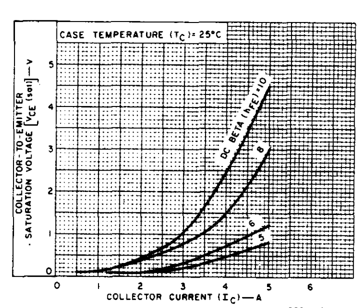


Fig. 6 - Typical saturation voltage characteristics for all types.

2N6077-2N6079

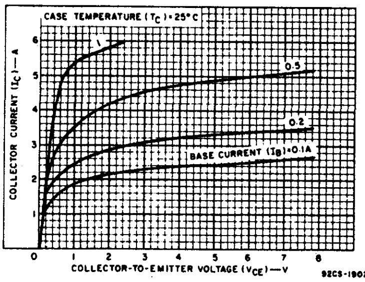


Fig. 7 - Typical output characteristics for all types.

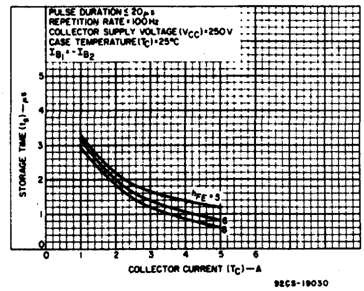


Fig. 8 - Typical storage-time characteristics for all types (with constant forced gain).

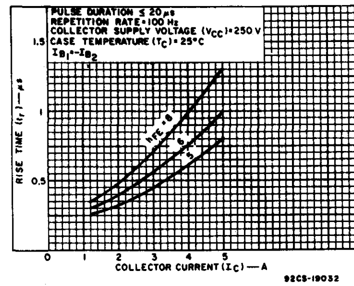


Fig. 9 - Typical rise-time characteristic for all types.

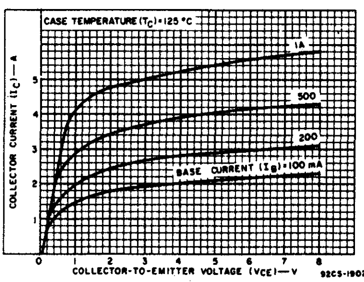


Fig. 10 - Typical output characteristics for all types.

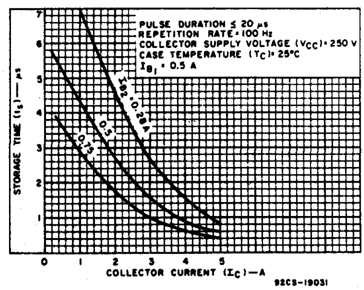


Fig. 11 - Typical storage-time characteristics for all types (with constant-base drives).

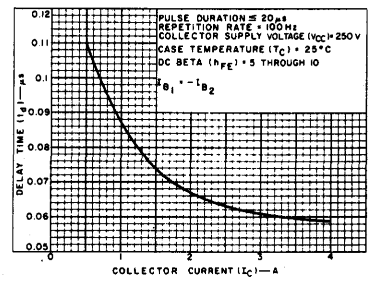


Fig. 12 - Typical delay-time characteristic for all types.

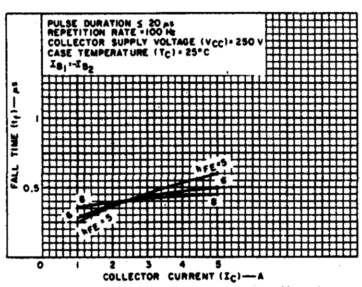


Fig. 13 - Typical fall-time characteristic for all types.

2N6098-2N6103, RCA3055

High-Current Silicon N-P-N VERSAWATT Transistor

Designed for Medium-Power Linear and Switching Service in Consumer, Automotive, and Industrial Applications

These RCA types are hometaxial-base silicon n-p-n transistors. Types 2N6098, 2N6100, and 2N6102 have formed emitter and base leads for easy insertion into TO-66 sockets. Types 2N6099, 2N6101, and 2N6103 are electrically identical to the 2N6098, 2N6100, and 2N6102, respectively.

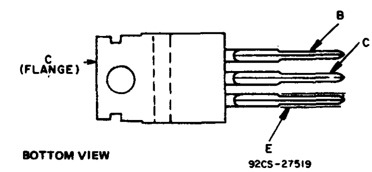
These new VERSAWATT package transistors differ in voltage ratings and in the currents at which the parameters are controlled. They are intended for a wide variety of medium-power switching and linear applications, such as series and shunt regulators, solenoid drivers, motor-speed controls, inverters, and driver and output stages of high-fidelity amplifiers.

OPTIONAL LEAD CONFIGURATION
An additional lead forming for printed-circuit board mounting is also available. Please submit requirements to your RCA Technical Sales Representative, or write to RCA Power Marketing, Somerville, N. J. 08876.

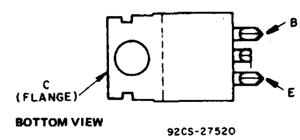
Features:

- **Low saturation voltage —**
  V_{CE}(sat) = 1 V max. at I_C = 4 A (2N6098, 2N6099)
  = 1 V max. at I_C = 5 A (2N6100, 2N6101)
  = 1 V max. at I_C = 8 A (2N6102, 2N6103)
- **VERSAWATT package (molded-silicone plastic)**
- **Maximum safe-area-of-operation curves**
- **Thermal-cycle rating curve**

TERMINAL DESIGNATIONS



JEDEC TO-220AB
2N6099, 2N6101, 2N6103



JEDEC TO-220AA
2N6098, 2N6100, 2N6102

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6102 2N6103	2N6098 2N6099	2N6100 2N6101	RCA3055	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	45	70	80	100	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}(sus)	45	65	75	70	V
* With base open	V_{CEO}(sus)	40	60	70	60	V
With base reverse-biased V_{BE} = −1.5 V	V_{CEV}(sus)	–	–	–	90	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	8	8	7	V
*COLLECTOR CURRENT (Continuous)	I_C	16	10	10	15	A
*BASE CURRENT	I_B	4	4	4	4	A
TRANSISTOR DISSIPATION:	P_T					
* At case temperatures up to 25°C		75	75	75	75	W
At ambient temperatures up to 25°C		1.8	1.8	1.8	1.8	W
* At case temperatures above 25°C, derate linearly		0.6				W/°C
At ambient temperatures above 25°C, derate linearly		0.0144				W/°C
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		−65 to 150				°C
*LEAD TEMPERATURE (During Soldering):						
At distance ≥ 1.8 in. (3.17 mm) from case of 10 s max.		235				°C

* 2N-Series types in accordance with JEDEC registration data format JS-6 RDF-2.

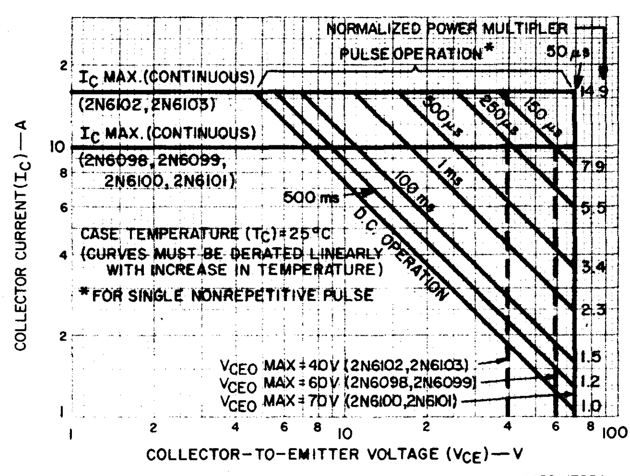


Fig. 1 — Maximum safe operating areas for 2N6098-2N6103, inclusive.

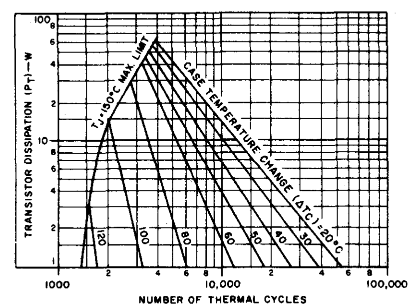


Fig. 2 — Thermal-cycling rating for all types.

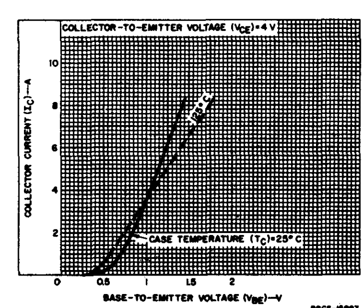


Fig. 3 — Typical transfer characteristics for all types.

2N6098-2N6103, RCA3055

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{EB}	CURRENT A dc I_C	I_B	LIMITS 2N6102 2N6103 MIN.	MAX.	2N6098 2N6099 MIN.	MAX.	2N6100 2N6101 MIN.	MAX.	RCA3055 MIN.	MAX.	UNITS
* I_{CEX}	40	1.5			–	2	–	–	–	–	–	–	mA
	65	1.5			–	–	–	2	–	–	–	–	
	75	1.5			–	–	–	–	–	2	–	–	
	100	1.5			–	–	–	–	–	–	–	5	
* I_{CEX} (T_C = 150°C)	40	1.5			–	10	–	–	–	–	–	–	
	65	1.5			–	–	–	10	–	–	–	–	
	75	1.5			–	–	–	–	–	10	–	–	
	100	1.5			–	–	–	–	–	–	–	30	
* I_{CEO}	30			0	–	2	–	–	–	–	–	0.7	mA
	50			0	–	–	–	2	–	–	–	–	
	60			0	–	–	–	–	–	2	–	–	
* I_{EBO}		5	0		–	1	–	–	–	–	–	–	mA
		7	0		–	–	–	–	–	–	–	5	
		8	0		–	–	–	1	–	1	–	–	
$V_{CER}(sus)$ R_{BE} = 100Ω[a]			0.2		45	–	65	–	75	–	70	–	V
* $V_{CEO}(sus)$[a]			0.2	0	40	–	60	–	70	–	60	–	
$V_{CEV}(sus)$[a]		1.5	0.1		–	–	–	–	–	–	90	–	
* h_{FE}[a]	4		4		–	–	20	80	–	–	20	70	
	4		5		–	–	–	–	20	80	–	–	
	4		8		15	60	–	–	–	–	–	–	
	4		10		–	–	5	–	5	–	5	–	
	4		16		5	–	–	–	–	–	–	–	
* V_{BE}[a]	4		4		–	–	–	1.7	–	–	–	1.8	V
	4		5		–	–	–	–	–	1.7	–	–	
	4		8		–	1.7	–	–	–	–	–	–	
* $V_{CE}(sat)$[a]			4	0.4	–	–	–	–	–	–	–	1.1	V
			10	2	–	–	–	2.5	–	2.5	–	–	
			16	3.2	–	2.5	–	–	–	–	–	–	
$I_{S/b}$[b] (t ≥ 1 s)	60				–	–	–	–	–	–	1.2	–	A
f_{hfe}	4		1		–	–	–	–	–	–	10	–	kHz
* h_{fe}	4	f=1kHz	0.5		15	–	15	–	15	–	15	120	
* $\|h_{fe}\|$	4	f= 0.1MHz	0.5		8	28	8	28	8	28	2	–	
$R_{\theta JC}$					–	1.67	–	1.67	–	1.67	–	1.67	°C/W
$R_{\theta JA}$					–	70	–	70	–	70	–	70	

*2N-series types in accordance with JEDEC registration data format (JS-6, RDF-2)

[a]Pulsed, pulse duration = 300 μs, duty factor = 0.018

2N6098-2N6103, RCA3055

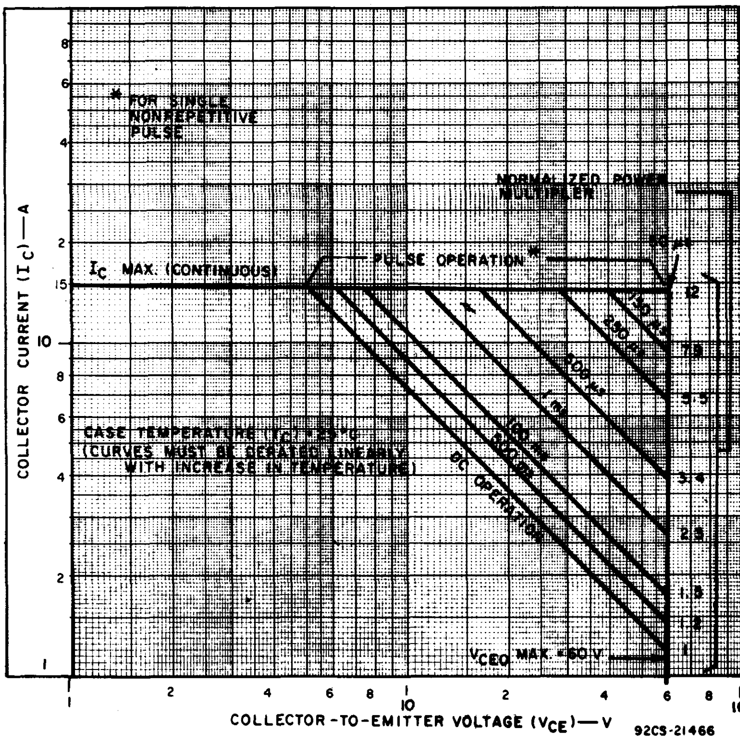


Fig. 4 — Maximum operating areas for RCA3055.

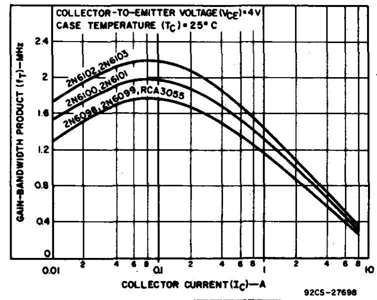


Fig. 5 — Typical gain-bandwidth product for all types.

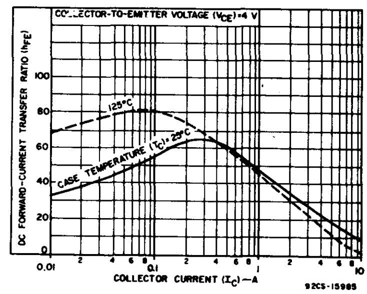


Fig. 6 — Typical dc beta characteristics for 2N6098, 2N6099, and RCA3055.

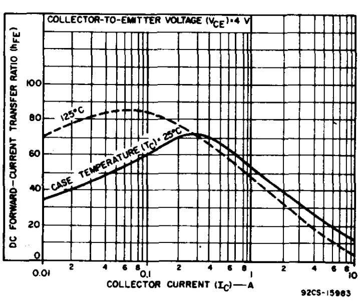


Fig. 7 — Typical dc beta characteristics for 2N6100 and 2N6101.

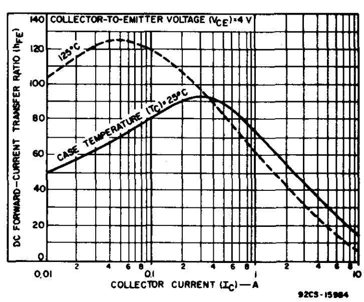


Fig. 8 - Typical dc beta characteristics for 2N6102 and 2N6103.

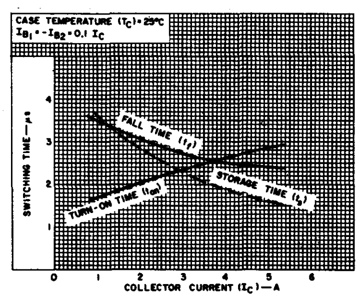


Fig. 9 - Typical saturated switching characteristics for all types.

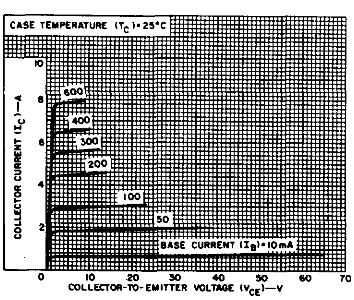


Fig. 10 - Typical output characteristics for 2N6098, 2N6099, and RCA3055.

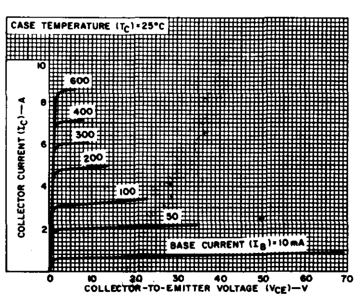


Fig. 11 - Typical output characteristics for 2N6100 and 2N6101.

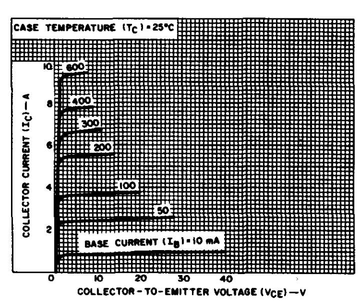


Fig. 12 - Typical output characteristics for 2N6102 and 2N6103.

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

Epitaxial-Base, Silicon N-P-N andP-N-P VERSAWATT Transistors

General-Purpose Medium-Power Types for Switching and Amplifier Applications

RCA 2N6106-2N6111, 2N6288-2N6293, and 2N6473-2N6476, 41500 and 41501 are epitaxial-base silicon transistors supplied in a VERSAWATT package. The 2N6288-2N6293, 2N6473, 2N6474, and 41500 are n-p-n complements of p-n-p types 2N6106-2N6111, 2N6475, 2N6476, and 41501, respectively. All these transistors are intended for a wide variety of medium-power switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers.

The 2N6289, 2N6291, and 2N6293 n-p-n types and 2N6106, 2N6108, and 2N6110 p-n-p devices fit into TO-66 sockets. The remaining types are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. All of these devices are also available on special order in a variety of lead-form configurations.

Features:

- **Low saturation voltages**
- **VERSAWATT package (molded silicone plastic)**
- **Complementary n-p-n and p-n-p types**
- **Thermal-cycling ratings**
- **Maximum safe-area-of-operation curves specified for dc operation**

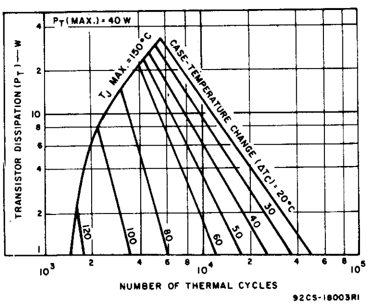
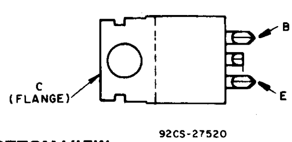


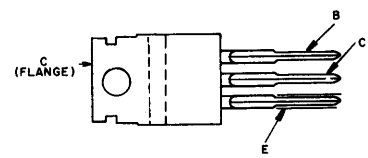
Fig. 1 - Thermal-cycling ratings for all types.

TERMINAL DESIGNATIONS



BOTTOM VIEW 92CS-27520

JEDEC TO-220AA
2N6106, 2N6108, 2N6110
2N6289, 2N6291, 2N6293



BOTTOM VIEW 92CS-27519

JEDEC TO-220AB
2N6107, 2N6109, 2N6111, 2N6288, 2N6290, 2N6292, 2N6473, 2N6474, 2N6475, 2N6476, 41500, 41501

MAXIMUM RATINGS, *Absolute-Maximum Values:*	N-P-N / P-N-P	2N6288 2N6289 / 2N6110♦ 2N6111♦	2N6290 2N6291 / 2N6108♦ 2N6109♦	2N6292 2N6293 / 2N6106♦ 2N6107♦	2N6473 / 2N6475♦	2N6474 / 2N6476♦	41500 / 41501♦	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	40	60	80	110	130	35	V
*COLLECTOR-TO-EMITTER VOLTAGE:								
With external base-supply resistance (R_{BB}) = 100Ω, and base supply voltage (V_{BB}) = 0 V	V_{CEX}	40	60	80	110	130	35	V
With base open	V_{CEO}	30	50	70	100	120	25	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	5	3	V
*COLLECTOR CURRENT (Continuous)								
At case temperature ⩽ 106°C	I_C	7	7	7	4	4	7	A
*BASE CURRENT (Continuous)								
At case temperature ⩽ 130°C	I_B	3	3	3	2	2	3	A
TRANSISTOR DISSIPATION:	P_T							
At case temperatures up to 25°C		40	40	40	40	40	40	W
* At case temperatures up to 100°C		16	16	16	16	16	16	W
At ambient temperatures up to 25°C		1.8	1.8	1.8	1.8	1.8	1.8	W
At case temperatures above 25°C		Derate linearly at 0.32 W/°C						
* At case temperatures above 100°C		Derate lineraly at 0.32 W/°C						
At ambient temperatures above 25°C		Derate linearly at 0.0144 W/°C						
*TEMPERATURE RANGE:								
Storage and Operating (Junction)		–65 to 150						°C
*LEAD TEMPERATURE (During Soldering):								
At distance ⩾ 1/8 in. (3.17 mm) from case for 10 s max.		235						°C

* 2N-Series types in accordance with JEDEC registration data format (JS-6, RDF-2)

♦For p-n-p devices, voltage and current values are negative

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS♦ VOLTAGE V dc		CURRENT A dc		LIMITS 2N6292, 2N6293, 2N6106♦, 2N6107♦		2N6290, 2N6291, 2N6108♦, 2N6109♦		UNITS
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
I_{CER} (R_{BE} = 100 Ω)	75				–	0.1	–	–	mA
	55				–	–	–	0.1	mA
(T_C = 150°C)	70				–	2	–	–	mA
	50				–	–	–	2	mA
* I_{CEX}	75	−1.5			–	0.1	–	–	mA
	56	−1.5			–	–	–	0.1	mA
* (T_C = 150°C)	70	−1.5			–	2	–	–	mA
	50	−1.5			–	–	–	2	mA
* I_{CEO}	40			0	–	–	–	1	mA
	60			0	–	1	–	–	mA
* I_{EBO}		−5	0		–	1	–	1	mA
* V_{CEO}(sus)			0.1[a]	0	70	–	50	–	V
V_{CER}(sus) (R_{BE} = 100Ω)			0.1		80	–	60	–	V
* h_{FE}	4		2[a]		30	150	–	–	
	4		2.5[a]		–	–	30	150	
	4		7[a]		2.3	–	2.3	–	
* V_{BE} 2N6292, 2N6293	4		2[a]		–	1.5	–	–	V
2N6290, 2N6291	4		2.5[a]		–	–	–	1.5	V
All Types	4		7[a]		–	3	–	3	V
* V_{CE}(sat)			2[a]	0.2	–	1	–	–	V
			2.5[a]	0.25	–	–	–	1	V
			7[a]	3[a]	–	3.5	–	3.5	V
* h_{fe} (f = 50 kHz)	4		0.5		20	–	20	–	
f_T 2N6290 - 2N6293	4		0.5		4	–	4	–	MHz
2N6106 - 2N6109	−4		−0.5		10	–	10	–	MHz
* $\|h_{fe}\|$ (f = 1 MHz) 2N6290 - 2N6293	4		0.5		4	–	4	–	
2N6106 - 2N6109	−4		−0.5		10	–	10	–	
* C_{obo} (f = 1 MHz, V_{CB} = 10 V)			0		–	250	–	250	pF
$R_{\theta JC}$					–	3.125	–	3.125	°C/W
$R_{\theta JA}$					–	70	–	70	°C/W

[a]Pulsed; pulse duration = 300 μs, duty factor = 0.018.

♦For p-n-p devices, voltage and current values are negative

*In accordance with JEDEC registration data format (JS-6 RDF-2).

CAUTION: The sustaining voltages V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer.

2N6106-2N6111, 2N6288-2N6293, 2N6473- 2N6476, 41500, 41501

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS♦				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6474 2N6476♦		2N6473 2N6475♦		41500 41501♦		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CER} (R_{BE} = 100Ω)	30 120 100				– – –	– 0.1 –	– – –	– – 0.1	– – –	0.25 – –	mA
(T_C = 100°C)	120 100				– –	2 –	– –	– 2	– –	– –	
* I_{CEX}	120 100	−1.5 −1.5			– –	0.1 –	– –	– 0.1	– –	– –	mA
* (T_C = 100°C)	120 100	−1.5 −1.5			– –	2 –	– –	– 2	– –	– –	
* I_{CEO}	60 50			0 0	– –	1 –	– –	– 1	– –	– –	mA
* I_{EBO}		−5 −3	0 0		– –	1 –	– –	1 –	– –	– 1	mA
* V_{CEO}(sus)			0.1[a]	0	120	–	100	–	25	–	V
V_{CER}(sus) (R_{BE} = 100Ω)			0.1		130	–	110	–	35	–	V
* h_{FE}	4 4 2.5		1[a] 1.5[a] 4[a]		– 15 2	– 150 –	– 15 2	– 150 –	25 – –	– – –	
* V_{BE}	4 4 2.5		1[a] 1.5[a] 4[a]		– – –	– 2 3.5	– – –	– 2 3.5	– – –	1.5 – –	V
* V_{CE}(sat)			1[a] 1.5[a] 4[a]	0.1 0.15 2	– – –	– 1.2 2.5	– – –	– 1.2 2.5	– – –	1 – –	V
* h_{fe} (f = 50 kHz)	4		0.5		20	–	20	–	20	–	
f_T 41500, 2N6473, 2N6474 2N6475, 2N6476	 4 −4		 0.5 −0.5		 4 5	 – –	 4 5	 – –	 4 –	 – –	MHz
* $\|h_{fe}\|$ (f = 1 MHz) 41500, 2N6473, 2N6474 2N6475, 2N6476	 4 −4		 0.5 −0.5		 4 5	 – –	 4 5	 – –	 4 –	 – –	
* C_{obo} (f = 1 MHz, V_{CB} = 10 V)			0		–	250	–	250	–	250	pF
$R_{\theta JC}$					–	3.125	–	3.125	–	3.125	°C/W
$R_{\theta JA}$					–	70	–	70	–	70	

[a]Pulsed; pulse duration = 300 μs, duty factor = 0.018.

♦For p-n-p devices, voltage and current values are negative.

*2N-series types in accordance with JEDEC registration data format (JS-6 RDF-2).

CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer.

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6288 2N6289 MIN.	MAX.	2N6110♦ 2N6111♦ MIN.	MAX.	UNITS
Collector-Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	35				–	0.1	–	–0.1	mA
With (R_{BE}) = 100 Ω and T_C = 150°C	I_{CER}	30				–	2	–	–2	mA
* With base-emitter junction reverse-biased	I_{CEX}	37.5	–1.5			–	0.1	–	–0.1	mA
* With base-emitter junction reverse-biased and T_C = 150°C	I_{CEX}	30	–1.5			–	2	–	–2	mA
* With base open	I_{CEO}	20			0	–	1	–	–1	mA
* Emitter-Cutoff Current	I_{EBO}		5	0		–	1	–	–1	mA
Collector-to-Emitter Sustaining Voltage: * With base open	$V_{CEO}(sus)$			0.1[a]	0	30	–	–30	–	V
With external base-to emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1		40	–	–40	–	V
* DC Forward Current Transfer Ratio	h_{FE}	4 4		3[a] 7[a]		30 2.3	150 –	30 2.3	150 –	
* Base-to-Emitter Voltage: 2N6288, 2N6289 All Types	V_{BE}	4 4		3[a] 7[a]		– –	1.5 3	– –	– 3	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			3[a] 7[a]	0.3 3	– –	1 3.5	– –	–1 –3.5	V
* Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 50 kHz	h_{fe}	4		0.5		20	–	20	–	
Gain-Bandwidth Product: 2N6288-2N6289 2N6110-2N6111	f_T	4 –4		0.5 –0.5		4 –	– –	– 10	– –	MHz
* Magnitude of Common-Emitter, Small-Signal, Forward-Current Transfer Ratio: f = 1 MHz 2N6288-2N6289 2N6110-2N6111	$\|h_{fe}\|$	4 –4		0.5 –0.5		4 –	– –	4 10	– –	
* Collector-to-Base Capacitance: f = 1 MHz, V_{CB} = 10 V	C_{obo}			0		–	250	–	250	pF
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	3.125	–	3.125	°C/W
Junction-to-Ambient	$R_{\theta JA}$					–	70	–	70	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 0.018. ♦For p-n-p devices, voltage and current values are negative.
*In accordance with JEDEC registration data format (JS-6 RDF-2).
CAUTION: The sustaining voltage $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

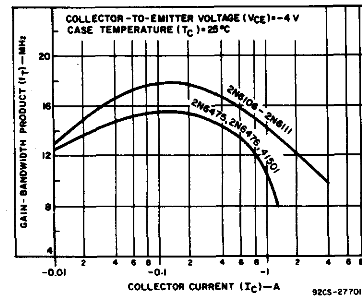


Fig. 2 - Typical gain-bandwidth product for 2N6106–2N6111, 2N6475, 2N6476, and 41501.

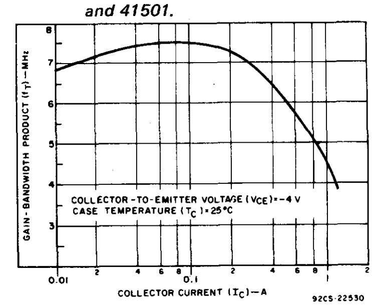


Fig. 3 - Typical gain-bandwidth product for 2N6473 and 2N6474.

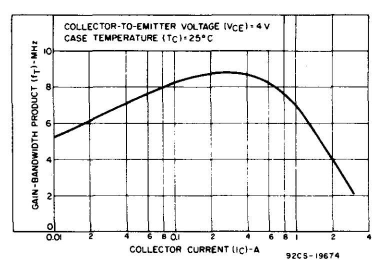


Fig. 4 - Typical gain-bandwidth product for 2N6288–2N6293, and 41500.

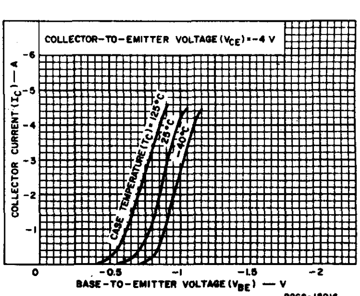


Fig. 5 - Typical transfer characteristics for 2N6106–2N6111.

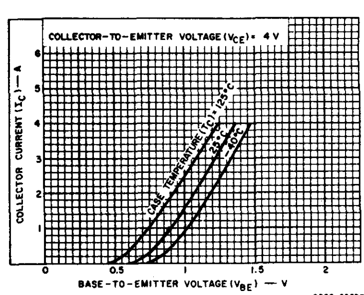


Fig. 6 - Typical transfer characteristics for 2N6473 and 2N6474.

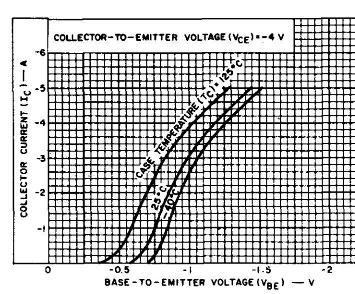


Fig. 7 - Typical transfer characteristics for 2N6475 and 2N6476.

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

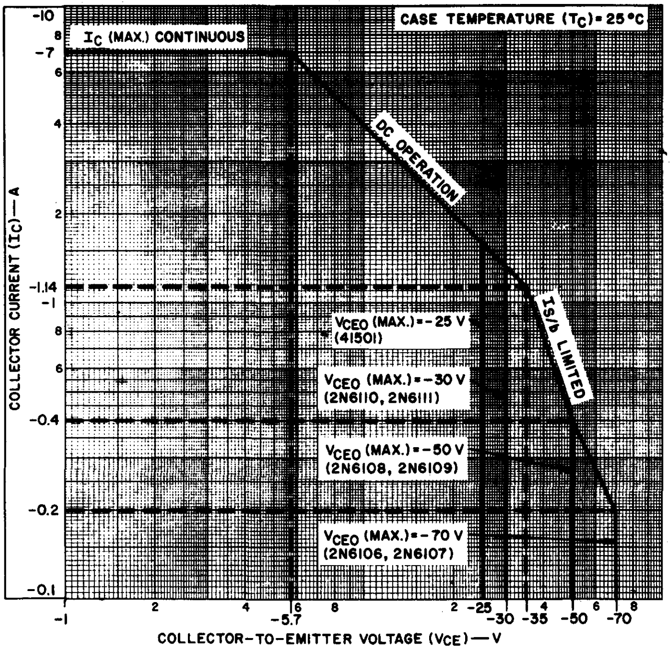


Fig. 8 - Maximum operating areas for 2N6106–2N6111 and 41501.

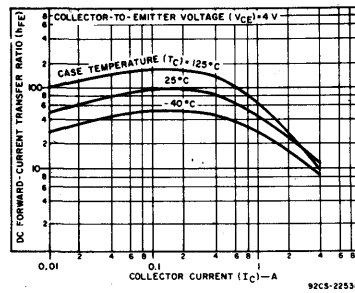


Fig. 9 - Typical dc beta characteristics for 2N6473 and 2N6474.

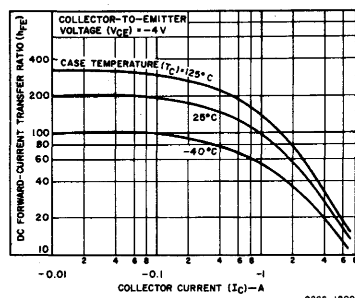


Fig. 10 - Typical dc beta characteristics for 2N6106–2N6111.

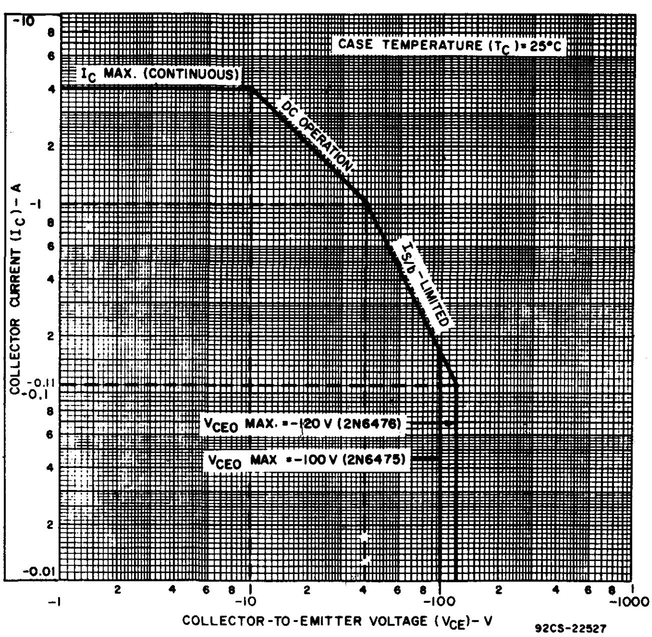


Fig. 11 - Maximum operating areas for 2N6475–2N6476.

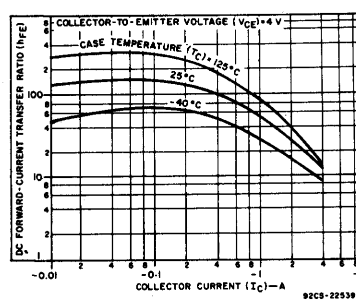


Fig. 12 - Typical dc beta characteristics for 2N6475 and 2N6476.

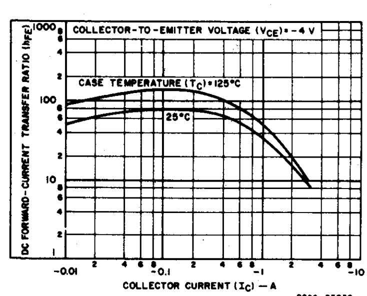


Fig. 13 - Typical dc beta characteristics for 41501.

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

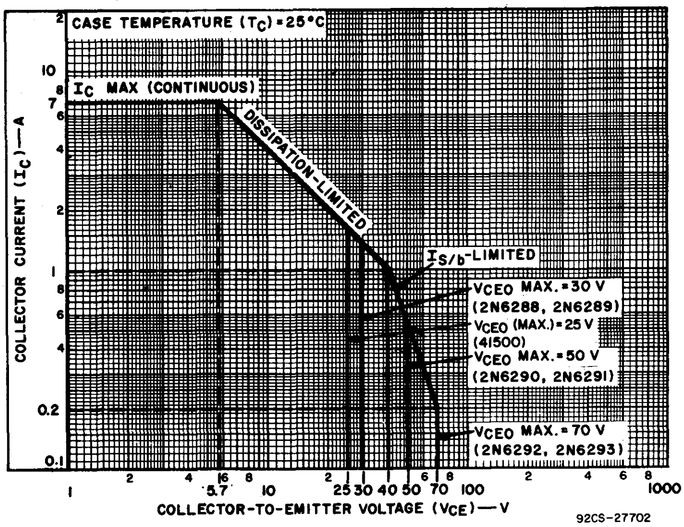


Fig. 14 - Maximum operating areas for 2N6288–2N6293 and 41500.

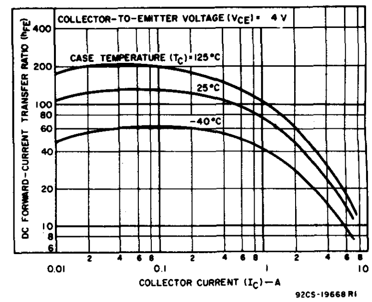


Fig. 15 - Typical dc beta characteristics for 2N6288–2N6293, and 41500.

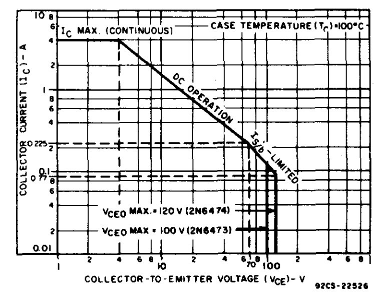


Fig. 16 - Maximum operating areas for 2N6473–2N6474.

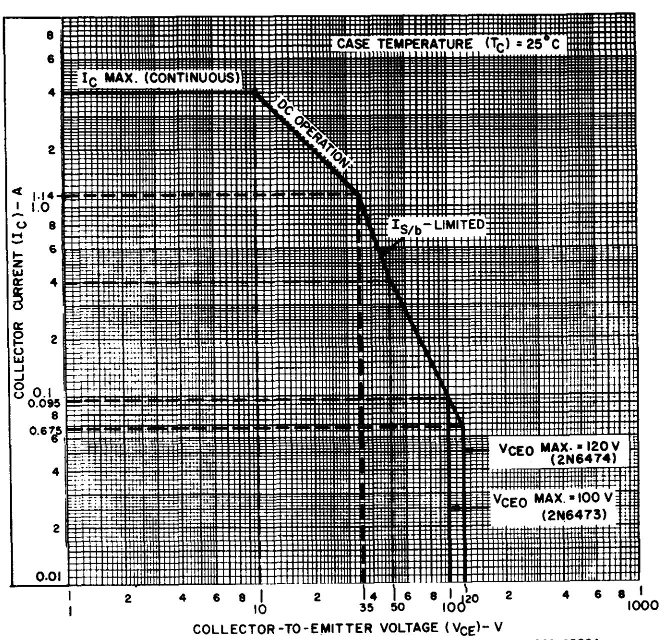


Fig. 17 - Maximum operating areas for 2N6473 and 2N6474.

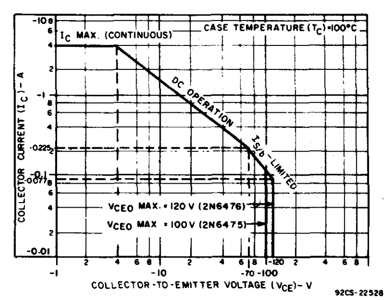


Fig. 18 - Maximum operating areas for 2N6475 and 2N6476.

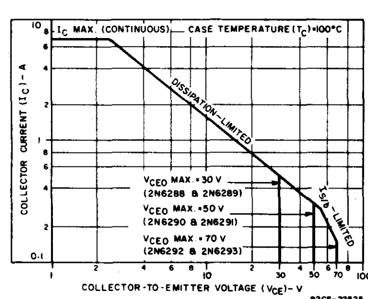


Fig. 19 - Maximum operating areas for 2N6288–2N6293.

2N6106-2N6111, 2N6288-2N6293, 2N6473-2N6476, 41500, 41501

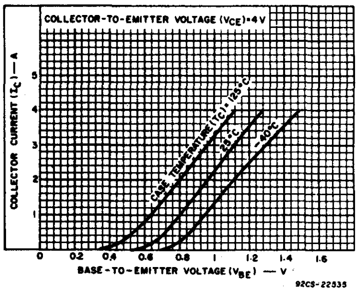


Fig. 20 - Typical transfer characteristics for 2N6288–2N6293, and 41500.

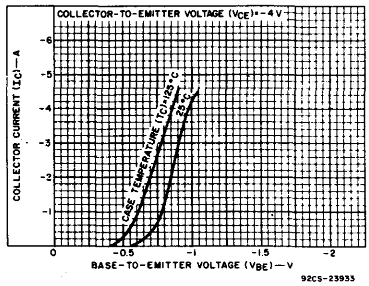


Fig. 21 - Typical transfer characteristics for 41501.

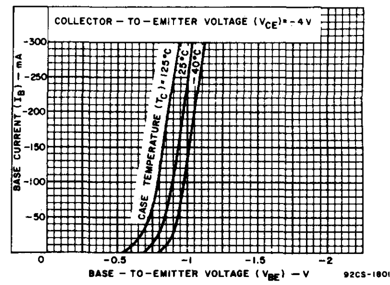


Fig. 22 - Typical input characteristics for 2N6106–2N6111, 2N6475, and 2N6476.

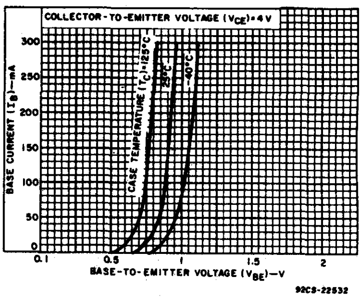


Fig 23 - Typical input characteristics for 2N6473 and 2N6474.

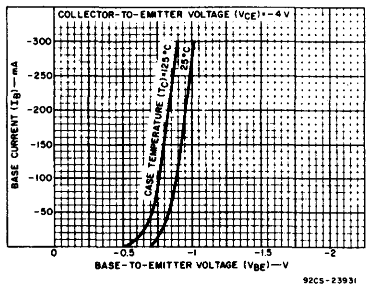


Fig. 24 - Typical input characteristics for 41501.

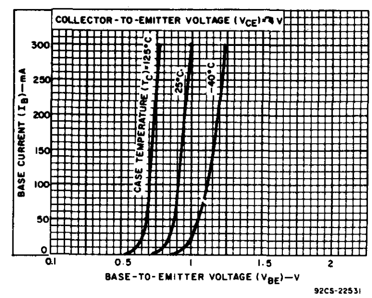


Fig. 25 - Typical input characteristics for 2N6288–2N6293.

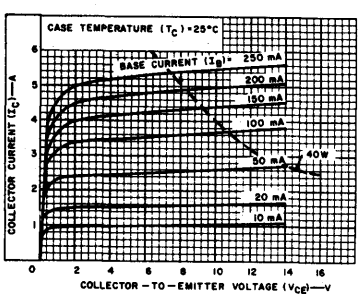


Fig. 26 - Typical output characteristics for 2N6288–2N6293, and 41500.

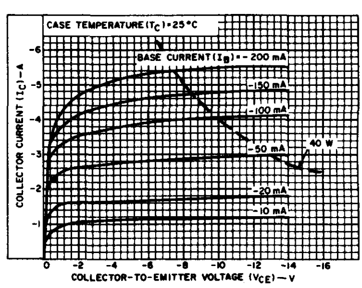


Fig. 27 - Typical output characteristics for 2N6106–2N6111.

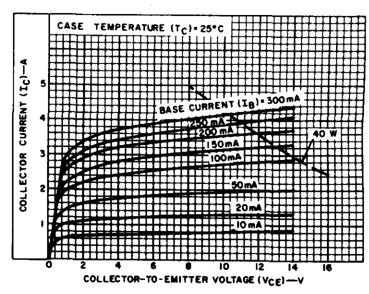


Fig. 28 - Typical output characteristics for 2N6473 and 2N6474.

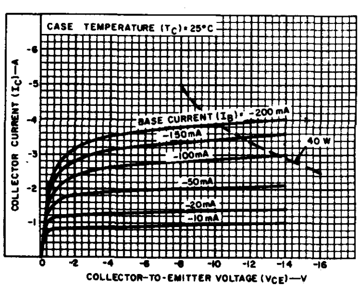


Fig. 29 - Typical output characteristics for 2N6475 and 2N6476.

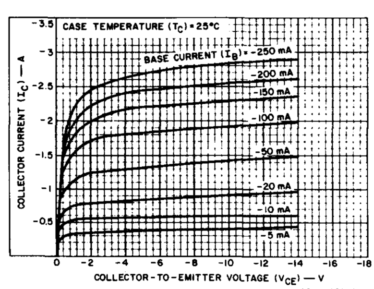


Fig. 30 - Typical output characteristics for 41501.

2N6211-2N6214

High-Voltage, Medium-Power Silicon P-N-P Transistors

For Switching and Amplifier Applications
In Military, Industrial, and Commercial Equipment

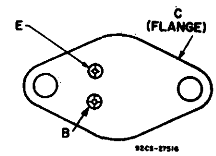
RCA types 2N6211, 2N6212, 2N6213, and 2N6214● are epitaxial silicon p-n-p transistors with high breakdown-voltage ratings and fast switching speeds. They are supplied in the popular JEDEC TO-66 package; they differ in breakdown-voltage ratings and leakage-current values.

● Formerly RCA Dev. Nos. TA7719, TA7410, TA8330, and TA8331, respectively.

Applications:
- Power-Switching Circuits
- Switching Regulators
- Converters
- Inverters
- High-Fidelity Amplifiers

Features:
- High voltage ratings:
  $V_{CEO}(sus)$ = −400 V max. (2N6214)
  = −350 V max. (2N6213)
  = −300 V max. (2N6212)
  = −225 V max. (2N6211)
- Large safe-operating area
- Complements to 2N3585 transistor family
- Thermal-cycling rating

TERMINAL DESIGNATIONS



JEDEC TO-66

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6211	2N6212	2N6213	2N6214	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−275	−350	−400	−450	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With base open	$V_{CEO}(sus)$	−225	−300	−350	−400	V
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$	−250	−325	−375	−425	V
* With base-emitter junction reverse-biased (V_{BE} = 1.5 V)	$V_{CEX}(sus)$	−275	−350	−400	−450	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	−6	−6	−6	−6	V
*COLLECTOR CURRENT (Continuous)	I_C	−2	−2	−2	−2	A
*BASE CURRENT (Continuous)	I_B	−1	−1	−1	−1	A
TRANSISTOR DISSIPATION:	P_T					
* At case temperatures up to 100°C and V_{CE} up to 50 V		20	20	20	20	W
At case temperatures up to 25°C and V_{CE} up to 40 V		35	35	35	35	W
At case temperatures up to 25°C and V_{CE} above 40 V		See Fig. 1				
At case temperatures above 25°C		Derate linearly to 200°C				
*TEMPERATURE RANGE:						
Storage & Operating (Junction)		← −65 to 200 →				°C
*LEAD TEMPERATURE (During Soldering):						
At distance ≥ 1/32 in. (0.8 mm) from case for 10s max.		← 230 →				°C

*In accordance with JEDEC registration data format (JS-6 RDF-1)

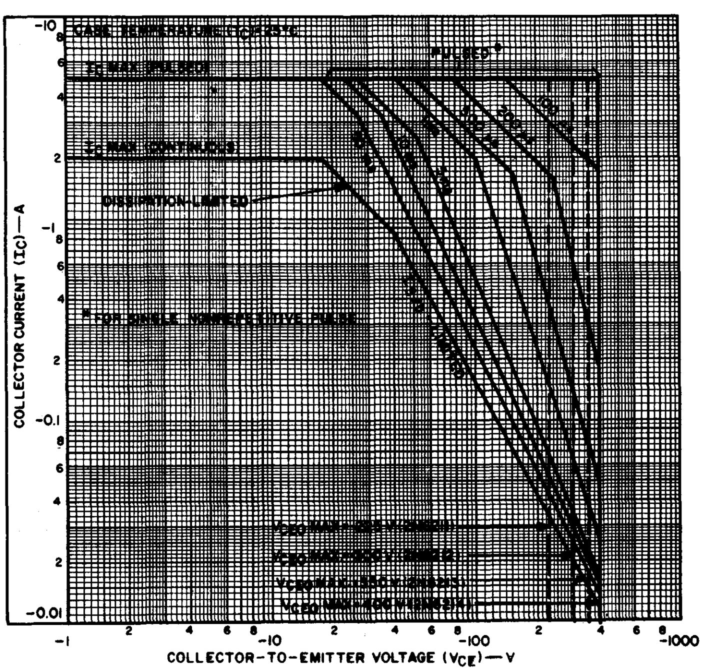


Fig. 1 - Maximum operating areas for all types.

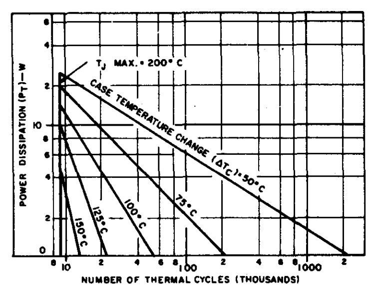


Fig. 2 - Thermal-cycling rating chart for all types.

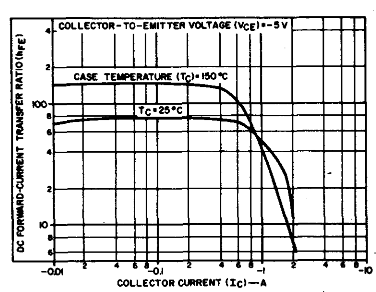


Fig. 3 - Typical dc beta characteristic for all types.

2N6211-2N6214

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: Voltage V dc: V_{CE}	TEST CONDITIONS: Voltage V dc: V_{BE}	TEST CONDITIONS: Current A dc: I_C	TEST CONDITIONS: Current A dc: I_B	LIMITS: 2N6211 Min.	2N6211 Max.	2N6212 Min.	2N6212 Max.	2N6213 Min.	2N6213 Max.	2N6214 Min.	2N6214 Max.	UNITS
Collector-Cutoff Current: With base open	I_{CEO}	–150			0	–	–5	–	–5	–	–5	–	–5	mA
• With base-emitter junction reverse-biased	I_{CEV}	–250	1.5			–	–0.5	–	–	–	–	–	–	mA
		–315	1.5			–	–	–	–0.5	–	–	–	–	
		–360	1.5			–	–	–	–	–	–0.5	–	–	
		–410	1.5			–	–	–	–	–	–	–	–1	
• With base-emitter junction reverse biased and T_C = 100°C	I_{CEV}	–250	1.5			–	–5	–	–	–	–	–	–	
		–315	1.5			–	–	–	–5	–	–	–	–	
		–360	1.5			–	–	–	–	–	–5	–	–	
		–410	1.5			–	–	–	–	–	–	–	–10	
• Emitter-Cutoff Current	I_{EBO}		6	0		–	1	–	–0.5	–	–0.5	–	–0.5	mA
• DC Forward-Current Transfer Ratio	h_{FE}	–2.8		–1[a]		10	100	–	–	–	–	–		
		–3.2		–1[a]		–	–	10	100	–	–	–	–	
		–4		–1[a]			–		–	10	100	–	–	
		–5		–1[a]				–			–	10	100	
• Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			–0.2[a]	0	–225	–	–300		–350	–	–400		V
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$			–0.2[a]		250		–325		–375	–	–425		V
With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CEX}(sus)$		1.5	–0.2[a]		275		350		400	–	–450		V
• Emitter-to-Base Voltage	V_{EBO}				0.5 mA 1 mA	6		–6		–6		–6	–	V
• Emitter-to-Base Saturation Voltage	$V_{BE}(sat)$			–1[a]	0.125		1.4		–1.4	–	–1.4	–	–1.4	V
• Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			–1[a]	0.125		1.4		1.6	–	–2		–2.5	V
Output Capacitance (f = 1 MHz)	C_{obo}	–10 (V_{CB})					220		220	–	220		220	pF
Second Breakdown Collector Current (Base forward-biased)	$I_{S/b}$	–40				0.875		–0.875		–0.875	–	–0.875	–	A
• Magnitude of Common Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 5 MHz)	$\|h_{fe}\|$	–10		–0.2		4	–	4	–	4	–	4	–	
• Saturated Switching Times: Rise time	t_r	V_{CC} = –200 V		–1	I_{B1} & I_{B2} –0.125		0.6	–	0.6	–	0.6	–	0.6	μs
Storage time	t_s	V_{CC} = –200 V		–1	I_{B1} & I_{B2} –0.125	–	2.5	–	2.5	–	2.5	–	2.5	μs
Fall time	t_f	V_{CC} = –200 V		–1	I_{B1} & I_{B2} –0.125	–	0.6	–	0.6	–	0.6	–	0.6	μs
Thermal Resistance (Junction-to-case)	$R_{\theta JC}$	–10		–1		–	5	–	5	–	5	–	5	°C/W

•In accordance with JEDEC registration data format JS-6 RDF-1.

[a]Pulsed, pulse duration = 300 μs; duty factor ≤2%.

2N6211-2N6214

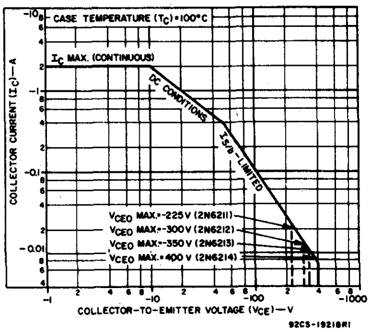


Fig. 4 - Maximum operating areas for all types.

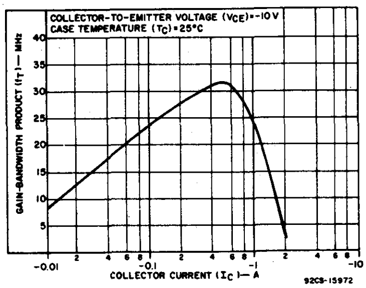


Fig. 5 - Typical gain-bandwidth product for all types.

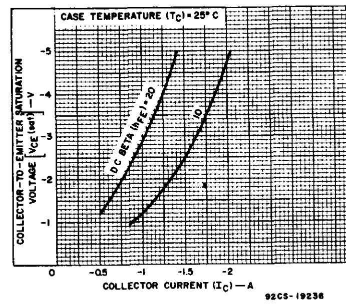


Fig. 6 - Typical saturation-voltage characteristics for all types.

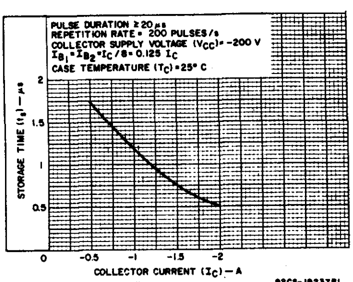


Fig. 7 - Typical storage-time characteristic for all types.

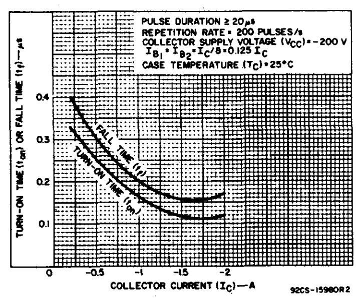


Fig. 8 - Typical turn-on time and fall-time characteristics for all types.

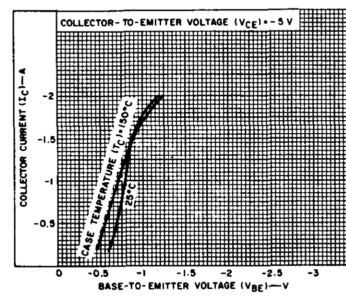


Fig. 9 - Typical transfer characteristics for all types.

2N6246, 2N6247, 2N6248, 2N6469, 2N6470, 2N6471, 2N6472

Silicon N-P-N and P-N-P Epitaxial-Base High-Power Transistors

General-Purpose Types for Switching and Linear-Amplifier Applications

RCA-2N6246, 2N6247, 2N6248, and 2N6469▲ are epitaxial-base silicon p-n-p transistors featuring high gain at high current. RCA-2N6470, 2N6471, and 2N6472● are epitaxial-base silicon n-p-n transistors. They may be used as complements to the 2N6469, 2N6246, and 2N6247, respectively. All of these devices have a dissipation capability of 125 watts at case temperatures up to 25°C. They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the JEDEC TO-3 package.

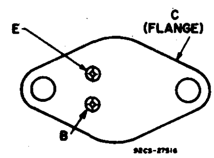
▲ Formerly RCA Dev. Nos. TA7281, TA7280, TA7279, and TA8724, respectively.

● Formerly RCA Dev. Nos. TA8726, TA8443, and TA8442, respectively.

Features:

- High dissipation capability: 125 W at 25°C
- Low saturation voltages
- Maximum safe-area-of-operation curves
- Hermetically sealed JEDEC TO-3 package
- High gain at high current
- Thermal-cycling rating curve

TERMINAL DESIGNATIONS



JEDEC TO-3

Maximum Ratings, *Absolute-Maximum Values:*

		N-P-N	2N6470	2N6471	2N6472		
		P-N-P	2N6469♦	2N6246♦	2N6247♦	2N6248♦	
*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}		50	70	90	110	V
COLLECTOR-TO-EMITTER VOLTAGE:							
* With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}		50	70	90	110	V
With base open	V_{CEO}		40	60	80	100	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}		5	5	5	5	V
*CONTINUOUS COLLECTOR CURRENT	I_C		15	15	15	10	A
*CONTINUOUS BASE CURRENT	I_B		5	5	5	5	A
*TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C			125	125	125	125	W
At case temperatures above 25°C			← Derate linearly 200°C →				
*TEMPERATURE RANGE:							
Storage & Operating (Junction)			← −65 to +200 →				°C
*PIN TEMPERATURE (During Soldering):							
At distances ≥ 1/32" (0.8 mm) from seating plane for 10 s max.			← +235 →				°C

* In accordance with JEDEC registration data format (JS-6 RDF-2).

♦ For p-n-p devices, voltage and current values are negative.

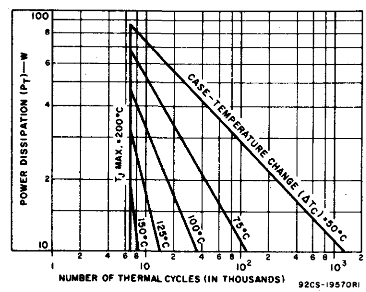


Fig. 1 - Thermal-cycling rating chart for all types.

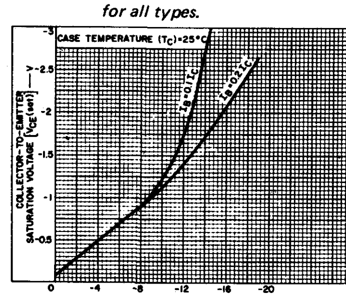


Fig. 2 - Typical collector-to-emitter saturation-voltage characteristics for 2N6246, 2N6247, 2N6248, and 2N6469.

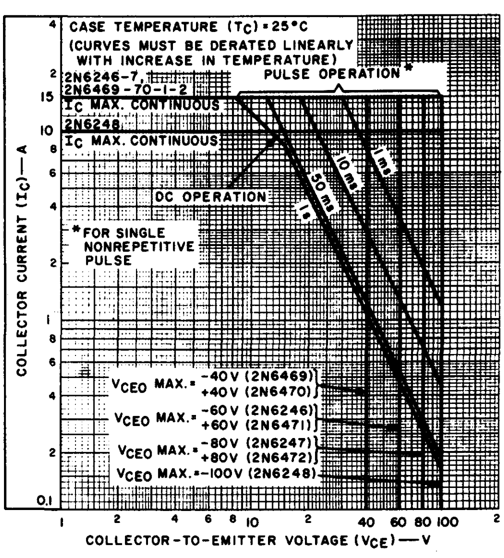


Fig. 3 - Maximum operating areas for all types.♦

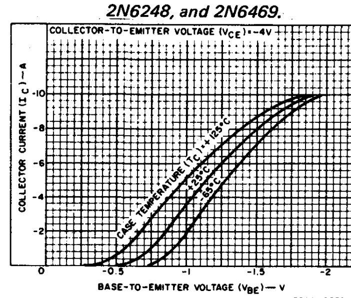


Fig. 4 - Typical transfer characteristics for 2N6246, 2N6247, 2N6248, and 2N6469.

♦For p-n-p devices, voltage and current values are negative.

2N6246, 2N6247, 2N6248, 2N6469, 2N6470, 2N6471, 2N6472

ELECTRICAL CHARACTERISTICS FOR N-P-N TYPES, *At case temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CE}	CURRENT A dc I_C	I_B	LIMITS 2N6470 Min.	2N6470 Max.	2N6471 Min.	2N6471 Max.	2N6472 Min.	2N6472 Max.	UNITS
Collector-Cutoff Current: With external base-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	35			–	500	–	–	–	–	µA
		55			–	–	–	500	–	–	
		75			–	–	–	–	–	500	
* With base-emitter junction reverse-biased V_{BE} = −1.5 V	I_{CEX}	45			–	500	–	–	–	–	µA
		65			–	–	–	500	–	–	
		85			–	–	–	–	–	500	
* With reverse bias, V_{BE} = −1.5 V, and T_C = 150°C	I_{CEX}	40			–	5	–	–	–	–	mA
		60			–	–	–	5	–	–	
		80			–	–	–	–	–	5	
* With base open	I_{CEO}	20		0	–	1	–	–	–	–	mA
		30		0	–	–	–	1	–	–	
		40		0	–	–	–	–	–	1	
* Emitter-Cutoff Current: V_{BE} = −5 V	I_{EBO}		0		–	1	–	1	–	1	mA
* DC Forward-Current Transfer Ratio	h_{FE}	4	5[a]		20	150	20	150	20	150	
		4	15[a]		5	–	5	–	5	–	
Collector-to-Emitter Sustaining Voltage: * With base open	$V_{CEO}(sus)$		0.2	0	40[b]	–	60[b]	–	80[b]	–	V
With external base-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$		0.2		50[b]	–	70[b]	–	90[b]	–	V
* Base-to-Emitter Voltage	V_{BE}	4	5[a]		–	1.3	–	1.3	–	1.3	V
		4	15[a]		–	3.5	–	3.5	–	3.5	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$		5[a]	0.5	–	1.3	–	1.3	–	1.3	V
			15[a]	5	–	3.5	–	3.5	–	3.5	
* Magnitude of Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio: f = 1 MHz	$\|h_{fe}\|$	4	1		5	–	5	–	5	–	
* Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio: f = 1 kHz	h_{fe}	4	1		25	–	25	–	25	–	
Thermal Resistance: Junction-to-case	$R_{\theta JC}$				–	1.4	–	1.4	–	1.4	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-2).

[a] Pulsed; pulse duration ≐ 300 µs, duty factor = 1.8%.

[b] *CAUTION: Sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.*

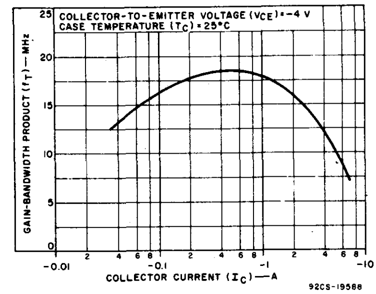


Fig. 5 - Typical gain-bandwidth product as a function of collector current for 2N6246, 2N6247, 2N6248, and 2N6469.

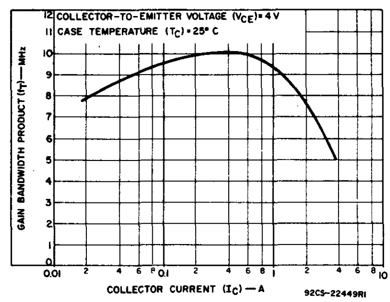


Fig. 6 - Typical gain-bandwidth product as a function of collector current for 2N6470, 2N6471, and 2N6472.

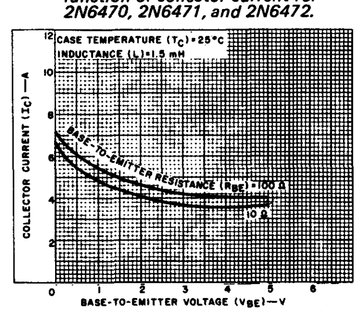


Fig. 7 - Minimum reverse-bias second-break-down characteristics for all types. (Values for p-n-p types are negative).

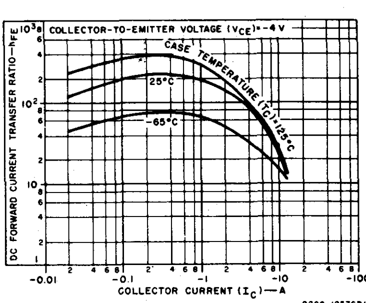


Fig. 8 - Typical dc beta characteristics for 2N6246, 2N6247, and 2N6469.

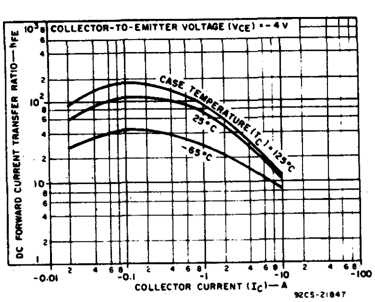


Fig. 9 - Typical dc beta characteristics for 2N6248.

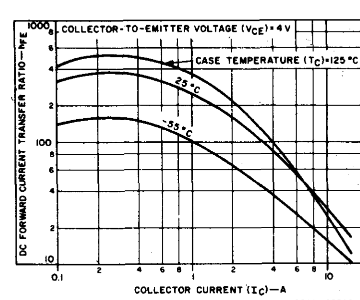


Fig. 10 - Typical dc beta characteristics for 2N6470, 2N6471, and 2N6472.

2N6246. 2N6247, 2N6248, 2N6469, 2N6470, 2N6471, 2N6472

ELECTRICAL CHARACTERISTICS FOR P-N-P TYPES, *At case temperature (T_C) = 25°C unless otherwise specified*

SYMBOL	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS 2N6469		LIMITS 2N6246		TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS 2N6247		LIMITS 2N6248		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CER} (R_{BE}) = 100 Ω	−35 −55				– –	−200 –	– –	– −200	−75 −95				– –	−200 –	– –	– −200	μA
• I_{CEX}	−45 −65	1.5 1.5			– –	−200 –	– –	– −200	−85 −100	1.5 1.5			– –	−200 –	– –	– −200	μA
• T_C = 150°C	−45 −55	1.5 1.5			– –	−5 –	– –	– −5	−70 −90	1.5 1.5			– –	−5 –	– –	– −5	mA
• I_{CEO}	−20 −30			0 0	– –	−1 –	– –	– −1	−40 −50			0 0	– –	−1 –	– –	– −1	mA
• I_{EBO}		5		0	–	−5	–	−5		5		0	–	−1	–	−1	mA
• h_{FE}	−4 −4 −4		-5^a -7^a -15^a		20 – 5	150 – –	– 20 5	– 100 –	−4 −4 −4 −4		-5^a -6^a -10^a -15^a		– 20 – 5	– 100 – –	20 – 5 –	100 – – –	
• V_{CEO}(sus)			−0.2	0	-40^b	–	-60^b	–			−0.2	0	-80^b	–	-100^b	–	V
V_{CER}(sus)			−0.2		-50^b	–	-70^b	–			−0.2		-90^b	–	-110^b	–	V
• V_{BE}	−4 −4		-15^a -7^a		– –	−3.5 –	– –	– −2	−4 −4		-6^a -5^a		– –	−1.8 –	– –	– −1.8	V
• V_{CE}(sat)			-5^a -7^a -15^a -15^a	−0.5 −0.7 −5 −3	– – – –	−1.3 – −3.5 –	– – – –	– −1.3 – −2.5			-5^a -6^a -15^a -10^a	−0.5 −0.6 −4 −2	– – – –	– −1.3 −3.5 –	– – – –	−1.3 – – −3.5	V
• $\|h_{fe}\|$ f = 2 MHz	−4		−1		5	–	5	–	−4		−1		5	–	5	–	
• h_{fe} f = 1 kHz	−4		−1		25	–	25	–	−4		−1		25	–	25	–	
$R_{\theta JC}$					–	1.4	–	1.4					–	1.4	–	1.4	°C/W

• In accordance with JEDEC registration data format (JS-6 RDF-2).

[a] Pulsed; pulse duration = 300 μs, duty factor = 1.8%.

[b] *CAUTION: CAUTION: Sustaining voltages V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer.*

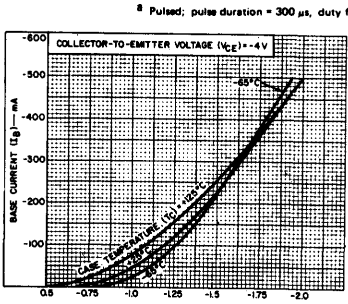


Fig. 11 - Typical input characteristics for 2N6246, 2N6247, and 2N6449.

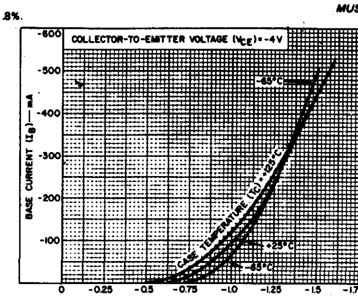


Fig. 12 - Typical input characteristics for 2N6248.

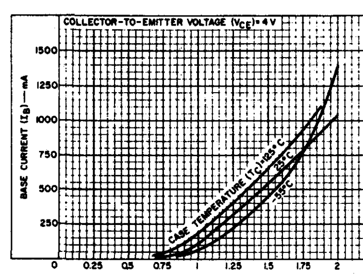


Fig. 13 - Typical input characteristics for 2N6470, 2N6471, and 2N6472.

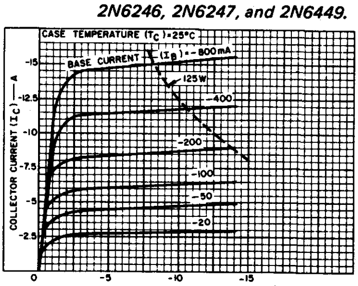


Fig. 14 - Typical output characteristics for 2N6246, 2N6247, and 2N6469.

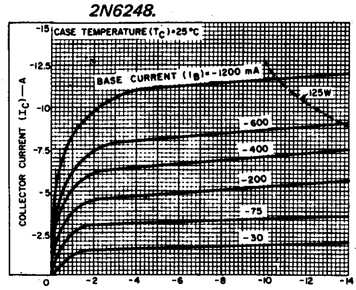


Fig. 15 - Typical output characteristics for 2N6248.

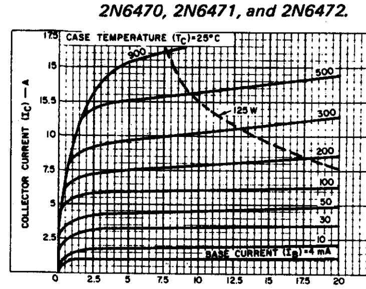


Fig. 16 - Typical output characteristics for 2N6470, 2N6471, and 2N6472.

2N6246, 2N6247, 2N6248, 2N6469, 2N6470, 2N6471, 2N6472

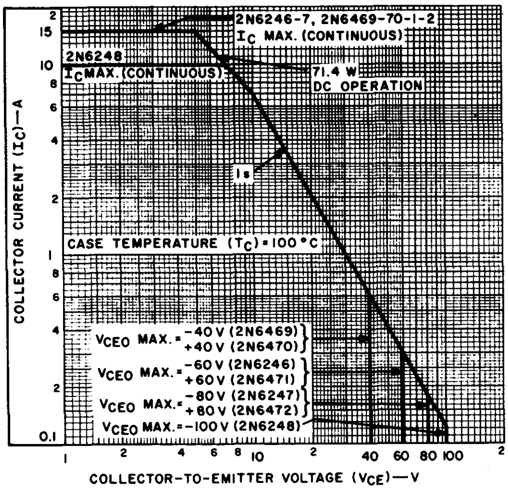


Fig. 17 - Maximum operating areas for all types.♦

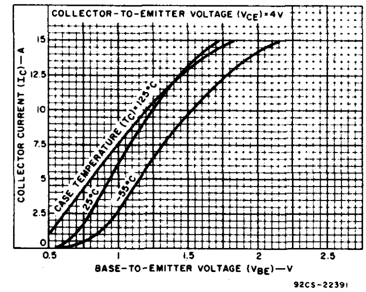


Fig. 18 - Typical transfer characteristics for 2N6470, 2N6471, and 2N6472.

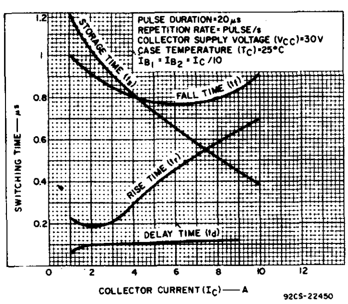


Fig. 19 - Typical saturated switching characteristics for 2N6470, 2N6471, and 2N6472.

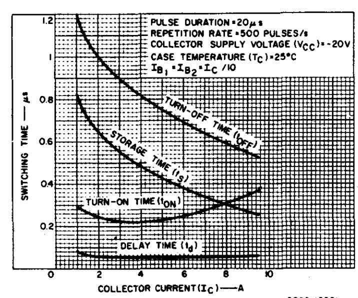


Fig. 20 - Typical saturated switching characteristics for 2N6246, 2N6247, 2N6248, and 2N6469.

♦For p-n-p devices, voltage and current values are negative.

2N6249, 2N6250, 2N6251

450-V, 30-A, 175-W Silicon N-P-N Switching Transistors

For Switching Applications in Industrial and Commercial Equipment

Features:
- **High voltage ratings:**
  V_{CBO} = 450 V (2N6251)
  375 V (2N6250)
  300 V (2N6249)
- **High dissipation rating:**
  P_T = 175 W
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**

RCA-2N6269, 2N6250 and 2N6251 are multiple epitaxial silicon n-p-n power transistors utilizing a multiple-emitter-site structure. Multiple-epitaxial construction maximizes the volt-ampere characteristic of the device and provides fast switching speeds. Multiple-emitter-site design assures uniform current flow throughout the structure, which produces a high $I_{S/b}$ and a large safe-operation area.

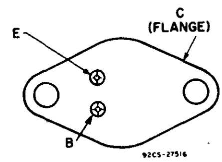
These devices use the popular JEDEC TO-3/TO-204MA package; they differ mainly in voltage ratings, leakage-current limits, and V_{CE}(sat) ratings.

The exceptional second-breakdown capabilities and high voltage-breakdown ratings make these transistors especially suitable for off-line inverters, switching regulators motor controls, and deflection circuit applications.

The high gain and high $E_{S/b}$ energy-handling capability of the 2N6249 make it an excellent choice for motor-control applications in which large winding inductances are encountered and high surge currents are required to start the motor.

The high breakdown voltages, low saturation voltages, and fast-switching capability of the 2N6250 and 2N6251 make them especially suitable for inverter circuits operating directly off the rectified 115-V power line or a bridge configuration operating from the rectified 220-V line.

TERMINAL DESIGNATIONS



JEDEC TO3/TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6249	2N6250	2N6251	
* V_{CBO}	300	375	450	V
V_{CEO}(sus)	200	275	350	V
* V_{CEX}(sus) (V_{BE} = 0 V)	225	300	375	V
V_{CER}(sus) (R_{BE}) ≤ 50 Ω	225	300	375	V
* V_{EBO}	6	6	6	V
* I_C	10	10	10	A
I_{CM}	30	30	30	A
* I_B	10	10	10	A
* P_T				
At T_C up to 25°C and V_{CE} up to 30 V	175	175	175	W
At T_C up to 25°C and V_{CE} above 30 V	Derate linearly at 1			°C/W
* $T_J + T_{stg}$	−65 to +200			°C
* T_L				
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230			°C

* 2N-Series types in accordance with JEDEC registration data format (JS-6, RDF-1).

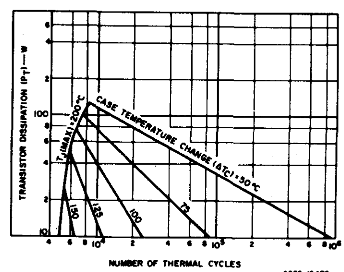


Fig. 1 — Thermal-cycle rating chart for all types.

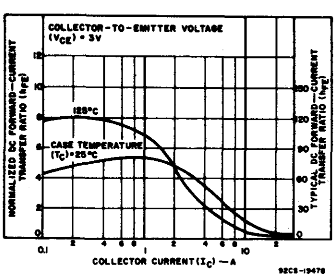


Fig. 2 — Typical normalized dc beta characteristics for all types.

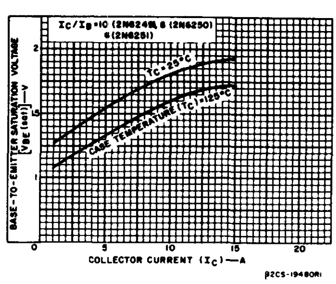


Fig. 3 — Typical base-to-emitter saturation voltage characteristics for all types.

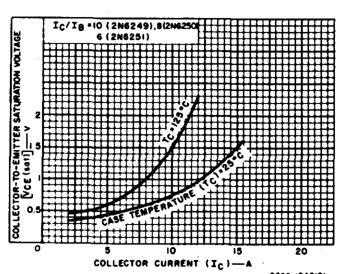


Fig. 4 — Typical collector-to-emitter saturation voltage characteristics for all types.

2N6249, 2N6250, 2N6251

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS DC VOLTAGE (V) V_{CE}	DC CURRENT (A) I_C	I_B	LIMITS 2N6249 MIN.	TYP.	MAX.	2N6250 MIN.	TYP.	MAX.	2N6251 MIN.	TYP.	MAX.	UNITS
I_{CEO}	150		0	–	–	5	–	–	–	–	–	–	
	225		0	–	–	–	–	–	5	–	–	–	
	300		0	–	–	–	–	–	–	–	–	5	
* I_{CEV} $V_{BE}=-1.5$	225			–	–	5	–	–	–	–	–	–	
	300			–	–	–	–	–	5	–	–	–	mA
	375			–	–	–	–	–	–	–	–	5	
	450			–	–	–	–	–	–	–	–	–	
* I_{CEV} $V_{BE}=-1.5$ $T_C=125°C$	225			–	–	10	–	–	–	–	–	–	
	300			–	–	–	–	–	10	–	–	–	
	375			–	–	–	–	–	–	–	–	10	
	450			–	–	–	–	–	–	–	–	–	
* I_{EBO} $V_{BE}=-6$				–	–	1	–	–	1	–	–	1	mA
* $V_{CEO}(sus)$		0.2		200[b]	–	–	275[b]	–	–	350[b]	–	–	V
$V_{CER}(sus)$ $R_{BE}=50\ \Omega$		0.2		225[b]	–	–	300[b]	–	–	375[b]	–	–	V
* V_{EBO} $I_E=1$ mA				6	–	–	6	–	–	6	–	–	V
* h_{FE}	3	10[a]		10	–	50	–	–	–	–	–	–	
	3	10[a]		–	–	–	8	–	50	–	–	–	
	3	10[a]		–	–	–	–	–	–	6	–	50	
	4	10[a]		–	–	–	–	–	–	–	–	–	
* $V_{BE}(sat)$		10[a]	1	–	–	2.25	–	–	–	–	–	–	
		10[a]	1.25	–	–	–	–	–	2.25	–	–	–	V
		10[a]	1.67	–	–	–	–	–	–	–	–	2.25	
		16[a]	3.2	–	–	–	–	–	–	–	–	–	
* $V_{CE}(sat)$		10[a]	1	–	–	1.5	–	–	–	–	–	–	
		10[a]	1.25	–	–	–	–	–	1.5	–	–	–	V
		10[a]	1.67	–	–	–	–	–	–	–	–	1.5	
		16[a]	3.2	–	–	–	–	–	–	–	–	–	
* $\|h_{fe}\|$ f = 1 MHz	10	1		2.5	8	–	2.5	8	–	2.5	8	–	
* $I_{S/b}$ t_p = 1s nonrep.	30			5.8	–	–	5.8	–	–	5.8	–	–	A
* $E_{S/b}$ $V_{BE}=-4$ $R_B=50\ \Omega$, $L=50\ \mu H$		10[c]		2.5	–	–	2.5	–	–	2.5	–	–	mJ
* t_r $V_{CC}=200$ V, $I_{B1}=-I_{B2}$		10	1	–	0.8	2	–	–	–	–	–	–	
		10	1.25	–	–	–	–	0.8	2	–	–	–	
		10	1.67	–	–	–	–	–	–	–	0.8	2	
* t_s $V_{CC}=200$ V, $I_{B1}=-I_{B2}$		10	1	–	1.8	3.5	–	–	–	–	–	–	
		10	1.25	–	–	–	–	1.8	3.5	–	–	–	µs
		10	1.67	–	–	–	–	–	–	–	1.8	3.5	
* t_f $V_{CC}=200$ V, $I_{B1}=-I_{B2}$		10	1	–	0.5	1	–	–	–	–	–	–	
		10	1.25	–	–	–	–	0.5	1	–	–	–	
		10	1.67	–	–	–	–	–	–	–	0.5	1	
$R_{\theta JC}$	10	5		–	–	1	–	–	1	–	–	1	°C/W

* 2N-Series types in accordance with JEDEC registration data format (JS-6 RDF-1).

a Pulsed; pulse duration ≤300 µs, duty factor = 2%.

b CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

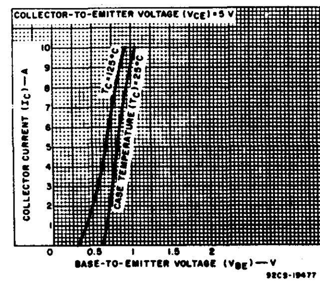


Fig. 5 — Typical transfer characteristics for all types.

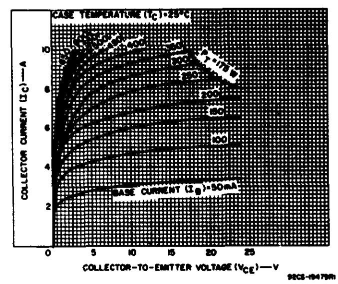


Fig. 6 — Typical output characteristics for all types.

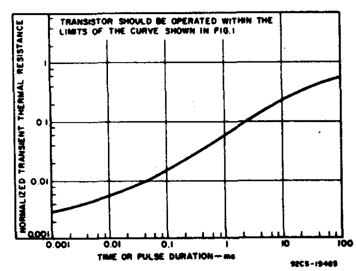


Fig. 7 — Typical thermal response characteristics for all types.

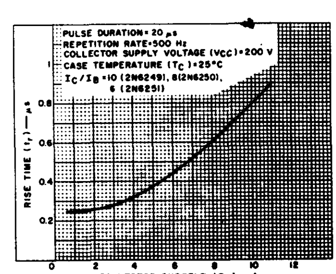


Fig. 8 — Typical rise-time characteristics for all types.

2N6249, 2N6250, 2N6251

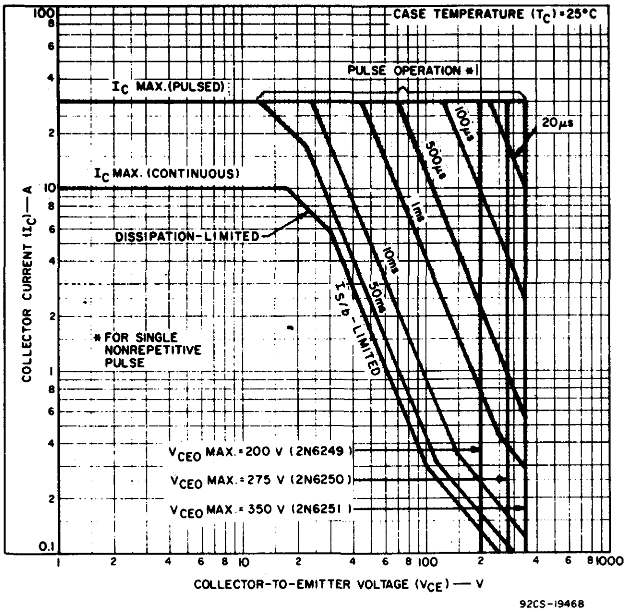


Fig. 9 — Maximum operating areas for all types at $T_C = 25°C$.

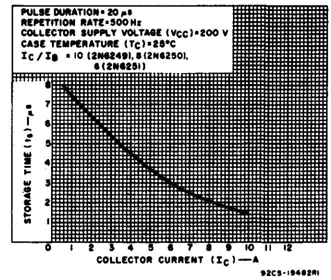


Fig. 11 — Typical storage-time characteristics for all types (with constant forced gain).

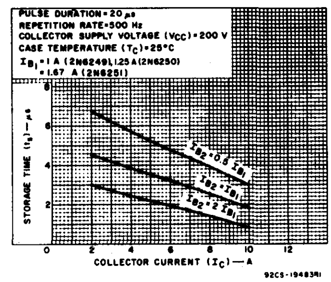


Fig. 12 — Typical storage-time characteristics for all types (with constant base drive).

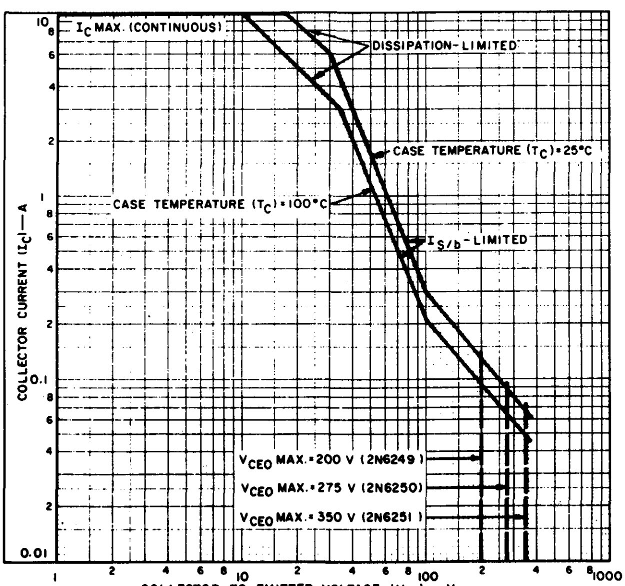


Fig. 10 — Maximum operating areas for all types at $T_C = 100°C$.

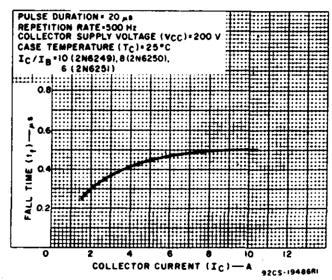


Fig. 13 — Typical fall-time characteristic for all types.

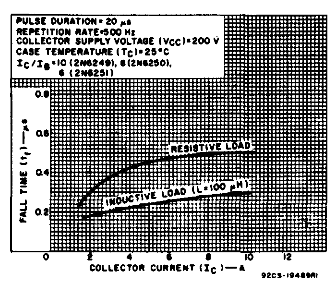


Fig. 14 — Typical inductive- and resistive-load fall-time characteristics for all types.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287

20-Ampere Complementary N-P-N and P-N-P Monolithic Darlington Power Transistors

60-80-100 Volts, 160 Watts
Gain of 2400 (Typ.) at 10 A (2N6282, 2N6283, 2N6284)
Gain of 3500 (Typ.) at 10 A (2N6285, 2N6286, 2N6287)

The RCA-2N6282, 2N6283, and 2N6284 and the 2N6285, 2N6286, and 2N6287 are complementary n-p-n and p-n-p monolithic silicon Darlington transistors designed for general-purpose amplifier and low-speed switching applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. These devices are supplied in the JEDEC TO-3 hermetic steel package.

Features:

- **Operates from IC without predriver**
- **High reverse second-breakdown capability**
- **Monolithic construction**
- **High voltage ratings:**
  $V_{CEO}(sus)$ = 60 V Min. – 2N6282, 2N6285•
  = 80 V Min. – 2N6283, 2N6286•
  = 100 V Min. – 2N6284, 2N6287•

Applications:

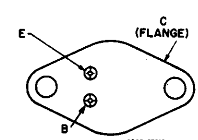
- **Power switching**
- **Hammer drivers**
- **Series and shunt regulators**
- **Audio amplifiers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

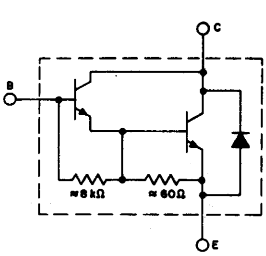
	2N6282 2N6285•	2N6283 2N6286•	2N6284 2N6287•	
* V_{CBO}	60	80	100	V
* $V_{CEO}(sus)$	60	80	100	V
* V_{EBO}	5	5	5	V
* I_C	20	20	20	A
* I_{CM}	40	40	40	A
* I_B	0.5	0.5	0.5	A
* P_T				
$T_C \leq 25°C$	160	160	160	W
$T_C > 25°C$ Derate linearly		0.915		W/°C
* Tstg, TJ		−65 to 200		°C
* T_L				
At distances ≥1/16 in. (1.58 mm) from case for 10 s max.		235		°C

* In accordance with JEDEC registration data.
• For p-n-p devices, voltage and current values are negative.

TERMINAL DESIGNATIONS

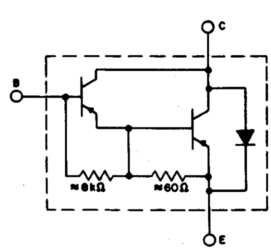


JEDEC TO-3



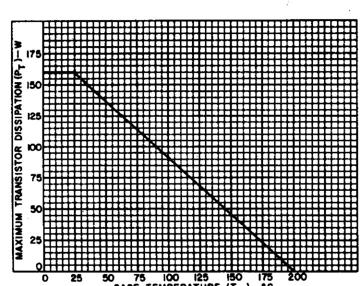
92CS-29128

Fig. 1 – Schematic diagram for 2N6282, 2N6283, and 2N6284.



92CS-29129

Fig. 2 – Schematic diagram for 2N6285, 2N6286, and 2N6287.



92CS-29131

Fig. 3 – Power derating curve for all types.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6282 2N6285•		2N6283 2N6286•		2N6284 2N6287•		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30			0	–	1	–	–	–	–	mA
	40			0	–	–	–	1	–	–	
	50			0	–	–	–	–	–	1	
* I_{CEX}	60	−1.5			–	0.5	–	–	–	–	
	80	−1.5			–	–	–	0.5	–	–	
	100	−1.5			–	–	–	–	–	0.5	
T_C = 150°C	60	−1.5			–	5	–	–	–	–	
	80	−1.5			–	–	–	5	–	–	
	100	−1.5			–	–	–	–	–	5	
* I_{EBO}		−5	0		–	2	–	2	–	2	mA
* V_{CEO}(sus)			0.1[a]	0	60	–	80	–	100	–	V
* h_{FE}	3		20[a]		100	–	100	–	100	–	
	3		10[a]		750	18,000	750	18,000	750	18,000	
* V_{CE}(sat)			20[a]	0.2	–	3	–	3	–	3	V
			10[a]	0.04	–	2	–	2	–	2	
* V_{BE}	3		10[a]		–	2.8	–	2.8	–	2.8	V
* V_{BE}(sat)			20[a]	0.2	–	4	–	4	–	4	V
* h_{fe} f = 1 kHz	3		10		300	–	300	–	300	–	
* $\|h_{fe}\|$ f = 1 MHz	3		10		4	–	4	–	4	–	
* C_{ob} V_{CB} = 10 V, I_E 0, f = 0.1 MHz											
2N6282-84					–	400	–	400	–	400	pF
2N6285-87					–	600	–	600	–	600	
$I_{S/b}$ t = 1 s, nonrep.	30				5.3	–	5.3	–	5.3	–	A
$R_{\theta JC}$						1.09	–	1.09	–	1.09	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.
* In accordance with JEDEC registration data.
• For p-n-p devices, voltage and current values are negative.

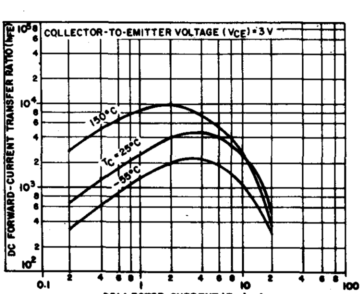


Fig. 4 – Typical dc beta characteristics for 2N6282, 2N6283, and 2N6284.

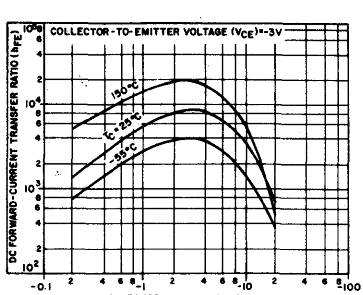


Fig. 5 – Typical dc beta characteristics for 2N6285, 2N6286, and 2N6287.

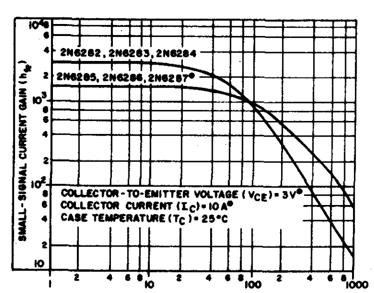
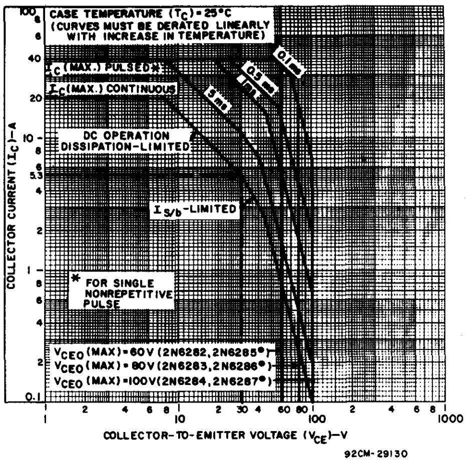


Fig. 6 – Typical small-signal current gain for all types.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287



•FOR p-n-p DEVICES, VOLTAGE AND CURRENT VALUES ARE NEGATIVE

Fig. 7 — Maximum operating areas for all types.

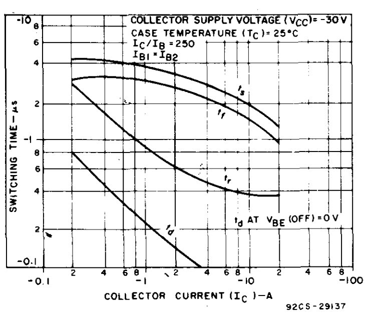
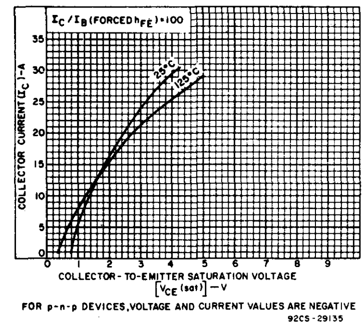


Fig. 10 — Typical switching times for 2N6285, 2N6286, and 2N6287.



FOR p-n-p DEVICES, VOLTAGE AND CURRENT VALUES ARE NEGATIVE

92CS-29135

Fig. 8 — Typical saturation characteristics for all types.

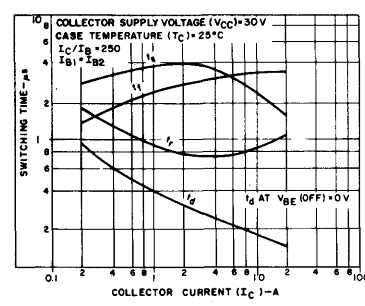


Fig. 9 — Typical switching times for 2N6282, 2N6283, and 2N6284.

2N6300, 2N6301

8-Ampere Silicon N-P-N Monolithic Darlington Power Transistors

60- and 80-Volt, 75-Watt Types With Gain of 750 at 4 Amperes

The RCA-2N6300 and 2N6301 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability. Their high gain makes it possible for them to be driven directly from integrated circuits.

These transistors are supplied in JEDEC TO-213MA/TO-66 hermetic packages.

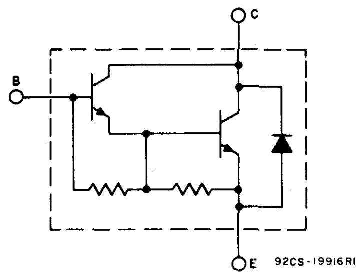
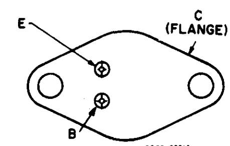


Fig. 1 – Schematic diagram of 2N6300 and 2N6301 Darlington power transistors.

Features:
- Operation from IC without predriver
- Low leakage at high temperature
- High reverse-second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-213MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6300	2N6301	
*	V_{CBO}	60	80	V
*	V_{CEO}	60	80	V
*	V_{EBO}	5	5	V
*	I_C	8	8	A
	I_{CM}	16	16	A
*	I_B	120	120	mA
*	P_T			
	$T_C \leq 25°C$	75	75	W
	$T_C > 25°C$	See Figs. 2 and 3		
*	T_{stg}, T_J	−65 to +200		°C
*	T_L			
	At distances ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235		°C

* In accordance with JEDEC registration format JS-6 RDF-2.

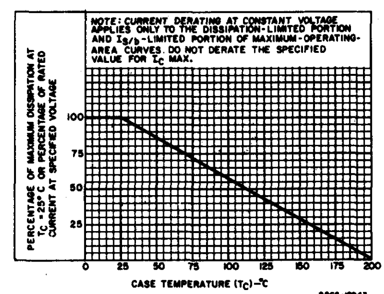


Fig. 3 — Derating curve for both types.

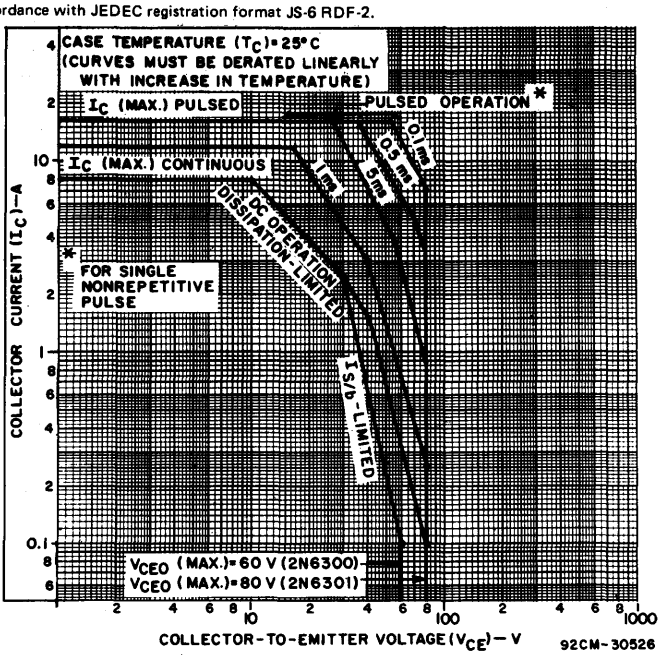


Fig. 2 — Maximum operating areas for types 2N6300 and 2N6301.

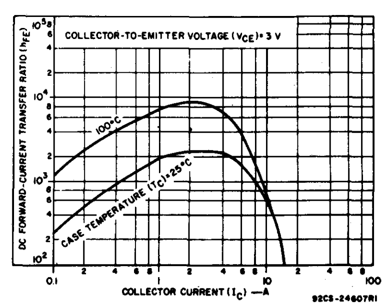


Fig. 4 — Typical dc beta characteristics for both types.

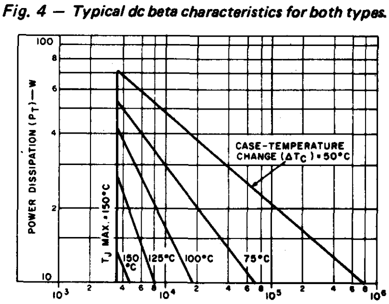


Fig. 5 — Thermal-cycling rating chart for both types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)= 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS: DC VOLTAGE V			TEST CONDITIONS: DC CURRENT A			LIMITS: 2N6300		LIMITS: 2N6301		UNITS
	V_{CE}	V_{EB}	V_{BE}	I_C	I_E	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30					0	–	0.5	–	–	mA
	40					0	–	–	–	0.5	
* I_{CEX}	60		−1.5				–	0.5	–	–	
	80		−1.5				–	–	–	0.5	
* I_{CEX} T_C = 150°C	60		−1.5				–	5	–	–	
	80		−1.5				–	–	–	5	
* I_{EBO}		5		0			–	2	–	2	mA
* h_{FE}	3			8[a]			100	–	100	–	
	3			4[a]			750	18,000	750	18,000	
* $V_{CEO}(sus)$				0.1[a]			60[a]	–	80[a]	–	V
* $V_{CE}(sat)$				4[a]		0.016	–	2	–	2	V
				8[a]		0.08	–	3	–	3	
* V_{BE}	3			4[a]			–	2.8	–	2.8	V
* $V_{BE}(sat)$				8[a]		0.08	–	4	–	4	
* $\|h_{fe}\|$ f = 1 MHz	3			3			4	–	4	–	
* C_{obo} f = 0.1 MHz, V_{CB} = 10 V					0		–	200	–	200	pF
* h_{fe} f = 1 kHz	3			3			300	–	300	–	
$I_{S/b}$ t = 1 s, non rep.	30						2.5	–	2.5	–	A
$R_{\theta JC}$							–	2.33	–	2.33	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

a Pulsed: Pulse duration = 300 μs, duty factor = 2%.

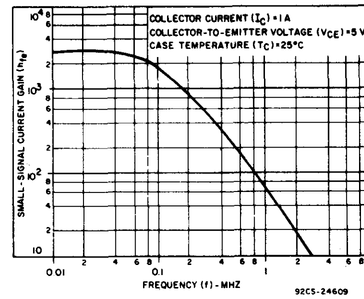


Fig. 6 – Typical small-signal gain for both types.

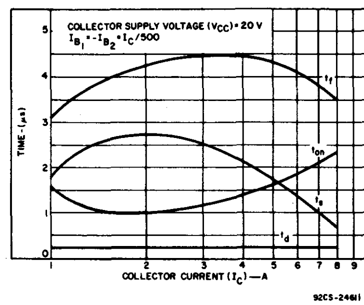


Fig. 7 – Typical saturated switching-time characteristics for both types.

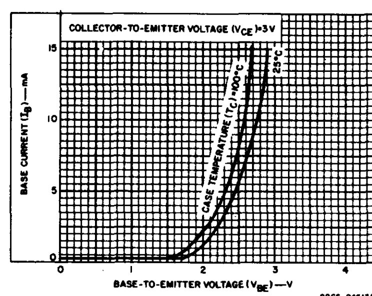


Fig. 8 – Typical input characteristics for both types.

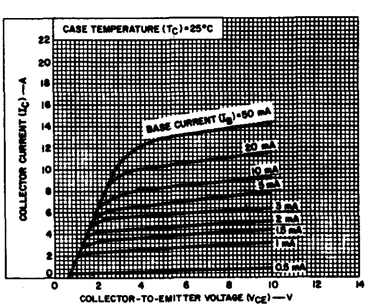


Fig. 9 – Typical output characteristics for both types.

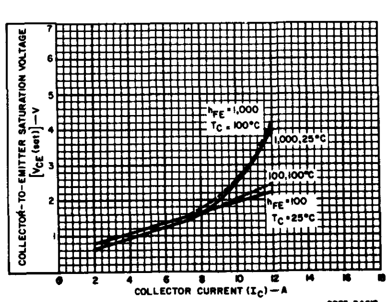


Fig. 10 – Typical saturation-voltage characteristics for both types.

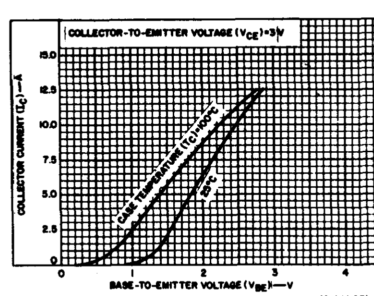


Fig. 11 – Typical transfer characteristics for both types.

2N6306-2N6308, RCS579

High-Voltage, High-Current Silicon N-P-N Power-Switching Transistors

For Off-Line Power Supplies and Other High-Voltage Switching Applications

The RCA-2N6306, 2N6307, 2N6308, and RCS579 are epitaxial silicon n-p-n power transistors with pi-nu construction. They are hermetically sealed in a steel JEDEC TO-3 package, and differ mainly in voltage ratings, saturation voltage, and beta characteristics. The exceptional second-breakdown and high voltage ratings, together with the high gain, low saturation voltage and fast-switching capability of this series of devices, make them particularly suitable for inverter circuits operating directly off the rectified 120-volt power line or in a bridge configuration operating from the rectified 240-volt line.

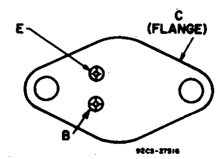
Features:

- Fast Switching Speed
- High Voltage Ratings: V_{CER} = 350 V to 450 V
- High Gain at I_C = 3 A
- Thermal-Cycling Rating Chart

Applications:

- Off-Line Power Supplies
- High-Voltage Inverters
- Switching Regulators
- Motor Controls

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCS579	2N6306	2N6307	2N6308	
* V_{CBO}	500	500	600	700	V
$V_{CER(sus)}$					
R_{BE} = 50 Ω	400	350	400	450	V
* $V_{CEO(sus)}$	250	250	300	350	V
* V_{EBO}	6	8	8	8	V
* I_C	8	8	8	8	A
* I_{CM}	16	16	16	16	A
* I_B	4	4	4	4	A
* P_T					
T_C up to 25°C	125	125	125	125	W
T_C above 25°C	Derate linearly to 200°C				
* T_{stg}, T_J	−65 to +200				°C
* T_L					
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235				°C

*2N-Series types in accordance with JEDEC registration data format (JS-6 RDF-1)

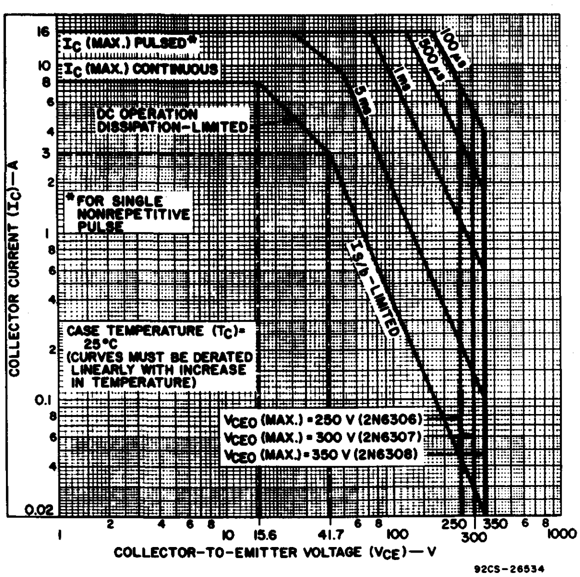


Fig. 1 - Maximum operating areas for 2N6306–2N6308.

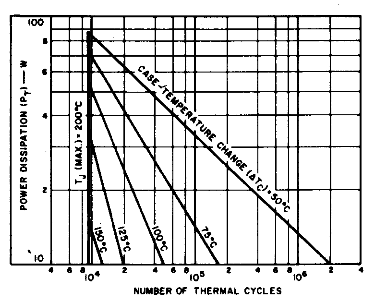


Fig. 2 - Thermal-cycling rating chart for all types.

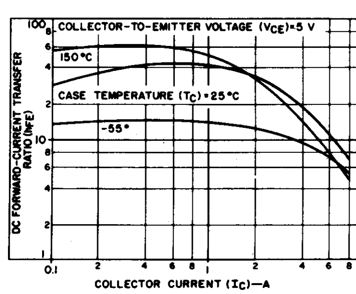


Fig. 3 - Typical dc beta characteristics for all types.

2N6306-2N6308, RCS579

ELECTRICAL CHARACTERISTICS, *T_C - 25°C Unless Otherwise Specified.*

CHARACTERISITC	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N6306		2N6307		2N6308		RCS579		UNITS
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	250			0	–	0.5	–	–	–	–	–	0.5	
	300			0	–	–	–	0.5	–	–	–	–	
	350			0	–	–	–	–	–	0.5	–	–	
* I_{CEV}	500	−1.5			–	0.5	–	–	–	–	–	0.5	mA
	600	−1.5			–	–	–	0.5	–	–	–	–	
	700	−1.5			–	–	–	–	–	0.5	–	–	
* T_C = 150°C	450	−1.5			–	2.5	–	–	–	–	–	2.5	
	550	−1.5			–	–	–	2.5	–	–	–	–	
	650	−1.5			–	–	–	–	–	2.5	–	–	
* I_{EBO}		−6	0		–	–	–	–	–	–	–	2	mA
		−8	0		–	1	–	1	–	1	–	–	
* $V_{CEO}(sus)$			0.1[a]	0	250	–	300	–	350	–	250	–	V
$V_{CER}(sus)$ R_{BR} = 50 Ω			0.1[b]		350	–	400	–	450	–	400	–	V
V_{EBO} I_E = 1 mA			0		–	–	–	–	–	–	6	–	V
* h_{FE}	5		3[a]		15	75	15	75	12	60	12	–	
	5		8[a]		4	–	4	–	3	–	3	–	
* V_{BE}	5		3[a]		–	1.3	–	1.3	–	1.5	–	1.5	V
* $V_{BE}(sat)$			8[a]	2	–	2.3	–	2.3	–	–	–	–	V
			8[a]	2.67	–	–	–	–	–	2.5	–	2.5	
* $V_{CE}(sat)$			3[a]	0.6	–	0.8	–	1	–	1.5	–	1.5	
			8[a]	2	–	5	–	5	–	–	–	–	V
			8[a]	2.67	–	–	–	–	–	5	–	5	
* $\|h_{fe}\|$ * f = 1 MHz	10		0.3		5	–	5	–	5	–	5	–	
* $E_{S/b}$ L = 40 mH R_{BB} = 3kΩ		−1.5	3		180	–	180	–	180	–	180	–	mJ
$I_{S/b}$ t_p = 1 s, nonrep.	40				3.15	–	3.15	–	3.15	–	3.15	–	A
* C_{obo} V_{CB} = 10 V, f = 0.1 MHz					–	250	–	250	–	250	–	250	pF
* t_r V_{CC} = 125 V			3	0.6	–	0.6	–	0.6	–	0.6	–	0.6	
* t_s V_{CC} = 125 V t_p = 25 µs			3	+0.6 −1.5	–	1.6	–	1.6	–	1.6	–	2	µs
t_p = 5 µs			3	+0.6 −1.5	–	0.8	–	0.8	–	0.8	–	–	
* t_f V_{CC} = 125 V			3	+0.6 −1.5	–	0.4	–	0.4	–	0.4	–	0.4	
$R_{\theta JC}$					–	1.4	–	1.4	–	1.4	–	1.4	°C/W

* 2N-Series types in accordance with JEDEC registration data fomat (JS-6, RDF-1).

[a] Pulsed; pulse duration = 300 µs, duty factor ≤ 2%.

[b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. $V_{CEO}(sus)$ should be measured by the pulse method (Note "a").

2N6306-2N6308, RCS579

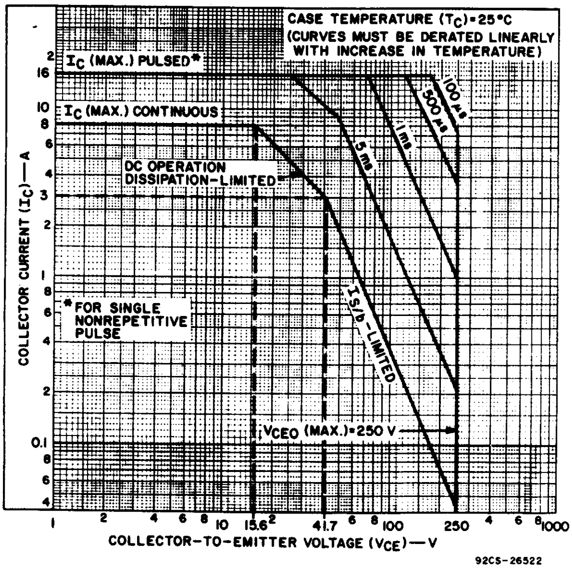


Fig. 4 - Maximum operating areas for RCS579.

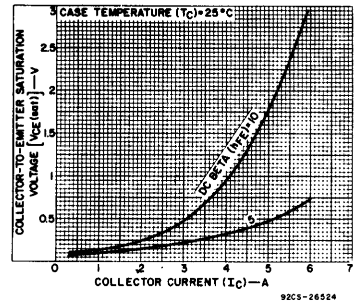


Fig. 5 - Typical collector-to-emitter saturation-voltage characteristics for all types.

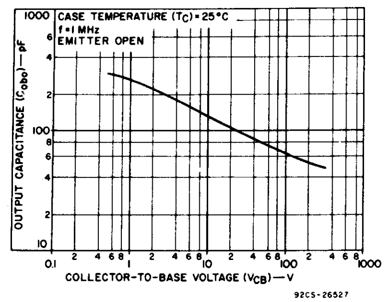


Fig. 6 - Typical output capacitance for all types.

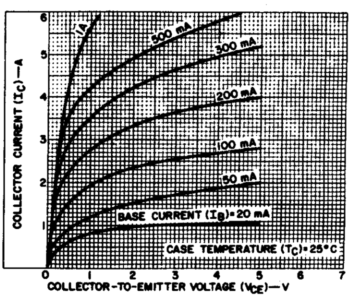


Fig. 7 - Typical output characteristics for all types.

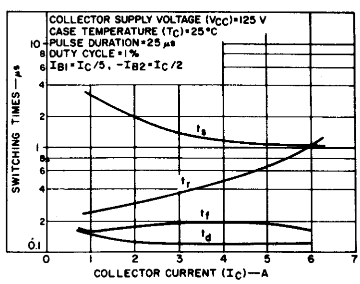


Fig. 8 - Typical saturated-switching-time characteristics for all types.

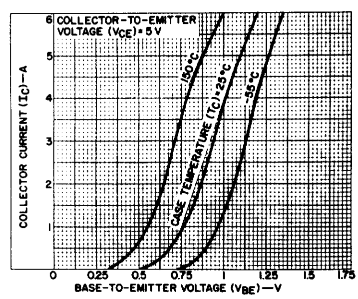


Fig. 9 - Typical transfer characteristics for all types.

2N6326, 2N6327

High-Current, High-Power, High-Speed N-P-N Power Transistors

The RCA-2N6326 and 2N6327 are epitaxial-base silicon n-p-n transistors intended for a wide variety of high-power, high-current applications, such as power-switching circuits, driver and output stages for series and shunt regulators, dc-to-dc converters, inverters, and solenoid (hammer)/relay drivers.

These devices differ in maximum voltage ratings. They are supplied in JEDEC TO-204MA hermetic steel packages.

Features:

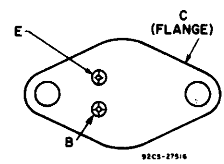
- Specification for h_{FE} and V_{CE}(sat) up to 30 A
- Current gain bandwidth product f_T = 3 MHz (min.) at 1 A
- Low saturation voltage with high beta
- High dissipation capability
- 200 mJ $E_{S/b}$ characteristic

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6326	2N6327	
* V_{CBO}	60	80	V
* V_{CEO}(sus)	60	80	V
* V_{EBO}	5		V
* I_C	30		A
* I_{CM}	40		A
* I_B	10		A
I_{BM}	15		A
* P_T			
At $T_C \leq 25°C$	200		W
At $T_C > 25°C$ Derate linearly	1.15		W/°C
	See Figs. 1 and 2		
* T_{stg}, T_J	−65 to 200		°C
T_L			
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230		°C

* In accordance with JEDEC registration data format JS-6 RDF-2.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

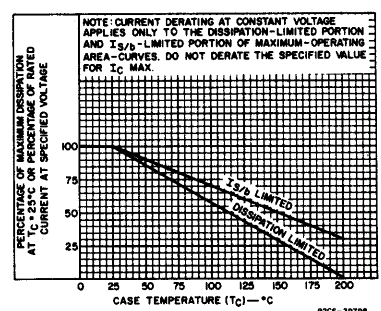


Fig. 2 – Derating curves for 2N6326 and 2N6327.

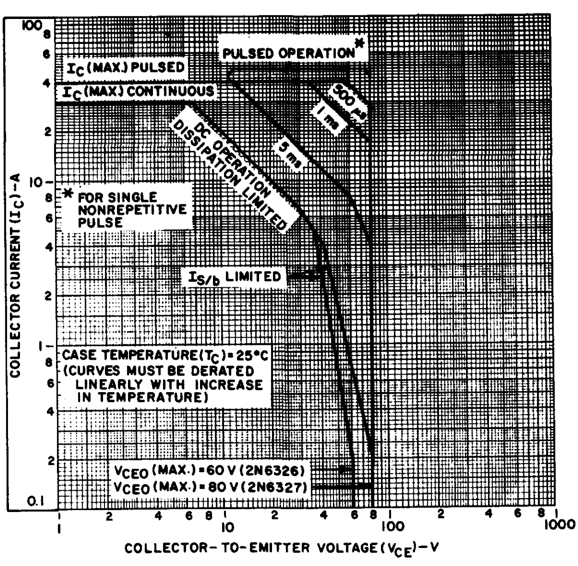


Fig. 1 – Maximum operating areas for 2N6326 and 2N6327.

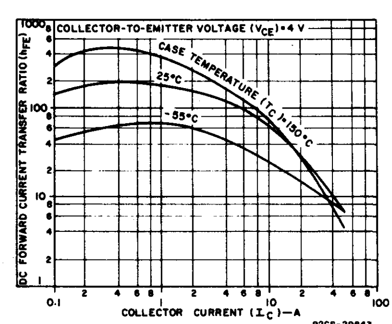


Fig. 3 – Typical dc beta characteristics as a function of collector current for 2N6326 and 2N6327.

2N6326, 2N6327

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6326		2N6327		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
* I_{CES}	60				–	0.5	–	–	mA
	80				–	–	–	0.5	
* I_{CES} T_C = 150°C	30				–	5	–	–	
	40				–	–	–	5	
* I_{CEO}	30				–	1	–	–	
	40				–	–	–	1	
* I_{EBO}		–5			–	0.5	–	0.5	
* h_{FE}	4		5[a]		25	–	25	–	
	4		15[a]		12	–	12	–	
	4		30[a]		6	30	6	30	
* $V_{CEO}(sus)$			0.03		60	–	80	–	V
* V_{BE}	4		15[a]		–	2	–	2	
	4		30[a]		–	4	–	4	
* $V_{CE}(sat)$			15[a]	2	–	1.5	–	1.5	
			30[a]	7.5	–	3	–	3	
$I_{S/b}$ t_p = 1 s nonrep.	20				10	–	10	–	A
$E_{S/b}$ L = 125 µH, R_{BE} = 51 Ω		–1.5	10		6.25	–	6.25	–	mJ
L = 20 mH, R_{BE} = 100 Ω		0	4.47		200	–	200	–	
* $\|h_{fe}\|$ f = 1 MHz	10		1		3	–	3	–	
* h_{fe} f = 1 kHz	10		1		30	–	30	–	
t_{on}	V_{CC} = 30		15	2	0.45 (Typ.)		0.45 (Typ.)		µs
t_{off}			15	2[b]	0.9 (Typ.)		0.9 (Typ.)		
$R_{\theta JC}$	20		5		–	0.875	–	0.875	°C/W

*In accordance with JEDEC registration data format JS-6 RDF-2.

[a]Pulsed; pulse duration = 300 µs, duty factor = 1.8%.

[b]$I_{B_1} = -I_{B_2}$.

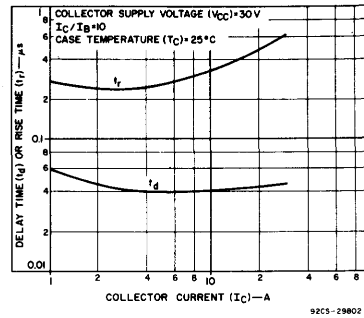


Fig. 4 — Typical delay-time and rise-time characteristics as a function of collector current for 2N6326 and 2N6327.

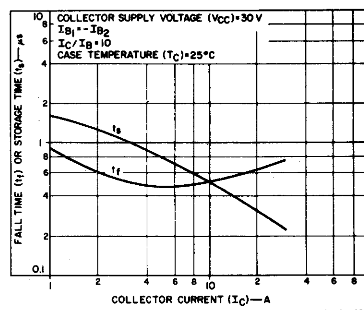


Fig. 5 — Typical storage-time and fall-time characteristics as a function of collector current for 2N6326 and 2N6327.

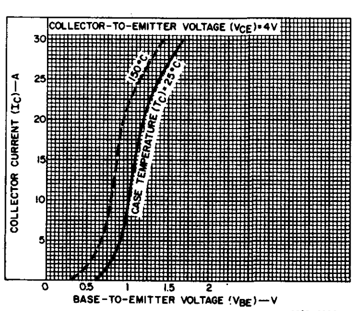


Fig. 6 — Typical transfer characteristics for 2N6326 and 2N6327.

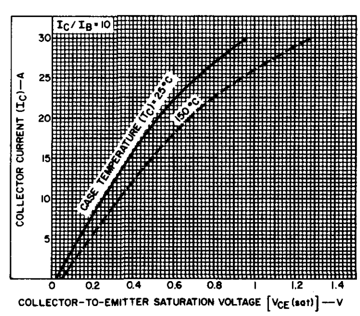


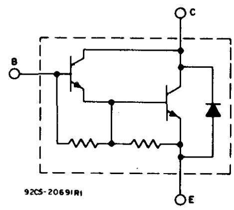
Fig. 7 — Typical saturation voltage characteristics for for 2N6326 and 2N6327.

2N6383-2N6385, 2N6055, 2N6056, RCA1000, RCA1001

8- and 10-Ampere N-P-N Darlington Power Transistors

For Use as Output Devices in Switching and Amplifier Applications 40-60-80 Volts, 90-100 Watts

The RCA devices are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.



Schematic diagram for all types.

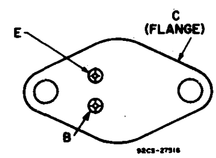
Features:

- **Operation from IC without predriver**
- **Low leakage at high temperature**
- **High reverse-second-breakdown capability**

Applications:

- **Power switching**
- **Audio amplifiers**
- **Series and shunt regulators**
- **Hammer drivers**

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6385	2N6384	2N6383	2N6055	2N6056	RCA1000	RCA1001	
*V_{CBO}	80	60	40	60	80	60	80	V
$V_{CER}(sus)$ $R_{BE} = 100\ \Omega$	80	60	40	60	80	–	–	V
*$V_{CEO}(sus)$	80	60	40	60	80	60	80	V
$V_{CEV}(sus)$ $V_{BE} = -1.5$ V	–	–	–	60	80	–	–	V
*V_{CEX} $V_{BE} = -1.5$ V, $R_{BB} = 100\ \Omega$	80	60	40	–	–	–	–	V
*V_{EBO}	5	5	5	5	5	5	5	V
*I_C	10	10	10	8	8	8	8	A
I_{CM}	15	15	15	16	16	15	15	A
*I_B	0.25	0.25	0.25	0.12	0.12	0.1	0.1	mA
*P_T $T_C \leq 25°C$	100	100	100	100	100	90	90	W
$T_C > 25°C$	Derate linearly to 200°C							
*T_{stg}, T_J	−65 to +200							°C
*T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235							°C

*2N-Series types in accordance with JEDEC registration data format JS-6 RDF-2.

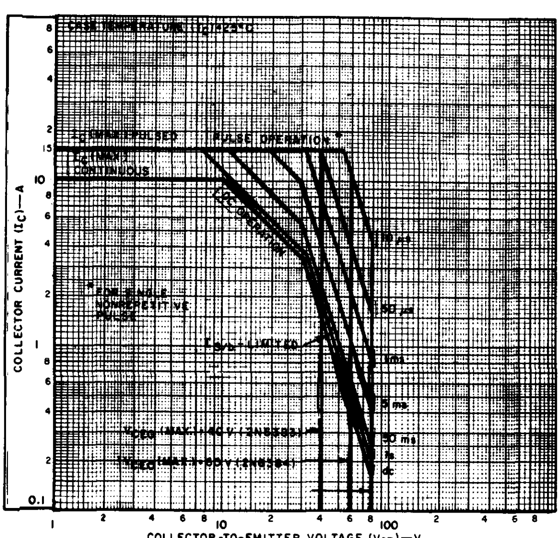


Fig. 1 – Maximum operating area for 2N6383–2N6385.

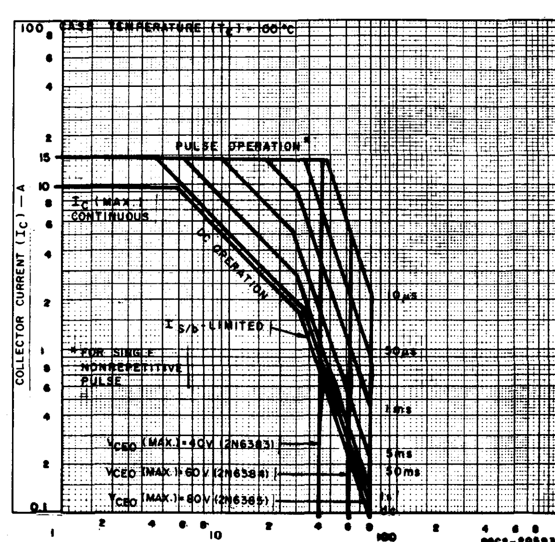


Fig. 2 – Maximum operating area for 2N6383 – 2N6385 at $T_C = 100°C$.

2N6383-2N6385, 2N6055, 2N6056, RCA1000, RCA1001

ELECTRICAL CHARACTERISTICS, *At Case Temperature, T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS					LIMITS						UNITS
	VOLTAGE V dc			CURRENT A dc		2N6385		2N6384		2N6383		
	V_{CE}	V_{EB}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	80				0	–	1	–	–	–	–	
	60				0	–	–	–	1	–	–	
	40				0	–	–	–	–	–	1	
* I_{CEV}	80		−1.5			–	0.3	–	–	–	–	
	60		−1.5			–	–	–	0.3	–	–	
	40		−1.5			–	–	–	–	–	0.3	mA
T_C = 150°C	80		−1.5			–	3	–	–	–	–	
	60		−1.5			–	–	–	3	–	–	
	40		−1.5			–	–	–	–	–	3	
* I_{EBO}		5		0		–	5	–	5	–	5	mA
* $V_{CEO}(sus)$				0.2[a]	0	80	–	60	–	40	–	
* $V_{CER}(sus)$ R_{BE} = 100 Ω				0.2[a]		80	–	60	–	40	–	V
$V_{CEV}(sus)$			−1.5	0.2[a]		80	–	60	–	40	–	
* h_{FE}	3			5[a]		1000	20,000	1000	20,000	1000	20,000	
	3			10[a]		100	–	100	–	100	–	
* V_{BE}	3			5[a]		–	2.8	–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	–	4.5	
* $V_{CE}(sat)$				5[a]	0.01[a]	–	2	–	2	–	2	V
				10[a]	0.1[a]	–	3	–	3	–	3	
V_F				−10		–	4	–	4	–	4	
* h_{fe} f = 1 kHz	5			1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	20	–	
* C_{obo} f = 1 MHz	V_{CB} = 10				I_E=0	–	200	–	200	–	200	pF
$I_{S/b}$	75					0.22	–	–	–	–	–	
t = 1 s,	55					–	–	0.55	–	–	–	A
non rep.	30					3.33	–	3.33	–	3.33	–	
$R_{\theta JC}$						–	1.75	–	1.75	–	1.75	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

* 2N-Series types in accordance with JEDEC registration data format JS-6 RDF-2.

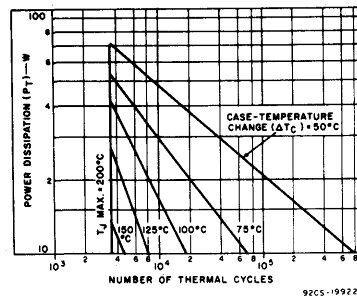


Fig. 3 - Thermal-cycling rating chart for 2N6055–2N6056, 2N6383–2N6385.

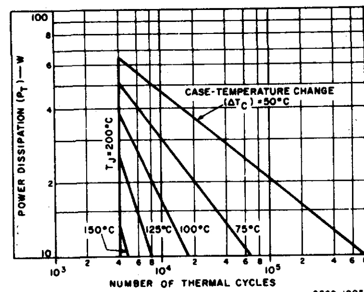


Fig. 4 - Thermal-cycling rating chart for RCA1000, RCA1001.

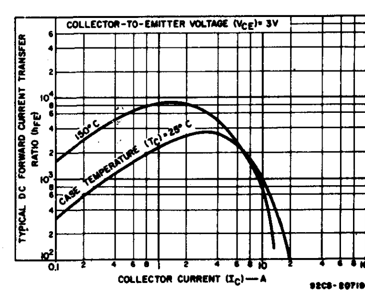


Fig. 5 - Typical dc beta characteristics for all types.

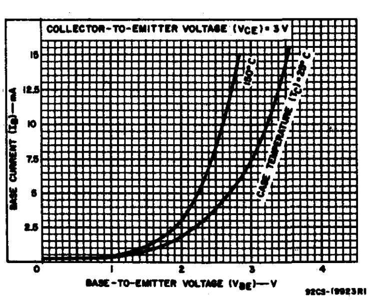


Fig. 6 - Typical input characteristics for 2N6383–2N6385, 2N6055, 2N6056.

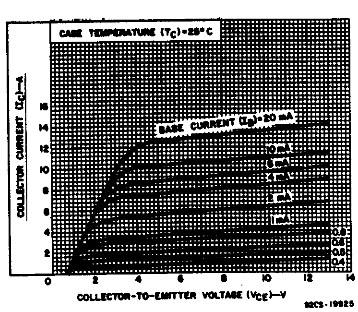


Fig. 7 - Typical output characteristics for 2N6383–2N6385, 2N6055, 2N6056.

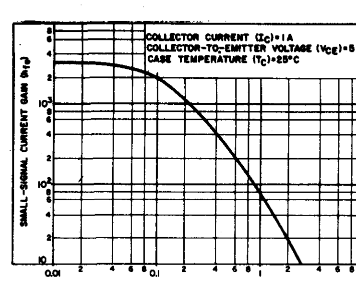


Fig. 8 - Typical small-signal gain for all types.

2N6383-2N6385, 2N6055, 2N6056, RCA1000, RCA1001

ELECTRICAL CHARACTERISTICS, *At Case Temperature, T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS DC VOLTAGE V			DC CURRENT A			LIMITS 2N6055		2N6056		RCA1000		RCA1001		UNITS
	V_{CE}	V_{EB}	V_{BE}	I_C	I_E	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30					0	–	0.5	–	–	–	0.5	–	–	mA
	40					0	–	–	–	0.5	–	–	–	0.5	
I_{CER}	60						–	–	–	–	–	1	–	–	
R_{BE} = 1 kΩ	80						–	–	–	–	–	–	–	1	
I_{CER}	60						–	–	–	–	–	5	–	–	mA
R_{BE} = 1 kΩ, T_C = 150°C	80						–	–	–	–	–	–	–	5	
I_{CEX}	60		–1.5				–	0.5	–	–	–	–	–	–	mA
	80		–1.5				–	–	–	0.5	–	–	–	–	
I_{CEX}	60		–1.5				–	5	–	–	–	–	–	–	
T_C = 150°C	80		–1.5				–	–	–	5	–	–	–	–	
* I_{EBO}		5		0			–	2	–	2	–	2	–	2	mA
* h_{FE}	3			8[a]			100	–	100	–	–	–	–	–	
	3			4[a]			750	18,000	750	18,000	750	–	750	–	
	3			3[a]			–	–	–	–	1000	–	1000	–	
$V_{(BR)CEO}$				0.1[a]	0		–	–	–	–	60	–	80	–	V
V_{CEO}(sus)				0.1[a]			60[a]	–	80[a]	–	–	–	–	–	
V_{CER}(sus) R_{BE} = 100 Ω				0.1[a]			60[a]	–	80[a]	–	–	–	–	–	V
V_{CEX}(sus)			–1.5	0.1[a]			60[a]	–	80[a]	–	–	–	–	–	
* V_{CE}(sat)				3[a]		0.012	–	–	–	–	–	2	–	2	V
				4[a]		0.016	–	2	–	2	–	–	–	–	
				8[a]		0.04	–	–	–	–	–	4	–	4	
				8[a]		0.08	–	3	–	3	–	–	–	–	
* V_{BE}	3			3[a]			–	–	–	–	–	2.5	–	2.5	V
	3			4[a]			–	2.8	–	2.8	–	–	–	–	
V_{BE}(sat)				8[a]		0.08	–	4	–	4	–	–	–	–	
* $\|h_{fe}\|$ f = 1 MHz	3			3			4	–	4	–	–	–	–	–	
* C_{obo} f = 0.1 MHz, V_{CB} = 10 V					0		–	200	–	200	–	–	–	–	pF
* h_{fe} f = 1 kHz	3			3			300	–	300	–	–	–	–	–	
$I_{S/b}$ t = 1 s, non rep.	33.3						3	–	3	–	–	–	–	–	A
	40						–	–	2	–	–	–	–	–	
$R_{\theta JC}$							–	1.75	–	1.75	–	1.94	–	1.94	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

[a] Pulsed: Pulse duration = 300 μs, duty factor = 2%

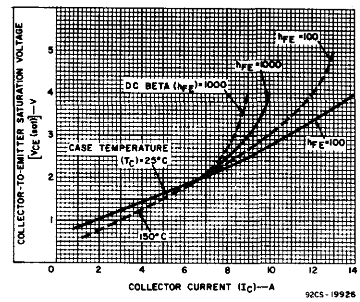


Fig. 9 - Typical saturation characteristics for 2N6055, 2N6056, RCA1000, RCA1001.

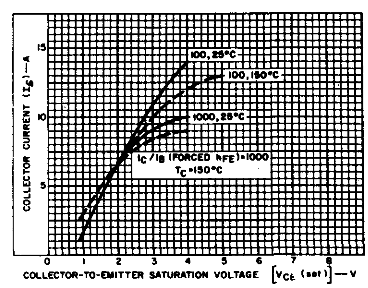


Fig. 10 - Typical saturation characteristics for 2N6383—2N6385.

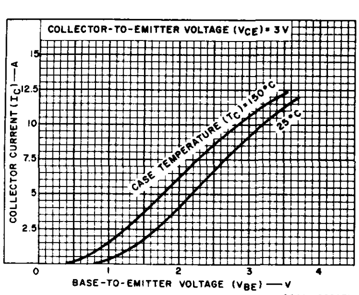


Fig. 11 - Typical transfer characteristics for 2N6383—2N6385, 2N6055, 2N6056.

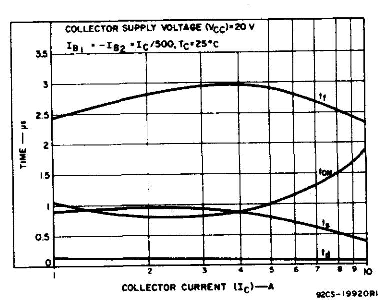


Fig. 12 - Typical saturated switching-time characteristics for 2N6383—2N6385, 2N6055, 2N6056.

2N6383-2N6385, 2N6055, 2N6056, RCA1000, RCA1001

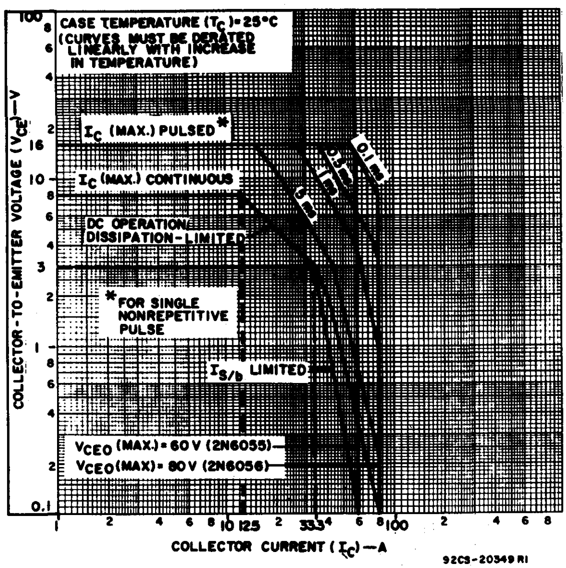


Fig. 13 – Maximum operating areas for 2N6055 and 2N6056.

2N6386, 2N6387, 2N6388

8- and 10-Ampere N-P-N Darlington Power Transistors

60-80-100 Volts, 65 Watts

These RCA devices are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these transistors provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

The 2N6386 is complementary to the RCA8203 and the 2N6666, the 2N6387 is complementary to the RCA8203A and the 2N6667, and the 2N6388 is complementary to the RCA8203B and the 2N6668.

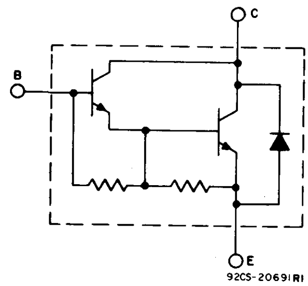


Fig. 1 - Schematic diagram for all types.

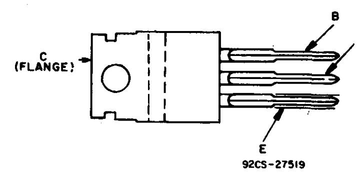
Features:

- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:

- Power switching
- Hammer drives
- Series and shunt regulators
- Audio amplifiers

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6386	2N6387	2N6388	
V_{CBO}	40	60	80	V
$V_{CER}(sus)$ $R_{BE} = 100\ \Omega$	40	60	80	V
$V_{CEO}(sus)$	40	60	80	V
$V_{CEV}(sus)$ $V_{BE} = -1.5$ V	40	60	80	V
V_{EBO}	5	5	5	V
I_C	8	10	10	A
I_{CM}	15	15	15	A
I_B	0.25	0.25	0.25	A
P_T $T_C \leq 25^oC$	65	65	65	W
$T_C > 25^oC$	Derate linearly to 150°C			
T_{stg}, T_J	−65 to +150			°C
T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235			°C

• 2N- Series types in accordance with JEDEC registration data format JS-6 RDF-2.

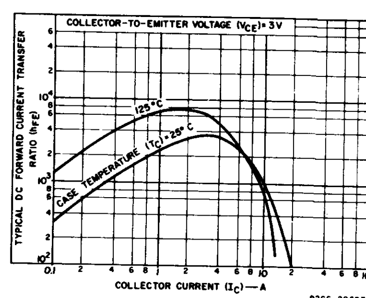


Fig. 2 — Typical dc beta characteristics for 2N6386, 2N6387, and 2N6388.

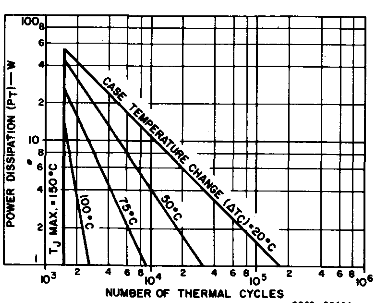


Fig. 3 — Thermal-cycling rating chart for 2N6386, 2N6387, and 2N6388.

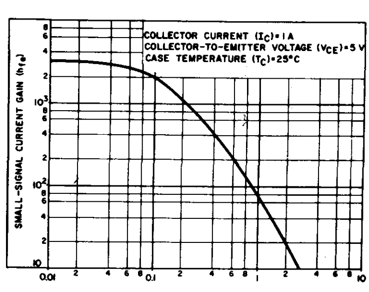


Fig. 4 — Typical small-signal gain for all types.

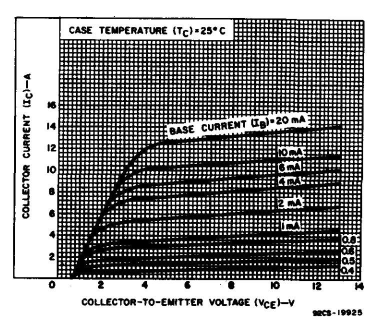


Fig. 5 — Typical output characteristics for 2N6386, 2N6387, and 2N6388.

2N6386, 2N6387, 2N6388

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6386 MIN.	MAX.	2N6387 MIN.	MAX.	2N6388 MIN.	MAX.	UNITS
* I_{CEO}	80			0	–	–	–	–	–	1	
	60			0	–	–	–	1	–	–	
	40			0	–	1	–	–	–	–	
* I_{CEV}	80	−1.5			–	–	–	–	–	0.3	
	60	−1.5			–	–	–	0.3	–	–	mA
	40	−1.5			–	0.3	–	–	–	–	
T_C = 125°C	80	−1.5			–	–	–	–	–	3	
	60	−1.5			–	–	–	3	–	–	
	40	−1.5			–	3	–	–	–	–	
* I_{EBO}		5	0		–	5	–	5	–	5	mA
* V_{CEO}(sus)			0.2[a]	0	40	–	60	–	80	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2[a]		40	–	60	–	80	–	V
V_{CEV}(sus)		−1.5	0.2[a]		40	–	60	–	80	–	
* h_{FE}	3		3[a]		1000	20,000	–	–	–	–	
	3		5[a]		–	–	1000	20,000	1000	20,000	
	3		8[a]		100	–	–	–	–	–	
	3		10[a]		–	–	100	–	100	–	
* V_{BE}	3		3[a]		–	2.8	–	–	–	–	
	3		5[a]		–	–	–	2.8	–	2.8	V
	3		8[a]		–	4.5	–	–	–	–	
	3		10[a]		–	–	–	4.5	–	4.5	
* V_{CE}(sat)			3[a]	0.006[a]	–	2	–	–	–	–	
			5[a]	0.01[a]	–	–	–	2	–	2	V
			8[a]	0.08[a]	–	3	–	–	–	–	
			10[a]	0.1[a]	–	–	–	3	–	3	
V_F			−8[a]		–	4	–	–	–	–	V
			−10[a]		–	–	–	4	–	4	
* h_{fe} f = 1 kHz	5		1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	20	–	
* C_{ob} V_{CB} = 10 V, f = 1 MHz					–	200	–	200	–	200	pF
$I_{S/b}$ t = 1 s, nonrep.	25				2.6	–	2.6	–	2.6	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

* In accordance with JEDEC registration data format JS-6 RDF-2.

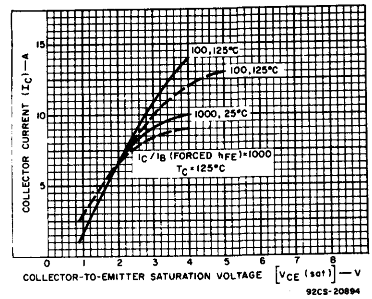


Fig. 6 – Typical saturation characteristics for 2N6386, 2N6387, and 2N6388.

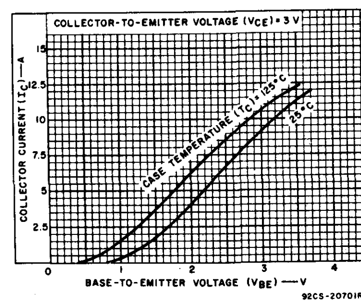


Fig. 7 – Typical transfer characteristics for 2N6386, 2N6387, and 2N6388.

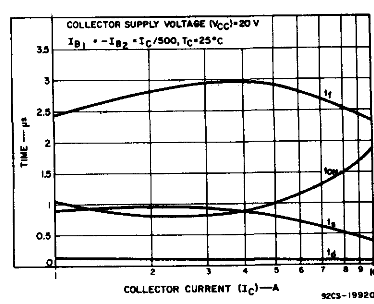


Fig. 8 – Typical saturated switching-time characteristics for 2N6386, 2N6387, and 2N6388.

2N6386, 2N6387, 2N6388

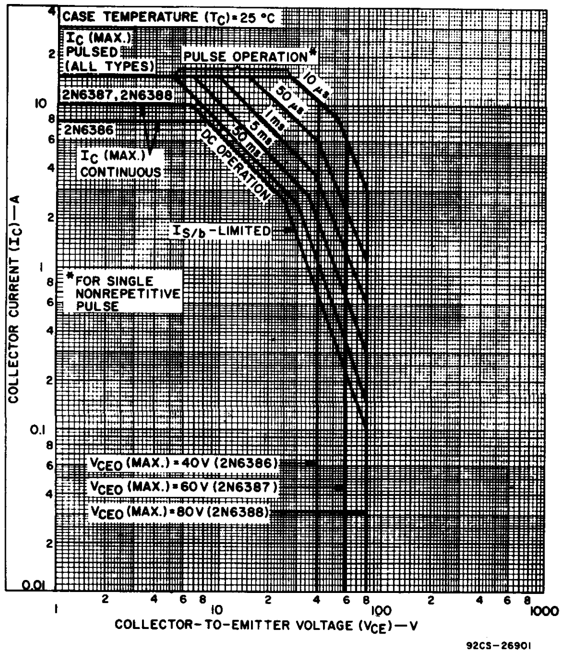


Fig. 9 — Maximum operating areas for 2N6386, 2N6387, and 2N6388 at T_C = 25°C.

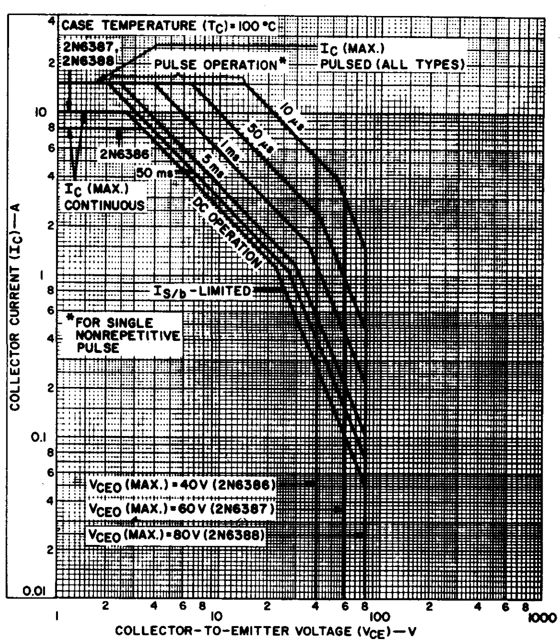


Fig. 10 — Maximum operating areas for 2N6386, 2N6387, and 2N6388 at T_C = 100°C.

2N6420, 2N6421, 2N6422, 2N6423

High-Voltage Medium-Power Silicon P-N-P Transistors

For High-Speed Switching and Linear-Amplifier Applications

The RCA-2N6420, 2N6421, 2N6422, and 2N6423 are epitaxial silicon p-n-p power transistors with high-voltage ratings and fast switching speeds. Typical applications for these transistors include high-voltage operational amplifiers, switching regulators, converters, inverters, deflection stages and high-fidelity amplifiers.

These types are supplied in steel JEDEC TO-213MA hermetic packages.

Features:

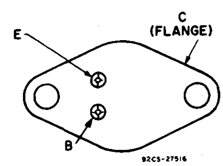
- **High voltage ratings:**
  $V_{CEO}(sus)$ = −175 V max. (2N6420)
  = −250 V max. (2N6421)
  = −300 V max. (2N6422)
  = −300 V max. (2N6423)
- **Large safe-operating area**
- **Thermal-cycling rating**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6420	2N6421	2N6422	2N6423	
* V_{CBO}	−250	−375	−500	−500	V
$V_{CEO}(sus)$	−175	−250	−300	−300	V
* V_{EBO}	−6				V
* I_C	−1	−2			A
* I_{CM}	−5				A
* I_B	−1				A
P_T					
$T_C \leq 100°C$, $V_{CE} \leq 50$ V	20				W
* $T_C \leq 25°C$, $V_{CE} \leq 40$ V	35				W
$T_C \leq 25°C$, $V_{CE} > 40$ V	*See Fig. 1*				
$T_C > 25°C$, $V_{CE} > 40$ V	*See Figs. 1 & 3*				
* T_{stg}, * T_J	−65 to +200				°C
* T_L					
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	235				°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-213MA

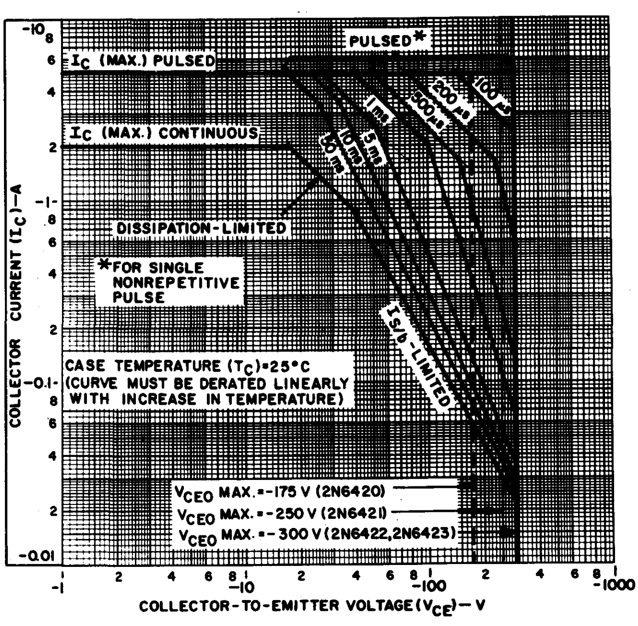


Fig. 1 — Maximum operating areas for all types at T_C = 25°C.

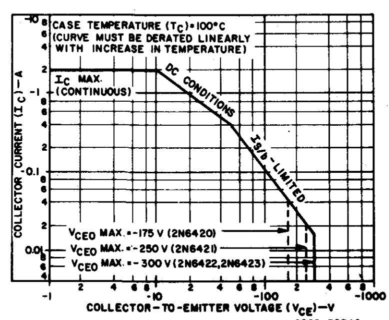


Fig. 2 — Maximum operating areas for all types, at T_C = 100°C.

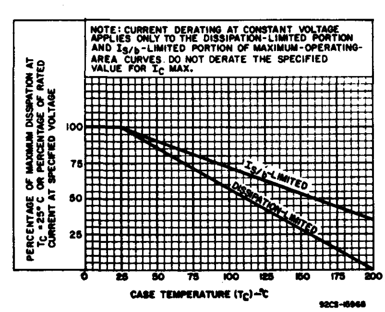


Fig. 3 — Derating curves for all types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6420 Min.	2N6420 Max.	2N6421 2N6422 Min.	2N6421 2N6422 Max.	2N6423 Min.	2N6423 Max.	Units
* I_{CEO}	−150				–	−10	–	−5	–	−5	mA
* I_{CEX}	−225	1.5			–	−1	–	–	–	–	mA
2N6421	−340	1.5			–	–	–	−1	–	–	mA
2N6422	−450	1.5			–	–	–	−1	–	–	mA
	−450	1.5			–	–	–	–	–	−2	mA
* ICEX T_C=150°C	−225	1.5			–	−3	–	–	–	–	mA
	−300	1.5			–	–	–	−3	–	−5	mA
* I_{EBO}		6	0		–	−5	–	−0.5	–	−0.5	mA
h_{FE}	−10		−0.1[a]		40	–	40	–	40	–	
	−10		−0.5[a]		40	200	–	–	–	–	
*	−2		−0.75[a]		–	–	–	–	10	100	
	−10		−0.75[a]		–	–	–	–	30	150	
*	−2		−1[a]		–	–	8	80	–	–	
*	−10		−1[a]		10	–	25	100	–	–	
V_{BE}	−10		−1[a]		–	−1.4	–	−1.4	–	−1.4	V
* V_{BE}(sat)			−0.75[a]	−0.075	–	–	–	–	−1.8	–	V
			−1[a]	−0.1	–	−1.4	–	−1.4	–	–	V
V_{CE}(sat)			−0.75[a]	−0.075	–	–	–	–	–	−1	V
			−1[a]	−0.125	–	−5	–	−0.75	–	–	V
* V_{CEO}(sus)[b]			−0.05[a]	0	−175	–	–	–	−300	–	V
2N6421			−0.05[a]	0	–	–	−250	–	–	–	V
2N6422			−0.05[a]	0	–	–	−300	–	–	–	V
$I_{S/b}$	−100				−0.15	–	−0.15	–	−0.15	–	A
* $\|h_{fe}\|$ f = 5 MHz	−10		−0.2		2	–	2	–	3	–	
* f = 1 kHz	−30		−0.1		25	350	–	–	–	–	
C_{obo} V_{CB}=10V f = 1 MHz			0		–	180	–	180	–	180	pF
* t_r[c]			−0.75	−0.075[d]	–	–	–	–	–	0.5	µs
			−1	−0.1[d]	–	–	–	3	–	–	µs
* t_s[c]			−0.75	−0.075[d]	–	–	–	–	–	6	µs
			−1	−0.1[d]	–	–	–	4	–	–	µs
* t_f[c]			−0.75	−0.075[d]	–	–	–	–	–	3	µs
			−1	−0.1[d]	–	–	–	3	–	–	µs
$R_{\theta JC}$	−10		−1		–	5	–	5	–	5	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed: pulse duration = 300 µs, duty factor ≤2%.
[b] CAUTION: The sustaining voltage V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.
[c] V_{CC} = −200 V, t_p = 20 µs
[d] $-I_{B_1} = I_{B_2}$

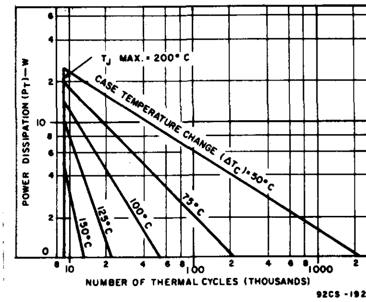


Fig. 4 – Thermal-cycling rating chart for all types.

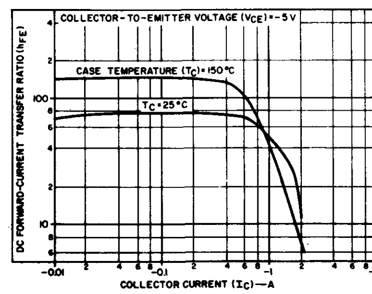


Fig. 5 – Typical dc beta characteristics for all types.

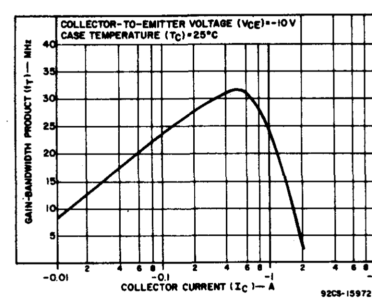


Fig. 6 – Typical gain-bandwidth product for all types.

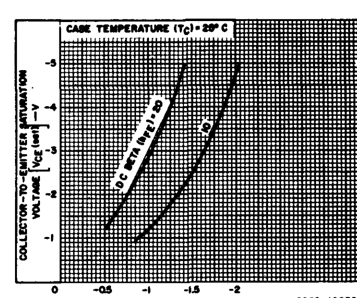


Fig. 7 – Typical saturation-voltage characteristics for all types.

2N6420, 2N6421, 2N6422, 2N6423

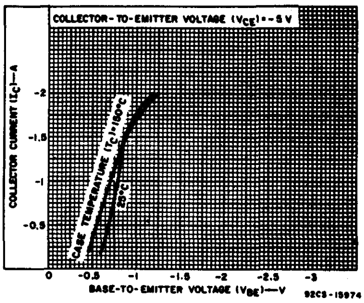


Fig. 8 — Typical transfer characteristics for all types.

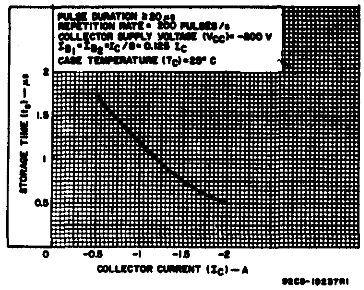


Fig. 9 — Typical storage time characteristic for all types.

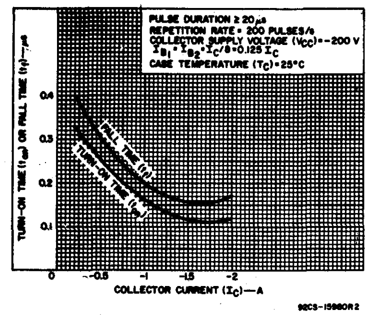


Fig. 10 — Typical turn-on time and fall-time characteristics for all types.

2N6477, 2N6478, RCA3441, RCA6263

Hometaxial-Base, Medium-Power Silicon N-P-N Transistors

Designed for Medium-Power Linear and Switching Service in Consumer, Automotive, and Industrial Applications

RCA 2N6477 and 2N6478 are hometaxial-base silicon n-p-n transistors intended for a wide variety of medium-to-high power, high-voltage applications. These devices, which are voltage extensions of the 2N5298 family, are especially useful in vertical output stages in color and black-and-white TV. The units differ in voltage ratings and in the currents at which parameters are controlled.

RCA3441 and RCA6263 are silicon n-p-n transistors intended for a wide variety of high-current applications. The hometaxial-base construction of these devices renders them highly resistant to second breakdown over a wide range of operating conditions. The VERSAWATT case has a proven thermal-cycling capability. This capability is assured by real-time quality controls in our manufacturing locations. All these types are supplied in the JEDEC TO-220AB straight-lead version of the package. They are also available on special order in a variety of lead-form configurations. Two popular variations have leads formed to fit TO-66 sockets (specify formed lead No. 6201) or printed-circuit boards (specify formed lead No. 6207). Detailed information on these and other VERSAWATT outlines may be obtained from your RCA Sales Office.

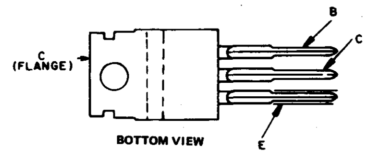
Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltages**
- **High dissipation ratings**
- **Thermal-cycling rating curves**

Applications:

- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power switching circuits**
- **Solenoid drivers**
- **Vertical output stages in color and B/W TV**

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	Symbol	2N6477	2N6478	RCA6263	RCA3441	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	140	160	140	160	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	120	140	120	140	V
With base open	$V_{CEO}(sus)$	130	150	130	150	V
With base reverse-biased V_{BE} = −1.5 V	$V_{CEV}(sus)$	140	160	140	160	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	7	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	2.5	2.5	3	3	A
PEAK COLLECTOR CURRENT		4	4	4	4	A
CONTINUOUS BASE CURRENT	I_B	1	1	2	2	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		50	50	36	36	W
At case temperatures above 25°C		Derate linearly to 150°C				
		1.8	1.8	—	—	W
		Derate linearly at 0.0144		—	—	W/°C
TEMPERATURE RANGE:						
Storage and Operating (Junction)				−65 to 150		°C
PIN TEMPERATURE (During Soldering):						
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.				235		°C

* 2N- Series types in accordance with JEDEC registration data format JS-6 RDF-2.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N6477		2N6478		UNITS
			V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
*	Collector-Cutoff Current: With base open	I_{CEO}	80 100			0 0	– –	2 –	– –	– 2	mA
	With base-emitter junction reverse-biased	I_{CEV}	130 150	−1.5 −1.5			– –	2 –	– –	– 2	mA
	At T_C = 150°C	I_{CEV}	120 140	−1.5 −1.5			– –	10 –	– –	– 10	mA
*	Emitter-Cutoff Current	I_{EBO}		−5	0		–	2	–	2	mA
*	Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.1[a]	0	120	–	140	–	V
	With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.1[a]		130	–	150	–	V
	With base-emitter junction reverse-biased	$V_{CEV}(sus)$		−1.5	0.1[a]		140	–	160	–	V
*	DC Forward-Current Transfer Ratio	h_{FE}	4 4		1[a] 2.5[a]		25 5	150 –	25 5	150 –	
*	Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			1[a] 2.5[a]	0.1 0.5	– –	1 2	– –	1 2	V
*	Base-to-Emitter Voltage	V_{BE}	4 4		1[a] 2.5[a]		– –	1.8 3	– –	1.8 3	V
*	Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio: f = 40 kHz	$\|h_{fe}\|$	4		0.5		5	–	5	–	
	Gain-Bandwidth Product	f_T	4		0.5		200	–	200	–	kHz
*	Common-Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio: f = 1 kHz	h_{fe}	4		0.1		25	–	25	–	
	Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	2.5	–	2.5	°C/W
	Junction-to-Ambient	$R_{\theta JC}$					–	70	–	70	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-2).

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

CAUTION: The sustaining voltage $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ MUST NOT be measured on a curve tracer.

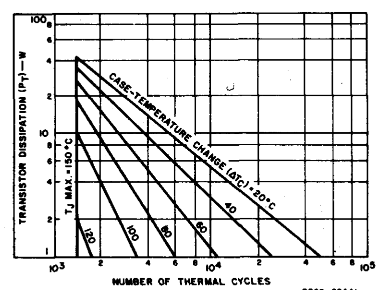


Fig. 1 - Thermal-cycling rating chart for 2N6477, 2N6478.

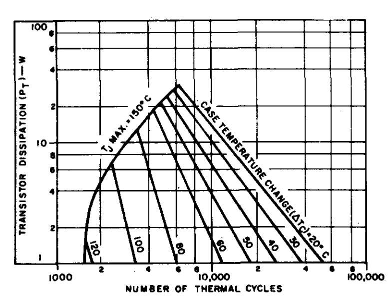


Fig. 2 - Thermal-cycling rating chart for RCA3441, RCA6263.

2N6477, 2N6478, RCA3441, RCA6263

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS					LIMITS				UNITS
		VOLTAGE V dc			CURRENT A dc		RCA6263		RCA3441		
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
Collector-Cutoff Current: With base open	I_{CEO}	100 120				0 0	– –	5 –	– –	– 5	mA
With base-emitter junction reverse-biased	I_{CEX}	120 140		−1.5 −1.5			– –	5 –	– –	– 5	mA
At T_C = 150°C	I_{CEX}	120 140		−1.5 −1.5			– –	10 –	– –	– 10	mA
Emitter-Cutoff Current	I_{EBO}		5		0		–	2	–	2	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$				0.1[a]	0	120	–	140	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$				0.1[a]		130	–	150	–	V
With base-emitter junction reverse-biased	$V_{CEV}(sus)$			−1.5	0.1[a]		140	–	160	–	V
DC Forward-Current Transfer Ratio	h_{FE}	4			0.5[a]		20	150	20	150	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				0.5[a]	0.05[a]	–	1.2	–	1.2	V
Base-to-Emitter Voltage	V_{BE}	4			0.5[a]		–	2	–	2	V
Gain-Bandwidth Product	f_T	4			0.2		200	–	200	–	kHz
Common-Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	4			0.1		25	–	25	–	
Forward-Bias Second Breakdown Collector Current[b] (t ≥ 1 s)	$I_{S/b}$	120					0.3	–	0.3	–	A
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						–	3.5	–	3.5	°C/W
Junction-to-Ambient	$R_{\theta JA}$						–	70	–	70	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b]Pulsed: 1-second non-repetitive pulse.

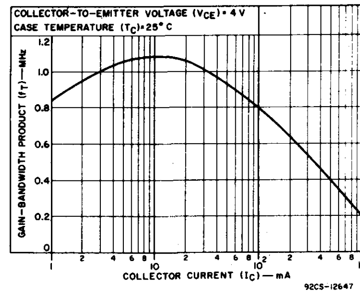


Fig. 3 - Typical gain-bandwidth product for all types.

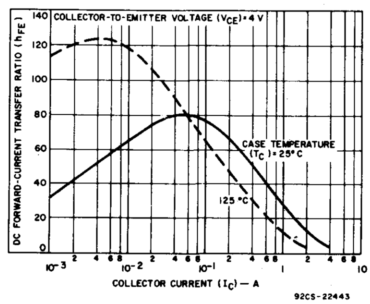


Fig. 4 - Typical dc beta characteristics for 2N6477.

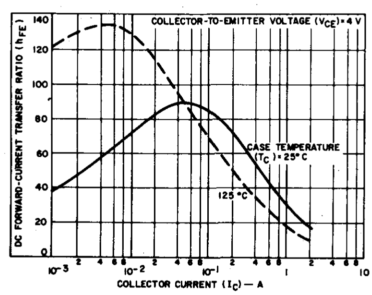


Fig. 5 - Typical dc beta characteristics for 2N6478.

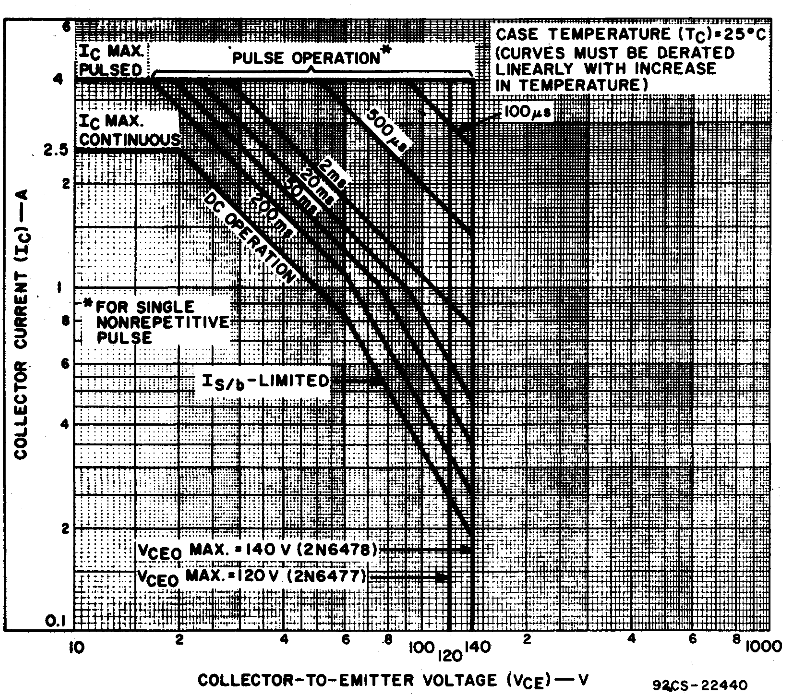


Fig. 6 - Maximum operating areas for 2N6477 and 2N6478.

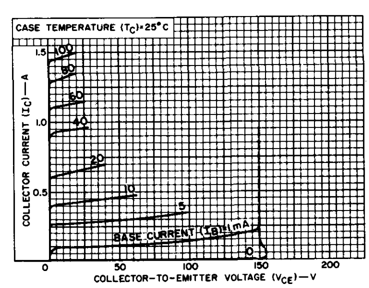


Fig. 7 - Typical output characteristics for 2N6478 and RCA3441.

2N6477, 2N6478, RCA3441, RCA6263

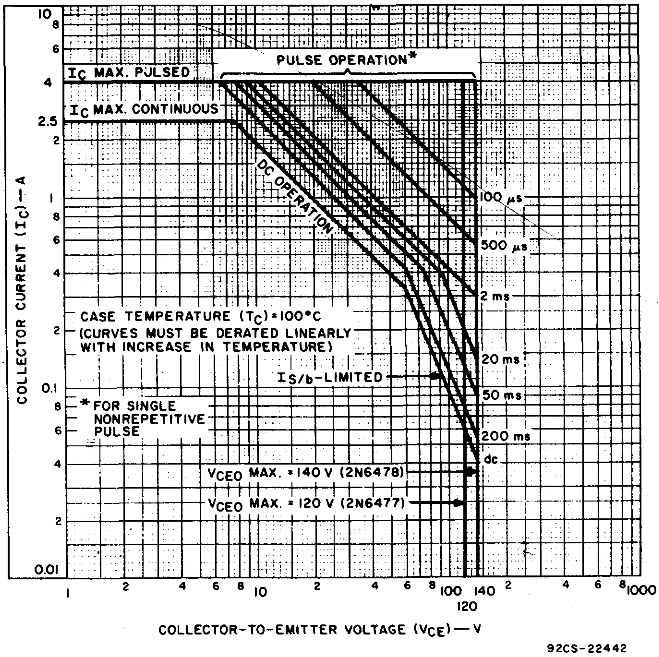


Fig. 8 - Maximum operating areas for 2N6477 and 2N6478.

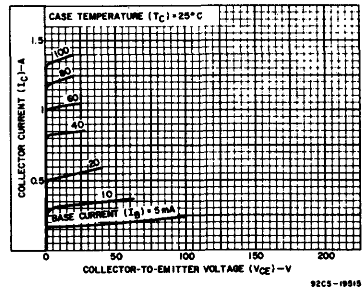


Fig. 9 - Typical output characteristics for 2N6477 and RCA6263.

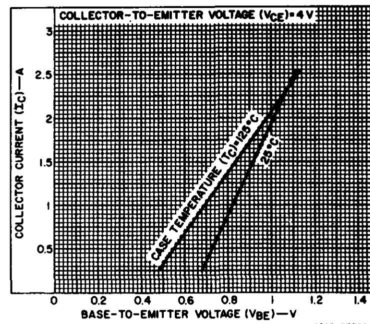


Fig. 10 - Typical transfer characteristics for 2N6477 and 2N6478.

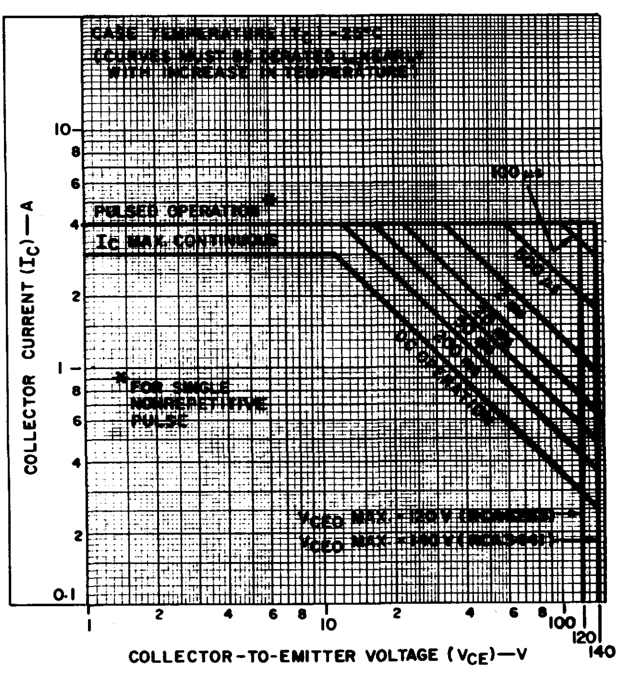


Fig. 11 - Maximum operating areas for RCA3441, RCA6263.

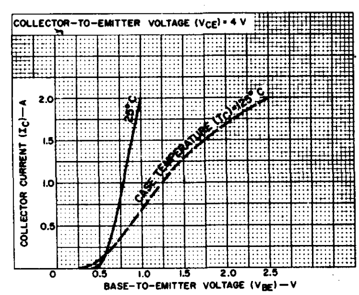


Fig. 12 - Typical transfer characteristics for RCA3441.

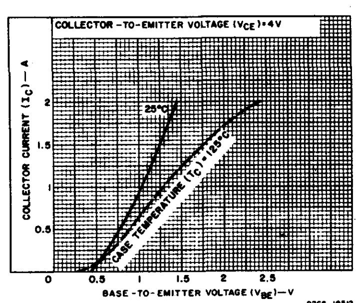


Fig. 13 - Typical transfer characteristics for RCA6263.

2N6479, 2N6480

Radiation-Hardened Silicon N-P-N Power Transistors

Epitaxial-Planar Types for Aerospace and Military Applications

Rated for Operation in Radiation Environments with Cumulative Neutron Fluence Levels to 1 x 10^{14} Neutrons/cm^2 and Gamma Intensity to 1 x 10^8 Rad(Si)/s

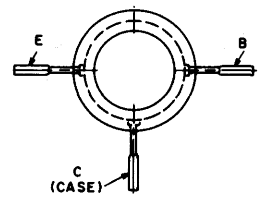
The RCA-2N6479 and 2N6480* are epitaxial silicon n-p-n planar power-switching transistors. They are designed for aerospace applications in which they might be subjected to extreme neutron and gamma-ray exposure.

The 2N6479 and 2N6480 are intended for use in 5-to-10 ampere high-frequency power inverter service.

They are supplied in hermetic flat 3/4-inch (19.05 mm) diameter packages with radial leads.

*Formerly RCA Dev. Nos. TA8007 and TA8007B, respectively.

TERMINAL DESIGNATIONS



(RADIAL)

MAXIMUM RATINGS, *Absolute-Maximum Values*

	2N6479	2N6480	
* V_{CBO}	100	100	V
$V_{CER}(sus)$ $R_{BE} \leq 100\ \Omega$	80	100	V
* V_{CEX}	60	80	V
* $V_{CEO}(sus)$	60	80	V
* V_{EBO}	6	6	V
* I_C	12	12	A
I_{CM}	25	25	A
* I_B	5	5	A
* P_T:			
$T_C \leq 25\,°C$	87	87	W
$T_C < 25\,°C$	See Fig. 1 and 5	See Fig. 1 and 5	
* $T_C = 100\,°C$	50	50	W
* T_J, T_{stg}	−65 to 200	−65 to 200	°C
* T_L: During soldering, at distances 1/32 in. (0.8 mm) from seating plane for 10 s max.	230	230	°C

*In accordance with JEDEC registration data

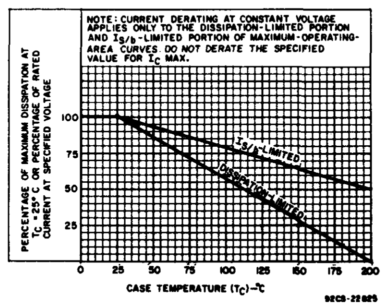


Fig. 1 - Derating curves for both types.

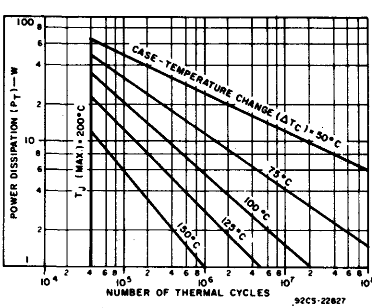


Fig. 2 - Thermal-cycling rating chart for both types.

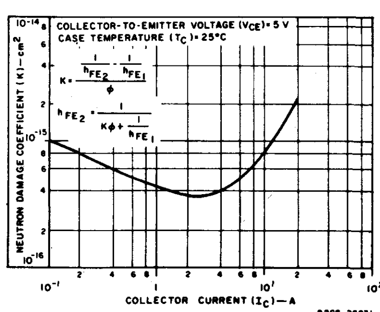


Fig. 3 - Typical 1-Me V-equivalent neutron damage coefficient as a function of collector current for both types.

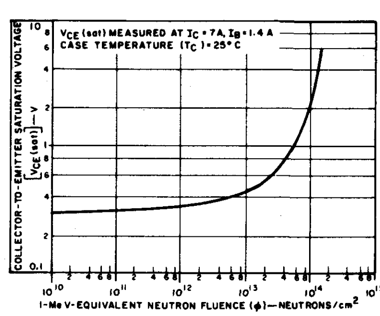


Fig. 4 - Typical collector-to-emitter saturation voltage as a function of 1-Me V-equivalent neutron fluence for both types.

2N6479, 2N6480

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C* PRE-RADIATION

CHARACTERISTIC	TEST CONDITIONS				LIMITS		UNITS
	VOLTAGE V dc		CURRENT A dc		2N6479 2N6480		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	
I_{CBO}	100[a]				—	1	mA
I_{CES}	60				—	200	μA
* I_{CEV}	100	0			—	1	mA
(T_C = 100°C)	60	0			—	1	
* I_{EBO}		−6			—	2	
V_{EBO} (I_E = 2 mA)					6	—	V
* $V_{CEO}(sus)$[b] 2N6479			0.2[c]		60	—	
2N6480			0.2[c]		80	—	
$V_{CER}(sus)$[b] (R_{BE} = 100 Ω) 2N6479			0.2[c]		80	—	
2N6480			0.2[c]		100	—	
* h_{FE}	2		12[c]		20	300	
* $V_{BE}(sat)$			12[c]	1.2	—	1.5	V
* $V_{CE}(sat)$			12[c]	1.2	—	0.75	
$I_{S/b}$ (t = 1 s)	12				7.3	—	A
$E_{S/b}$ (R_{BE} = 100 Ω, L = 100μH)			5		1.25	—	mJ
* $\|h_{fe}\|$ (f = 10 MHz)	5		1		10	—	
f_T	5		1		100	—	MHz
C_{obo} (f = 1 MHz)	10[a]				—	400	pF
* t_r	30[d]		12	1.2	—	400	ns
* t_s	30[d]		12	1.2[e]	—	800	
* t_f	30[d]		12	1.2[e]	—	200	
$R_{\theta JC}$	10			5	—	2	°C/W

*In accordance with JEDEC registration data.
[a] V_{CB} value.
[b] CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig. 10.
[c] Pulsed; pulse duration ≤ 350 μs, duty factor ≤ 2%.
[d] V_{CC} value.
[e] $I_{B_1} = -I_{B_2}$.

TYPICAL CHARACTERISTIC DURING GAMMA EXPOSURE FOR DOSE RATES OF LESS THAN 1 x 10^8 RAD(SI)/sec

CHARACTERISTIC	TEST CONDITIONS		LIMITS	UNITS
	VOLTAGE — V dc		For both Types	
	V_{CB}	V_{BE}	TYPICAL	
Collector-to-Base Charge Generation Constant (C)	20	0	5×10^{-8}	Coulomb Rad

The charge generated in the depletion region of a transistor is proportional to the volume of the depletion region, the total dose, and the energy of the gamma radiation.

The primary base-collector photo current $[I_{pp(base)}] = (C)\dot{\gamma}$, where $\dot{\gamma}$ is the gamma dose rate in Rad(SI)/s.

2N6479, 2N6480

POST-NEUTRON-RADIATION ELECTRICAL CHARACTERISTICS AFTER EXPOSURE TO 5 x 10^{13} NEUTRONS/cm^2 (1 MeV equiv.), *At Case Temperature (T_C = 25°C*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		CURRENT A dc		LIMITS 2N6479 2N6480		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	
* I_{CEV}	100	0			—	1.2	mA
* I_{EBO}		−5			—	2.2	mA
* $V_{CEO}(sus)$[b] 2N6479			0.2[c]		60	—	V
2N6480			0.2[c]		80	—	V
* h_{FE}	5		7[c]		12	—	
* $V_{BE}(sat)$			7[c]	1.4	—	1.5	V
* $V_{CE}(sat)$			7[c]	1.4	—	1.5	V
* $\|h_{fe}\|$ (f = 10 MHz)	5		1		10		
* K▲					—	9×10^{-16}	

*In accordance with JEDEC registration data.
[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer. This sustaining voltage should be measured by means of test circuit shown in Fig. 10.
[c]Pulsed; pulse duration ≤ 350 μs, duty factor ≤ 2%.

▲Damage constant $K = \dfrac{\dfrac{1}{h_{FE_2}} - \dfrac{1}{h_{FE_1}}}{\phi}$

Where h_{FE_1} = Beta prior to exposure
h_{FE_2} = Beta after exposure
θ = Neutron fluence (1 MeV equiv.)

Knowing K, h_{FE_2} may be calculated for other fluences using the relationship:

$$h_{FE_2} = \frac{1}{K\phi + \dfrac{1}{h_{FE_1}}}$$

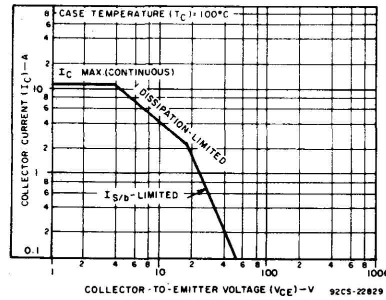


Fig. 6 - *Maximum operating area for both types (T_C = 100°C).*

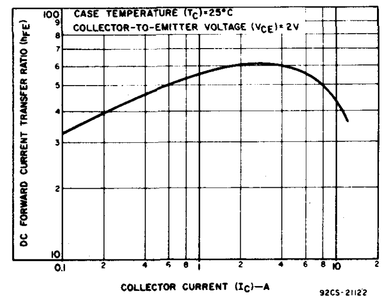


Fig. 7 - *Typical dc beta characteristic for both types.*

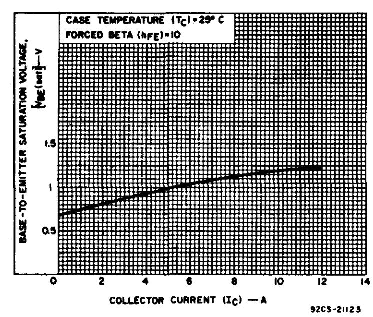


Fig. 8 - *Typical base-to-emitter saturation voltage characteristic as a function of collector current for both types.*

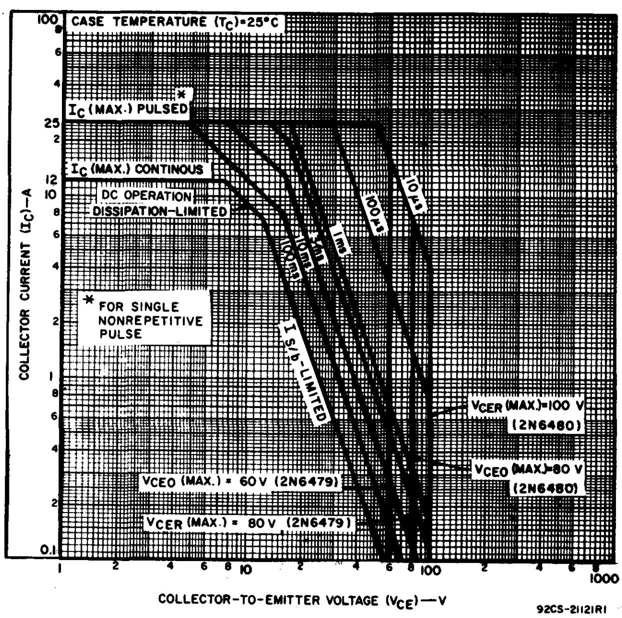


Fig. 5 - *Maximum operating areas for both types (T_C = 25°C).*

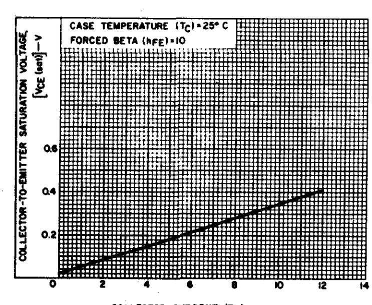


Fig. 9 - *Typical collector-to-emitter saturation voltage characteristic as a function of collector current for both types.*

2N6486-2N6491

15-A, 75-W, Silicon N-P-N and P-N-P Epitaxial-Base VERSAWATT Transistors

Complementary Pairs for General-Purpose Switching and Amplifier Applications

RCA-2N6486–2N6491●, inclusive, are epitaxial-base silicon transistors. The 2N6486, 2N6487, and 2N6488 are n-p-n complements of p-n-p types 2N6489, 2N6490, and 2N6491, respectively. All these devices are intended for a wide variety of medium-power switching and amplifier applications, and are particularly useful in high-fidelity amplifiers utilizing complementary-symmetry circuits.

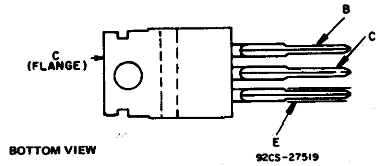
● Formerly RCA Dev. Nos. TA8325, TA8324, TA8323, TA8328, TA8327, and TA8326, respectively.

These devices are supplied in the RCA VERSAWATT package in color-coded molded-silicone plastic; the 2N6489–2N6491 (p-n-p) devices are green, and the 2N6486–2N6488 (n-p-n) devices are gray. All are regularly supplied in the JEDEC TO-220AB straight-lead version of the package. They are also available on special order in a variety of lead-form configurations.

Features:

- **Thermal-cycling ratings**
- **Maximum safe-area-of-operation curves**
- **Color-coded packages of molded-silicone plastic:**
  - **Green – p-n-p (2N6489, 2N6490, 2N6491)**
  - **Gray – n-p-n (2N6486, 2N6487, 2N6488)**

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		N-P-N 2N6486 / P-N-P 2N6489♦	N-P-N 2N6487 / P-N-P 2N6490♦	N-P-N 2N6488 / P-N-P 2N6491♦	
* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	50	70	90	V
COLLECTOR-TO-EMITTER VOLTAGE:					
* With 1.5 volts (V_{BE}) of reverse bias, and external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CEX}	50	70	90	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	45	65	85	V
With base open	V_{CEO}	40	60	80	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	V
* CONTINUOUS COLLECTOR CURRENT	I_C	15	15	15	A
* CONTINUOUS BASE CURRENT	I_B	5	5	5	A
* TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		75	75	75	W
At ambient temperatures up to 25°C		1.8	1.8	1.8	W
At case temperatures above 25°C		Derate linearly 0.6			W/°C
At ambient temperatures above 25°C		Derate linearly 0.0144			W/°C
* TEMPERATURE RANGE:					
Storage and operating (Junction)		–65 to +150			°C
* LEAD TEMPERATURE (During soldering): At distance ≥ 1/8 in. (3.17 mm) from seating plane for 10 s max.		235			°C

* In accordance with JEDEC registration data format JS-6 RDF-2.

♦ For p-n-p devices, voltage and current values are negative.

ELECTRICAL CHARACTERISTICS, *At case temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURR. A dc I_C	LIMITS 2N6486 2N6489♦ Min.	Max.	2N6487 2N6490♦ Min.	Max.	2N6488 2N6491♦ Min.	Max.	UNITS
Collector-Cutoff Current: With external base-emitter resistance (R_{BE}) = 100Ω	I_{CER}	35			–	500	–	–	–	–	µA
		55			–	–	–	500	–	–	
		75			–	–	–	–	–	500	
* With base-emitter junction reverse biased and external base-to-emitter resistance (R_{BE}) = 100Ω	I_{CEX}	45	–1.5		–	500	–	–	–	–	µA
		65	–1.5		–	–	–	500	–	–	
		85	–1.5		–	–	–	–	–	500	
* At T_C = 150°C	I_{CEX}	40	–1.5		–	5	–	–	–	–	mA
		60	–1.5		–	–	–	5	–	–	
		80	–1.5		–	–	–	–	–	5	
* With base open	I_{CEO}	20			–	1	–	–	–	–	mA
		30			–	–	–	1	–	–	
		40			–	–	–	–	–	1	
* Emitter-Cutoff Current	I_{EBO}		–5	0	–	1	–	1	–	1	mA
* DC Forward-Current Transfer Ratio	h_{FE}	4		5[a]	20	150	20	150	20	150	
		4		15[a]	5	–	5	–	5	–	
* Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$			0.2	40[b]		60[b]		80[b]		V
With external base-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$			0.2	45[b]		65[b]		85[b]		V
With base-emitter junction reverse-biased and external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CEX}(sus)$		1.5	0.2	50[b]		70[b]		90[b]		V
* Base-to-Emitter Voltage	V_{BE}	4		5[a]		1.3		1.3	–	1.3	V
		4		15[a]		3.5	–	3.5	–	3.5	
* Collector-to-Emitter Saturation Voltage, I_B = 0.5 A	$V_{CE}(sat)$			5[a]		1.3		1.3	–	1.3	V
I_B = 5 A				15[a]		3.5	–	3.5	–	3.5	
* Magnitude of Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio: f = 1 MHz	$\|h_{fe}\|$	4		1	5		5	–	5	–	
* Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		1	25	–	25	–	25	–	
Thermal Resistance: Junction-to-case	$R_{\theta JC}$				–	1.67	–	1.67	–	1.67	°C/W
Junction-to-ambient	$R_{\theta JA}$				–		–	70	–	70	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-2).

[a] Pulsed; pulse duration = 300 µs, duty factor = 1.8%

[b] *CAUTION: Sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ MUST NOT be measured on a curve tracer. (See Fig. 19)*

♦ For p-n-p devices, voltage and current values are negative.

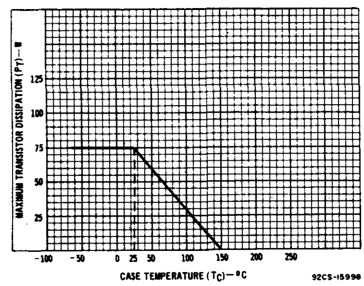


Fig. 1 - Derating chart for all types.

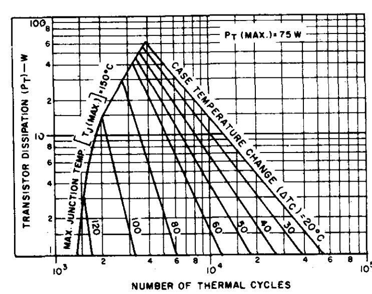


Fig. 2 - Thermal-cycling rating chart for all types

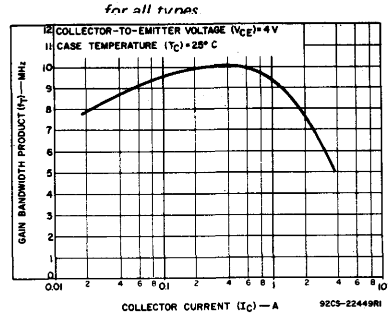


Fig. 3 - Typical gain-bandwidth product as a function of collector current for all types.♦

♦ For p-n-p devices, voltage and current values are negative.

2N6486-2N6491

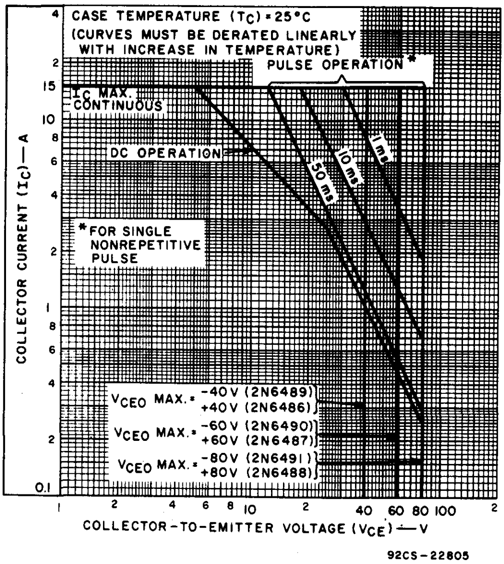


Fig. 4 - Maximum operating areas for all types.♦

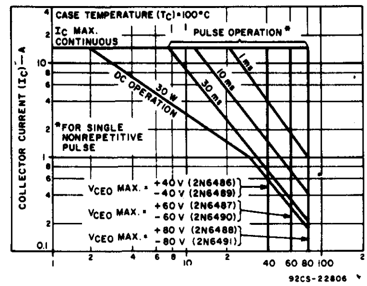


Fig. 5 - Maximum operating areas for all types.♦

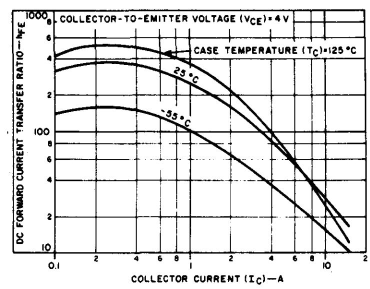


Fig. 6 - Typical dc beta characteristics for 2N6486, 2N6487, and 2N6488.

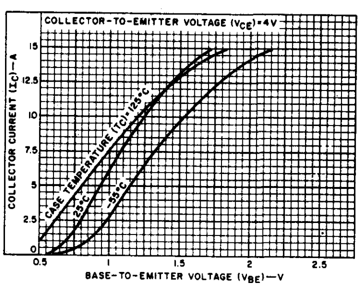


Fig. 7 - Typical transfer characteristics for all types.♦

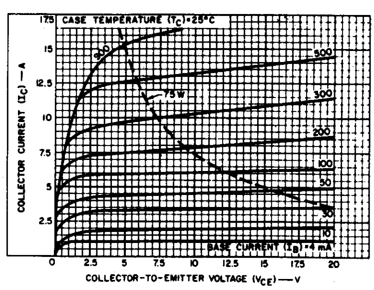


Fig. 8 - Typical output characteristics for all types.♦

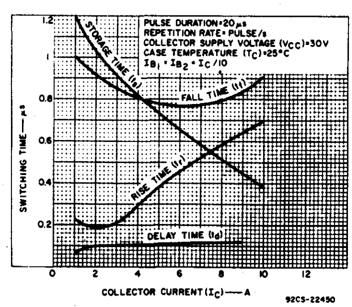


Fig. 9 - Typical saturated switching characteristics for 2N6486, 2N6487, and 2N6488.

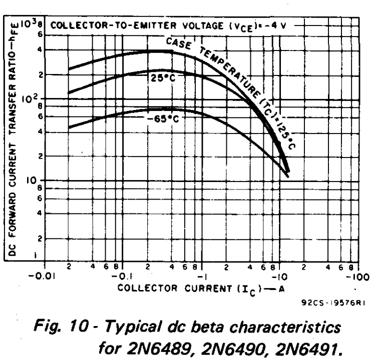


Fig. 10 - Typical dc beta characteristics for 2N6489, 2N6490, 2N6491.

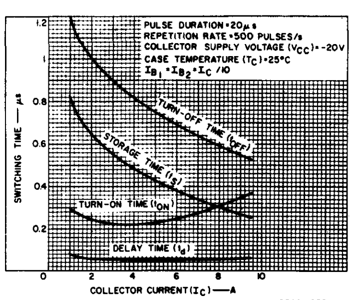


Fig. 11 - Typical saturated switching characteristics for 2N6489, 2N6490, and 2N6491.

♦ For p-n-p devices, voltage and current values are negative.

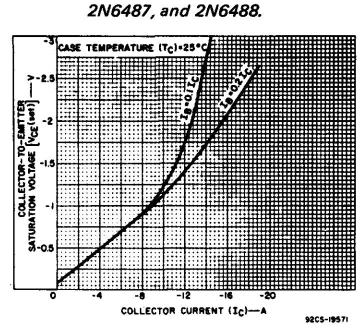


Fig. 12 - Typical collector-to-emitter saturation-voltage characteristics for all types.

2N6510-2N6514

High-Voltage, High-Current, Silicon N-P-N Power Switching Transistors

For Switching Applications in Industrial Commercial and Military Equipment

Features:
- Fast switching speed
- Epitaxial pi-nu construction
- Hermetic steel package—JEDEC TO-3
- Maximum-safe-area-of-operation curves
- Thermal-cycling rating chart

The RCA-2N6510, -2N6511, -2N6512, -2N6513, and -2N6514• are epitaxial silicon n-p-n power transistors with pi-nu construction. They are especially designed for use in electronic ignition circuits and other applications requiring high-voltage, high-energy, and fast-switching-speed capability.

These devices are hermetically sealed in a steel JEDEC TO-3 package. They differ from each other in breakdown-voltage ratings, leakage, and beta characteristics.

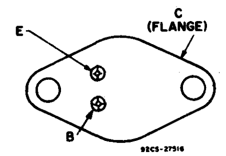
•Formerly RCA Dev. Nos. TA8847D, TA8847A, TA8847B, TA8847C, and TA8847E, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N6510	2N6511	2N6512	2N6513	2N6514	
•COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	250	300	350	400	350	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:							
With external base-to-emitter resistance R_{BE} = 50 Ω	$V_{CER}(sus)$	250	300	350	400	350	V
• With base open	$V_{CEO}(sus)$	200	250	300	350	300	V
•EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	6	V
•CONTINUOUS COLLECTOR CURRENT	I_C	7	7	7	7	7	A
•CONTINUOUS BASE CURRENT	I_B	3	3	3	3	3	A
•EMITTER CURRENT	I_E	10	10	10	10	10	A
•TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C		120	120	120	120	120	W
At case temperatures above 25°C		See Figs. 1 and 2.					
•TEMPERATURE RANGE:							
Storage and Operating (Junction)		−65 to +200					°C
•PIN TEMPERATURE (During Soldering):							
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230					°C

•In accordance with JEDEC registration data format JC-25 RDF-1.

TERMINAL DESIGNATIONS



JEDEC TO-3

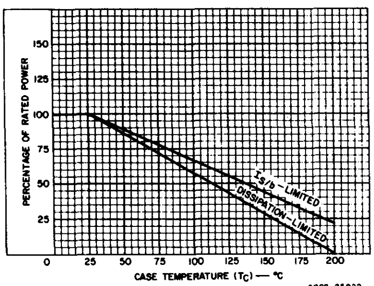


Fig. 2 - Derating curve for all types.

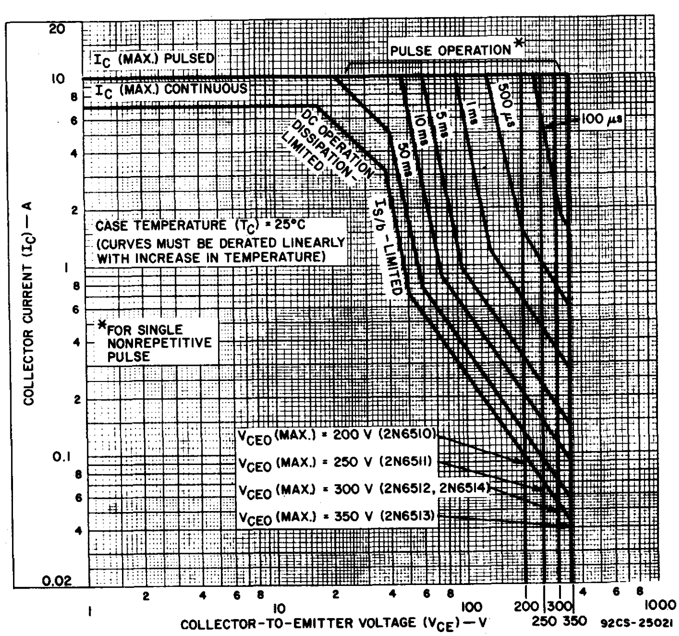


Fig. 1 - Maximum operating areas for all types.

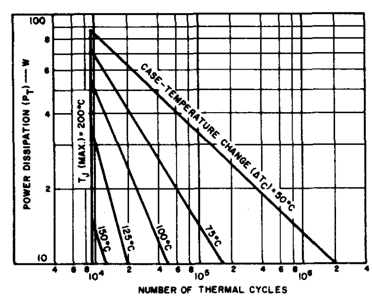


Fig. 3 - Thermal-cycling rating chart for all types.

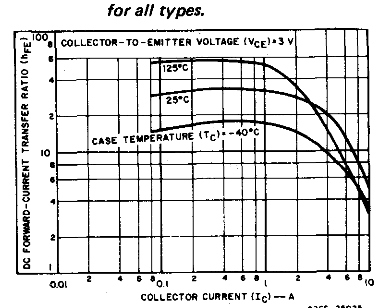


Fig. 4 - Typical dc beta characteristic for all types.

2N6510-2N6514

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6512 2N6514 Min.	Typ.	Max.	2N6513 Min.	Typ.	Max.	UNITS
Collector-Cutoff Current: With base open	I_{CEO}	250 300				– –	– –	5 –	– –	– –	– 5	mA
• With base-emitter junction reverse biased	I_{CEV}	350 400	−1.5 −1.5			– –	– –	5 –	– –	– –	– 5	mA
• With base-emitter junction reverse biased, T_C = 100°C	I_{CEV}	350 400	−1.5 −1.5			– –	– –	10 –	– –	– –	– 10	mA
• Emitter-Cutoff Current	I_{EBO}		−6			–	–	3	–	–	3	mA
• Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.2		300[b]	–	–	350[b]	–	–	V
With external base-to-emitter resistance: R_{BE} = 50 Ω	$V_{CER}(sus)$			0.2		350[b]	–	–	400[b]	–	–	V
• Emitter-to-Base Voltage: I_E = 3 mA	V_{EBO}					6	–	–	6	–	–	V
• DC Forward-Current Transfer Ratio: 2N6512, 2N6513 2N6514	h_{FE}	3 3		4[a] 5[a]		10 10	– –	50 50	10 –	– –	50 –	
• Base-to-Emitter Saturation Voltage: 2N6512, 2N6513 2N6514	$V_{BE}(sat)$			4[a] 5[a]	0.8 1	– –	– –	1.7 1.7	– –	– –	1.7 –	V
• Collector-to-Emitter Saturation Voltage: 2N6512, 2N6513 2N6514 All types	$V_{CE}(sat)$			4[a] 5 7	0.8 1 3	– – –	– – 1.5	1.5 1.5 2.5	– – –	– – 1.5	1.5 – 2.5	V
• Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}					100	–	200	100	–	200	pF
• Magnitude of Common Emitter, Small-Signal Short-Circuit, Forward-Current Transfer Ratio: f = 1 MHz	$\|h_{fe}\|$	10		1		3	–	9	3	–	9	MHz
• Forward-Bias, Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	38 200				3.16 0.1	– –	– –	3.16 0.1	– –	– –	A
• Switching Time:[c] (V_{CC} = 200 V, I_{B1} = I_{B2}): Delay Time: 2N6512, 2N6513 2N6514	t_d			4 5	0.8 1	– –	0.1 0.1	0.2 0.2	– –	0.1 –	0.2 –	µs
Rise Time: 2N6512, 2N6513 2N6514	t_r			4 5	0.8 1	– –	0.7 0.7	1.5 1.5	– –	0.7 –	1.5 –	µs
Storage Time: 2N6512, 2N6513 2N6514	t_s			4 5	0.8 1	– –	3 3	5 5	– –	3 –	5 –	µs
Fall Time: 2N6512, 2N6513 2N6514	t_f			4 5	0.8 1	– –	0.5 0.5	1.5 1.5	– –	0.5 –	1.5 –	µs
• Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	20		5		–	–	1.46	–	–	1.46	°C/W

• Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

a Pulsed; pulse duration = 300 µs, duty factor ≤ 2%.

b CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

c See Figs. 10 and 11.

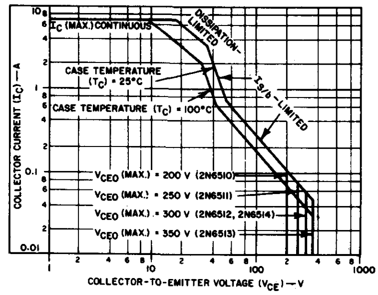


Fig. 5 - Maximum operating areas for all types at 25°C and 100°C.

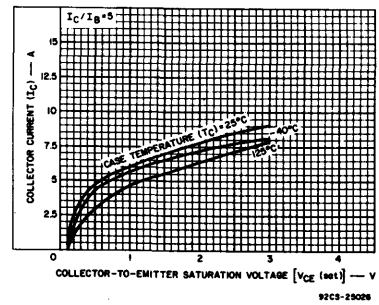


Fig. 6 - Typical collector-to-emitter saturation-voltage characteristics for all types.

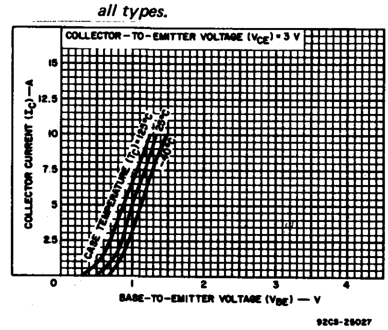


Fig. 7 - Typical transfer characteristics for all types.

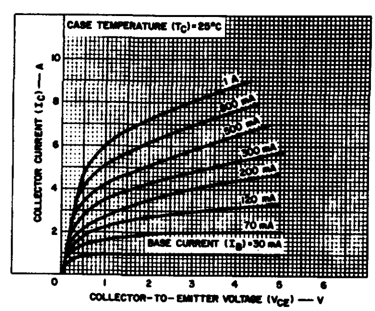


Fig. 8 - Typical output characteristics for all types.

2N6510-2N6514

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS 2N6510			LIMITS 2N6511			UNITS
		V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current: With base open	I_{CEO}	150 200				– –	– –	5 –	– –	– –	– 5	mA
* With base-emitter junction reverse biased	I_{CEV}	250 300	−1.5 −1.5			– –	– –	5 –	– –	– –	– 5	mA
* With base-emitter junction reverse biased, T_C = 100°C	I_{CEV}	250 300	−1.5 −1.5			– –	– –	10 –	– –	– –	– 10	mA
* Emitter-Cutoff Current	I_{EBO}		−6			–	–	3	–	–	3	mA
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.2		200[b]	–	–	250[b]	–	–	V
With external base-to-emitter resistance: R_{BE} = 50 Ω	$V_{CER}(sus)$			0.2		250[b]	–	–	300[b]	–	–	V
* Emitter-to-Base Voltage: I_E = 3 mA	V_{EBO}					6	–	–	6	–	–	V
* DC Forward-Current Transfer Ratio	h_{FE}	3 3		3[a] 4[a]		10 –	– –	50 –	– 10	– –	– 50	
* Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			3[a] 4[a]	0.6 0.8	– –	– –	1.7 –	– –	– –	– 1.7	V
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			3[a] 4[a] 7[a]	0.6 0.8 3	– – –	– – 1.5	1.5 – 2.5	– – –	– – 1.5	– 1.5 2.5	V
* Output Capacitance: V_{CB} = 10 V, f = 1 MHz	C_{obo}					100	–	200	100	–	200	pF
* Magnitude of Common Emitter, Small-Signal Short-Circuit, Forward-Current Transfer Ratio: f = 1 MHz	$\|h_{fe}\|$	10		1		3	–	9	3	–	9	MHz
* Forward-Bias, Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	38 200				3.16 0.1	– –	– –	3.16 0.1	– –	– –	A
* Switching Time:[c] (V_{CC} = 200 V, I_{B1} = I_{B2}): Delay Time	t_d			3 4	0.6 0.8	– –	0.1 –	0.2 –	– –	– 0.1	– 0.2	μs
Rise Time	t_r			3 4	0.6 0.8	– –	0.7 –	1.5 –	– –	– 0.7	– 1.5	μs
Storage Time	t_s			3 4	0.6 0.8	– –	3 –	5 –	– –	– 3	– 5	μs
Fall Time	t_f			3 4	0.6 0.8	– –	0.5 –	1.5 –	– –	– 0.5	– 1.5	μs
* Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	20		5		–	–	1.46	–	–	1.46	°C/W

* Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

[a] Pulsed; pulse duration = 300 μs, duty factor ≤ 2%.

[b] CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig. 11.

[c] See Figs. 8-10.

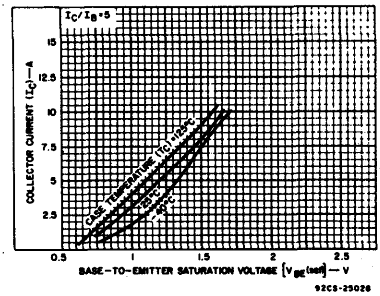


Fig. 9 - Typical base-to-emitter saturation-voltage characteristics for all types.

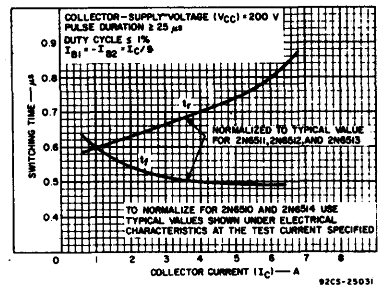


Fig. 10 - Typical rise- and fall-time characteristics for all types.

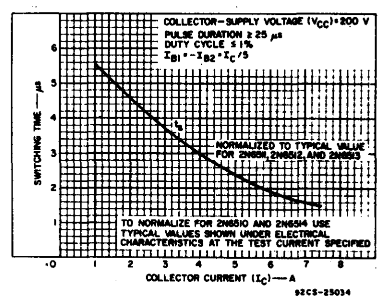


Fig. 11 - Typical storage-time characteristic for all types.

2N6530-2N6533

8-Ampere N-P-N Darlington Power Transistors

80, 100, 120 Volts, 60 Watts
Gain of 1000 at 5 A (2N6530, 2N6532)

Gain of 1000 at 3 A (2N6533)
Gain of 500 at 3 A (2N6531)

The RCA-2N6530, 2N6531, 2N6532, and 2N6533● are monolithic n-p-n silicon Darlington transistors designed for power applications at low and medium frequencies. The double epitaxial construction of these devices provides good forward and reverse second-breakdown characteristics. Their high gain allows them to be driven directly from integrated circuits.

● Formerly RCA Dev. Nos. TA8904C, TA8904D, TA8904B, and TA8904A, respectively.

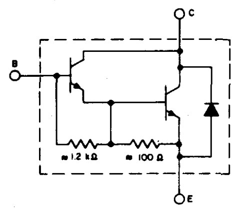
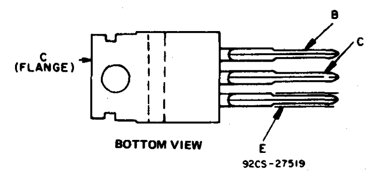


Fig. 1 - Schematic diagram for all types.

Features:
- Operate from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6530	2N6531	2N6532	2N6533	
*V_{CBO}	80	100	100	120	V
$V_{CER}(sus)$					
R_{BE} = 100 Ω	80	100	100	120	V
$V_{CEO}(sus)$	80	100	100	120	V
*$V_{CEV}(sus)$					
V_{BE} = −1.5 V	80	100	100	120	V
*V_{EBO}	5	5	5	5	V
*I_C	8	8	8	8	A
I_{CM}	15	15	15	15	A
*I_B	0.25	0.25	0.25	0.25	A
*P_T					
Up to 25°C	65	65	65	65	W
Above 25°C	See Fig. 2				
*T_J, T_{stg}	−65 to +150				°C
*T_L					
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

* In accordance with JEDEC registration data format JS-6, RDF-4.

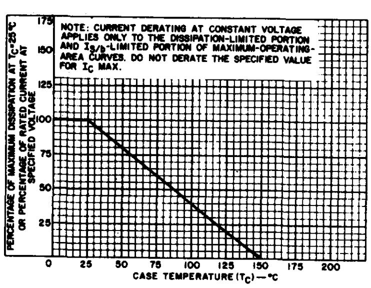


Fig. 2 - Dissipation derating curve for all types.

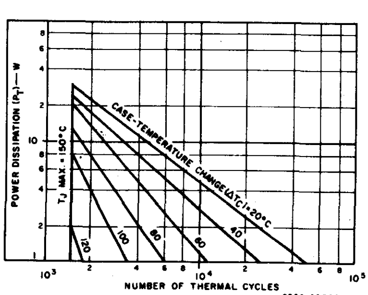


Fig. 3 - Thermal-cycling rating chart for all types.

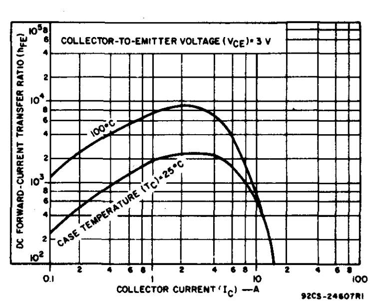


Fig. 4 - Typical dc beta characteristics for all types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6530 Min.	Max.	2N6531 Min.	Max.	UNITS
I_{CEO}	80 100			0 0	– –	1 –	– –	– 1	
* I_{CEV}	80 100	−1.5 −1.5			– –	0.5 –	– –	– 0.5	mA
* T_C = 125°C	80 100	−1.5 −1.5			– –	5 –	– –	– 5	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		5[a] 3[a] 8[a]		1,000 – 100	10,000 – 5,000	– 500 100	– 10,000 5,000	
$V_{CEO}(sus)$			0.2	0	80[b]	–	100[b]	–	
$V_{CER}(sus)$ R_{BE} = 100 Ω			0.2		80[b]	–	100[b]	–	V
* $V_{CEV}(sus)$		−1.5	0.2		80[b]	–	100[b]	–	
V_{BE}	3 3 3		5[a] 3[a] 8[a]		– – –	2.8 – 4.5*	– – –	– 2.8 4.5*	V
$V_{CE}(sat)$			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	3 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 0.5 s, nonrep.	24				2.7	–	2.7	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	1.92	–	1.92	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

a Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

b *CAUTION:* Sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ *MUST NOT* be measured on a curve tracer.

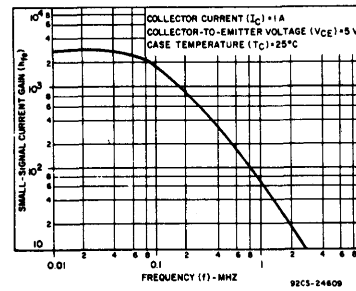


Fig. 5 - Typical small-signal current gain for all types.

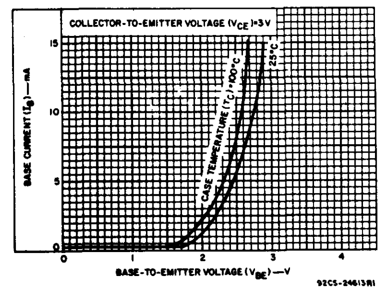


Fig. 6 - Typical input characteristics for all types.

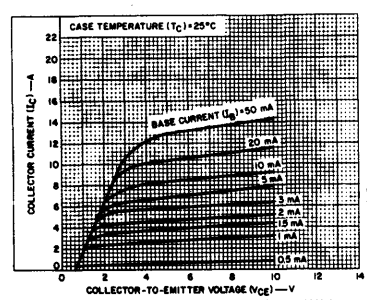


Fig. 7 - Typical output characteristics for all types.

2N6530-2N6533

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6532		2N6533		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	120 100			0 0	– –	– 1	– –	1 –	
* I_{CEV}	120 100	−1.5 −1.5			– –	– 0.5	– –	0.5 –	mA
* T_C = 125°C	120 100	−1.5 −1.5			– –	– 5	– –	5 –	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		3[a] 5[a] 8[a]		– 1,000 100	– 10,000 5,000	1,000 – 100	10,000 – 5,000	
V_{CEO}(sus)			0.2	0	100[b]	–	120[b]	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2		100[b]	–	120[b]	–	V
* V_{CEV}(sus)		−1.5	0.2		100[b]	–	120[b]	–	
V_{BE}	3 3 3		3[a] 5[a] 8[a]		– – –	– 2.8 4.5*	– – –	2.8 – 4.5*	V
V_{CE}(sat)			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	2 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 0.5 s, nonrep.	24				2.7	–	2.7	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	1.92	–	1.92	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽ 2%.

[b] *CAUTION:* Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEV}(sus) *MUST NOT* be measured on a curve tracer.

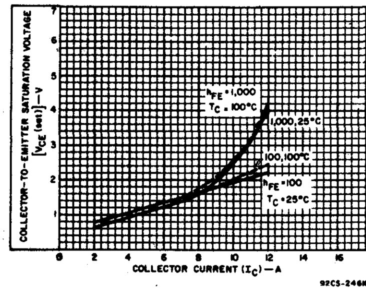


Fig. 8 - Typical saturation characteristics for all types.

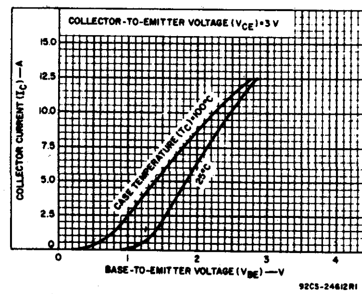


Fig. 9 - Typical transfer characteristics for all types.

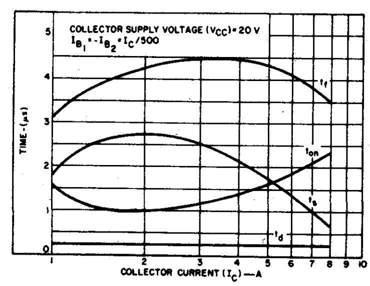


Fig. 10 - Typical saturated switching-time characteristics for all types.

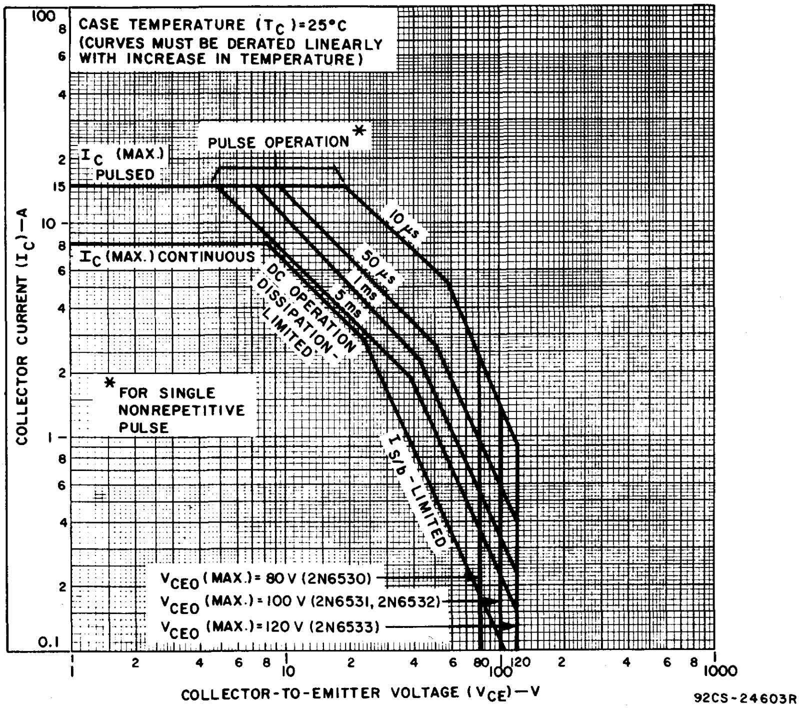


Fig. 11 - Maximum operating areas for all types at case temperature of 25°C.

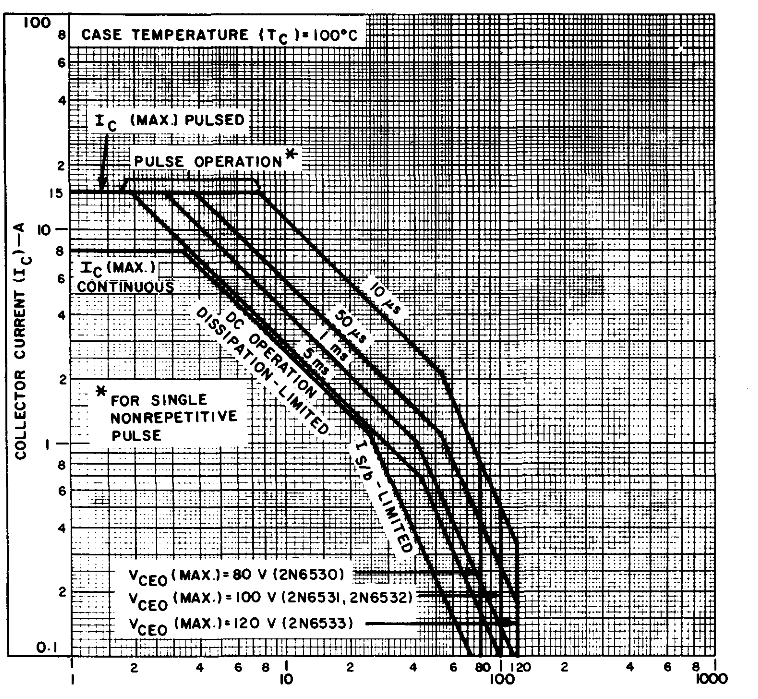


Fig. 12 - Maximum operating areas for all types at case temperature of 100°C.

2N6534-2N6537

8-Ampere N-P-N Darlington Power Transistors

80, 100, 120 Volts, 36 Watts
Gain of 1000 at 5 A (2N6534, 2N6536)
Gain of 1000 at 3 A (2N6537)
Gain of 500 at 3 A (2N6535)

Features:
- **Operate from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:
- **Power switching**
- **Audio amplifiers**
- **Hammer drivers**
- **Series and shunt regulators**

The RCA-2N6534, 2N6535, 2N6536, and 2N6537● are monolithic n-p-n silicon Darlington transistors designed for power applications at low and medium frequencies. The double epitaxial construction of these devices provides good forward and reverse second-breakdown characteristics. Their high gain allows them to be driven directly from integrated circuits.

These transistors are supplied in JEDEC TO-66 hermetic packages.

● Formerly RCA Dev. Nos. TA8941C, TA8941D, TA8941B, and TA8941A, respectively.

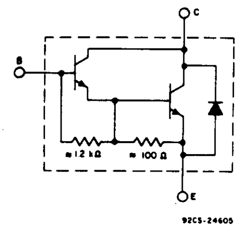
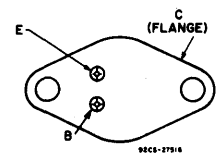


Fig. 1 - Schematic diagram for all types.

TERMINAL DESIGNATIONS



JEDEC TO-66

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6534	2N6535	2N6536	2N6537	
*V_{CBO}	80	100	100	120	V
$V_{CER}(sus)$					
R_{BE} = 100 Ω	80	100	100	120	V
$V_{CEO}(sus)$	80	100	100	120	V
*$V_{CEV}(sus)$					
V_{BE} = −1.5 V	80	100	100	120	V
*V_{EBO}	5	5	5	5	V
*I_C	8	8	8	8	A
I_{CM}	15	15	15	15	A
*I_B	0.25	0.25	0.25	0.25	A
*P_T					
Up to 25°C	36	36	36	36	W
Above 25°C	See Fig. 2				
*T_{stg}	−65 to +200				°C
*T_J	−65 to +150				°C
*T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

* In accordance with JEDEC registration data format JS-6, RDF-4.

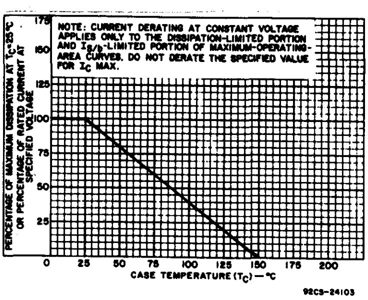


Fig. 2 - Dissipation derating curve for all types.

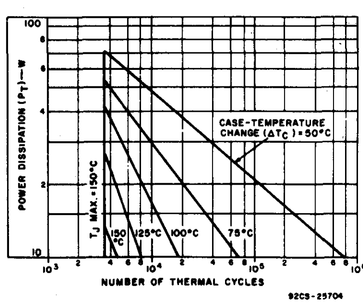


Fig. 3 - Thermal-cycling rating chart for all types.

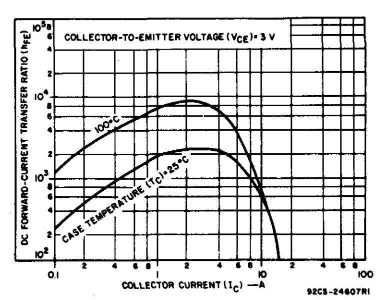


Fig. 4 - Typical dc beta characteristics for all types.

2N6534-2N6537

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6534		2N6535		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	80 100			0 0	– –	1 –	– –	– 1	
* I_{CEV}	80 100	−1.5 −1.5			– –	0.5 –	– –	– 0.5	mA
* T_C = 150°C	80 100	−1.5 −1.5			– –	5 –	– –	– 5	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		5[a] 3[a] 8[a]		1,000 – 100	10,000 – 5,000	– 500 100	– 10,000 5,000	
V_{CEO}(sus)			0.2	0	80[b]	–	100[b]	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2		80[b]	–	100[b]	–	V
* V_{CEV}(sus)		−1.5	0.2		80[b]	–	100[b]	–	
V_{BE}	3 3 3		5[a] 3[a] 8[a]		– – –	2.8 – 4.5*	– – –	– 2.8 4.5*	V
V_{CE}(sat)			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	3 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 1 s, nonrep.	34				1.06	–	1.06	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	3.5	–	3.5	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

[b] *CAUTION:* Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEV}(sus) ***MUST NOT*** be measured on a curve tracer.

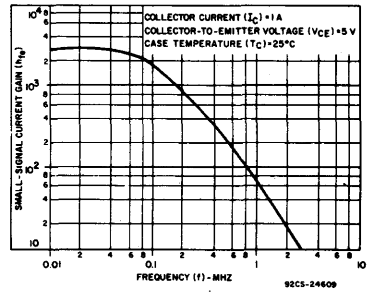


Fig. 5 - Typical small-signal current gain for all types.

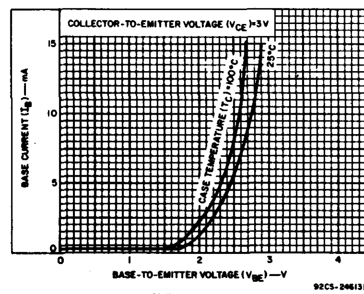


Fig. 6 - Typical input characteristics for all types.

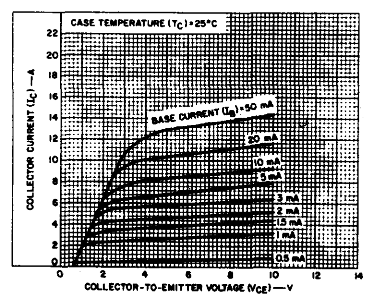


Fig. 7 - Typical output characteristics for all types.

2N6534-2N6537

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6536		2N6537		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	120 100			0 0	– –	– 1	– –	1 –	
* I_{CEV}	120 100	−1.5 −1.5			– –	– 0.5	– –	0.5 –	mA
* T_C = 150°C	120 100	−1.5 −1.5			– –	– 5	– –	5 –	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		3[a] 5[a] 8[a]		– 1,000 100	– 10,000 5,000	1,000 – 100	10,000 – 5,000	
V_{CEO}(sus)			0.2	0	100[b]	–	120[b]	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2		100[b]	–	120[b]	–	V
* V_{CEV}(sus)		−1.5	0.2		100[b]	–	120[b]	–	
V_{BE}	3 3 3		3[a] 5[a] 8[a]		– – –	– 2.8 4.5*	– – –	2.8 – 4.5*	V
V_{CE}(sat)			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	2 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 1 s, nonrep.	34				1.06	–	1.06	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	3.5	–	3.5	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽ 2%.

[b] *CAUTION:* Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEV}(sus) *MUST NOT* be measured on a curve tracer.

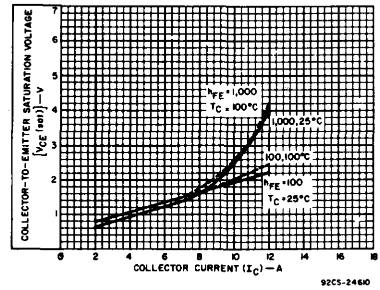


Fig. 8 - Typical saturation characteristics for all types.

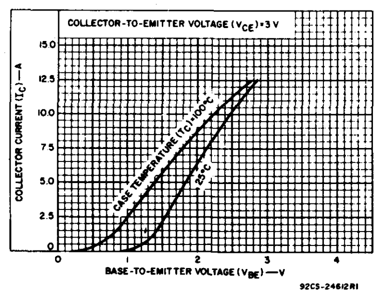


Fig. 9 - Typical transfer characteristics for all types.

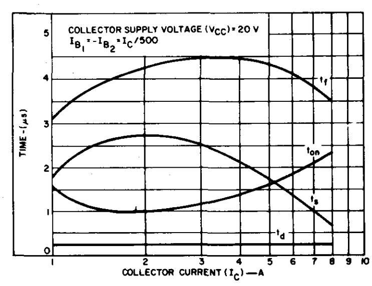


Fig. 10 - Typical saturated switching-time characteristics for all types.

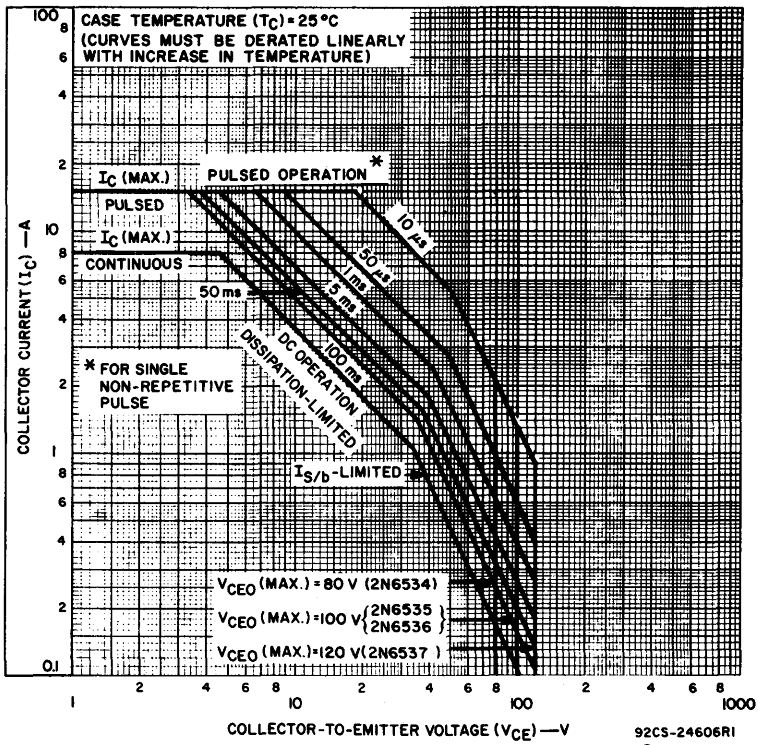


Fig. 11 - Maximum operating areas for all types at case temperature of 25°C.

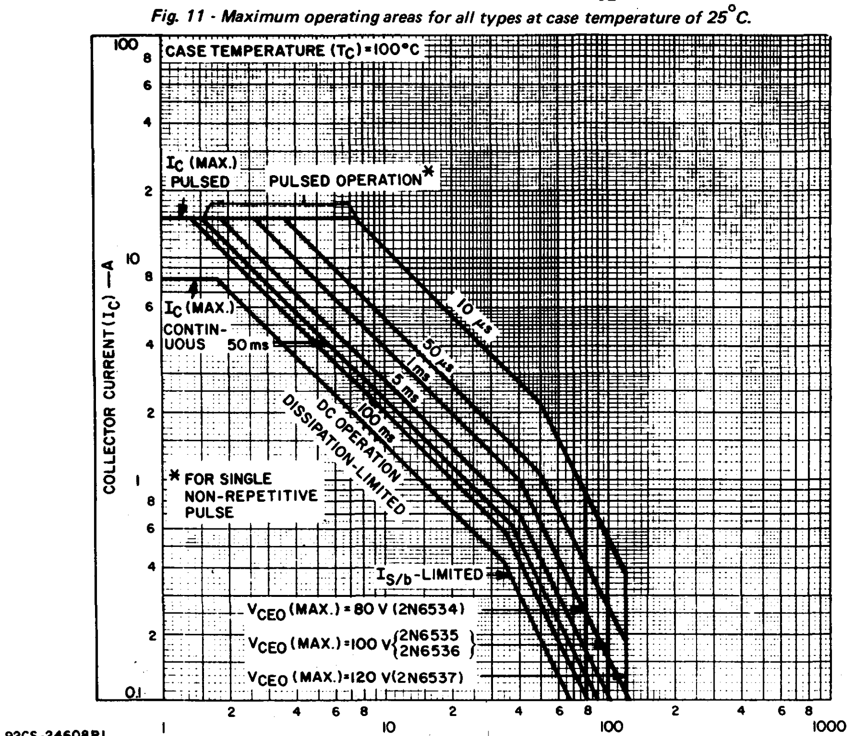


Fig. 12 - Maximum operating areas for all types at case temperature of 100°C.

2N6542, 2N6544, 2N6546

3-, 5-, and 10-A Power-Switching Transistors

High-Voltage N-P-N Types for Off- Line Power Supplies and Other High-Voltage Switching Applications

The RCA-2N6542, 2N6544, and 2N6546 series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are eassential to the design to high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are characterized at 100°C; as well as at 25°C, to provide information necessary for worst-case design.

The 2N6542, 2N6544 and 2N6546 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

Features:

- 100% High Temperature Tested for 100°C Parameters
- Fast Switching Speed
- High Voltage Rating: V_{CEX} = 350 V
- Low V_{CE}(sat) at I_C = 3-, 5-, and 10-A
- Steel Hermetic TO-204MA Package

Applications:

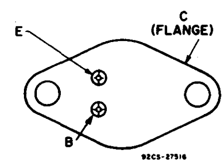
- Off-Line Power Supplies
- High Voltage Inverters
- Switching Regulators

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6542	2N6544	2N6546	
* V_{CBO}		650		V
* V_{CEV} V_{BE} = −1.5 V		650		V
* V_{CEX}(Clamped) V_{BE} = −1.5 V		350		V
* V_{CEO}		300		V
* V_{EBO}		9		V
I_C(sat)	3	5	10	A
* I_C	5	8	15	A
I_{CM}	10	16	30	A
* I_B	5	8	10	A
* P_T				
T_C up to 25°C	100	125	175	W
T_C above 25°C, derate linearly	0.57	0.714	1	W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L At distance ≥ 1/8 in. (3.17 mm) from seating plane for 5 s max.		275		°C

* In accordance with JEDEC registration data.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

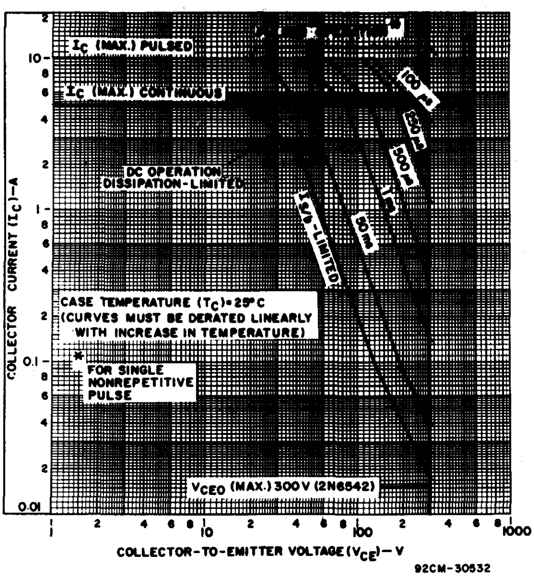


Fig. 1 – Maximum operating areas for type 2N6542 (T_C = 25°C).

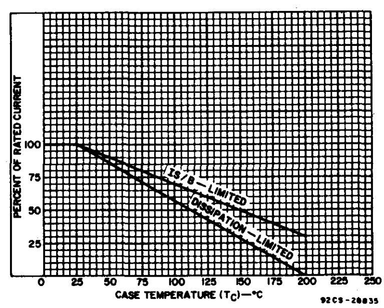


Fig. 2 – Dissipation and $I_{S/b}$ derating curves for all types.

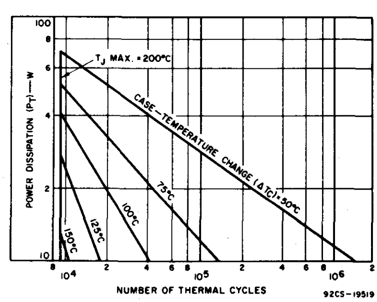


Fig. 3 – Thermal-cycling chart for type 2N6542.

2N6542, 2N6544, 2N6546

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						Units
	VOLTAGE V dc		CURRENT A dc		2N6542		2N6544		2N6546		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
$T_C = 25°C$											
* I_{CEV}	650	−1.5			–	0.5	–	0.5	–	1	mA
* I_{EBO}		−9	0		–	1	–	1	–	1	mA
* $V_{CEO}(sus)^b$			0.1[a]		300	–	300	–	300	–	V
* h_{FE}	2		3[a]		7	35	–	–	–	–	
	2		1.5[a]		12	60	–	–	–	–	
	3		5[a]		–	–	7	35	–	–	
	3		2.5[a]		–	–	12	60	–	–	
	2		10[a]		–	–	–	–	6	30	
	2		5[a]		–	–	–	–	12	60	
* $V_{BE}(sat)$			3[a]	0.6	–	1.4	–	–	–	–	V
			5[a]	1	–	–	–	1.6	–	–	V
			10[a]	2	–	–	–	–	–	1.6	V
* $V_{CE}(sat)$			3[a]	0.6	–	1	–	–	–	–	V
			5[a]	1	–	5	–	1.5	–	–	V
			8[a]	2	–	–	–	5	–	–	V
			10[a]	2	–	–	–	–	–	1.5	V
			15[a]	3	–	–	–	–	–	5	V
* $I_{S/b}$ t = 1 s	100				0.2	–	0.2	–	0.2	–	A
* f_T f = 1 MHz	10		0.2		6	28	–	–	–	–	MHz
	10		0.3		–	–	6	28	–	–	MHz
	10		0.5		–	–	–	–	6	28	MHz
* C_{obo} f = 1 MHz	10[d]				50	200	75	300	125	500	pF
* t_d^e			3	0.6	–	0.05	–	–	–	–	μs
			5	1	–	–	–	0.05	–	–	μs
			10	2	–	–	–	–	–	0.05	μs
* t_r^e			3	0.6	–	0.7	–	–	–		μs
			5	1	–	–	–	1	–	–	μs
			10	2	–	–	–	–	–	1	μs
* t_s^e			3	0.6	–	4	–	–	–	–	μs
			5	1	–	–	–	4	–	–	μs
			10	2	–	–	–	–	–	4	μs
* t_f^e			3	0.6	–	0.8	–	–	–	–	μs
			5	1	–	–	–	1	–	–	μs
			10	2	–	–	–	–	–	0.7	μs

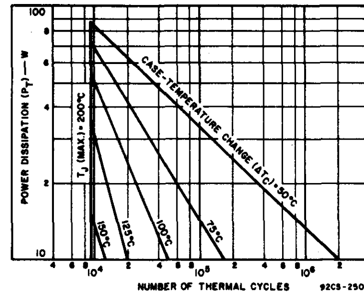


Fig. 4 — Thermal-cycling chart for type 2N6544.

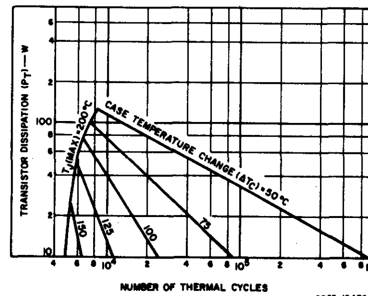


Fig. 5 — Thermal-cycle rating chart for type 2N6546.

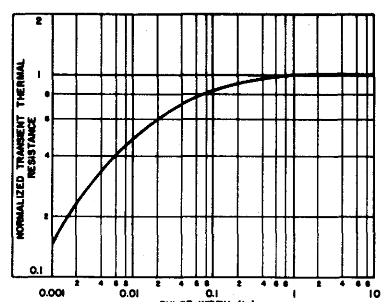


Fig. 6 — Typical thermal-response characteristic for types 2N6542 and 2N6544.

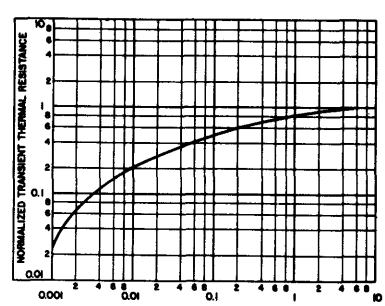


Fig. 7 — Typical thermal-response characteristic for type 2N6546.

2N6542, 2N6544, 2N6546

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6542 Min.	Max.	2N6544 Min.	Max.	2N6546 Min.	Max.	Units
$T_C = 100°C$											
* I_{CEV}	650	−1.5			–	2.5	–	2.5	–	4	mA
* I_{CER} $R_{BE} = 50\ \Omega$	650				–	3	–	3	–	5	mA
* $V_{CEX}(sus)$[b,c] $V_{CC} = 20$ V, L=180 µH, $R_C = 0.05\Omega$, V_{clamp} = Rated V_{CEX}			2.6[a]		350	–	–	–	–	–	V
			4.5[a]		–	–	350	–	–	–	V
			8[a]		–	–	–	–	350	–	V
V_{clamp} = Rated V_{CEO} −100 V			5[a]		200	–	–	–	–	–	V
			8[a]		–	–	200	–	–	–	V
			15[a]		–	–	–	–	200	–	V
* $V_{BE}(sat)$			3[a]	0.6	–	1.4	–	–	–	–	V
			5[a]	1	–	–	–	1.6	–	–	V
			10[a]	2	–	–	–	–	–	1.6	V
* $V_{CE}(sat)$			3[a]	0.6	–	2	–	–	–	–	V
			5[a]	1	–	–	–	2.5	–	–	V
			10[a]	2	–	–	–	–	–	2.5	V
* t_s[f]		−5	3	0.6	–	4	–	–	–	–	µs
		−5	5	1	–	–	–	4	–	–	µs
		−5	10	2	–	–	–	–	–	5	µs
* t_f[f]		−5	3	0.6	–	0.8	–	–	–	–	µs
		−5	5	1	–	–	–	0.9	–	–	µs
		−5	10	2	–	–	–	–	–	1.5	µs
* $R_{\theta JC}$					–	1.75	–	1.4	–	1	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed: pulse duration = 300 µs, duty factor ≤2%.
[b] **CAUTION:** The sustaining voltage $V_{CEO}(sus)$ and $V_{CEX}(sus)$ ***MUST NOT*** be measured on a curve tracer.
[c] $V_{CC} = 20$ V, L = 180 µH, $R_C = 0.05\ \Omega$
[d] V_{CB} value
[e] Resistive load, $V_{CC} = 250$ V, $t_p = 100$ µs, $I_{B_1} = -I_{B_2}$
[f] Inductive load, V_{clamp} = Rated $V_{CEX}(sus)$, $I_{B_1} = -I_C/5$, L = 180 µH, $R_C = 0.05\ \Omega$, $V_{CC} = 20$ V

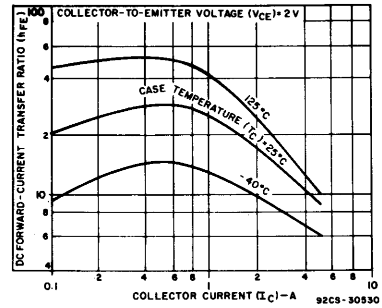


Fig. 8 — Typical dc beta characteristics for type 2N6542.

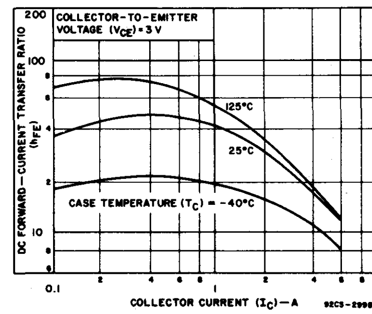


Fig. 9 — Typical dc beta characteristics for type 2N6544.

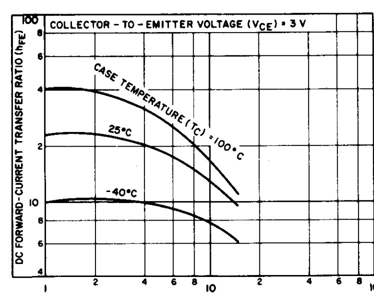


Fig. 10 — Typical dc beta characteristics for type 2N6546.

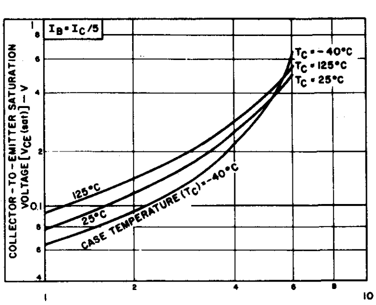


Fig. 11 — Typical collector-to-emitter saturation voltage as a function of collector current for types 2N6542 and 2N6544.

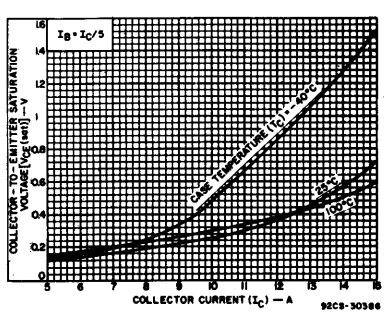


Fig. 12 — Typical collector-to-emitter saturation voltage characteristics for type 2N6546.

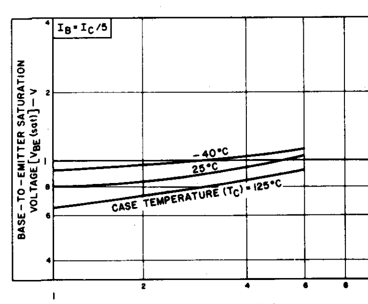


Fig. 13 — Typical base-to-emitter saturation voltage as a function of collector current for types 2N6542 and 2N6544.

2N6542, 2N6544, 2N6546

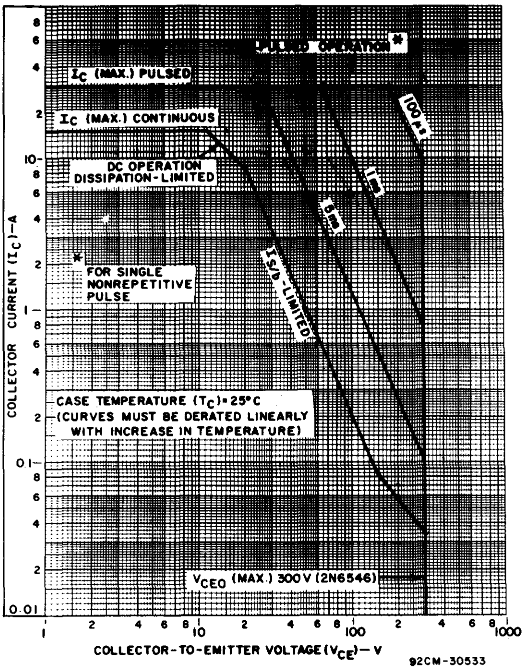


Fig. 14 — Maximum operating areas for type 2N6546 (T_C = 25°C).

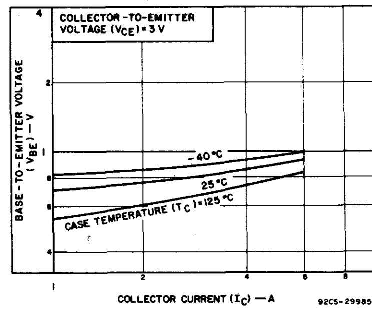


Fig. 16 — Typical base-to-emitter voltage as a function of collector current for types 2N6542 and 2N6544.

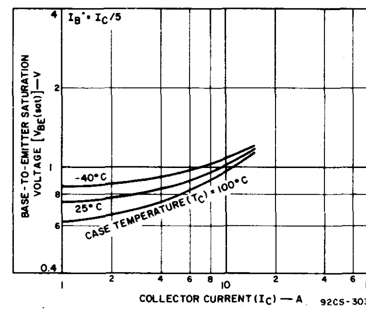


Fig. 17 — Typical base-to-emitter saturation voltage characteristics for type 2N6546.

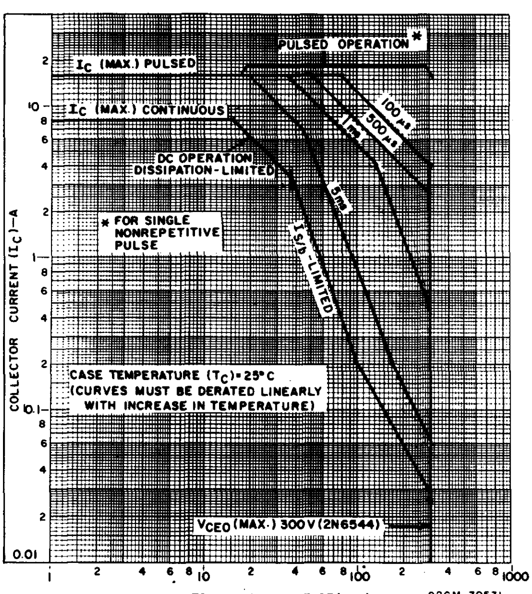


Fig. 15 — Maximum operating areas for type 2N6544 (T_C = 25°C).

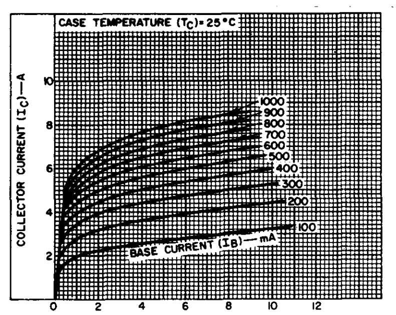


Fig. 18 — Typical output characteristics for types 2N6542 and 2N6544.

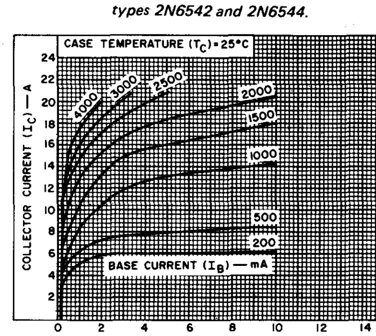


Fig. 19 — Typical output characteristics for type 2N6546.

2N6609, MJ15004, RCA9116C, RCA9116D, RCA9116E

Silicon P-N-P Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable
For Industrial and Commercial Use

The RCA-2N6609, MJ15004, RCA9116C, RCA9116D, and RCA9116E are ballasted epitaxial-base silicon p-n-p transistors featuring high gain at high current. They may be used as complements to the n-p-n types RCA3773, MJ15003, RCA8638C, RCA 8638D, and RCA8638E, respectively.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA packages.

Features:

- High-dissipation capability
- Low saturation voltages
- Maximum safe-area-of-operation curves
- f_T = 2 MHz
- High gain at high current

Applications:

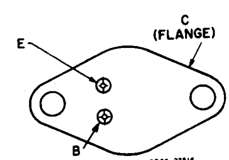
- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6609	MJ15004	RCA9116C	RCA9116D	RCA9116E	
* V_{CBO}	−160	−140	−140	−120	−100	V
$V_{CEX}(sus)$ V_{BE} = −1.5 V; R_{BE} = 100 Ω	−160	–	–	–	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω	−150	−150	−150	−130	−110	V
* $V_{CEO}(sus)$	−140	−140	−140	−120	−100	V
* V_{EBO}	−7	−5				V
* I_C	−16	−20				A
* I_B	−4	−5				A
* P_T						
At $T_C \geq 25°C$	150	250	200	200	200	W
At $T_C > 25°C$ Derate linearly	0.857	1.43	1.14			W/°C
* T_{stg}, T_J	−65 to 200					°C
* T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	265	230				°C

* 2N-type in accordance with JEDEC registration data format JS25RDF1, Issue 1.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

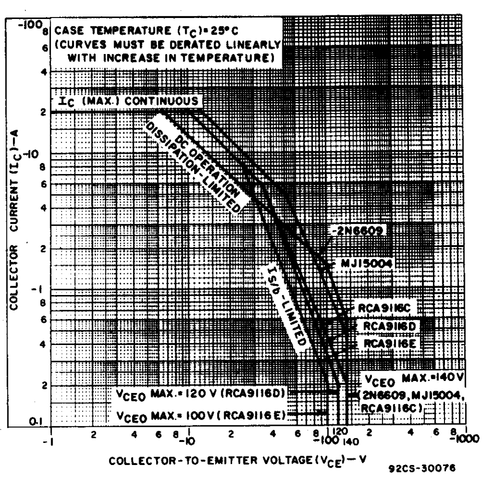


Fig. 1 — Maximum operating areas for all types.

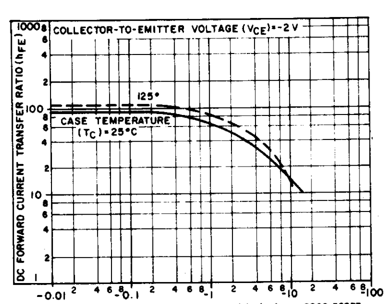


Fig. 2 — Typical dc beta characteristics as a function of collector current for all types.

2N6609, MJ15004, RCA9116C, RCA9116D, RCA9116E

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc: V_{CE}	V_{BE}	CURRENT A dc: I_C	LIMITS: 2N6609 Min.	2N6609 Max.	MJ15004 Min.	MJ15004 Max.	UNITS
* I_{CBO}	−160[a] −140[a]			– –	−4 −2	– –	– −1	mA
I_{CEX}	−140	1.5		–	–	–	−0.1	mA
I_{CEX} T_C = 150°C	−140	1.5		–	–	–	−2	mA
* I_{CEV}	−140	1.5		–	−2	–	–	mA
* I_{CEV} T_C = 150°C	−140	1.5		–	−10	–	–	mA
I_{CEO} I_B = 0 *	−140 −120			– –	– −10	– –	−0.25 –	mA
* I_{EBO}	−7 −5			– –	−5 –	– –	– −0.1	mA
* h_{FE} *	−4 −4 −2 −2		−8[c] −16[c] −5[c] −10[c]	15 5 – –	60 – – –	– – 25 10	– – 150 –	
$V_{CEX}(sus)$[b] R_{BE} = 100Ω		1.5	−0.2	−160	–	–	–	V
$V_{CER}(sus)$[b] $R_{BE} \leq$ 100Ω			−0.2	−150	–	−150	–	V
* $V_{CEO}(sus)$[b]			−0.2	−140	–	−140	–	V
V_{EBO} I_E = −1 mA			0	−7	–	−5[d]	–	V
V_{BE}	−4 −2		−8[c] −5[c]	– –	−2.2 –	– –	– −2	V
$V_{CE}(sat)$ * I_B = −3.2A * = −0.8A = −0.5A			−16[c] −8[c] −5[c]	– – –	−4 −1.4 –	– – –	– – −1	V
$I_{S/b}$ t_p = 1 s nonrep.	−100 −50			−1.5 –	– –	−1 −5	– –	A
* $\|h_{fe}\|$ f = 0.05 = 0.5 MHz	−4 −10		−1 −0.5	4 4	– –	– 4	– –	
f_T				2	–	2	–	MHz
* h_{fe} f = 1 kHz	−4		−1	40	–	–	–	
C_{ob} f = 0.1 MHz	−10[a]			–	1000	–	1000	pF
$R_{\theta JC}$	−10		−10	–	1.17	–	0.7	°C/W

See page 252 for footnotes.

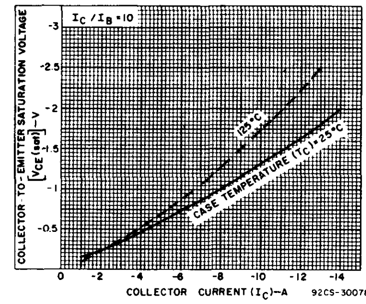


Fig. 3 — Typical saturation voltage characteristics for all types.

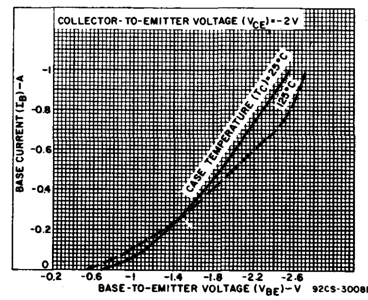


Fig. 4 — Typical input characteristics for all types.

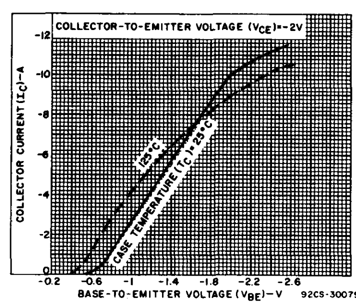


Fig. 5 — Typical transfer characteristics for all types.

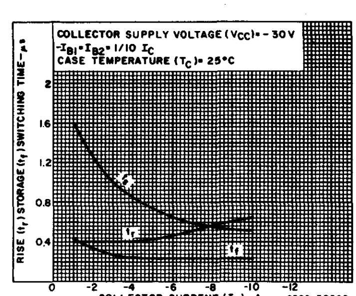


Fig. 6 — Typical saturated-switching times for all types.

2N6609, MJ15004, RCA9116C, RCA9116D, RCA9116E

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified (Cont'd)*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		CURRENT A dc	LIMITS: RCA9116C		RCA9116D		RCA9116E		UNITS
	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO}	−140[a]			–	−1	–	–	–	–	mA
	−120[a]			–	–	–	−1	–	–	
	−100[a]			–	–	–	–	–	−1	
I_{CEX}	−140	1.5		–	−1	–	–	–	–	
	−120	1.5		–	–	–	−1	–	–	
I_{CEX} T_C = 150°C	−140	1.5		–	−5	–	–	–	–	
	−120	1.5		–	–	–	−5	–	–	
I_{CEO} I_B = 0	−70			–	−1	–	–	–	–	
	−60			–	–	–	−1	–	–	
I_{EBO}	−5			–	−1	–	−1	–	−1	
h_{FE}	−2		−5[c]	25	150	25	150	–	–	
	−2		−7.5[c]	–	–	–	–	10	100	
	−2		−10[c]	10	–	10	–	–	–	
V_{CER}(sus)[b] $R_{BE} \leq 100\Omega$			−0.2	−150	–	−130	–	−110	–	V
V_{CEO}(sus)[b]			−0.2	−140	–	−120	–	−100	–	
V_{EBO} I_E = −1 mA			0	−5	–	−5	–	−5	–	
V_{BE}	−2		−7.5[c]	–	–	–	–	–	−3	
	−2		−5[c]	–	−2	–	−2	–	–	
V_{CE}(sat) I_B = −0.75A			−7.5[c]	–	–	–	–	–	−1.5	
= −0.5A			−5[c]	–	−1	–	−1	–	–	
$I_{S/b}$ t_p = 1 s nonrep.	−35			−5.71	–	−5.71	–	–	–	A
	−25			–	–	–	–	−8	–	
$\|h_{fe}\|$ f = 0.5 MHz	−10		−0.5	4	–	4	–	4	–	
f_T				2	–	2	–	2	–	MHz
C_{ob} f = 0.1 MHz	−10[a]			–	1000	–	1000	–	1000	pF
$R_{\theta JC}$	−10		−10	–	0.875	–	0.875	–	0.875	°C/W

* 2N-types in accordance with JEDEC registration data format JS25 RDF1, Issue 1.

[a] V_{CB}

[b] **CAUTION**: Sustaining voltages V_{CEX}(sus), V_{CER}(sus), and V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.

[c] Pulsed; pulse duration = 300 μs, duty factor = 1.8%.

[d] Measured at I_E = −0.1 mA.

2N6648, 2N6649, 2N6650, RCA8350, RCA8350A, RCA8350B

10-Ampere P-N-P Darlington Power Transistors

40-60-80 Volts, 70 Watts
Gain of 1000 at 5 A

Features:
- Operates from IC without predriver
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

The 2N6648, 2N6649, 2N6650, and RCA8350, RCA8350A, RCA8350B•, are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. The 2N6648 and RCA8350 are complementary to the 2N6383; the 2N6649 and the RCA8350A are complementary to the 2N6384; and the 2N6650 and RCA8350B are complementary to the 2N6385.

They are all supplied in hermetic steel JEDEC TO-204MA packages.

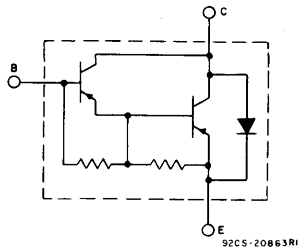
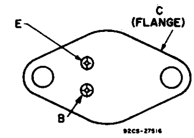


Fig. 1 – Schematic diagram for all types.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

• Formerly RCA Dev. Nos. TA8351, TA8488, and TA8350, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6648 RCA8350	2N6649 RCA8350A	2N6650 RCA8350B	
* V_{CBO}	−40	−60	−80	V
V_{CER}(sus) R_{BE} = 100 Ω	−40	−60	−80	V
* V_{CEO}(sus)	−40	−60	−80	V
V_{CEV}(sus) V_{BE} = −1.5 V	−40	−60	−80	V
* V_{EBO}	−5	−5	−5	V
* I_C	−10	−10	−10	A
I_{CM}	−15	−15	−15	A
* I_B	−0.25	−0.25	−0.25	A
* P_T				
$T_C \leqslant 25°C$	70	70	70	W
$T_C > 25°C$ Derate linearly		0.56		W/°C
* T_{stg}, T_J		−65 to +150		°C
* T_L At distances ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data format (JS-6 RDF-4)

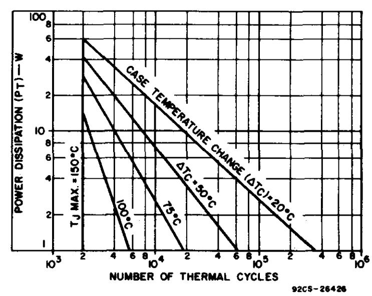


Fig. 2 – Thermal-cycling rating chart for all types.

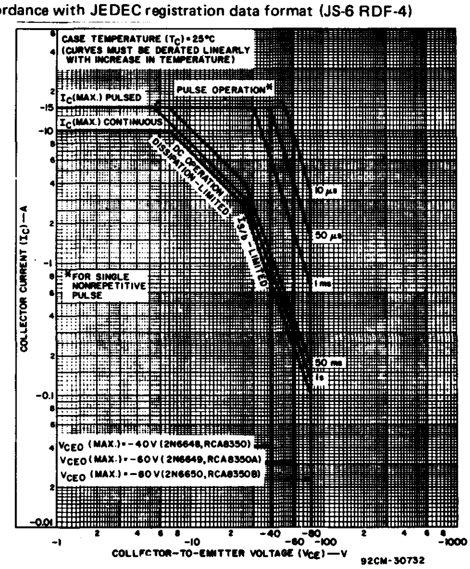


Fig. 3 – Maximum operating areas for all types.

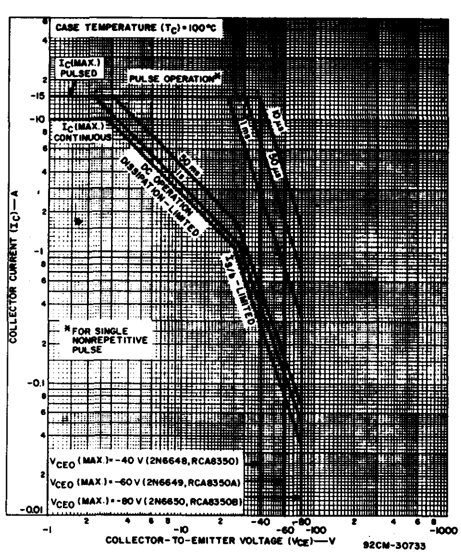


Fig. 4 – Maximum operating areas for all types at $T_C = 100°C$.

2N6648, 2N6649, 2N6650, RCA8350, RCA8350A, RCA8350B

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS 2N6648 RCA8350		2N6649 RCA8350A		2N6650 RCA8350B		UNITS
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CEO}	−40			0	–	−1	–	–	–	–	
	−60			0	–	–	–	−1	–	–	mA
	−80			0	–	–	–	–	–	−1	
* I_{CEV}	−40	1.5			–	−0.3	–	–	–	–	
	−60	1.5			–	–	–	−0.3	–	–	
	−80	1.5			–	–	–	–	–	−0.3	
T_C = 150°C	−40	1.5			–	−3	–	–	–	–	
	−60	1.5			–	–	–	−3	–	–	
	−80	1.5			–	–	–	–	–	−3	
* I_{EBO}		5	0		–	−10	–	−10	–	−10	mA
* V_{CEO}(sus)			−0.2[a]	0	−40	–	−60	–	−80	–	
V_{CER}(sus) R_{BE} = 100 Ω			−0.2[a]		−40	–	−60	–	−80	–	V
V_{CEV}(sus)		1.5	−0.2[a]		−40	–	−60	–	−80	–	
* h_{FE}	−3		−5[a]		1000	20,000	1000	20,000	1000	20,000	
	−3		−10[a]		100	–	100	–	100	–	
V_{BE}	−3		−5[a]		–	−2.8	–	−2.8	–	−2.8	
	−3		−10[a]		–	−4.5*	–	−4.5*	–	−4.5*	V
V_{CE}(sat)			−5[a]	−0.01[a]	–	−2	–	−2	–	−2	
			−10[a]	−0.1[a]	–	−3*	–	−3*	–	−3*	V
V_F			10[a]		–	4	–	4	–	4	V
h_{fe} f = 1 kHz	−5		−1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	−5		−1		20	–	20	–	20	–	
$E_{S/b}$ L = 3 mH, R_{BE} = 100 Ω		1.5	−4.5		30	–	30	–	30	–	mJ
$I_{S/b}$ t = 1 s, nonrep.	−35				−1	–	−1	–	−1	–	
	−25				−2.8	–	−2.8	–	−2.8	–	A
$R_{\theta JC}$					–	1.75	–	1.75	–	1.75	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-4).

a Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

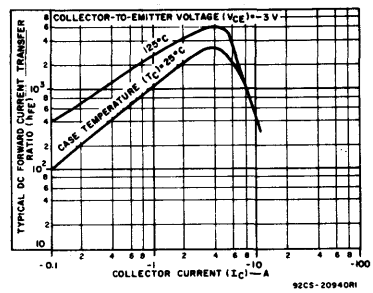


Fig. 5 – Typical dc beta characteristics for for all types.

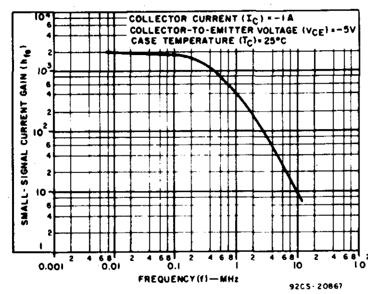


Fig. 6 – Typical small-signal gain for all types

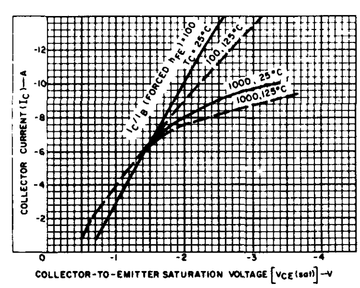


Fig. 7 – Typical saturation characteristics for all types.

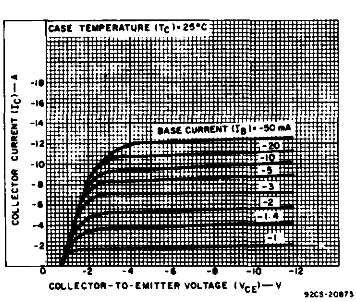


Fig. 8 – Typical output characteristics for all types.

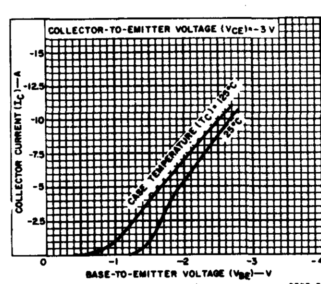


Fig. 9 – Typical transfer characteristics for all types.

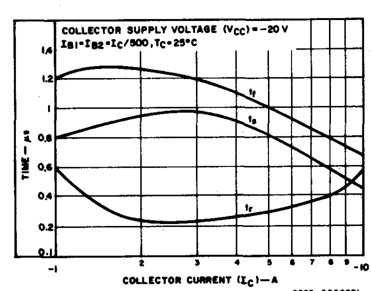


Fig. 10 – Typical saturated switching-time characteristics for all types.

2N6666, 2N6667, 2N6668, RCA8203, RCA8203A, RCA8203B

10-Ampere P-N-P Darlington Power Transistors

40-60-80 Volts, 65 Watts
Gain of 1000 at 3 A (2N6666, RCA8203)
Gain of 1000 at 5 A (2N6667, 2N6668, RCA8203A, RCA8203B)

The 2N6666, 2N6667, 2N6668, and RCA8203, RCA8203A, RCA8203B are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. The 2N6666 and RCA 8203 are complementary to the 2N6386; the 2N6667 and RCA8203A are complementary to the 2N6387; and the 2N6668 and RCA8203B are complementary to the 2N6388.▲

●Formerly RCA Dev. Nos. TA8204, TA8487 and TA8203, respectively.
▲Technical data for 2N6386-2N6388 are given in RCA Bulletin File No. 610.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSA-WATT package

Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

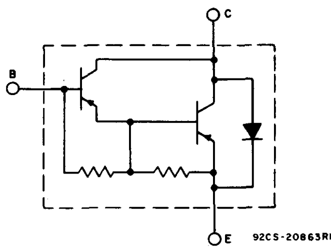
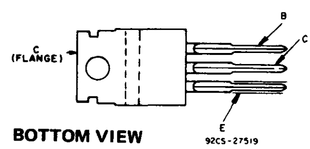


Fig. 1 — Schematic diagram for all types.

Features:
- Operates from IC without predriver
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6666 RCA8203	2N6667 RCA8203A	2N6668 RCA8203B	
* V_{CBO}	−40	−60	−80	V
V_{CER}(sus) R_{BE} = 100 Ω	−40	−60	−80	V
V_{CEO}(sus)	−40	−60	−80	V
V_{CEV}(sus) V_{BE} = −1.5 V	−40	−60	−80	V
* V_{EBO}	−5	−5	−5	V
* I_C	−8	−10	−10	A
I_{CM}	−15	−15	−15	A
* I_B	−0.25	−0.25	−0.25	A
* P_T $T_C \leq 25°C$	65	65	65	W
$T_C > 25°C$ derate linearly		0.52		W/°C
* T_{stg}, T_J		−65 to +150		°C
* T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

*In accordance with JEDEC registration data format (JS-6 RDF-4).

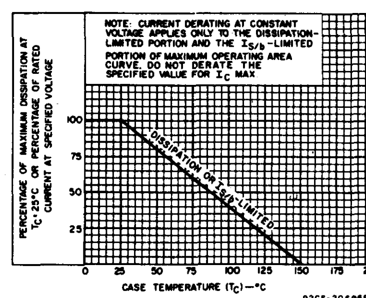


Fig. 2 — Derating curve for all types.

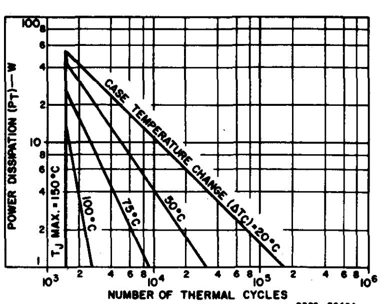


Fig. 3 — Thermal-cycling rating chart for all types.

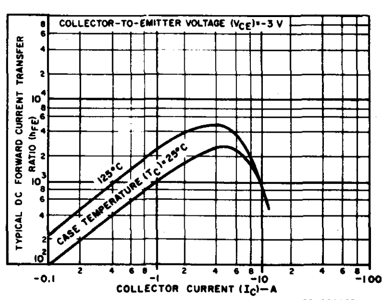


Fig. 4 — Typical dc beta characteristics for all types.

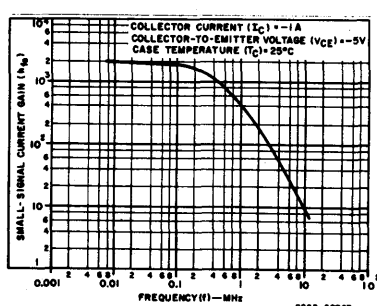


Fig. 5 — Typical small-signal gain for all types.

2N6666, 2N6667, 2N6668, RCA8203, RCA8203A, RCA8203B

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	TEST CONDITIONS VOLTAGE V dc V_{BE}	TEST CONDITIONS CURRENT A dc I_C	TEST CONDITIONS CURRENT A dc I_B	LIMITS 2N6666 RCA8203 MIN.	LIMITS 2N6666 RCA8203 MAX.	LIMITS 2N6667 RCA8203A MIN.	LIMITS 2N6667 RCA8203A MAX.	LIMITS 2N6668 RCA8203B MIN.	LIMITS 2N6668 RCA8203B MAX.	UNITS
I_{CEO}	−80			0	–	–	–	–	–	−1	mA
	−60			0	–	–	–	−1	–	–	
	−40			0	–	−1	–	–	–	–	
* I_{CEV}	−80	1.5			–	–	–	–	–	−0.3	
	−60	1.5			–	–	–	−0.3	–	–	
	−40	1.5			–	−0.3	–	–	–	–	
T_C = 125°C	−80	1.5			–	–	–	–	–	−3	
	−60	1.5			–	–	–	−3	–	–	
	−40	1.5			–	−3	–	–	–	–	
I_{EBO}		5	0		–	−10	–	−10	–	−10	mA
* V_{CEO}(sus)			−0.2[a]	0	−40	–	−60	–	−80	–	V
V_{CER}(sus) R_{BE} = 100 Ω			−0.2[a]		−40	–	−60	–	−80	–	
V_{CEV}(sus)		1.5	−0.2[a]		−40	–	−60	–	−80	–	
* h_{FE}	−3		−3[a]		1000	20,000	–	–	–	–	
	−3		−5[a]		–	–	1000	20,000	1000	20,000	
	−3		−8[a]		100	–	–	–	–	–	
	−3		−10[a]		–	–	100	–	100	–	
V_{BE}	−3		−3[a]		–	−2.8	–	–	–	–	V
	−3		−5[a]		–	–	–	−2.8	–	−2.8	
	−3		−8[a]		–	−4.5	–	–	–	–	
	−3		−10[a]		–	–	–	−4.5	–	−4.5	
* V_{CE}(sat)			−3[a]	−0.006[a]	–	−2	–	–	–	–	V
			−5[a]	−0.01[a]	–	–	–	−2	–	−2	
			−8[a]	−0.08[a]	–	−3	–	–	–	–	
			−10[a]	−0.1[a]	–	–	–	−3	–	−3	
V_F			8[a]		–	4	–	–	–	–	V
			10[a]		–	–	–	4	–	4	
h_{fe} f = 1 kHz	−5		−1		1000		1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	−5		−1		20		20	–	20	–	
$E_{s/b}$ L = 3 mH, R_{BE} = 100 Ω		1.5	−4.5		30	–	30	–	30	–	mJ
$I_{S/b}$ t = 1 s, nonrep.	−20				3.2	–	−3.2	–	−3.2	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 2%.
*In accordance with JEDEC registration data format (JS-6 RDF-4).

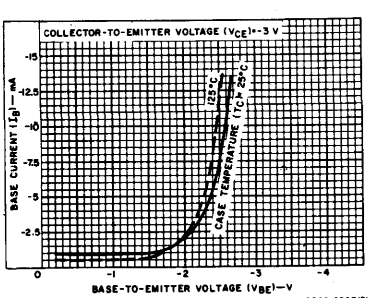


Fig. 6 — Typical input characteristics for all types.

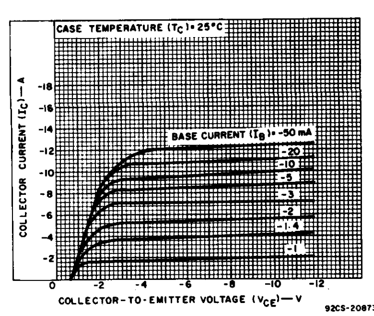


Fig. 7 — Typical output characteristics for all types.

2N6666, 2N6667, 2N6668, RCA8203, RCA8203A, RCA8203B

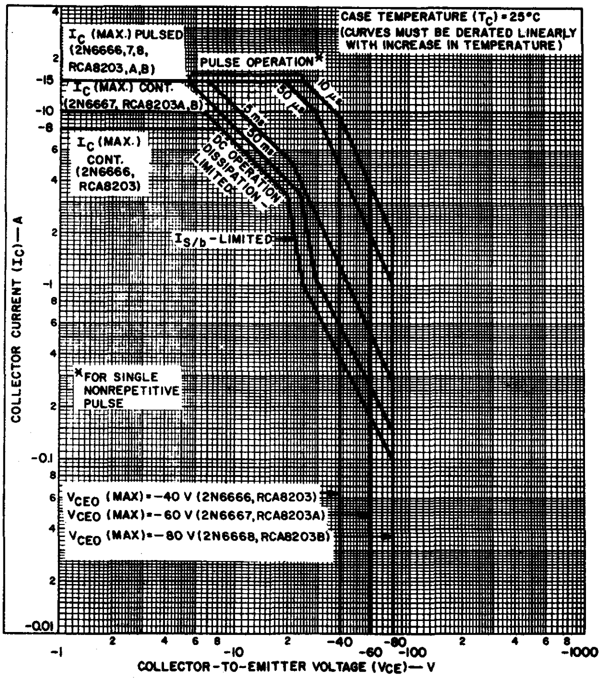


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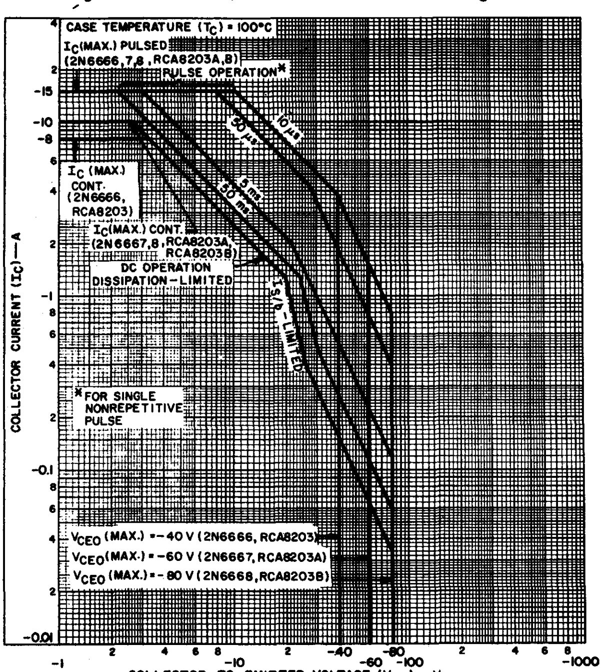
Fig. 8 — Maximum operating areas for all types of $T_C = 25°C$.



92CM-30730

Fig. 11 — Maximum operating areas for all types at $T_C = 100°C$.

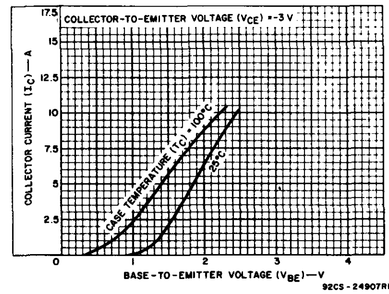


Fig. 9 — Typical transfer characteristics for all types.

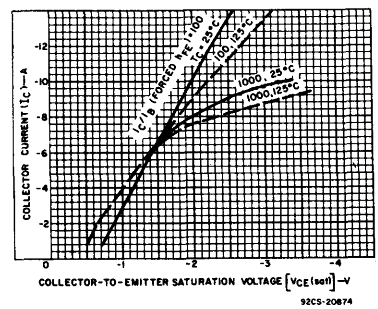


Fig. 10 — Typical saturation characteristics for all types.

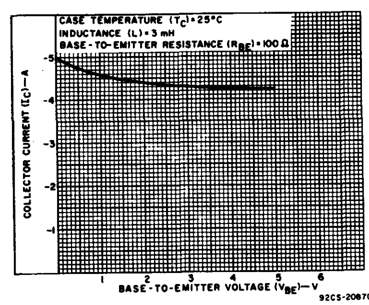


Fig. 12 — Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

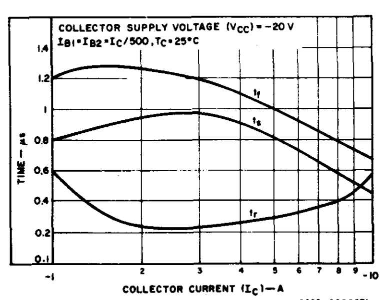


Fig. 13 — Typical saturated switching-time characteristics for all types.

2N6669

Epitaxial-Base, Silicon N-P-N VERSAWATT Transistor

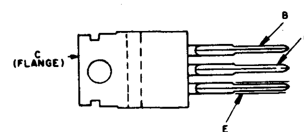
General-Purpose, Medium-Power Type for Switching and Amplifier Applications

Features:
- Low saturation voltages
- Switching speed

The RCA-2N6669● is an epitaxial-base silicon n-p-n transistor supplied in the VERSAWATT package. This transistor is intended for a wide variety of medium-power switching and amplifier applications such as series and shunt regulators, automotive voltage regulators, and driver stages for high-fidelity amplifiers.

●Formerly RCA Dev. No. TA9105.

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6669	
* V_{CBO}	40	V
* V_{CEO}	30	V
* V_{EBO}	5	V
* I_C	10	A
* I_B	4	A
* I_E	14	A
* P_T:		
At T_C = 25°C	40	W
At T_C = 100°C	16	W
At T_C ≥ 25°C ... Derate linearly	0.32	W/°C
* T_{stg}, T_J	−65 to 150	°C
* T_L (During soldering): At distance 0.125 in. (3.17 mm) from case for 10 s max.	235	°C

* In accordance with JEDEC registration data format (JC-25 RDF-1).

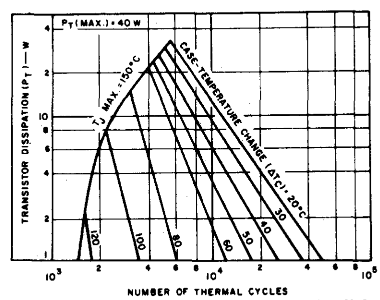


Fig. 1 – Thermal-cycling rating chart.

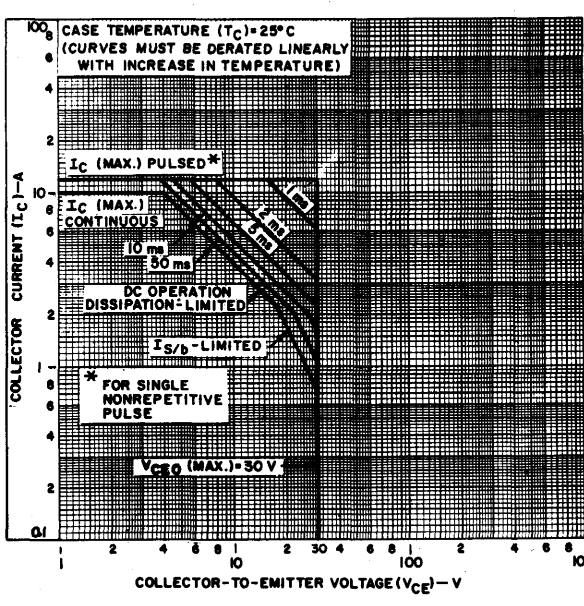


Fig. 2 – Maximum operating areas at T_C = 25°C.

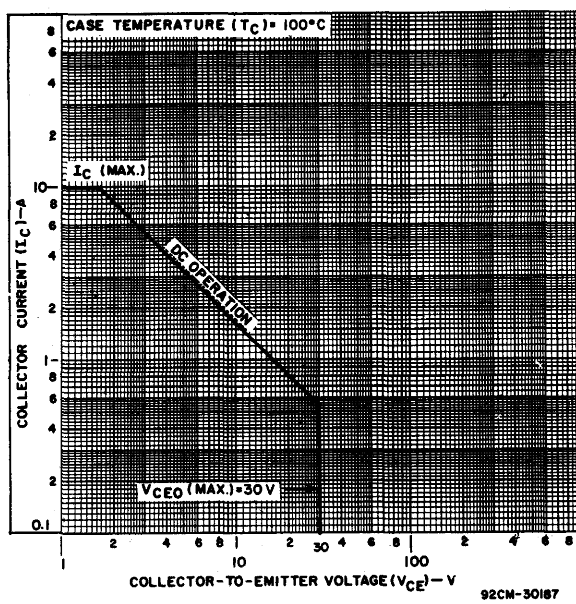


Fig. 3 – Maximum operating areas at T_C = 100°C.

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS			UNITS
	VOLTAGE V dc		CURRENT A dc		2N6669			
	V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	
I_{CEO}	20				–	–	0.1	mA
* I_{CEV}	40	–1.5			–	–	0.1	mA
T_C = 100°C	20	–1.5			–	–	5.0	
* I_{EBO}		5.0			–	–	1.0	mA
* V_{CEO}(sus)			0.2		30	–	–	V
V_{CER}(sus) R_{BE} = 50 Ω			0.2		40	–	–	
* h_{FE}	2		5[a]		20	–	100	
* V_{BE}(sat)			5[a]	0.5	–	–	2.0	V
* V_{CE}(sat)			5[a]	0.5	–	–	1.0	V
			10[a]	1.0	–	–	2.5	
* C_{obo} V_{CB} = 10 V, f = 1 MHz					50	–	150	pF
* $\|h_{fe}\|$ f = 1 MHz	2		0.5		10	–	70	
$I_{S/b}$ t = 0.5 s, nonrepetitive	25				1.0	–	–	A
	10				4.0	–	–	
* t_d[c]			5.0	0.5	–	0.03	0.05	µs
* t_r[c]			5.0	0.5	–	0.2	0.3	
* t_s[c]			5.0	0.5	–	0.3	0.5	
* t_f[c]			5.0	0.5	–	0.3	0.5	
* $R_{\theta JC}$	10		4		–	–	3.125	°C/W

*Minimum and maximum values and test conditions in accordance with JEDEC registration data format JC-25 RDF-1.

[a]Pulsed; pulse duration = 300 µs, duty factor ≤ 2%.

[b]CAUTION: The sustaining voltages V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer.

[c] V_{CC} = 30V, $I_{B1} = -I_{B2}$

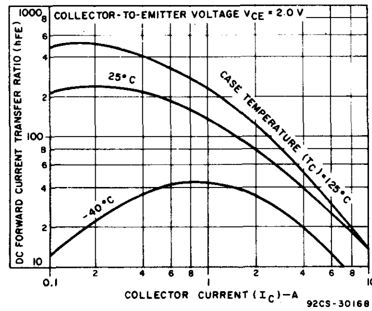


Fig. 4 — Typical dc beta characteristics.

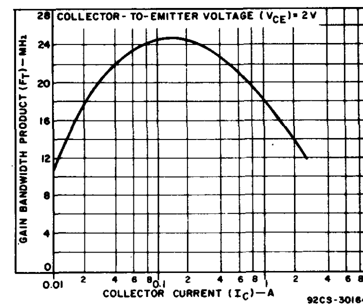


Fig. 5 — Typical gain-bandwidth product.

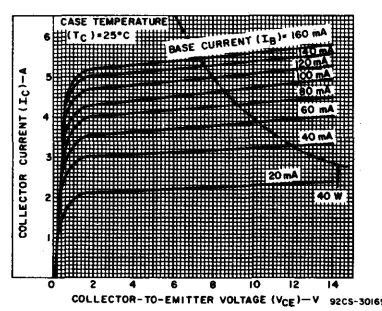


Fig. 6 — Typical output characteristics.

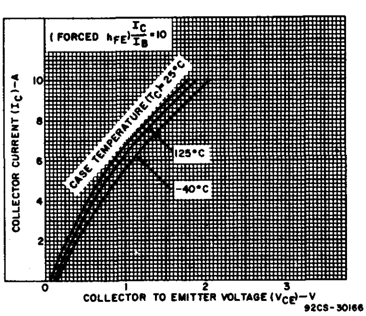


Fig. 7 — Typical saturation characteristics.

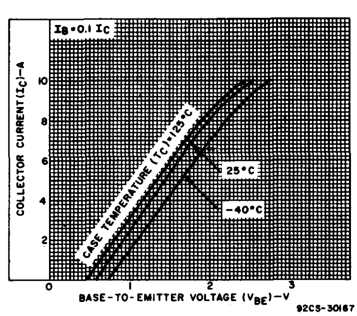


Fig. 8 — Typical base-to-emitter saturation characteristics.

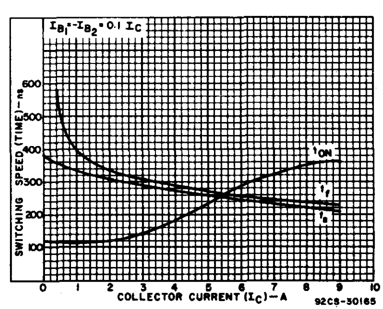


Fig. 9 — Typical saturated switching characteristics.

2N6671, 2N6672, 2N6673

5-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

Features:

- 100% High-Temperature Tested for 125°C Parameters
- Fast Switching Speed
- High Voltage Ratings: V_{CEX} = 350 V to 450 V
- Low V_{CE}(sat) at I_C = 5 A
- Steel Hermetic TO-204MA Package

Applications:

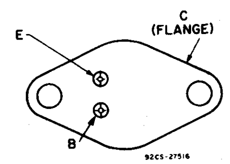
- Off-Line Power Supplies
- High-Voltage Inverters
- Switching Regulators

The RCA-2N6671, 2N6672, and 2N6673• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are tested at 125°C, as well as at 25°C, to provide information necessary for worst-case design.

The RCA-2N6671, 2N6672, and 2N6673 series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

• Formerly RCA8767, RCA8767A, and RCA8767B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6671	2N6672	2N6673	
* V_{CEV} V_{BE} = −1.5 V	450	550	650	V
* V_{CEX} (Clamped) V_{BE} = −1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
I_C(sat)		5		A
* I_C		8		A
I_{CM}		10		A
* I_B		4		A
* P_T				
T_C up to 25°C		150		W
T_C above 25°C, derate linearly		0.86		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

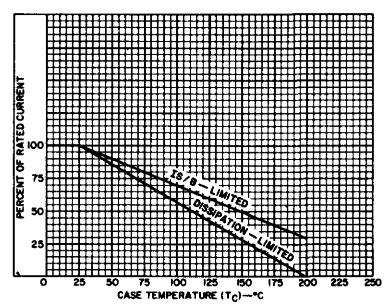


Fig. 1 — Dissipation and $I_{S/b}$ derating curves for all types.

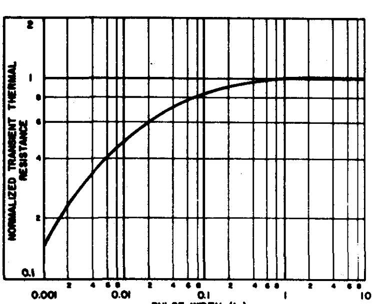


Fig. 2 — Typical thermal-response characteristic for all types.

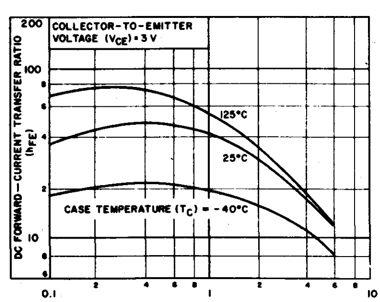


Fig. 3 — Typical dc beta characteristics for all types.

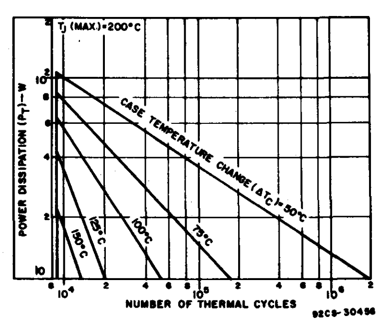


Fig. 4 — Thermal-cycling chart for all types.

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6671 Min.	Max.	2N6672 Min.	Max.	2N6673 Min.	Max.	UNITS
$T_C = 25^oC$											
* I_{CEV}	450 550 650	−1.5 −1.5 −1.5			– – –	0.1 – –	– – –	– 0.1 –	– – –	– – 0.1	mA
* I_{EBO}		−8	0		–	2	–	2	–	2	
* $V_{CEO}(sus)$[b]			0.2[a]	0	300	–	350	–	400	–	V
* h_{FE}	3		5[a]		10	40	10	40	10	40	
* $V_{BE}(sat)$			5[a]	1	–	1.6	–	1.6	–	1.6	V
* $V_{CE}(sat)$			5[a] 8[a]	1 4	– –	1 2	– –	1 2	– –	1 2	V
* V_{CEX}[b] (Clamped $E_{S/b}$) L=170 µH, R_{BB}=5 Ω		−5 −5	5 8	1[e] 3[e]	350 200	– –	400 250	– –	450 300	– –	V
* $I_{S/b}$	25		6		1	–	1	–	1	–	s
* $\|h_{fe}\|$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
* C_{obo} f=0.1 MHz	10[c]				50	300	50	300	50	300	pF
* t_d[d]			5	1	–	0.1	–	0.1	–	0.1	µs
* t_r[d]			5	1	–	0.5	–	0.5	–	0.5	µs
* t_s[d]			5	1[e]	–	2.5	–	2.5	–	2.5	µs
* t_f[d]			5	1[e]	–	0.4	–	0.4	–	0.4	µs
* t_c V_{CC}=125 V, L=170 µH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	–	0.4	–	0.4	–	0.4	µs
$T_C = 125^oC$											
* I_{CEV}	450 550 650	−1.5 −1.5 −1.5			– – –	1 – –	– – –	– 1 –	– – –	– – 1	mA
* $V_{CE}(sat)$			5[a]	1	–	2	–	2	–	2	V
* t_r[d]			5	1	–	0.8	–	0.8	–	0.8	µs
* t_s[d]			5	1[e]	–	4	–	4	–	4	µs
* t_f[d]			5	1[e]	–	0.8	–	0.8	–	0.8	µs
* t_c V_{CC}=125 V, L=170 µH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	–	0.8	–	0.8	–	0.8	µs
* $R_{\theta JC}$					–	1.17	–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed: pulse duration = 300 µs, duty factor ≤ 2%.
[b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.
[c] V_{CB} value.
[d] V_{CC} = 125 V, t_p = 20 µs.
[e] $I_{B_1} = -I_{B_2}$

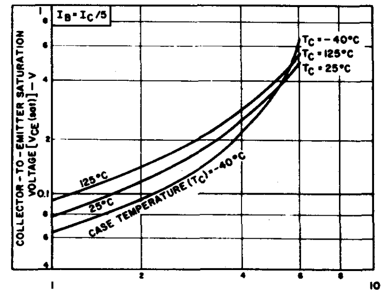


Fig. 5 — Typical collector-to-emitter saturation voltage as a function of collector current for all types.

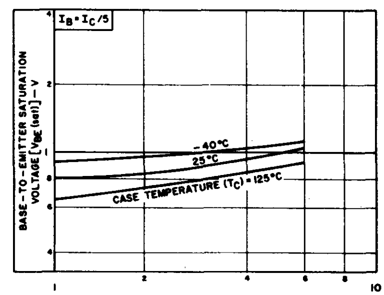


Fig. 6 — Typical base-to-emitter saturation voltage as a function of collector current for all types.

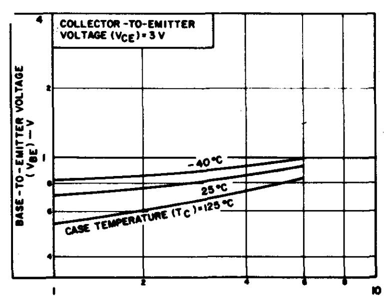


Fig. 7 — Typical base-to-emitter voltage as a function of collector current for all types.

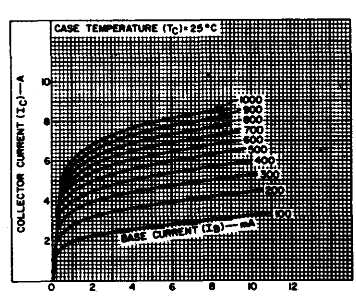


Fig. 8 — Typical output characteristics for all types.

2N6671, 2N6672, 2N6673

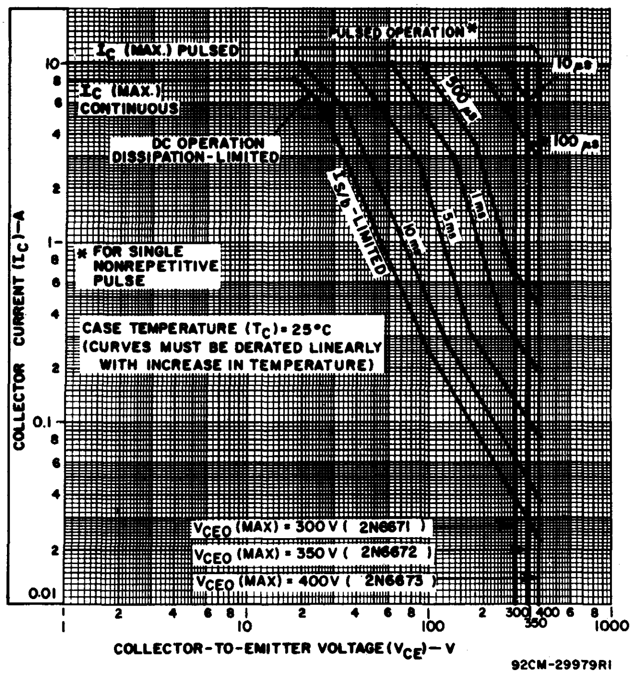


Fig. 9 — Maximum operating areas for all types (T_C = 25°C).

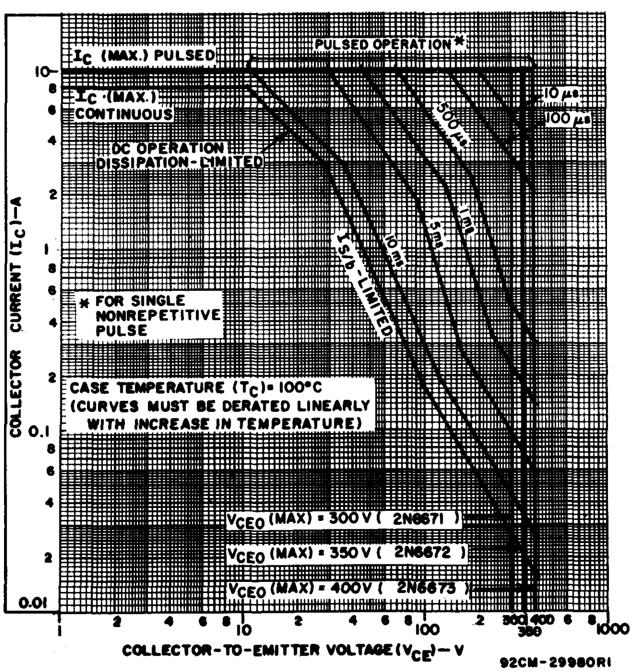


Fig. 10 — Maximum operating areas for all types (T_C = 100°C).

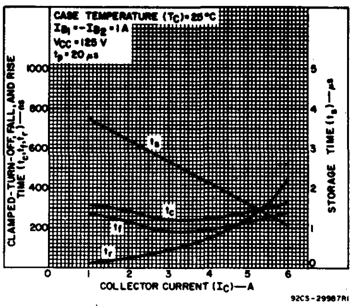


Fig. 11 – Typical saturated switching time characteristics for all types.

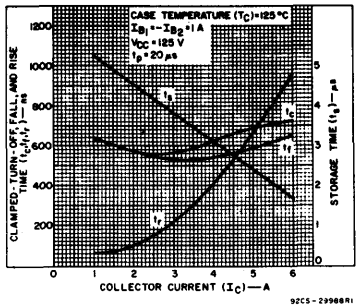


Fig. 12 – Typical saturated switching time characteristics for all types.

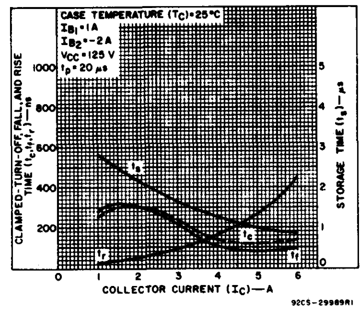


Fig. 13 – Typical saturated switching time characteristics for all types.

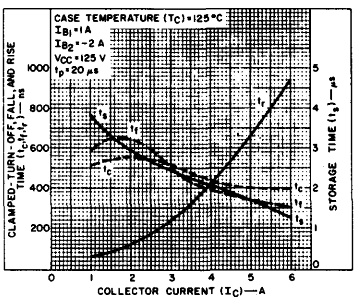


Fig. 14 – Typical saturated switching time characteristics for all types.

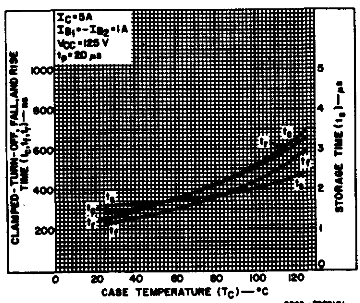


Fig. 15 – Typical saturated switching time characteristics as a function of case temperature for all types.

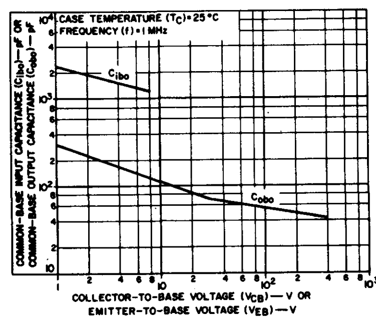


Fig. 16 – Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

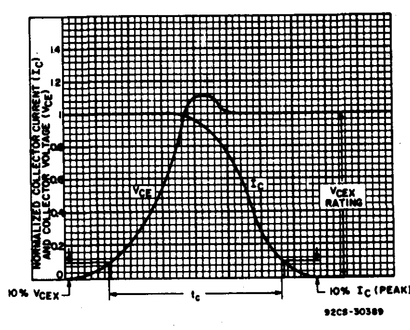


Fig. 17 – Oscilloscope display for measurement of clamped induction switching time (t_c).

2N6674, 2N6675

10-A *SwitchMax* Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

The RCA-2N6674 and 2N6675• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are tested at 100°C, as well as at 25°C, to provide information necessary for worst-case design.

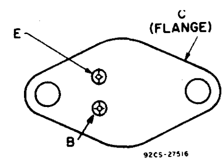
The 2N6674 and 2N6675 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

• Formerly RCA Dev. Type Nos. TA9114D and TA9114E, respectively.

Features:
- 100% High-Temperature Tested for
- Fast Switching Speed
- High Voltage Ratings: V_{CEX} = 350 V to 450 V
- Low V_{CE}(sat) at I_C = 10 A
- Steel Hermetic TO-204MA Package
- 100°C Parameters

Applications:
- Off-Line Power Supplies
- High-Voltage Inverters
- Switching Regulators

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6674	2N6675	
* V_{CEV} V_{BE} = −1.5 V	450	650	V
* V_{CEX}(Clamped) V_{BE} = −1.5 V	350	450	V
* V_{CEO}	300	400	V
* V_{EBO}	7	7	V
I_C(sat)	10	10	A
* I_C	15	15	A
I_{CM}	20	20	A
* I_B	5	5	A
* P_T			
T_C up to 25°C	175	175	W
T_C above 25°C, derate linearly	1	1	W/°C
* T_{stg}, T_J	−65 to 200	−65 to 200	°C
* T_L At distance ⩾ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235	235	°C

* In accordance with JEDEC registration data.

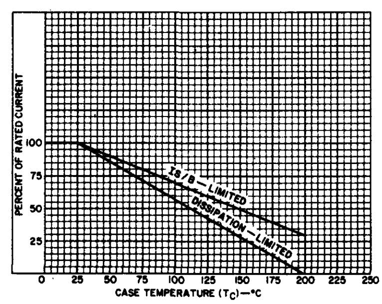


Fig. 2 – Dissipation and $I_{S/b}$ derating curves for both types.

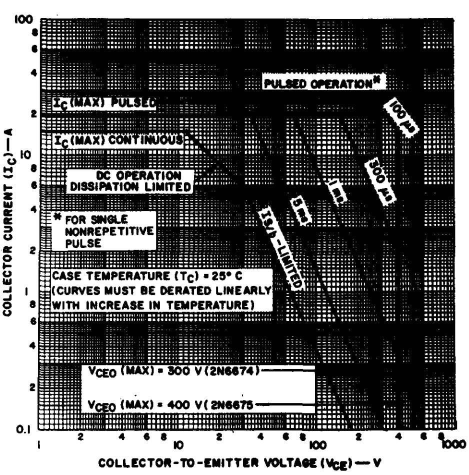


Fig. 1 – Maximum operating areas for both types (T_C = 25°C).

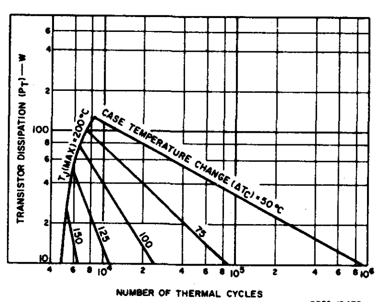


Fig. 3 – Thermal-cycling chart for both types.

2N6674, 2N6675

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6674		2N6675		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
$T_C = 25^oC$									
* I_{CEV}	450	−1.5			–	0.1	–	–	mA
	650	−1.5			–	–	–	0.1	mA
* I_{EBO}		−7	0		–	2	–	2	mA
* $V_{CEO}(sus)^b$			0.2[a]	0	300	–	400	–	V
* h_{FE}	2		10[a]		8	20	8	20	
* $V_{BE}(sat)$			10[a]	2	–	1.5	–	1.5	V
* $V_{CE}(sat)$			10[a]	2	–	1	–	1	V
			15[a]	5	–	5	–	5	V
V_{CEX}^b (Clamped $E_{S/b}$) L=50 µH, R_{BB}=2 Ω		−4	10	2	350	–	450	–	V
$I_{S/b}$	30		5.9		1	–	1	–	s
	100		0.35		1	–	1	–	s
* $\|h_{fe}\|$ f = 5 MHz	10		1		3	10	3	10	
f_T	10		1		15	50	15	50	MHz
* C_{obo} f = 0.1 MHz	10[c]				150	500	150	500	pF
* t_d^d		−6	10	2	–	0.1	–	0.1	µs
* t_r^d		−6	10	2	–	0.6	–	0.6	µs
* t_s^d		−6	10	2[e]	–	2.5	–	2.5	µs
* t_f^d		−6	10	2[e]	–	0.5	–	0.5	µs
* t_c V_{CC} = 135 V, L=50 µH, $R_C \leqslant$ 13.5 Ω, Collector clamped to V_{CEX}		−6	10	2[e]	–	0.5	–	0.5	µs
$T_C = 100^oC$									
* I_{CEV}	450	−1.5			–	1	–	–	mA
	650	−1.5			–	–	–	1	mA
* $V_{CE}(sat)$			10[a]	2	–	2	–	2	V
* t_r^d		−6	10	2	–	1	–	1	µs
* t_s^d		−6	10	2[e]	–	4	–	4	µs
* t_f^d		−6	10	2[e]	–	1	–	1	µs
* t_c V_{CC} = 135 V, L=50 µH, $R_C \leqslant$ 13.5 Ω, Collector clamped to V_{CEX}		−6	10	2[e]	–	0.8	–	0.8	µs
* $R_{\theta JC}$	10		5		–	1	–	1	°C/W

[a]Pulsed: pulse duration = 300 µs, duty factor $\leqslant$2%.

[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.

[c]V_{CB} value.

[d]V_{CC} = 135 V, t_p = 20 µs.

[e]$I_{B1} = -I_{B2}$.

*In accordance with JEDEC registration data.

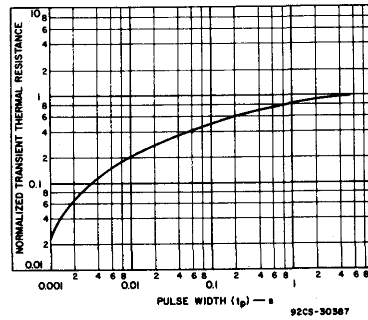


Fig. 4 – Typical thermal-response characteristic for both types.

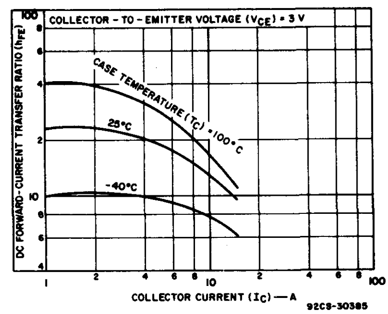


Fig. 5 – Typical dc beta characteristics for both types.

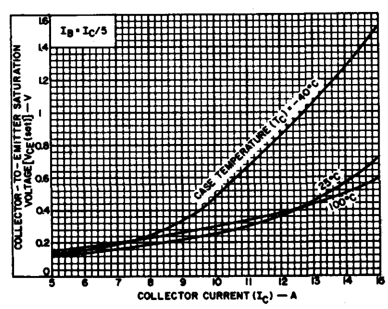


Fig. 6 – Typical collector-to-emitter saturation voltage characteristics for both types.

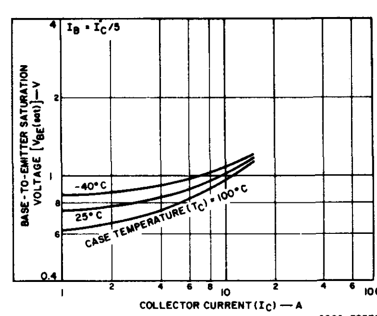


Fig. 7 – Typical base-to-emitter saturation voltage characteristics for both types.

2N6674, 2N6675

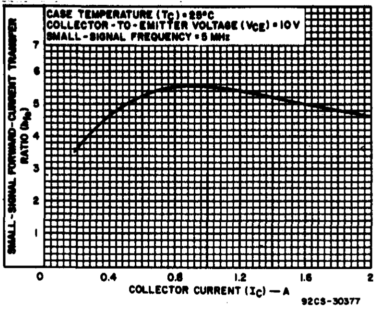


Fig. 8 – Typical small-signal forward current transfer ratio characteristic for both types (f = 5 MHz).

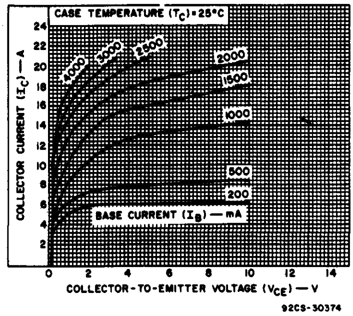


Fig. 9 – Typical output characteristics for both types.

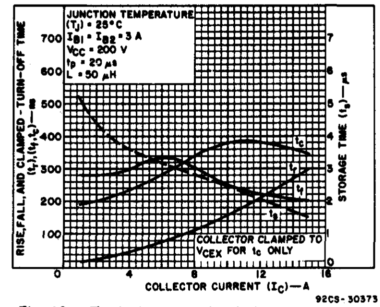


Fig. 10 – Typical saturated-switching-time characteristics at $T_J = 25°C$ as a function of collector current for both types.

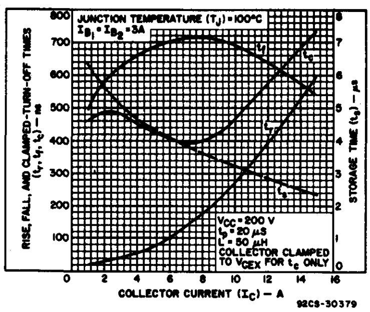


Fig. 11 – Typical saturated-switching-time characteristics at $T_J = 100°C$ as a function of collector current for both types.

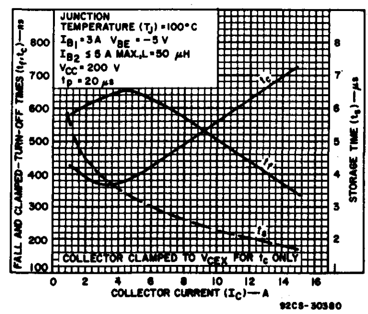


Fig. 12 – Typical saturated-switching-time characteristics at $T_J = 100°C$ as a function of collector current for both types.

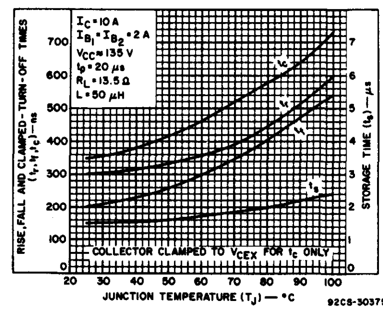


Fig. 13 – Typical saturated-switching-time characteristics as a function of junction temperature for both types.

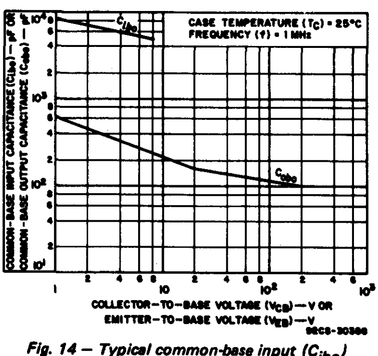


Fig. 14 – Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for both types.

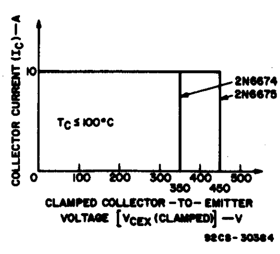


Fig. 15 – Maximum operating conditions for switching between saturation and cutoff for both types.

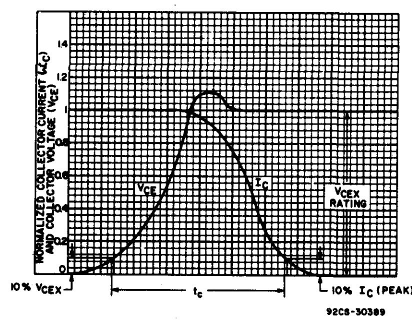


Fig. 16 – Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

15-A *SwitchMax* Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

The RCA-2N6676, 2N6677, and 2N6678● SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching time, including inductive turn-off time, and saturation voltages are tested at 100°C, as well as at 25°C, to provide information necessary for worst-case design.

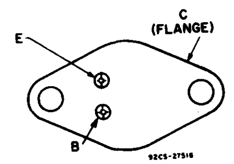
The 2N6676, 2N6677, and 2N6678 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

● Formerly RCA Dev. Type Nos. TA9114A, TA9114B, and TA9114C, respectively.

Features:
- **100% High-Temperature Tested for 100°C Parameters**
- **Fast Switching Speed**
- **High Voltage Ratings:** V_{CEX} = **350 V to 450 V**
- **Low $V_{CE}(sat)$ at I_C = 15 A**
- **Steel Hermetic TO-204MA Package**

Applications:
- **Off-Line Power Supplies**
- **High-Voltage Inverters**
- **Switching Regulators**

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6676	2N6677	2N6678	
* V_{CEV} V_{BE} = −1.5 V	450	550	650	V
* V_{CEX} (Clamped) V_{BE} = −1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
$I_C(sat)$		15		A
* I_C		15		A
I_{CM}		20		A
* I_B		5		A
* P_T				
T_C up to 25°C		175		W
T_C above 25°C, derate linearly		1		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L At distance ⩾ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

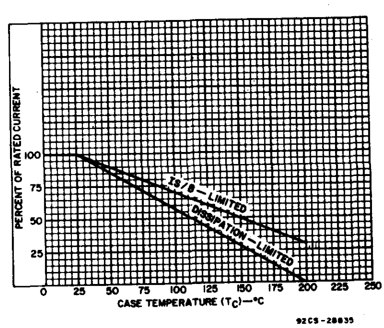


Fig. 2 — Dissipation and $I_{S/b}$ derating curves for all types.

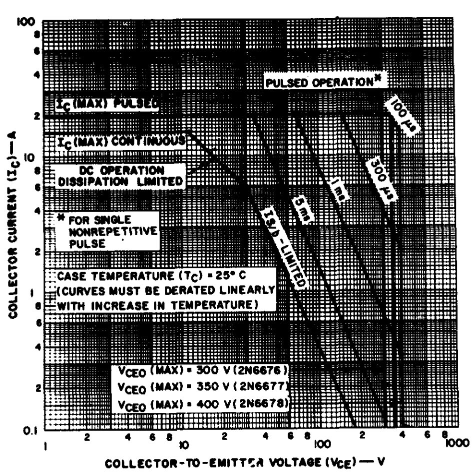


Fig. 1 — Maximum operating areas for all types (T_C = 25°C).

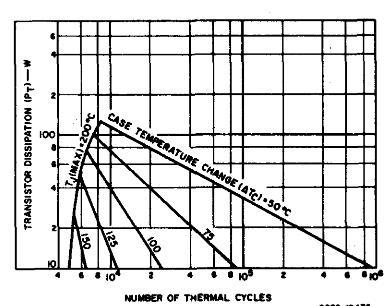


Fig. 3 — Thermal-cycling chart for all types.

2N6676, 2N6677, 2N6678

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6676 Min.	Max.	2N6677 Min.	Max.	2N6678 Min.	Max.	UNITS
$T_C = 25^oC$											
* I_{CEV}	450	−1.5			–	0.1	–	–	–	–	mA
	550	−1.5			–	–	–	0.1	–	–	
	650	−1.5			–	–	–	–	–	0.1	
* I_{EBO}		−8	0		–	2	–	2	–	2	
* $V_{CEO}(sus)$[b]			0.2[a]	0	300	–	350	–	400	–	V
* h_{FE}	3		15[a]		8	–	8	–	8	–	
* $V_{BE}(sat)$			15[a]	3	–	1.5	–	1.5	–	1.5	V
* $V_{CE}(sat)$			15[a]	3	–	1	–	1	–	1	
			15[a]	3	–	1.5	–	1.5	–	1.5	
* V_{CEX}[b] (Clamped $E_{S/b}$) L=50 μH, R_{BB}=2 Ω		−6	15	3	350	–	400	–	450	–	
$I_{S/b}$	30		5.9		1	–	1	–	1	–	s
	100		0.35		1	–	1	–	1	–	
* $\|h_{fe}\|$ f=5 MHz	10		1		3	10	3	10	3	10	
f_T	10		1		15	50	15	50	15	50	MHz
* C_{obo} f=0.1 MHz	10[c]				150	500	150	500	150	500	pF
* t_d[d]		−6	15	3	–	0.1	–	0.1	–	0.1	μs
* t_r[d]		−6	15	3	–	0.6	–	0.6	–	0.6	
* t_s[d]		−6	15	3[e]	–	2.5	–	2.5	–	2.5	
* t_f[d]		−6	15	3[e]	–	0.5	–	0.5	–	0.5	
* t_c[f] V_{CC}=200 V, L=50 μH, $R_C \leqslant$ 13.5 Ω		−6	15	3[e]	–	0.5	–	0.5	–	0.5	
$T_C = 100^oC$											
* I_{CEV}	450	−1.5			–	1	–	–	–	–	mA
	550	−1.5			–	–	–	1	–	–	
	650	−1.5			–	–	–	–	–	1	
* $V_{CE}(sat)$			15[a]	3	–	2	–	2	–	2	V
* t_r[d]		−6	15	3	–	1	–	1	–	1	μs
* t_s[d]		−6	15	3[e]	–	4	–	4	–	4	
* t_f[d]		−6	15	3[e]	–	1	–	1	–	1	
* t_c[f] V_{CC}=200 V, L=50 μH, $R_C \leqslant$13.5 Ω		−6	15	3[e]	–	0.8	–	0.8	–	0.8	
* $R_{\theta JC}$	10		5		–	1	–	1	–	1	°C/W

[a]Pulsed: pulse duration = 300 μs, duty factor $\leqslant$2%.
[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.
*In accordance with JEDEC registration data.
[c]V_{CB} value.
[d]V_{CC} = 200 V, t_p = 20 μs.
[e]$I_{B1} = -I_{B2}$.
[f]Collector clamped to V_{CEX}.

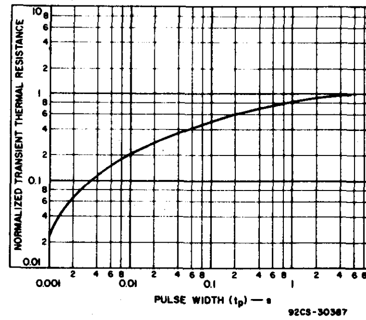


Fig. 4 – Typical thermal-response characteristic for all types.

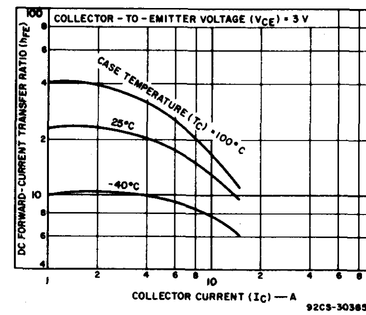


Fig. 5 – Typical dc beta characteristics for all types.

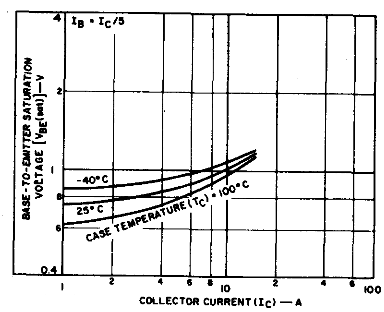


Fig. 6 – Typical base-to-emitter saturation voltage characteristics for all types.

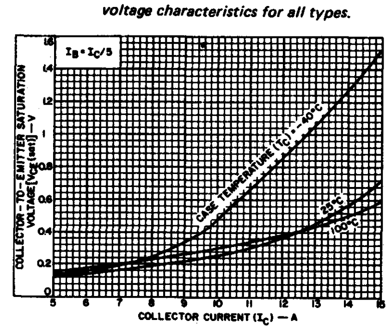


Fig. 7 – Typical collector-to-emitter saturation voltage characteristics for all types.

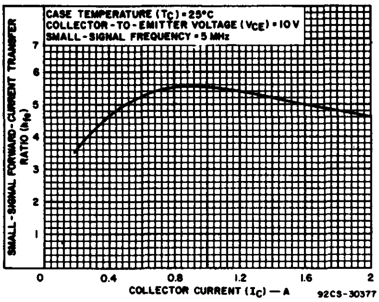


Fig. 8 – Typical small-signal forward current transfer ratio characteristic for all types (f = 5 MHz).

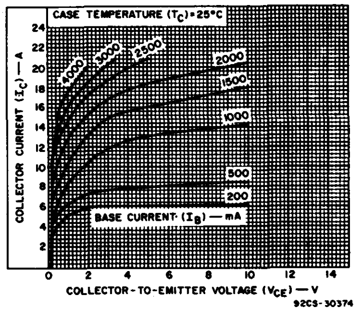


Fig. 9 – Typical output characteristics for all types.

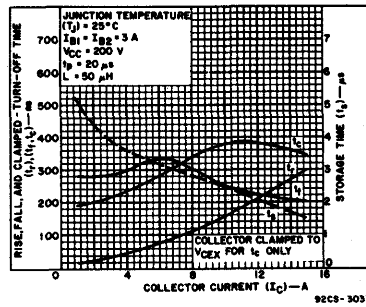


Fig. 10 – Typical saturated-switching-time characteristics at T_J = 25°C as a function of collector current for all types.

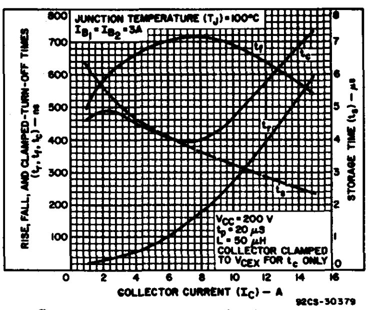


Fig. 11 – Typical saturated-switching-time characteristics at T_J = 100°C as a function of collector current for all types.

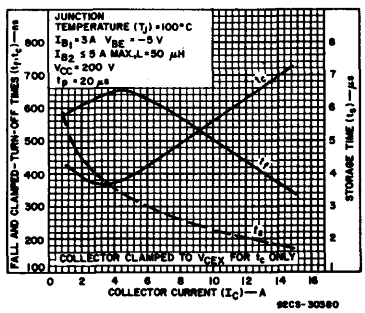


Fig. 12 – Typical saturated-switching-time characteristics at T_J = 100°C as a function of collector current for all types.

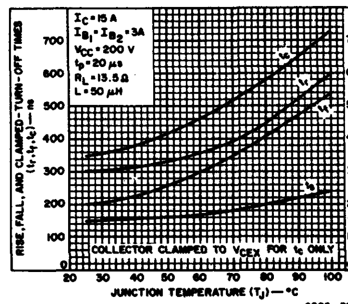


Fig. 13 – Typical saturated-switching-time characteristics as a function of junction temperature for all types.

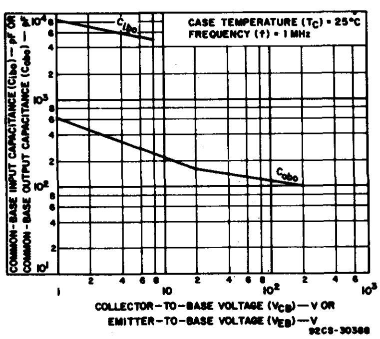


Fig. 14 – Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for all types.

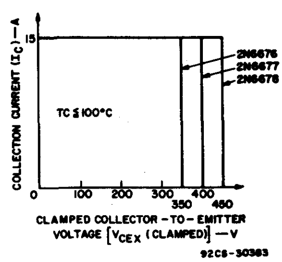


Fig. 15 – Maximum operating conditions for switching between saturation and cutoff for all types.

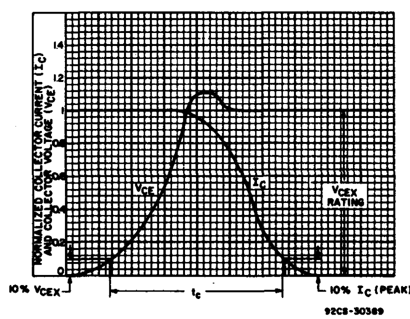


Fig. 16 – Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

40310-40314, 40316-40319, 40321-40325, 40327, 40362, 40363, 40537-40539

Silicon Transistors for Audio-Frequency Linear-Amplifier Applications

These RCA transistors are diffused-junction silicon n-p-n and p-n-p types intended for specific applications in audio amplifiers. They provide high-quality economical performance in applications from low-level input stages to driver and power-output stages of 5 to 50 watts. Supply voltages range from the nominal 12-volt vehicular type to 117-volt ac-dc type.

The use of all-silicon devices permits more flexibility in the mechanical and electrical design of amplifiers since the output heat sinks can be held to a minimum.

Features:

- **Hermetically-sealed packages**
- **Pellet bonded to header —**
  for greater power-handling capability
  for greater shock resistance
- **Freedom from second breakdown**
- **40319 and 40538 are p-n-p complements of 40317 and 40539, respectively**

N-P-N TYPES IN TO-66 PACKAGE

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	40310	40312	40313	40316	40318	40322	40324	
V_{CEO}(sus)	35	60	–	–	–	–	35	V
V_{CER}(sus)	–	–	300	40	300	300	–	V
At R_{BE}	–	–	500	500	500	500	–	Ω
V_{EBO}	2.5	2.5	2.5	5	6	6	2.5	V
I_C	4	4	2	4	2	2	4	A
I_B	2	2	1	2	1	1	2	A
P_T:								
$T_C \leq 25°C$	29	29	35	29	35	35	29	W
$T_C > 25°C$, derate linearly	0.17	0.17	0.2	0.17	0.2	0.2	0.17	W/°C
$T_C = 175°C$	–	–	5	–	5	5	–	W
T_{stg}, T_J	–65 to 200							°C
T_L (During soldering): At distances ≥ 1/16 in. (1.58 mm) from case for 10 s max.	235							°C

N-P-N TYPES IN TO-39 PACKAGE

MAXIMUM RATINGS, *Absolute-Maximum Values:*

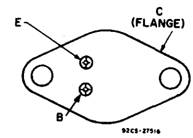
	40311	40314	40317	40321	40323	40327	40539	
V_{CEO}(sus)	30	40	40	–	18	–	–	V
V_{CER}(sus)	–	–	–	300	–	300	55	V
At R_{BE}	–	–	–	500	–	1000	500	Ω
V_{EBO}	2.5	2.5	2.5	5	2.5	5	5	V
I_C	0.7	0.7	0.7	1	0.7	1	0.7	A
I_B	0.2	0.2	0.2	0.5	0.2	0.5	–	A
P_T:								
$T_C \leq 25°C$	5	5	5	5	5	5	5	W
$T_C > 25°C$, derate linearly	0.029							W/°C
$T_A \leq 25°C$	1	1	1	1	1	1	1	W
T_{stg}, T_J	–65 to 200							°C
T_L (During soldering): At distances ≥ 1/16 in. (1.58 mm) from case for 10 s max.	300	300	300	255	300	255	255	°C

P-N-P TYPES IN TO-39 PACKAGE / N-P-N TYPES IN TO-3 PACKAGE

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	40319	40362	40537	40538	40325	40363	
V_{CBO}	–	–	–	–	35	–	V
V_{CEO}(sus)	–40	–	–	–	35	–	V
V_{CER}(sus)	–	–70	–55	–55	–	70	V
At R_{BE}	–	200	500	500	–	200	Ω
V_{CEV}(sus) At $V_{BE} = -1.5$ V	–	–	–	–	35	–	V
V_{EBO}	–2.5	–4	–5	–5	5	4	V
I_C	–0.7	–0.7	–0.7	–0.7	15	15	A
I_B	–0.2	–0.2	–0.2	–0.2	7	7	A
P_T:							
$T_C \leq 25°C$	5	5	5	5	117	115	W
$T_C > 25°C$, derate linearly	0.029	0.029	0.029	0.029	0.67	0.66	W/°C
$T_A \leq 25°C$	1	1	1	1	–	–	W
T_{stg}, T_J	–65 to 200				–65 to 200		°C
T_L (During soldering): At distances ≥ 1/16 in. (1.58 mm) from case for 10 s max.	230				235		°C

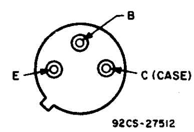
TERMINAL DESIGNATIONS



JEDEC TO-3

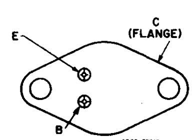
n-p-n

40325
40363



JEDEC TO-39

n-p-n	p-n-p
40311	40319
40314	40362
40317	40537
40321	40538
40323	
40327	
40539	



JEDEC TO-66

n-p-n

40310 40316
40312 40318
40313 40322
40324

40310-40314, 40316-40319, 40321-40325, 40327, 40362, 40363, 40537-40539

Types: 40321, 40323, 40327, n-p-n
Package: JEDEC TO-39
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)= 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS	LIMITS 40321 Min.	40321 Max.	40323 Min.	40323 Max.	40327 Min.	40327 Max.	UNITS
I_{CBO}	V_{CB}=15 V, I_E=0, T_C=25°C	–	–	–	0.25	–	–	µA
	V_{CB}=150 V, I_E=0, T_C=150°C	–	0.1	–	1	–	0.1	mA
I_{CER}	V_{CE}=150 V, R_{BE}=1000 Ω	–	5	–	–	–	5	µA
I_{EBO}	V_{BE}=–2.5 V (40323)	–	–	–	1	–	–	mA
	V_{BE}=–5 V (40321,40327)	–	0.1	–	–	–	0.1	
V_{CEO}(sus)	I_C=100 mA*	–	–	18	–	–	–	V
V_{CER}(sus)	I_C=50 mA*, R_{BE}=1000 Ω	300	–	–	–	300	–	V
V_{BE}	V_{CB}=4 V, I_C=50 mA* (40323)	–	–	–	1	–	–	V
	V_{CB}=10 V, I_C=50 mA* (40321,40327)	–	2	–	–	–	2	
h_{FE}	V_{CE}=4 V, I_C=50 mA* (40323)	–	–	70	350	–	–	
	V_{CE}=10 V, I_C=20 mA* (40321,40327)	25	200	–	–	40	250	
f_T	V_{CE}=10 V, I_C=50 mA	–	–	100 typ.		–	–	MHz
$R_{\theta JC}$		–	35	–	35	–	30	°C/W
$R_{\theta JA}$		–	–	–	175	–	–	

* Pulsed: Pulse duration = 300 µs, duty factor ≤ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40321	2N3439
40323	2N2102
40327	2N3439

Types: 40311, 40314, 40317, n-p-n 40319, p-n-p
Package: JEDEC TO-39
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS▲	LIMITS 40311 Min.	40311 Max.	40314 Min.	40314 Max.	40317 40319▲ Min.	40317 40319▲ Max.	UNITS
I_{CBO}	V_{CB}=15 V, I_E=0 T_C=25°C	–	0.25	–	0.25	–	0.25	µA
	T_C=150°C	–	1	–	1	–	1	mA
I_{EBO}	V_{BE}=–2.5 V	–	1	–	1	–	1	mA
V_{CEO}(sus)	I_C=100 mA*	30	–	40	–	40	–	V
V_{BE}	V_{CE}=4 V I_C=10 mA* (40317); I_C=50 mA (40311,40314,40319)	–	1	–	1	–	1	V
V_{CE}(sat)	I_C=150 mA*, I_B=15 mA	–	–	–	1.4	–	–1.4●	V
h_{FE}	V_{CE}=4 V I_C=10 mA* (40317); I_C= 50 mA* (40311,40314,40319)	70	350	70	350	40 35●	200 200●	
f_T	V_{CE}=10 V (40311); V_{CE}=4 V (40314,40319), I_C=50 mA	100 typ.		100 typ.		100 typ.●		MHz
$R_{\theta JC}$		–	35	–	35	–	35	°C/W
$R_{\theta JA}$		–	175	–	175	–	175	

▲ For p-n-p devices, voltage and current are negative.
● 40319 *Pulsed: Pulse duration = 300 µs, duty factor ≤ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40311	2N2102
40314	2N2102
40317	2N2102
40319	2N4036

40310-40314, 40316-40319, 40321-40325, 40327, 40362, 40363, 40537-40539

Types: 40362, 40537, 40538, p-n-p 40539, n-p-n
Package: JEDEC TO-39
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS●	LIMITS 40362 Min.	40362 Max.	40537 Min.	40537 Max.	40538 40539● Min.	40538 40539● Max.	UNITS
I_{CER}	V_{CE}=–45 V, R_{BE}=500 Ω, T_C=25°C	–	–	–	–10	–	–10	μA
	V_{CE}=–65 V, R_{BE}=1000 Ω, T_C=25°C	–	–1	–	–	–	–	
	V_{CE}=–60 V, R_{BE}=1000 Ω, T_C=150°C	–	–100	–	–	–	–	
I_{EBO}	V_{BE}=4 V	–	–1	–	–	–	–	mA
	V_{BE}=5 V	–	–	–	–1	–	–1	
V_{CER}(sus)	I_C=–100 mA*, R_{BE}=500 Ω	–	–	–55	–	–55	–	V
	I_C=–100 mA*, R_{BE}=1000 Ω	–70	–	–	–	–	–	
V_{BE}	V_{CE}=–4 V, I_C=–50 mA*	–	–1	–	–1.8	–	–	V
	V_{CE}=–4 V, I_C=–500 mA*	–	–	–	–	–	–2.7	
V_{CE}(sat)	I_C=–50 mA*, I_B=–5 mA	–	–	–	–1.1	–	–	V
	I_C=–150 mA*, I_B=–15 mA	–	–1.4	–	–	–	–	
	I_C=–500 mA*, I_B=–50 mA	–	–	–	–	–	–2	
h_{FE}	V_{CE}=–4 V, I_C=–50 mA*	35	200	50	300	–	–	
	V_{CE}=–4 V, I_C=–500 mA*	–	–	–	–	15	90	
f_T	V_{CE}=–4 V, I_C=–50 mA	100 typ.		100 typ.		100 typ.		MHz
$R_{\theta JC}$		–	35	–	–	–	35▲	°C/W
$R_{\theta JA}$		–	175	–	175	–	175	

● For n-p-n devices, voltage and current are positive.
▲ 40539 *Pulsed: Pulse duration = 300 μs, duty factor ⩽ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40362	2N4036
40531	2N4036
40538	2N5322
40539	2N5320

Types: 40310, 40312, 40316, 40324, n-p-n
Package: JEDEC TO-66
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS	LIMITS 40310 40312 Min.	40310 40312 Max.	40316 Min.	40316 Max.	40324 Min.	40324 Max.	UNITS
I_{CBO}	V_{CB}=15 V, I_E=0, T_C=25°C	–	10	–	10	–	10	μA
	T_C=150°C	–	5	–	5	–	5	mA
I_{EBO}	V_{BE}=–2.5 V	–	5	–	–	–	5	mA
	V_{BE}=–5 V	–	–	–	5	–	–	
V_{CEO}(sus)	I_C=100 mA*	35●	–	–	–	35	–	V
V_{CER}(sus)	I_C=100 mA*, R_{BE}=500 Ω	60#	–	40	–	–	–	V
V_{BE}	V_{CE}=2 V, I_C=1 A*	–	1.4	–	1.4	–	1.4	V
h_{FE}	V_{CE}=2 V, I_C=1 A*	20	120	20	120	20	120	
f_T	V_{CE}=4 V, I_C=500 mA	750 typ.		750 typ.		750 typ.		kHz
$R_{\theta JC}$		–	6	–	6	–	6	°C/W

● 40310 # 40312 *Pulsed: Pulse duration = 300 μs, duty factor ⩽ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40310	2N3054
40312	2N3054
40316	2N3054
40324	2N3054

40310-40314, 40316-40319, 40321-40325, 40327, 40362, 40363, 40537-40539

Types: 40313, 40318, 40322, n-p-n
Package: JEDEC TO-66
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS	LIMITS 40313 Min.	40313 Max.	40318 Min.	40318 Max.	40322 Min.	40322 Max.	UNITS
I_{CEO}	V_{CE}=150 V, I_B=0	–	5	–	5	–	–	mA
I_{CEV}	V_{CE}=150 V (40318), V_{CE}=300 V (40313), V_{BE}=–1.5 V, T_C=25°C	–	10	–	5	–	–	mA
	T_C=150°C	–	10	–	10	–	–	
I_{EBO}	V_{BE}=–2.5 V	–	5	–	–	–	–	mA
	V_{BE}=–6 V	–	–	–	5	–	5	
V_{CER}(sus)	I_C=200 mA*, R_{BE}=200 Ω, L=500 mH	300	–	300	–	300	–	V
V_{BE}	V_{CE}=10 V, I_C=100 mA*	–	1.5	–	–	–	–	V
	I_C=500 mA*	–	–	–	1.5	–	–	
h_{FE}	V_{CE}=10 V, I_C=500 mA*	40	–	50	–	75	–	
	I_C=100 mA*	40	250	–	–	–	–	
	I_C=20 mA*	–	–	40	–	40	–	
$I_{S/b}$	V_{CE}=150 V	150	–	100	–	100	–	mA
$E_{S/b}$	V_{BE}=–4 V	–	–	50	–	50	–	μJ
$R_{\theta JC}$		–	5	–	5	–	5	°C/W

*Pulsed: Pulse duration = 300 μs, duty factor ⩽ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40313	2N3585
40318	2N3585
40322	2N3585

Types: 40325, 40363, n-p-n
Package: JEDEC TO-3
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS	LIMITS 40325 Min.	40325 Max.	40363 Min.	40363 Max.	UNITS
I_{CBO}	V_{CB}=30 V, T_C=25°C	–	5	–	–	mA
	T_C=150°C	–	10	–	–	
I_{CER}	V_{CE}=60 V, R_{BE}=200 Ω, T_C=25°C	–	–	–	1	mA
	T_C=150°C	–	–	–	10	
I_{EBO}	V_{BE}=–5 V	–	10	–	–	mA
	V_{BE}=–4 V	–	–	–	5	
V_{CEO}(sus)	I_C=200 mA*	35	–	–	–	V
V_{CER}(sus)	I_C=200 mA*, R_{BE}=200 Ω	–	–	70	–	V
V_{CBO}	I_C=100 mA, I_E=0	35	–	–	–	V
V_{BE}	V_{CE}=4 V, I_C=8 A*	–	2	–	–	V
	I_C=4 A*	–	–	–	1.8	
V_{CE}(sat)	I_C=8 A*, I_B=800 mA	–	1.5	–	–	V
	I_C=4 A*, I_B=400 mA	–	–	–	1.1	
h_{FE}	V_{CE}=4 V, I_C=8 A*	12	60	–	–	
	I_C=4 A*	–	–	20	70	
f_T	V_{CE}=4 V, I_C=3 A	–	–	700 typ.		kHz
$R_{\theta JC}$		–	1.5	–	1.5	°C/W

*Pulsed: Pulse duration = 300 μs, duty factor ⩽ 2%.
For characteristics curves and test conditions, refer to published data for prototype.

Audio Type	Prototype
40325	2N3055
40363	2N3055

40406. 40408, 40410, 40407, 40409, 40411

Silicon N-P-N and P-N-P Power Transistors

For Audio-Amplifier Applications

RCA-40406-40411, inclusive, are diffused-junction silicon n-p-n and p-n-p transistors intended for use in audio amplifiers. Giving high-quality performance economically, these six devices have power dissipation ratings of 1 to 150 W. Types 40406, 40407, and 40408 are supplied in JEDEC TO-39 hermetic packages; types 40409 and 40410 are in TO-39 packages mounted on integral heat radiators. The 40411 unit, intended for use in audio output stages, is in a steel JEDEC TO-3 hermetic package.

	40406	40407	40408	40409	40410	40411	
$V_{CEO}(sus)$	-50	50	90	–	–	–	V
$V_{CER}(sus)$ $R_{BE} = 100\ \Omega$	–	–	–	90	-90	90	V
V_{EBO}	-4	4	4	4	-4	4	V
I_C	-0.7	0.7	0.7	0.7	-0.7	30	A
I_B	-0.2	0.2	0.2	0.2	-0.2	15	A
P_T:							
$T_A \leq 25°C$	1	1	1	–	–	–	W
$T_A \leq 50°C$	–	–	–	3	3	–	W
$T_C \leq 25°C$	–	–	–	–	–	150	W
T_J	-65 to +200						°C

Features:

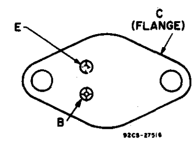
40406 & 40407
- $V_{CEO}(sus)$ = -50 V max. (40406)
- $V_{CEO}(sus)$ = 50 V max. (40407)
- 40406 is p-n-p complement of 40407
- 1 W dissipation rating

40408
- $V_{CEO}(sus)$ = 90 V max.
- 1 W dissipation rating

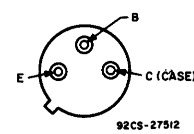
40409 & 40410
- $V_{CER}(sus)$ = 90 V max. (40409)
- $V_{CER}(sus)$ = -90 V max. (40410)
- 40410 is p-n-p complement of 40409
- 3 W free-air dissipation rating

40411
- $V_{CER}(sus)$ = 90 max.
- Hometaxial-base construction
- 150 W dissipation rating

TERMINAL DESIGNATIONS



JEDEC TO-3



JEDEC TO-39

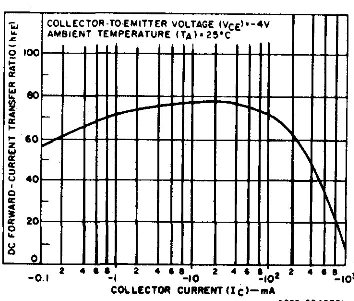


Fig. 1 – Typical dc beta characteristic for 40406 and 40410.

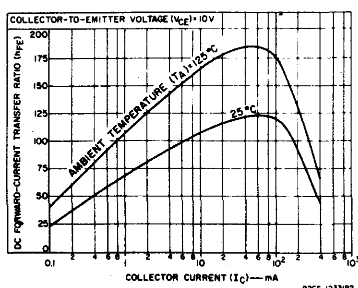


Fig. 2 – Typical dc beta characteristics for 40407, 40408, and 40409.

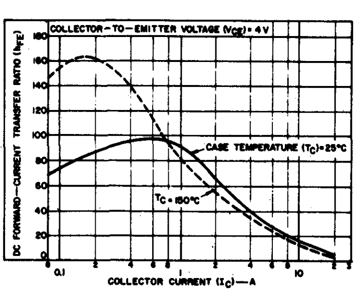


Fig. 3 – Typical dc beta characteristics for 40411.

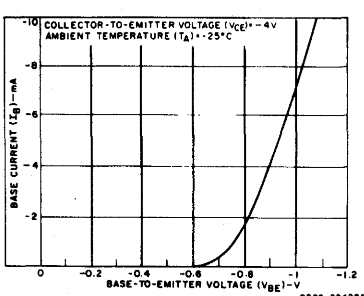


Fig. 4 – Typical input characteristic for 40406 and 40410.

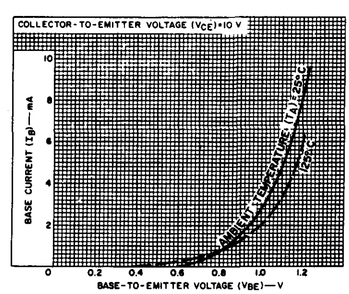


Fig. 5 – Typical input characteristics for 40407, 40408, and 40409.

40406, 40408, 40410, 40407, 40409, 40411

ELECTRICAL CHARACTERISTICS, *T_C = 25° Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc	TEST CONDITIONS CURRENT A dc		LIMITS 40406# 40407		40408		40409 40410#		40411		UNITS
	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E = 0$	10•			–	0.25♦	–	–	–	–	–	–	µA
I_{CEO}	40 80			– –	1 –	– –	– 1	– –	– –	– –	– –	µA
T_C = 150° C 40406 40407 40408	 40 40 80			 – – –	 0.01 0.1 –	 – – –	 – – 0.25	 – – –	 – – –	 – – –	 – – –	mA
I_{CER} R_{BE} = 100 Ω	80			–	–	–	–	–	1	–	500	µA
T_C = 150° C	80			–	–	–	–	–	0.1	–	2	mA
I_{EBO} V_{BE} = -4 V		0		–	100	–	100	–	100	–	500	µA
$V_{CEO}(sus)$		0.1[a]	0	50[b]	–	90[b]	–	–	–	–	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω		0.1 0.2			– –	– –	– –	 –	– –	– 90	– –	V
V_{BE}	10 4 4 4	0.001[a] 0.01[a] 0.15[a] 4[a]		– – – –	0.8[c] – – –	– – – –	– 1 – –	– – – –	– – 1 –	– – – –	– – – 1.2	V
$V_{CE}(sat)$		0.15[a] 4[a]	0.015 0.4	– –	– –	– –	1.4 –	– –	1.4 –	– –	– 0.8	V
h_{FE} 40406 40407 40408 40409-10 40411	10 10 4 4 4	0.1 mA[a] 0.001[a] 0.01[a] 0.15[a] 4[a]		30 40 – – –	200 200 – – –	– – 40 – –	– – 200 – –	– – – 50 –	– – – 250 –	– – – – 35	– – – – 100	
h_{fe} f = 20 MHz	10	0.05		6♦	–	–	–	–	–	–	–	
f_T	4	0.05		100 (typ.)		100 (typ.)		100 (typ.)		–	–	MHz
	4	4		–	–	–	–	–	–	800 (typ.)		kHz
C_{obo} $I_E = 0$ f = 1 MHz	10•			15♦	–	–	–	–	–	–	–	pF
$I_{S/b}$ t = 1s nonrep	40			–	–	–	–	5*	–	–	–	A
$R_{\theta JC}$				–	35	–	35	–	–	–	1.17	°C/W
$R_{\theta JA}$				–	175	–	175	–	50	–	–	°C/W

\# For p-n-p devices, voltage and current values are negative

• V_{CB} ♦ 40407 only * 40410 only

a Pulsed; pulse duration = 300 µs, duty factor ≤ 2%

b CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer. $V_{CEO}(sus)$ should be measured by the pulse method (Note 'a').

c 40406 tested at I_C = –0.1 mA

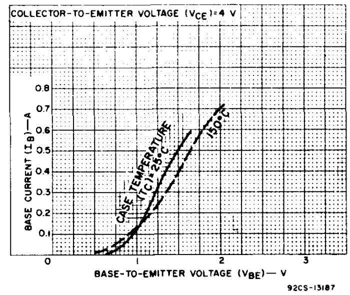


Fig. 6 – Typical input characteristics for 40411.

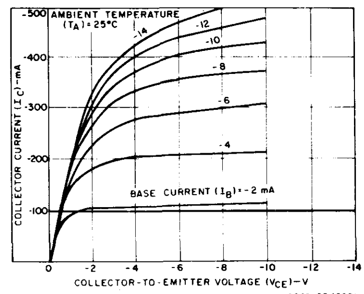


Fig. 7 – Typical output characteristics for 40406 and 40410.

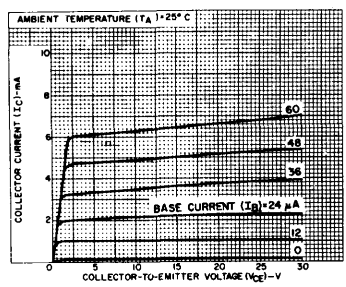


Fig. 8 – Typical output characteristics for 40407, 40408, and 40409.

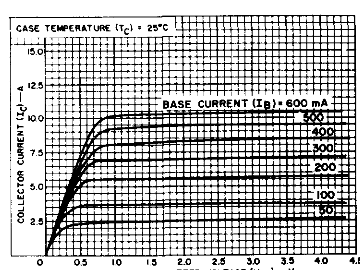


Fig. 9 – Typical output characteristics for 404II.

40631, 41504

Hometaxial-Base Silicon N-P-N VERSAWATT Transistors

Designed for Medium-Power
Linear and Switching Applications

The RCA-40631 and 41504 are hometaxial-base silicon n-p-n transistors intended for a wide variety of medium-power applications. The hometaxial-base construction of these devices renders them highly resistant to second breakdown over a wide range of operating conditions. Type 40631 is intended especially for use in driver and output stages in high-fidelity audio-amplifier circuits; the 41504 is a general-purpose device.

Both of these transistor types are supplied in the VERSAWATT flame-retardant plastic package. The 40631 is supplied in the JEDEC TO-220AA formed-lead version of this package for use with TO-66 sockets; the 41504 is supplied in the JEDEC TO-220AB, straight-lead version.

Features:

- **Low saturation voltages**
- **High dissipation ratings**

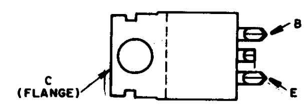
Applications:

- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

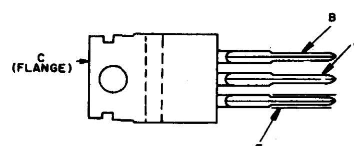
	40631	41504	
$V_{CER}(sus)$			
$R_{BE} = 100\ \Omega$	45	35	V
V_{EBO}	5	4	V
I_C	4	4	A
I_B	2	2	A
P_T:			
At $T_C \leq 25^oC$	36	36	W
At $T_C > 25^oC$ ... Derate linearly	0.288		W/^oC
At $T_A \leq 25^oC$	1.8	–	W
T_J, T_{stg}	−65 to +150		^oC
T_L			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235		^oC

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AA



BOTTOM VIEW

JEDEC TO-220AB

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25^{o}C*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 40631 Min.	40631 Max.	41504 Min.	41504 Max.	UNITS
I_{CER} $R_{BE} = 100\ \Omega$	20				–	–	–	5	mA
	40				–	0.5	–	–	
I_{EBO}		−4	0		–	–	–	1	mA
		−5	0		–	1	–	–	
$V_{CER}(sus)$ $R_{BE} = 100\ \Omega$			0.1[a]		–	–	35	–	V
			0.2[a]		45	–	–	–	
h_{FE}	4		1[a]		–	–	25	–	
	4		2[a]		20	70	–	–	
$V_{CE}(sat)$			1[a]	0.05	–	–	–	1	V
			2[a]	0.2	–	1	–	–	
V_{BE}	4		1[a]		–	–	–	1.5	V
	4		2[a]		–	1.5	–	–	
$\|h_{fe}\|$ f = 0.4 MHz	4		0.2		2	–	2	–	
$R_{\theta JC}$					–	3.5	–	3.5	^{o}C/W
$R_{\theta JA}$					–	70	–	70	

[a] Pulsed: Pulse duration = 300 μs, duty factor ≤ 2%.

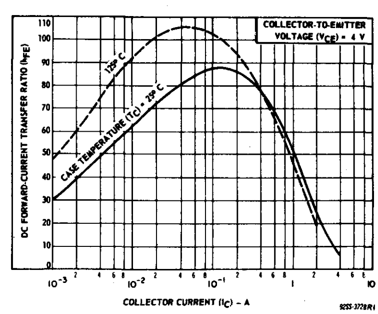


Fig. 1 – Typical dc beta characteristics for 40631.

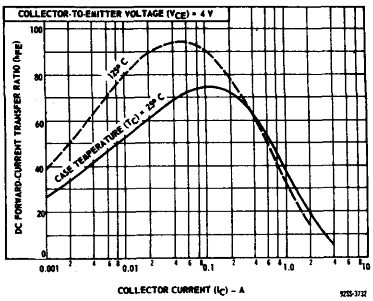


Fig. 2 – Typical dc beta characteristics for 41504.

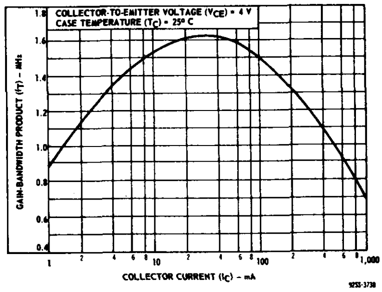


Fig. 3 – Typical gain-bandwidth product for 40631.

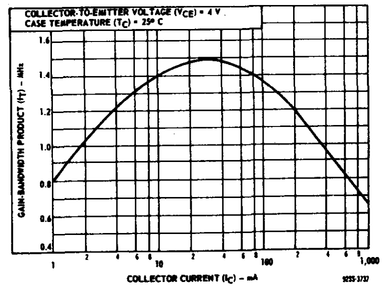


Fig. 4 – Typical gain-bandwidth product for 41504.

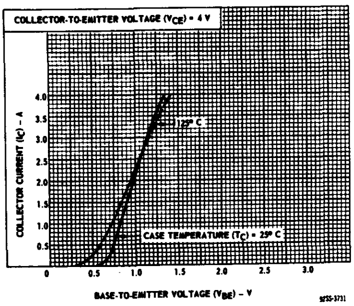


Fig. 5 – Typical transfer characteristics for 40631.

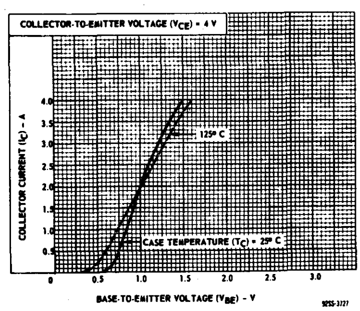


Fig. 6 – Typical transfer characteristics for 41504.

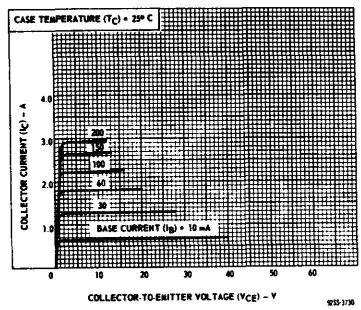


Fig. 7 – Typical output characteristics for 40631.

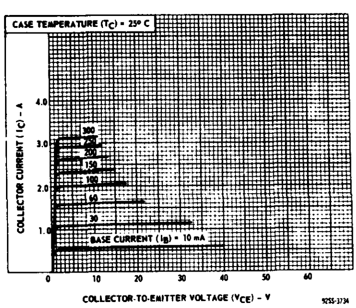


Fig. 8 – Typical otuput characteristics for 41504.

40850, 40851, 40852, 40854

450-V Silicon N-P-N Power Transistors

For Off-Line Switching-Regulator Type Power-Supply Applications

The RCA-40850, 40851, 40852, and 40854 are n-p-n types selected from RCA's line of silicon power transistors for power-supply applications. Their high-voltage ratings permit operation directly off the power line thereby eliminating the heavy and bulky 60-Hz power transformer; their fast switching speeds permit operation above the audio-frequency range (20 to 30 KHz) for quiet performance and permit the use of small ferrite-core transformers for changing voltage levels.

These devices have sufficient voltage capability to be used as push-pull inverters or pulse-width-modulated inverters operating directly off the 120-V power line; they can operate as switching regulators off a 240-V line; for 120-V lines, the prototypes can be used.

Features:

- **High-voltage ratings for operation from power lines without a step-down transformer**
- **Popular JEDEC TO-3 and TO-66 hermetic packages**

Applications:

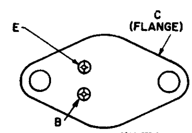
- **For use in switching-regulator supplies which feature:**
  - **—A substantial reduction in size and weight due to elimination of the 60-Hz power transformer.**
  - **—Operation with a substantial reduction of heat**
- **5-V, off-line supplies with current ratings of 25, 50, 100, or 200 A**
- **30-V, off-line supplies with current ratings of 5, 10, 20, or 40 A**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	40850	40851	40852	40854	
V_{CBO}	450	450	450	450	V
$V_{CEO}(sus)$	300	350	350	300	V
$V_{CER}(sus)$ $R_{BE} \leq 50\ \Omega$	400	375	375	325	V
V_{EBO}	6	9	9	6	V
I_C	2	7	7	15	A
I_{CM} (For 10 ms max.)	5	10	10	30	A
I_B	1	4	4	10	A
P_T:* $T_C \leq 25^oC$	35	45	100	175	W
$T_C > 25^oC$	Derate linearly to 200°C				
T_J, T_{stg}	−65 to +200				°C
T_L (During soldering): At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230				°C

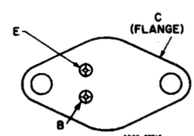
* Safe-operating-area curves for prototype devices should be extended to the maximum values of collector current for these devices.

TERMINAL DESIGNATIONS



JEDEC TO-3

40852
40853



JEDEC TO-66

40850
40851

Type 40850 (For 5-V, 25-A & 30-V, 5-A Power Supplies)
Package: JEDEC TO-66
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V	–	0.2	mA
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V, T_C = 125°C	–	2	mA
$V_{CEO}(sus)$[a]	I_C = 0.2 A, I_B = 0	300	–	V
$V_{CER}(sus)$[a]	I_C = 0.2 A, R_{BE} = 50 Ω	400	–	V
V_{EBO}	I_E = 5 mA, I_C = 0	6	–	V
h_{FE}	I_C = 0.75 A, V_{CE} = 10 V	25	–	
$V_{CE}(sat)$	I_C = 2 A, I_B = 0.4 A	–	2.0	V
$V_{BE}(sat)$	I_C = 2 A, I_B = 0.4 A	–	2.0	V
$I_{S/b}$[a]	V_{CE} = 100 V	0.35	–	A
$E_{S/b}$[a]	L = 100 μH, I_C(PEAK) = 2 A, R_{BE} = 20 Ω V_{BE} = -4 V	0.2	–	mJ

[a] For characteristics curves and test conditions, refer to published data for prototype 2N3585

40850, 40851, 40852, 40854

Type 40851 (For 5-V, 50-A & 30-V, 10-A Power Supplies)
Package: JEDEC TO-66
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V	–	0.5	mA
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V, T_C = 125°C	–	5	mA
V_{CEO}(sus)[a]	I_C = 0.2 A, I_B = 0	350	–	V
V_{CER}(sus)[a]	I_C = 0.2 A, R_{BE} = 50 Ω	375	–	V
V_{EBO}	I_E = 1 mA, I_C = 0	9	–	V
h_{FE}	I_C = 1.2 A, V_{CE} = 1.0 V	12	–	
V_{CE}(sat)	I_C = 4 A, I_B = 0.8 A	–	3	V
V_{BE}(sat)	I_C = 4 A, I_B = 0.8 A	–	2	V
$I_{S/b}$[a]	V_{CE} = 50 V	0.9	–	A
$E_{S/b}$[a]	L = 100 μH, I_C(PEAK) = 3 A, R_{BE} = 50 Ω V_{BE} = -4 V	0.45	–	mJ

[a] For characteristics curves and test conditions, refer to published data for prototype 2N6079

Type 40852 (For 5-V, 50-A & 30-V, 10-A Power Supplies
Package: JEDEC TO-3
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V	–	0.5	mA
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V, T_C = 125°C	–	5	mA
V_{CEO}(sus)[a]	I_C = 0.2 A, I_B = 0	350	–	V
V_{CER}(sus)[a]	I_C = 0.2 A, R_{BE} = 50 Ω	375	–	V
V_{EBO}	I_E = 1 mA, I_C = 0	9	–	V
h_{FE}	I_C = 1.2 A, V_{CE} = 1.0 V	12	–	
V_{CE}(sat)	I_C = 4 A, I_B = 0.8 A	–	3.0	V
V_{BE}(sat)	I_C = 4 A, I_B = 0.8 A	–	2.0	V
$I_{S/b}$[a]	V_{CE} = 40 V	2.5	–	A
$E_{S/b}$[a]	L = 100 μH, I_C(PEAK) = 3 A, R_{BE} = 50 Ω V_{BE} = -4 V	0.45	–	mJ

[a] For characteristics curves and test conditions, refer to published data for prototype 2N5240

40850, 40851, 40852, 40854

Type 40854 (For 5-V, 200-A & 30-V, 40-A Power Supplies)
Package: JEDEC TO-3
ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V	–	1.0	mA
I_{CEV}	V_{CE} = 450 V, V_{BE} = -1.5 V, T_C = 125°C	–	10	mA
V_{CEO}(sus)[a]	I_C = 0.2 A, I_B = 0	300	–	V
V_{CER}(sus)[a]	I_C = 0.2 A, R_{BE} = 50 Ω	325	–	V
V_{EBO}	I_E = 5 mA, I_C = 0	6	–	V
h_{FE}	I_C = 10 A, V_{CE} = 4 V	8	–	
V_{CE}(sat)	I_C = 16 A, I_B = 3.2 A	–	3	V
V_{BE}(sat)	I_C = 16 A, I_B = 3.2 A	–	3	V
$I_{S/b}$[a]	V_{CE} = 30 V	5.8	–	A
$E_{S/b}$[a]	L = 50 μH, I_C(PEAK) = 10 A, R_{BE} = 50 Ω, V_{BE} = -4 V	2.5	–	mJ

[a] For characteristics curves and test conditions, refer to published data for prototype 2N6251

40871, 40872

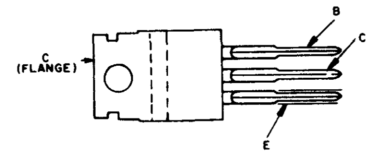
Epitaxial-Base, Silicon N-P-N and P-N-P VERSAWATT Transistors

General-Purpose Types for Medium-Power Switching and Amplifier Service in Consumer, Automotive, and Industrial Applications

Features:
- Low saturation voltage
- VERSAWATT package
- Maximum safe-operating-area curves
- Thermal-cycling ratings

RCA-40871 is an epitaxial-base silicon n-p-n transistor. RCA-40872 is an epitaxial-base p-n-p transistor. These devices are intended for a wide variety of medium-power switching and amplifier applications, such as switching regulators and inverters and driver and output stages of high-fidelity amplifiers. These plastic power transistors are supplied in the JEDEC TO-220AB VERSAWATT package.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		N-P-N 40871 / P-N-P 40872*	
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$	120	V
With base open	$V_{CEO(sus)}$	100	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	V
COLLECTOR CURRENT (Continuous)	I_C	7	A
BASE CURRENT (Continuous)	I_B	3	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		40	W
At ambient temperatures up to 25°C		1.8	W
At case temperatures above 25°C		Derate linearly at 0.32W/°C	–
At ambient temperatures above 25°C		Derate linearly at 0.0144 W/°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		–65 to 150	°C
LEAD TEMPERATURE (During Soldering):			
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235	°C

* For p-n-p device, voltage and current values are negative.

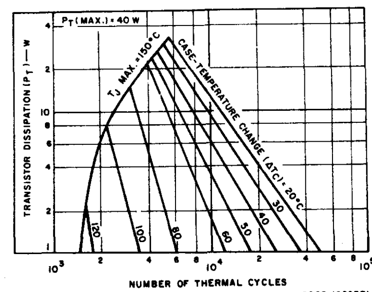


Fig. 1 - Thermal-cycling ratings for both types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{EB}	CURRENT A dc I_C	I_B	LIMITS 40871 40872* MIN.	MAX.	UNITS
Collector-Cutoff Current: With external base-to emitter resistance (R_{BE}) = 100 Ω	I_{CER}	110				–	1	mA
Emitter-Cutoff Current	I_{EBO}		5	0		–	1	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$			0.1	0	100	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$			0.1		120	–	V
DC Forward-Current Transfer Ratio	h_{FE}	4 4 4		1ª		50	250	
Base-to-Emitter Voltage	V_{BE}	4 4 4		1ª		– – –	1.5 – –	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$			1ª	0.1	–	1.0	V
Gain-Bandwidth Product	f_T	4		0.5		4	–	MHz
Thermal Resistance: Junction-to-Case Junction-to-Ambient	$R_{\theta JC}$ $R_{\theta JA}$					–	3.125 70	°C/W

* For p-n-p devices, voltage and current values are negative.
ª Pulsed: Pulse duration = 300 μs, duty factor = 0.018.
CAUTION: The sustaining voltages $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.

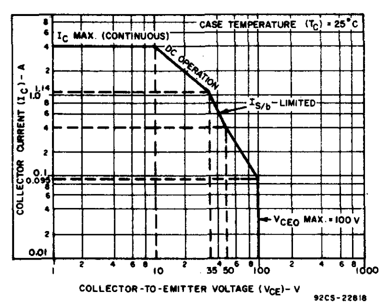


Fig. 2 - Maximum operating areas for 40871.

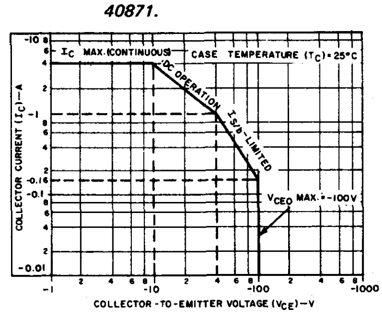


Fig. 3 - Maximum operating areas for 40872.

40871, 40872

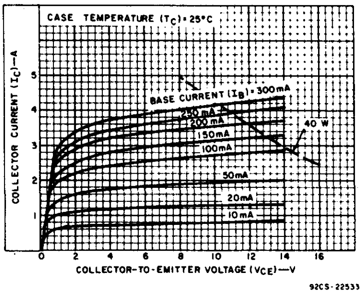


Fig. 4 - Typical output characteristics for 40871.

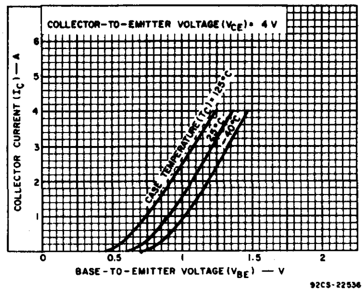


Fig. 5 - Typical transfer characteristics for 40871.

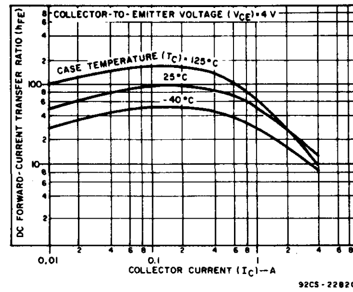


Fig. 6 - Typical dc beta characteristics for 40871.

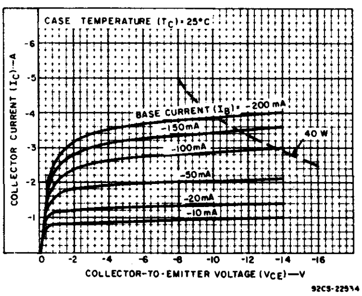


Fig. 7 - Typical output characteristics for 40872.

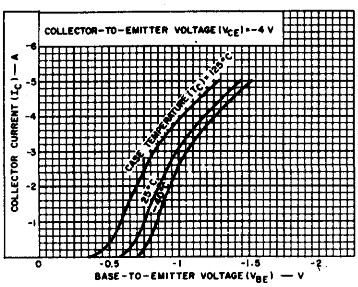


Fig. 8 - Typical transfer characteristics for 40872.

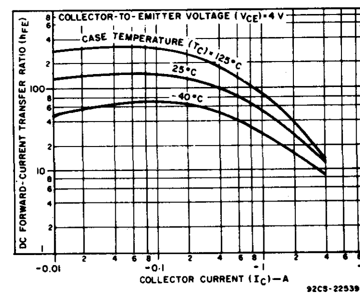


Fig. 9 - Typical dc beta characteristics for 40872.

BD142

Hometaxial-Base, High-Power Silicon N-P-N Transistor

Rugged General-Purpose Device For Commercial Use

The RCA-BD142 is a hometaxial-base diffused-junction silicon n-p-n transistor intended for a wide variety of intermediate-power and high-power applications. It is especially suited for use in audio and inverter circuits at 12 volts.

The BD142 is supplied in a JEDEC TO-3 hermetic steel package.

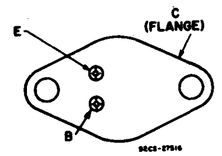
Applications:

- Series and shunt regulators
- High-fidelity amplifiers
- Power-switching circuits
- Solenoid drivers
- 12-V audio and inverter circuits

Features:

- Maximum-safe-area-of-operation curves
- Low saturation voltage
- High dissipation rating
- Thermal-cycling rating curve

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	50	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With base open	$V_{CEO}(sus)$	45	V
With base reverse bias V_{BE} = −1.5 V	$V_{CEV}(sus)$	50	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	15	A
CONTINUOUS BASE CURRENT	I_B	7	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		117	W
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage and Operating (Junction)		−65 to +200	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS					LIMITS		UNITS
		VOLTAGE V dc			CURRENT A dc				
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	MIN.	MAX.	
Collector Cutoff Current: With base-emitter junction reverse-biased	I_{CEV}	40		−1.5			–	2	mA
Emitter Cutoff Current	I_{EBO}		7				–	1	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$				0.2	0	45	–	V
With base-emitter junction reverse-biased	$V_{CEV}(sus)$			−1.5	0.1		50	–	
DC Forward Current Transfer Ratio	h_{FE}	4			4[a]		12.5	160	
Base-to-Emitter Voltage	V_{BE}	4			4[a]		–	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				4[a]	0.4	–	1.1	V
Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 1 kHz)	h_{fe}	4			1		10	–	
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 0.4 MHz)	$\|h_{fe}\|$	4			1		2	–	
Gain-Bandwidth Product	f_T				1		800	–	kHz
Forward-Bias Second-Breakdown Collector Current (t ≥ 1 s)	$I_{S/b}$	39					3	–	A
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$						–	1.5	°C/W

[a] Pulsed: Pulse duration = 300 µs, duty factor ≤ 2%.

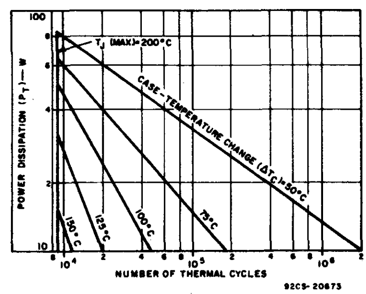


Fig. 1 — Thermal-cycling rating chart.

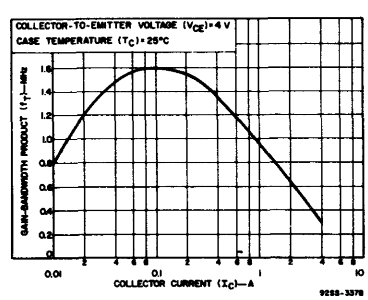


Fig. 2 — Typical gain-bandwidth product.

BD142

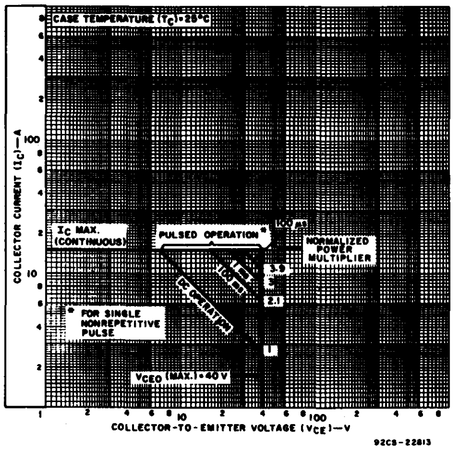


Fig. 3 – Maximum safe area of operation.

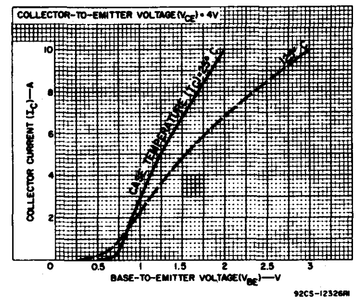


Fig. 4 – Typical transfer characteristics.

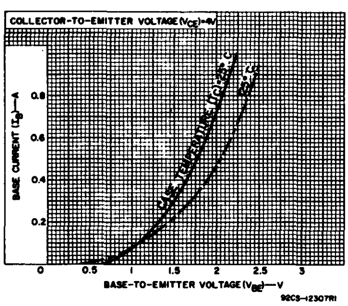


Fig. 5 – Typical input characteristics.

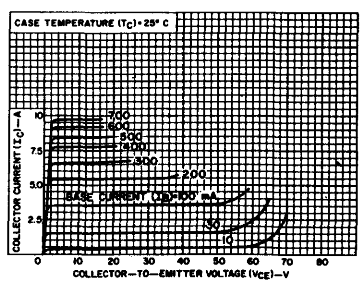


Fig. 6 – Typical output characteristics.

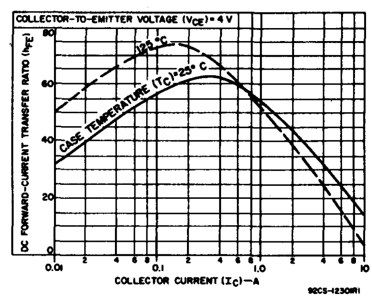


Fig. 7 – Typical dc beta characteristics.

BD181, BD182, BD183

Hometaxial-Base, High Power Silicon N-P-N Transistors

Rugged, Broadly Applicable Devices For Commercial Use

RCA-BD181, BD182 and BD183 are silicon n-p-n transistors intended for a wide variety of high-power applications. The hometaxial-base construction of these devices renders them highly resistant to second breakdown over a wide range of operating conditions.

These transistors are supplied in a JEDEC TO-3 hermetic steel package.

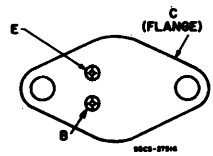
Applications:

- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltages**
- **High dissipation ratings**
- **Thermal-cycling rating curves**

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BD181	BD182	BD183	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	70	85	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	55	70	85	V
With base open	$V_{CEO}(sus)$	45	60	80	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	15	15	15	A
CONTINUOUS BASE CURRENT	I_B	7	7	7	A
TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		117	117	117	W
At case temperatures above 25°C		← See Fig. 2 →			
TEMPERATURE RANGE:					
Storage and Operating (Junction)		← −65 to +200 →			°C
PIN TEMPERATURE (During Soldering):					
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		← 235 →			°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{EB}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS: BD181 MIN.	BD181 MAX.	BD182 MIN.	BD182 MAX.	BD183 MIN.	BD183 MAX.	UNITS
Collector-Cutoff Current: With emitter open and T_C = 200°C	I_{CBO}	45					0	–	2	–	–	–	–	mA
		60					0	–	–	–	5	–	–	
		80					0	–	–	–	–	–	5	
With base-emitter junction reverse-biased	I_{CEX}		45		−1.5				1	–	–	–	–	
			60		−1.5			–	–	–	1	–	–	
			80		−1.5			–	–	–	–	–	1	
Emitter-Cutoff Current	I_{EBO}			7				–	5	–	5	–	5	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$					0.2^a	0	45	–	60	–	80	–	V
With external base-to-emitter resistance (R_{BE})=100 Ω	$V_{CER}(sus)$					0.2^a		55	–	70	–	85	–	
DC Forward Current Transfer Ratio	h_{FE}		4			4^a		–	–	20	70	–	–	
			4			3^a		20	70	–	–	20	70	
Base-to-Emitter Voltage	V_{BE}		4			3^a		–	1.5	–	–	–	1.5	V
			4			4^a		–	–	–	1.5	–	–	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					4^a	0.4^a	–	–	–	1	–	–	V
						3^a	0.3^a	–	1	–	–	–	1	
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 0.4 MHz)	$\|h_{fe}\|$		4			1		2	–	2	–	2	–	
Gain-Bandwidth Product	f_T					1		800	–	800	–	800	–	kHz
Common-Emitter, Short-Circuit, Small-Signal, Forward Current Transfer Ratio Cutoff Frequency	f_{hfe}		4			0.3		15	–	15	–	15	–	kHz
Forward-Bias Second Breakdown Collector Current (t ≥ 1 s)	$I_{S/b}$		30					3.95	–	3.95	–	3.95	–	A
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$							–	1.5	–	1.5	–	1.5	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

BD181, BD182, BD183

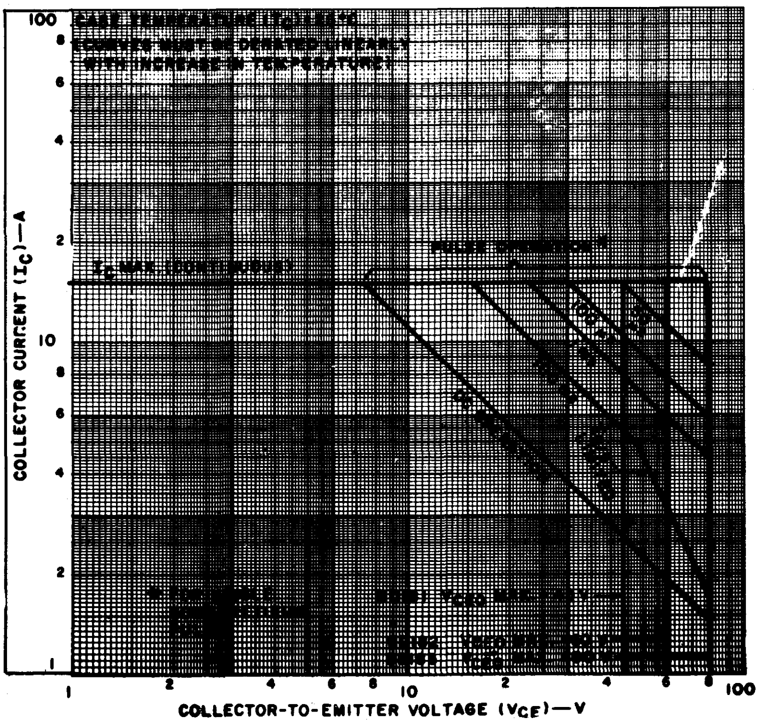


Fig. 1 — Maximum operating areas for all types.

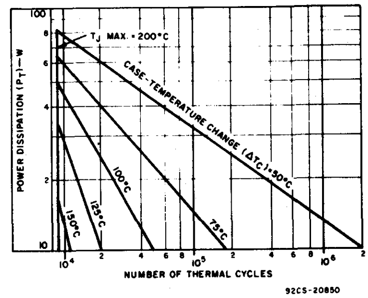


Fig. 2 — Thermal cycling rating chart for all types.

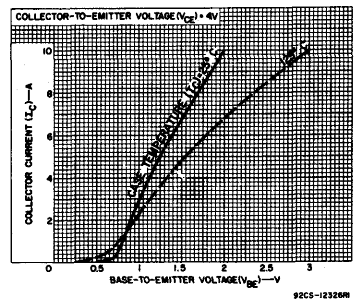


Fig. 3 — Typical transfer characteristics for all types.

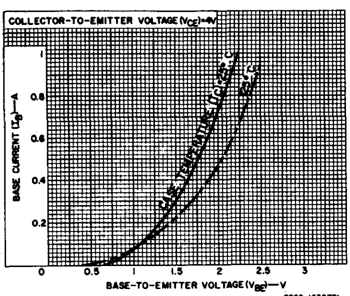


Fig. 4 — Typical input characteristics for BD182.

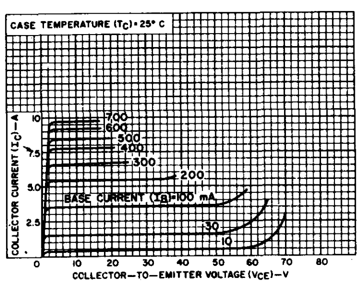


Fig. 5 — Typical output characteristics for BD182.

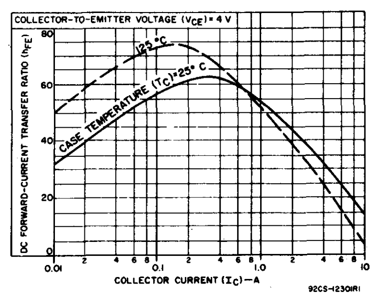


Fig. 6 — Typical dc-beta characteristics for BD182.

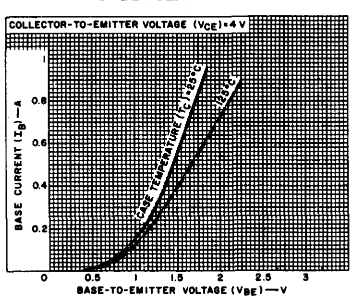


Fig. 7 — Typical input characteristics for BD181 and BD183.

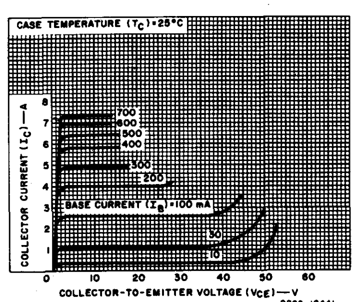


Fig. 8 — Typical output characteristics for BD181 and BD183.

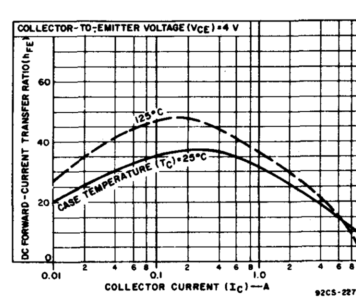


Fig. 9 — Typical dc-beta characteristics for BD181 and BD183.

BD181, BD182, BD183

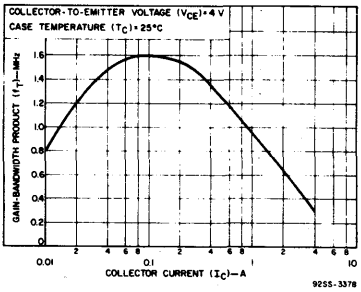


Fig. 10 – Typical gain-bandwidth product for all types.

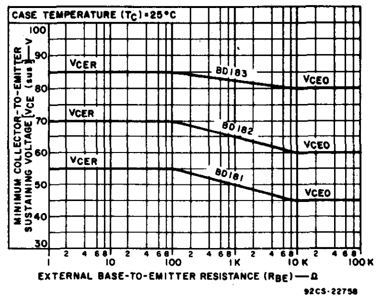


Fig. 11 – Sustaining voltage vs. base-to-emitter resistance for all types.

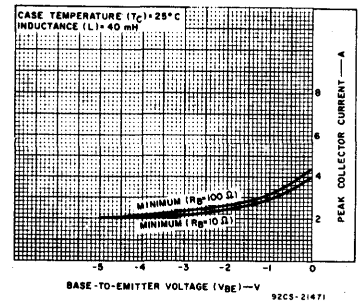


Fig. 12 – Minimum reverse-bias second-breakdown characteristics for all types.

BD239, BD239A, BD239B, BD239C BD240, BD240A, BD240B, BD240C

Epitaxial-Base Silicon N-P-N and P-N-P VERSAWATT Transistors

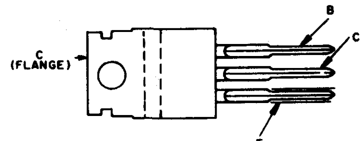
For Power-Amplifier and High-Speed-Switching Applications

Features:
- **30 W at 25°C case temperature**
- **4-A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 200 mA**

These RCA devices are epitaxial-base silicon n-p-n and p-n-p transistors; they differ only in their voltage ratings. These transistors are intended for a wide variety of switching and amplifier applications such as series and shunt regulators, and driver and output stages of high-fidelity amplifiers. The BD240-series p-n-p power transistors are complements of the n-p-n devices in the BD239 series.

All these transistors are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA International Sales Office.

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220 AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BD239 BD240♦	BD239A BD240A♦	BD239B BD240B♦	BD239C BD240C♦	
COLLECTOR-TO-EMITTER VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	55	70	90	115	V
With base open	V_{CEO}	45	60	80	100	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	V
CONTINUOUS COLLECTOR CURRENT	I_C	4	4	4	4	A
CONTINUOUS BASE CURRENT	I_B	1	1	1	1	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		30	30	30	30	W
At ambient temperatures up to 25°C .		2	2	2	2	W
At case temperatures above 25°C		Derate linearly to 150°C				
TEMPERATURE RANGE:						
Storage & Operating (Junction)......		← −65 to 150 →				°C
LEAD TEMPERATURE (During Soldering):						
At distance 1/8 in. (3.17 mm) from case for 10 s max.		← 235 →				°C

♦ For p-n-p devices, voltage and current values are negative.

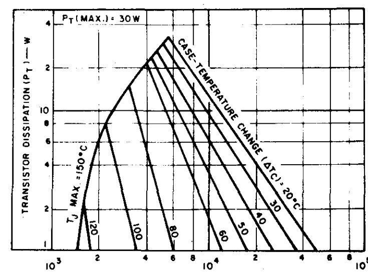


Fig. 1 — Thermal-cycling ratings for all types.

ELECTRICAL CHARACTERISTICS *at Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS BD239 BD240♦ MIN.	MAX.	BD239A BD240A♦ MIN.	MAX.	BD239B BD240B♦ MIN.	MAX.	BD239C BD240C♦ MIN.	MAX.	UNITS
Collector Cutoff Current: With base open	I_{CEO}	−30 −60			0 0	– –	−0.3 –	– –	−0.3 –	– –	– −0.3	– –	– −0.3	mA
With base-to-emitter junction short-circuited	I_{CES}	−45 −60 −80 −100	0 0 0 0			– – – –	−0.2 – – –	– – – –	– −0.2 – –	– – – –	– – −0.2 –	– – – –	– – – −0.2	mA
Emitter Cutoff Current	I_{EBO}		5	0		–	−1	–	−1	–	−1	–	−1	mA
Collector-to-Emitter Breakdown Voltage: With base open	$V_{BR(CEO)}$			−0.03[a]	0	−45	–	−60	–	−80	–	−100	–	V
DC Forward-Current Transfer Ratio	h_{FE}	−4 −4		−0.2[a] −1[a]		40 15	– –	40 15	– –	40 15	– –	40 15	– –	
Base-to-Emitter Voltage	V_{BE}	−4		−1[a]		–	−1.3	–	−1.3	–	−1.3	–	−1.3	V
Collector-to-Emitter *Saturation Voltage*	V_{CE}(sat)			−1[a]	−0.2	–	−0.7	–	−0.7	–	−0.7	–	−0.7	V
Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	−10		0.2		20	–	20	–	20	–	20	–	
Magnitude of Common Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 MHz)	$\|h_{fe}\|$	−10		0.2		3	–	3	–	3	–	3	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	4.17	–	4.17	–	4.17	–	4.17	°C/W
Junction-to-Ambient	$R_{\theta JA}$					–	62.5	–	62.5	–	62.5	–	62.5	°C/W

♦ For p-n-p devices, voltage and current values are negative.

[a]Pulsed: Pulse duration = 300 μs, duty factor = 2%.

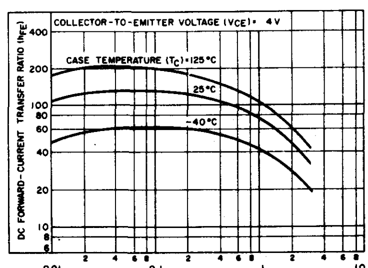


Fig. 2 — Typical dc beta characteristics for BD239-series types.

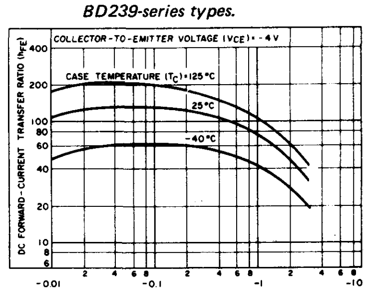


Fig. 3 — Typical dc beta characteristics for BD240-series types.

BD239, BD239A, BD239B, BD239C, BD240, BD240A, BD240B, BD240C

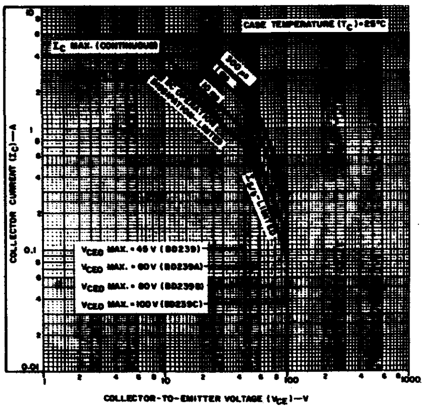


Fig. 4 — Maximum safe operating areas for BD239-series types.

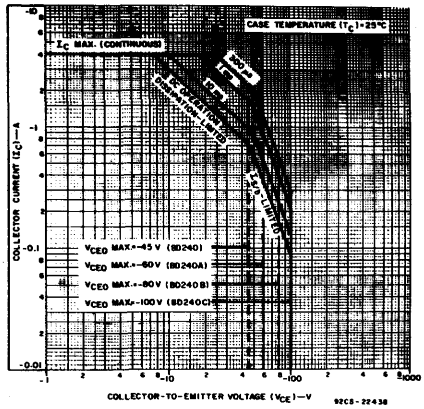


Fig. 5 — Maximum safe operating areas for BD240-series types.

BD241, BD241A, BD241B, BD241C, BD242, BD242A, BD242B, BD242C

Epitaxial-Base Silicon N-P-N and P-N-P VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

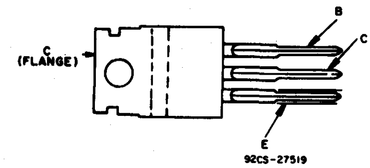
Features:

- **40 W at 25°C case temperature**
- **5-A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 500 mA**

These RCA devices are epitaxial-base silicon n-p-n and p-n-p transistors; they differ only in their voltage ratings. These transistors are intended for a wide variety of switching and amplifier applications such as series and shunt regulators, and driver and output stages of high-fidelity amplifiers. The BD242-series p-n-p power transistors are complements of the n-p-n devices in the BD241 series.

All these transistors are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA International Sales Office.

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220 AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BD241 BD242♦	BD241A BD242A♦	BD241B BD242B♦	BD241C BD242C♦	
COLLECTOR-TO-EMITTER VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	55	70	90	115	V
With base open	V_{CEO}	45	60	80	100	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	V
CONTINUOUS COLLECTOR CURRENT	I_C	5	5	5	5	A
CONTINUOUS BASE CURRENT	I_B	1	1	1	1	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		40	40	40	40	W
At ambient temperatures up to 25°C		2	2	2	2	W
At case temperatures above 25°C		Derate linearly to 150°C				
TEMPERATURE RANGE:						
Storage & Operating (Junction)		← −65 to 150 →				°C
LEAD TEMPERATURE (During Soldering):						
At distance 1/8 in. (3.17 mm) from case for 10 s max.		← 235 →				°C

♦ For p-n-p devices, voltage and current values are negative.

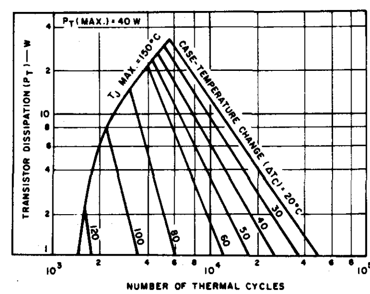


Fig. 1 — Thermal-cycling ratings for all types.

ELECTRICAL CHARACTERISTICS *at Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	VOLTAGE V dc V_{BE}	CURRENT A dc I_C	CURRENT A dc I_B	LIMITS BD241 BD242♦ MIN.	BD241 BD242♦ MAX.	BD241A BD242A♦ MIN.	BD241A BD242A♦ MAX.	BD241B BD242B♦ MIN.	BD241B BD242B♦ MAX.	BD241C BD242C♦ MIN.	BD241C BD242C♦ MAX.	UNITS
Collector Cutoff Current: With base open	I_{CEO}	30			0	–	0.3	–	0.3	–	–	–	–	mA
		60			0	–	–	–	–	–	0.3	–	0.3	
With base-to-emitter junction short-circuited	I_{CES}	45	0			–	0.2	–	–	–	–	–	–	
		60	0			–	–	–	0.2	–	–	–	–	
		80	0			–	–	–	–	–	0.2	–	–	
		100	0			–	–	–	–	–	–	–	0.2	
Emitter Cutoff Current	I_{EBO}		−5	0		–	1	–	1	–	1	–	1	mA
Collector-to-Emitter Breakdown Voltage: With base open	$V_{BR(CEO)}$			0.03[a]	0	45	–	60	–	80	–	100	–	V
DC Forward-Current Transfer Ratio	h_{FE}	4		1[a]		25	–	25	–	25	–	25	–	
		4		3[a]		10	–	10	–	10	–	10	–	
Base-to-Emitter Voltage	V_{BE}	4		3[a]		–	1.8	–	1.8	–	1.8	–	1.8	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			3[a]	0.6	–	1.2	–	1.2	–	1.2	–	1.2	V
Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	10		0.5		20	–	20	–	20	–	20	–	
Magnitude of Common Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 MHz)	$\|h_{fe}\|$	10		0.5		3	–	3	–	3	–	3	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	3.125	–	3.125	–	3.125	–	3.125	°C/W
Junction-to-Ambient	$R_{\theta JA}$					–	62.5	–	62.5	–	62.5	–	62.5	

[a]Pulsed: Pulse duration = 300 μs, duty factor = 2%.

♦ For p-n-p devices, voltage and current values are negative.

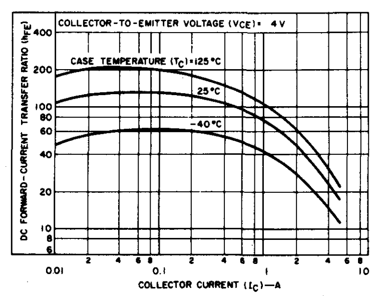


Fig. 2 — Typical dc beta characteristics for BD241-series types.

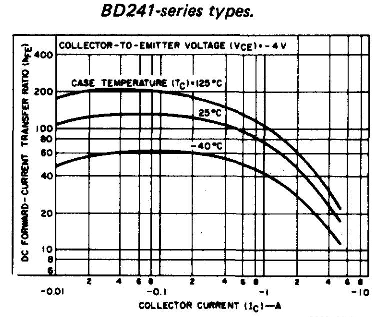


Fig. 3 — Typical dc beta characteristics for BD242-series types.

BD241, BD241A, BD241B, BD241C, BD242, BD242A, BD242B, BD242C

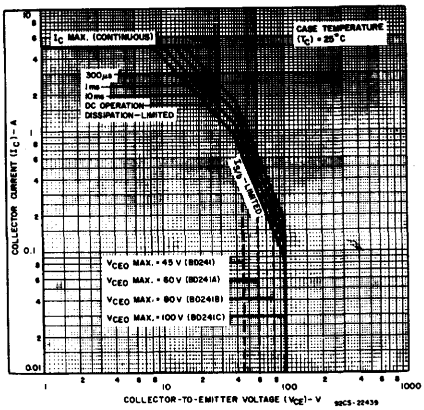


Fig. 4 – Maximum safe operating areas for BD241-series types.

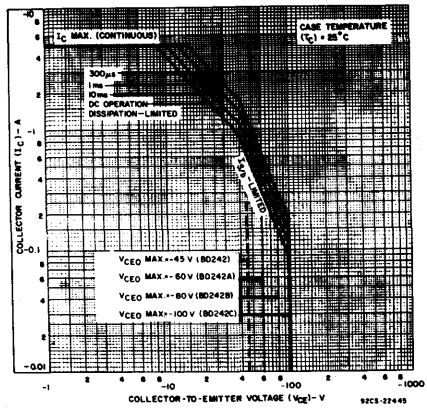


Fig. 5 – Maximum safe operating areas for BD242-series types.

BD243, BD243A, BD243B BD243C, BD244, BD244A BD244B, BD244C

Epitaxial-Base Silicon N-P-N and P-N-P VERSAWATT Transistors

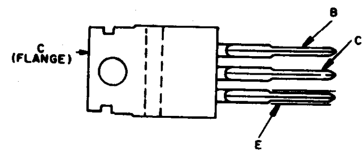
For Power-Amplifier and High-Speed-Switching Applications

These RCA devices are epitaxial-base silicon n-p-n and p-n-p transistors; they differ only in their voltage ratings. These transistors are intended for a wide variety of switching and amplifier applications such as series and shunt regulators, and driver and output stages of high-fidelity amplifiers. The BD244-series p-n-p power transistors are complements of the n-p-n devices in the BD243-series.

All these transistors are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA International Sales Office.

Features:
- **65 W at 25°C case temperature**
- **7-A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 500 mA**

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220 AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BD243 BD244♦	BD243A BD244A♦	BD243B BD244B♦	BD243C BD244C♦	
COLLECTOR-TO-EMITTER VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	55	70	90	115	V
With base open	V_{CEO}	45	60	80	100	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	V
CONTINUOUS COLLECTOR CURRENT	I_C	6.5	6.5	6.5	6.5	A
CONTINUOUS BASE CURRENT	I_B	1	1	1	1	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		65	65	65	65	W
At ambient temperatures up to 25°C		2	2	2	2	W
At case temperatures above 25°C		Derate linearly to 150°C				
TEMPERATURE RANGE:						
Storage & Operating (Junction)		←— −65 to 150 —→				°C
LEAD TEMPERATURE (During Soldering):						
At distance 1/8 in. (3.17 mm) from case for 10 s max.		←— 235 —→				°C

♦ For p-n-p devices, voltage and current values are negative.

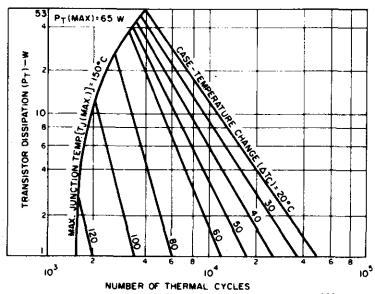


Fig. 1 — Thermal-cycling ratings for all types.

ELECTRICAL CHARACTERISTICS *at Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CE}	VOLTAGE V dc V_{BE}	CURRENT A dc I_C	CURRENT A dc I_B	LIMITS BD243 BD244♦ MIN.	BD243 BD244♦ MAX.	BD243A BD244A♦ MIN.	BD243A BD244A♦ MAX.	BD243B BD244B♦ MIN.	BD243B BD244B♦ MAX.	BD243C BD244C♦ MIN.	BD243C BD244C♦ MAX.	UNITS
Collector Cutoff Current: With base open	I_{CEO}	30			0	–	0.7	–	0.7	–	–	–	–	mA
		60			0	–	–	–	–	–	0.7	–	0.7	
With base-to-emitter junction short-circuited	I_{CES}	45	0			–	0.4	–	–	–	–	–	–	
		60	0			–	–	–	0.4	–	–	–	–	
		80	0			–	–	–	–	–	0.4	–	–	
		100	0			–	–	–	–	–	–	–	0.4	
Emitter Cutoff Current	I_{EBO}		−5	0		–	1	–	1	–	1	–	1	mA
Collector-to-Emitter Breakdown Voltage: With base open	$V_{BR(CEO)}$			0.03[a]	0	45	–	60	–	80	–	100	–	V
DC Forward-Current Transfer Ratio	h_{FE}	4		0.3[a]		30	–	30	–	30	–	30	–	
		4		3[a]		15	–	15	–	15	–	15	–	
Base-to-Emitter Voltage	V_{BE}	4		6[a]		–	2	–	2	–	2	–	2	V
Collector-to-Emitter Saturation Voltage	V_{CE}(sat)			6[a]	1	–	1.5	–	1.5	–	1.5	–	1.5	V
Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	10		0.5		20	–	20	–	20	–	20	–	
Magnitude of Common Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 MHz)	$\|h_{fe}\|$	10		0.5		3	–	3	–	3	–	3	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	–	1.92	°C/W
Junction-to-Ambient	$R_{\theta JA}$					–	62.5	–	62.5	–	62.5	–	62.5	

[a]Pulsed: Pulse duration = 300 μs, duty factor = 2%.   ♦ For p-n-p devices, voltage and current values are negative.

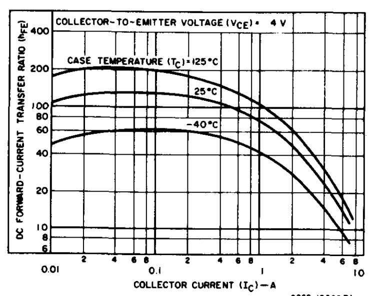


Fig. 2 — Typical dc beta characteristics for BD243-series types.

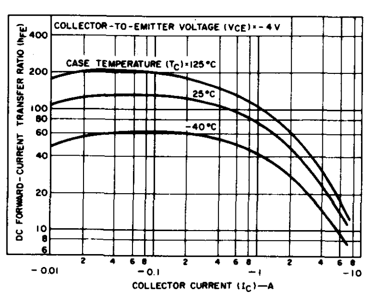


Fig. 3 — Typical dc beta characteristics for BD244-series types.

BD243, BD243A, BD243B, BD243C, BD244, BD244A, BD244B, BD244C

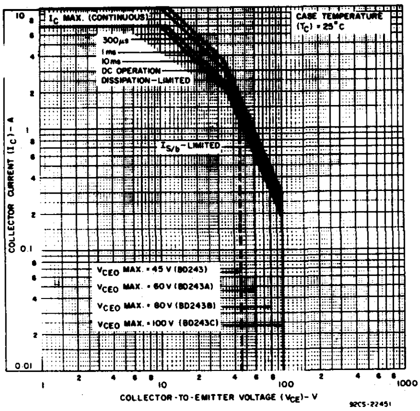


Fig. 4 — Maximum safe operating areas for BD243-series types.

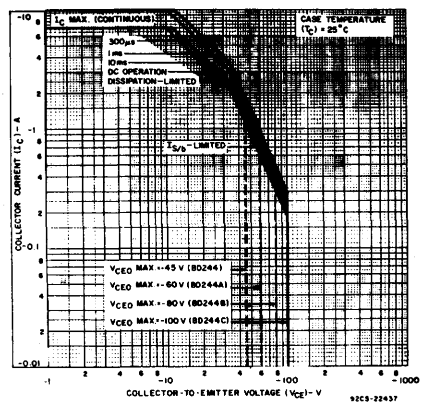


Fig. 5 — Maximum safe operating areas for BD244-series types.

BD277

7-A, 70-W, Epitaxial-Base, Silicon P-N-P VERSAWATT Transistor

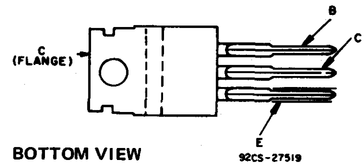
For Applications in Series and Shunt Regulators

Type BD277 is an epitaxial-base silicon p-n-p transistor supplied in the JEDEC TO-220AB straight-lead VERSAWATT package. It is also available in the TO-220AA package (leads formed to fit a TO-66 socket); to order this version, specify formed lead No. 6201.

The BD277 is useful in series regulators and shunt regulators because of its low saturation voltage and high power-dissipation capability. It is also useful as a replacement for germanium p-n-p transistors in many applications.

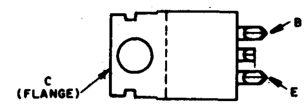
Features:
- **Thermal-cycling ratings**
- **Maximum-safe-area-of-operation curve**
- **Low saturation voltage**
- **VERSAWATT package (molded silicone plastic)**
- **High power-dissipation capability**

TERMINAL DESIGNATIONS



BOTTOM VIEW

TO-220AB



BOTTOM VIEW

TO-220AA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE: With emitter open	V_{CBO}	–45	V
COLLECTOR-TO-EMITTER VOLTAGE: With base open	V_{CEO}	–45	V
EMITTER-TO-BASE VOLTAGE: With collector open	V_{EBO}	–4	V
COLLECTOR CURRENT (Continuous)	I_C	–7	A
BASE CURRENT (Continuous)	I_B	–3	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		70	W
At case temperatures above 25°C		Derate linearly at 0.56 W/°C	
TEMPERATURE RANGE: Storage & Operating (Junction)		–65 to 150	°C
LEAD TEMPERATURE (During Soldering): At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless specified otherwise*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{CB}	V_{EB}	CURRENT A dc I_C	I_B	I_E	LIMITS MIN.	MAX.	UNITS
Collector Cutoff Current: With emitter open	I_{CBO}		–45				0	–	–0.1	mA
With emitter open and T_C = 150°C			–40				0	–	–2.0	
With base open	I_{CEO}	–30				0		–	–1.0	
Emitter Cutoff Current: With collector open	I_{EBO}			–4	0			–	–1.0	mA
Collector-to-Emitter Breakdown Voltage: With base open	$V_{(BR)CEO}$				–0.1*	0		–45	–	V
Base-to-Emitter Voltage	V_{BE}	–2			–1.75*			–	1.2	V
DC Forward-Current Transfer Ratio	h_{FE}	–2			–1.75*			30	150	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				–1.75*	–0.1		–	–0.5	V
Gain-Bandwidth Product	f_T	–4			–0.5			10	–	MHz
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$							–	1.78	°C/W
Junction-to-Ambient	$R_{\theta JA}$							–	70	

* Pulsed: Pulse duration = 300 μs, duty factor ≤ 2%.

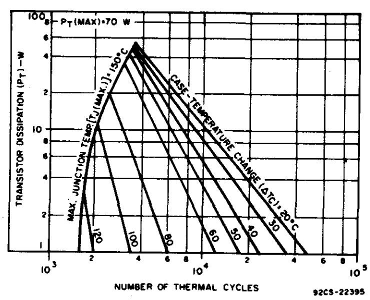


Fig. 1 – Thermal-cycling ratings.

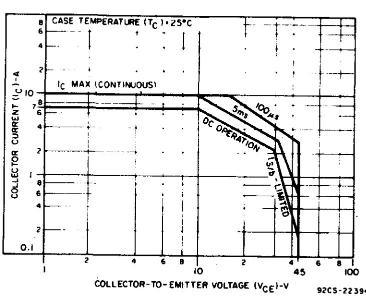


Fig. 2 – Maximum operating area.

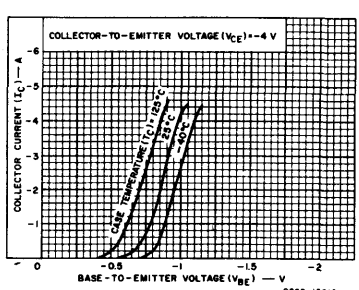


Fig. 3 – Typical transfer characteristics.

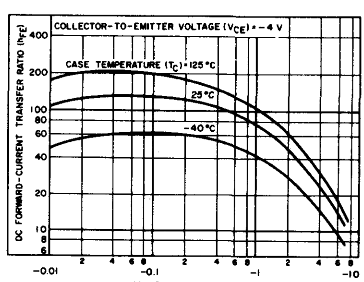


Fig. 4 – Typical dc beta characteristics.

BD278, BD278A

High-Current, Silicon N-P-N VERSAWATT Transistors

For Medium-Power Linear and Switching Service in Consumer, Automotive, and Industrial Applications

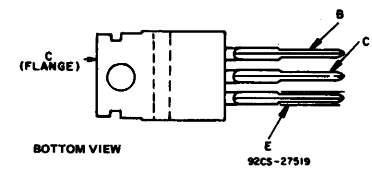
The RCA BD278 and BD278A are hometaxial-base silicon n-p-n transistors supplied in the JEDEC TO-220AB straight-lead VERSAWATT package. They are also available in the TO-220AA package (leads formed to fit a TO-66 socket); to order this version, specify formed lead No. 6201.

These transistors are intended for a wide variety of medium-power switching and linear applications such as series regulators, solenoid drivers, motor-speed controls, inverters, output stages for high-fidelity amplifiers, and power supply and vertical-deflection circuits for monochrome and color TV.

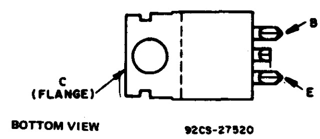
Features:

- Low saturation voltage: $V_{CE}(sat)$ = 1 V max. at I_C = 4 A
- VERSAWATT package (molded-silicon plastic)
- Maximum-safe-area-of-operation curve
- Thermal-cycling rating curve

TERMINAL DESIGNATIONS



JEDEC TO-220AB



JEDEC TO-220AA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BD278	BD278A	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	70	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:				
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$	55	70	V
With base open	$V_{CEO}(sus)$	45	60	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	V
COLLECTOR CURRENT (Continuous)	I_C	10	10	A
BASE CURRENT	I_B	4	4	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		75	75	W
At ambient temperatures up to 25°C		1.8	1.8	W
At case temperatures above 25°C, derate linearly		0.6	0.6	W/°C
At ambient temperatures above 25°C, derate linearly		0.0144	0.0144	W/°C
TEMPERATURE RANGE:				
Storage & Operating (Junction)		−65 to 150		°C
LEAD TEMPERATURE (During Soldering):				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

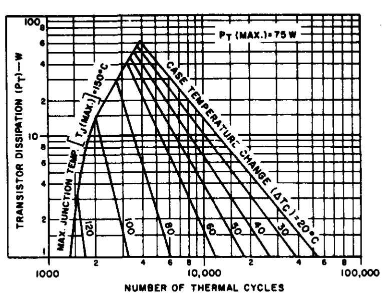


Fig. 1 – Thermal-cycling ratings.

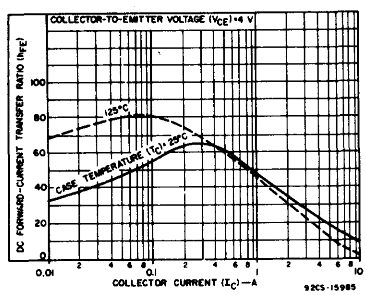


Fig. 2 – Typical dc beta characteristics.

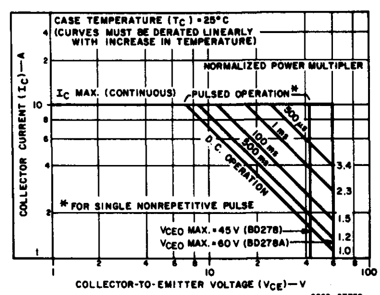


Fig. 3 – Maximum safe operating area.

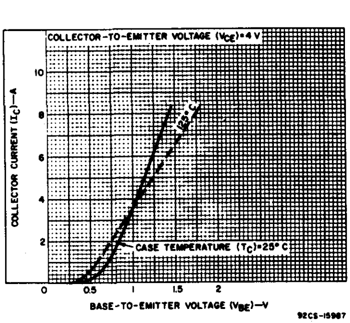


Fig. 4 – Typical transfer characteristics.

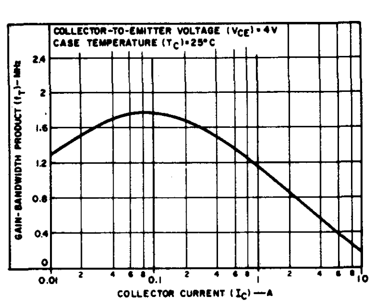


Fig. 5 – Typical gain bandwidth product.

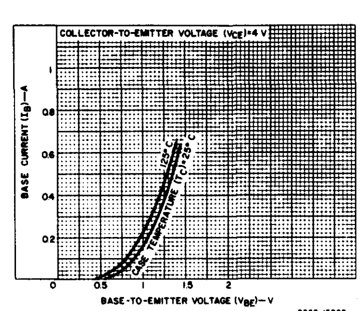


Fig. 6 – Typical input characteristics.

BD278, BD278A

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS				UNITS
		VOLTAGE V dc		CURRENT A dc		BD278		BD278A		
		V_{CE}	V_{EB}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	
Collector Cutoff Current: With base-to-emitter junction reverse-biased	I_{CEX}	55	1.5			–	2	–	–	mA
		70	1.5			–	–	–	2	
With base-to-emitter junction reverse-biased and T_C= 150°C		50	1.5			–	10	–	–	mA
		65	1.5			–	–	–	10	
With base open	I_{CEO}	30			0	–	2	–	–	
		45			0	–	–	–	2	
Emitter Cutoff Current	I_{EBO}		5			–	5	–	5	mA
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE})= 100Ω[a]	$V_{CER}(sus)$			0.2		55	–	70	–	V
With base open[a]	$V_{CEO}(sus)$			0.2	0	45	–	60	–	
DC Forward-Current Transfer Ratio[a]	h_{FE}	4		4		15	75	15	75	
Base-to-Emitter Voltage[a]	V_{BE}	4		4		–	1.8	–	1.8	V
Collector-to-Emitter Saturation Voltage[a]	$V_{CE}(sat)$			4	0.4	–	1	–	1	V
Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}	4		0.5		15	–	15	–	
Magnitude of Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (f = 0.1 MHz)	h_{fe}	4		0.5		8	28	8	28	
Forward-Bias Second-Breakdown Collector Current (t= 0.5 s)	$I_{S/b}$	40				1.87	–	1.87	–	A
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	1.67	–	1.67	°C/W
Junction-to-Ambient	$R_{\theta JA}$					–	70	–	70	

[a] Pulsed, pulse duration = 300μs, duty factor = 0.018

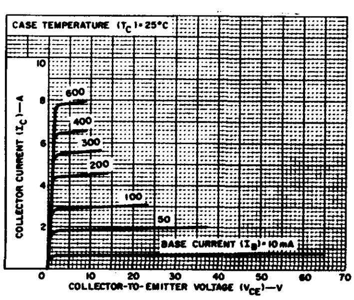


Fig. 7 — Typical output characteristics.

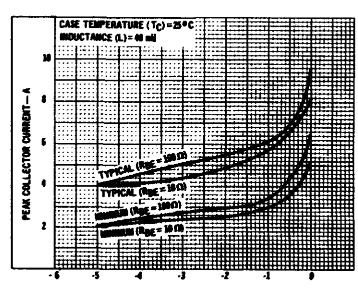


Fig. 8 — Reverse-bias second-breakdown characteristics.

BD450, BD451

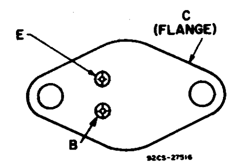
Silicon Transistors for 70-Watt Quasi-Complementary- Symmetry Audio Amplifiers with Hometaxial-Base Output Transistors

The RCA-BD450 and BD451 are n-p-n hometaxial-base silicon transistors particularly suitable for output stages of audio amplifiers. The BD451 is intended for 70-W amplifiers with 8-ohm loads and will also deliver 38 W with 16-ohm loads. The BD450 is intended for 70-W amplifiers with 4-ohm loads.

The 70-W amplifier shown in Figs. 2 and 5 uses two BD451 in conjunction with seven TO-39 case transistors, eleven diodes, and an 84-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. This amplifier is especially suitable for instrumentation applications where ruggedness is essential.

The BD450 and BD451 are supplied in the JEDEC TO-204MA (formerly TO-3) hermetic steel case.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

	BD450	BD451	
V_{CBO}	80	95	V
V_{CEO}	50	60	V
$V_{CER}(R_{BE} = 100\,\Omega)$	80	95	V
V_{EBO}	7		V
I_C	15		V
I_B	7		A
P_T:			
At $T_C \leq 25\,°C$	115		W
At $T_C > 25\,°C$	See Fig. 1		
T_{stg}, T_J	−65 to 200		°C
T_L:			
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230		°C

TYPICAL PERFORMANCE DATA
For 70-Watt Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

Power:
- Rated power (8-Ω load, at rated distortion) .... 70 W
- Typical power (4-Ω load) .... 70 W■
- Typical power (16-Ω load) .... 38 W
- Music power (8-Ω load, at 5% THD with regulated supply) .... 100 W
- Dynamic power (8-Ω load, at 1% THD with regulated supply) .... 88 W

Total Harmonic Distortion:
- Rated distortion 1.0%

IM Distortion:
- 10 dB below continuous power output at 60 Hz and 7 kHz (4:1) 0.1%

Sensitivity:
- At continuous power-output rating .... 700 mV

Hum and Noise:
- Below continuous power output:
  - Input shorted .... 85 dB
  - Input open .... 80 dB

Input Resistance .... 20 kΩ

■With 60-volt split power supply and 2-BD450 substituted for 2-BD451.

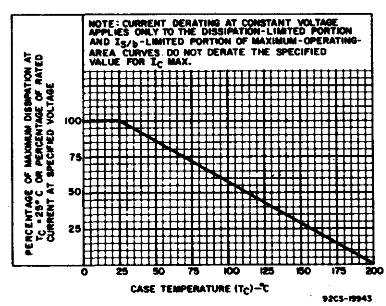


Fig. 1 - Derating curve.

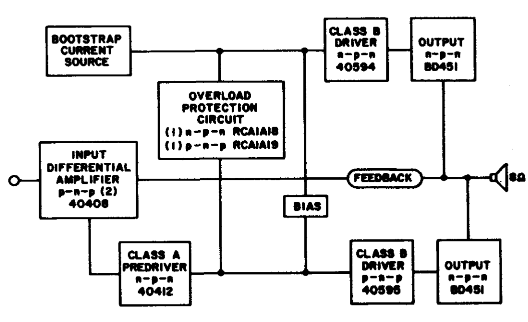


Fig. 2 - Block diagram and transistor complement for 70 watt quasi-complementary-symmetry audio amplifier with hometaxial-base output transistors.

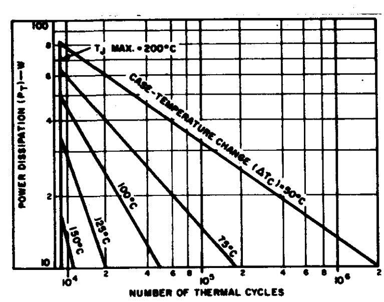


Fig. 3 - Thermal-cycling ratings.

BD450, BD451

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS	LIMITS BD450▲ Min.	LIMITS BD450▲ Max.	LIMITS BD451▲ Min.	LIMITS BD451▲ Max.	UNITS
I_{CER}	V_{CE} = 70 V, R_{BE} = 100Ω	—	0.5	—	—	mA
	V_{CE} = 85 V, R_{BE} = 100Ω	—	—	—	0.5	
I_{EBO}	V_{EB} = 4 V, I_C = 0	—	1	—	1	mA
V_{CER}	I_C = 0.2 A, R_{BE} = 100 Ω	80	—	95	—	V
f_T	I_C = 1 A, V_{CE} = 4 V	0.8	—	0.8	—	MHz
h_{FE}	I_C = 4 A, V_{CE} = 4 V	—	—	20	70	
	I_C = 6 A, V_{CE} = 4 V	20	70	—	—	
$V_{CE(sat)}$	I_C = 4 A, I_B = 0.4 A	—	—	—	1	V
	I_C = 6 A, I_B = 0.6 A	—	1	—	—	
V_{BE}	I_C = 4 A, V_{CE} = 4 V	—	—	—	1.4	V
	I_C = 6 A, V_{CE} = 4 V	—	1.4	—	—	
$I_{S/b}$	V_{CE} = 50 V, t = 1 s	2.3	—	—	—	A
	V_{CE} = 60 V, t = 1 s	—	—	1.95	—	

▲For characteristics curves and test conditions, refer to published data for prototype 2N3055 (Hometaxial), File 1077.

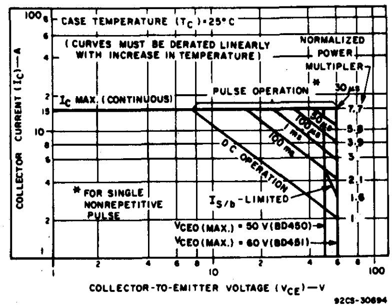


Fig. 4 - Maximum operating areas.

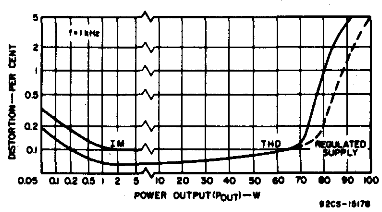


Fig. 6 - Typical intermodulation and total harmonic distortion as a function of power output at 1 kHz for 70-W amplifier.

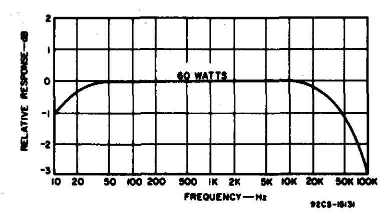
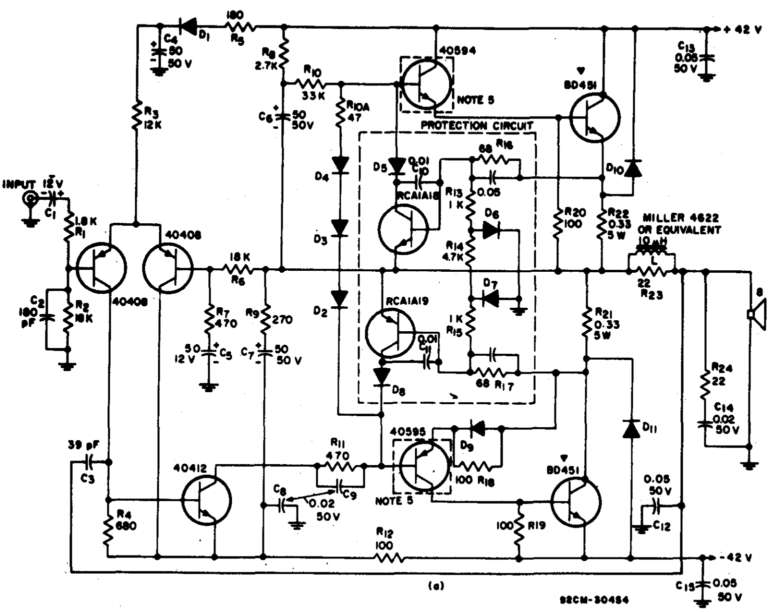


Fig. 7 - Typical response as a function of frequency at 60-W output for the 70-W amplifier.



NOTES:
1. D1-D11—D1201A.
2. Resistors are ½-watt, ± 10%, unless otherwise specified; values are in ohms.
3. Non-inductive resistors.
4. Capacitances are in μF unless otherwise specified.
5. Mount each device on TO-39 heat sink.
▼ 6. Provide heat sink of approx. 1.2°C/W per output device, with contact thermal resistance of 0.5°C/W max. and T_A = 45°C max.

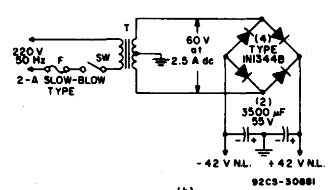


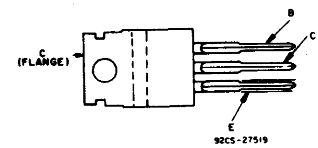
Fig. 5 - 70-watt amplifier circuit featuring quasi-complementary-symmetry output employing hometaxial-base construction output transistors: (a) basic amplifier circuit, (b) power-supply circuit.

BD500, BD501 Series

Silicon Transistors for 40-Watt Full-Complementary- Symmetry Audio Amplifiers

The BD500-Series and BD501-Series types are p-n-p and n-p-n epitaxial-base silicon transistors, respectively, especially suitable for audio-output applications. The 40-watt amplifier shown in Figs. 1 and 5 uses the BD500B and BD501B in conjunction with seven TO-39 transistors, ten diodes, and a 64-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. The BD500A and BD501A are intended for similar 40-watt audio amplifiers except for a 4-ohm speaker and a split 46-volt power supply. The BD500 and BD501 are intended for 25-watt audio amplifiers of similar circuitry except for a 4-ohm speaker and a split 40-volt power supply.

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BD501 / BD500•	BD501A / BD500A•	BD501B / BD500B•	N-P-N / P-N-P
V_{CBO}	60	70	90	V
V_{CEO}	50	60	80	V
$V_{CER}(R_{BE} = 100\,\Omega)$	55	65	85	V
V_{EBO}		5		V
I_C		10		A
I_B		4		A
P_T:				
At $T_C \leq 25\,°C$		75		W
At $T_C > 25\,°C$		See Figs. 2 and 4		
T_{stg}, T_J		−65 to 150		°C
T_L:				
At distances ⩾ 1/32 in. (0.8 mm) from case for 10 s max.		230		°C

•For p-n-p devices, voltage and current values are negative.

TYPICAL PERFORMANCE DATA
For 40-Watt Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

Power:
- Rated power (8-Ω load, at rated distortion) . . . 40 W
- Typical power (4-Ω load) . . . 75 W■
- Typical power (16-Ω load) . . . 22 W

Total Harmonic Distortion:
- Rated distortion . . . 1.0%
- Typical at 20 W . . . 0.05%

IM Distortion:
- 10 dB below continuous power output at 60 Hz and 7 kHz (4:1) . . . 0.1%

IHF Power Bandwidth:
- 3 dB below rated continuous power at rated distortion . . . 80 kHz

Sensitivity:
- At continuous power-output rating . . . 600 mV

Hum and Noise:
- Below continuous power output:
  - Input shorted . . . 80 dB
  - Input open . . . 75 dB

Input Resistance . . . 20 kΩ

■Typical power (4Ω load) with 46-volt split power supply and BD500A, BD501A output . . . 40 W
Typical power (4Ω load) with 40-volt split power supply and BD500, BD501 output . . . 25W

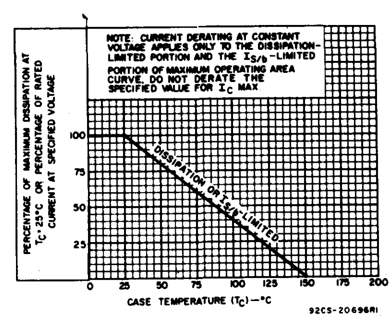


Fig. 2 - Derating curve for all types.

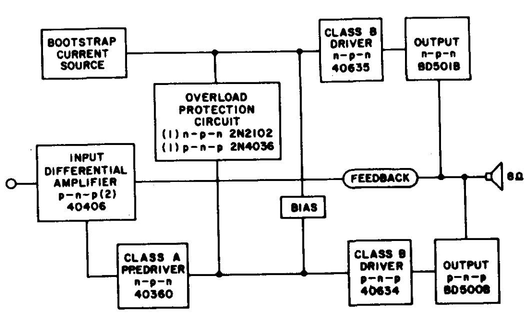


Fig. 1 - Block diagram and transistor complement for 40-watt full-complementary-symmetry audio amplifier.

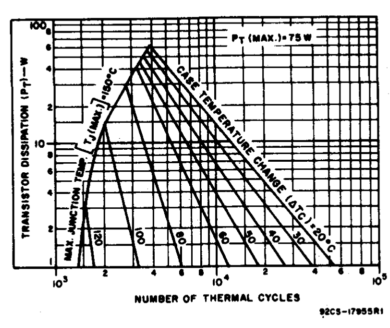


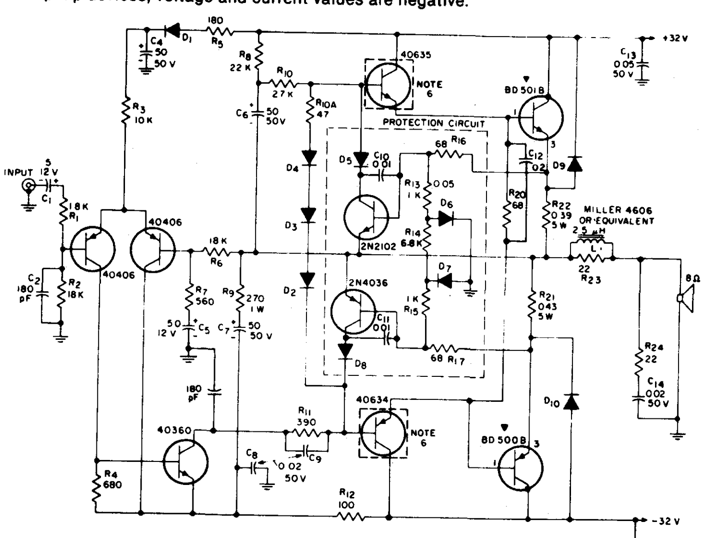
Fig. 3 - Thermal-cycling ratings.

BD500, BD501 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

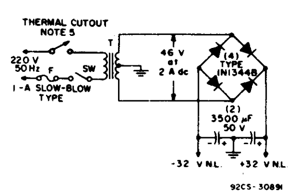
CHARAC-TERISTICS	TEST CONDITIONS	LIMITS▲ BD500• BD501 Min.	Max.	BD500A• BD501A Min.	Max.	BD500B• BD501B Min.	Max.	UNITS
I_{CER} R_{BE} = 100 Ω	V_{CE} = 45 V	—	1	—	—	—	—	mA
	V_{CE} = 55V	—	—	—	1	—	—	
	V_{CE} = 75 V	—	—	—	—	—	1	
I_{EBO}	V_{EB} = 5 V	—	1	—	1	—	1	mA
V_{CEO}	I_C = 0.1 A	50	—	60	—	80	—	V
V_{CER}	I_C = 0.1 A; R_{BE} = 100 Ω	55	—	65	—	85	—	V
f_T	I_C = 0.5 A; V_{CE} = 4 V	5	—	5	—	5	—	MHz
h_{FE}	I_C = 5 A; V_{CE} = 4 V	15	90	15	90	—	—	—
	I_C = 3.5 A; V_{CE} = 4 V	—	—	—	—	20	120	
$V_{CE}(sat)$	I_C = 5 A; I_B = 0.5 A	—	1.2	—	1.2	—	—	V
	I_C = 3.5 A; I_B = 0.35A	—	—	—	—	—	1	
V_{BE}	I_C = 5 A; V_{CE} = 4 V	—	1.8	—	1.8	—	—	V
	I_C = 3.5 A; V_{CE} = 4 V	—	—	—	—	—	1.5	
$I_{S/b}$	V_{CE} = 20 V; t = 0.55 s	3.75	—	—	—	—	—	A
	V_{CE} = 25 V; t = 0.55 s	—	—	3	—	—	—	
	V_{CE} = 30 V; t = 0.55 s	—	—	—	—	2.5	—	

▲For characteristics curves and test conditions, refer to published data for prototypes (File 678): 2N6487 (BD501, BD501A); 2N6488 (BD501B); 2N6490 (BD500, BD500A); 2N6491 (BD500B).
•For p-n-p devices, voltage and current values are negative.



(a)

NOTES *(for Fig. 5)*:
1. D1-D10—D1201A.
2. Resistors are ½-watt, ± 10%, unless otherwise specified; values are in ohms.
3. Non-inductive resistors.
4. Capacitances are in μF unless otherwise specified.
5. 55°C thermal cutout attached to heat sink of output devices.
6. TO-39 case devices with heat radiator attached.
7. Provide heat sink of approx. 1.2°C/W per output device with a contact thermal resistance of 1.3°C/W max. and T_A = 40°C max.



(b)

Fig. 5 - 40-watt amplifier circuit featuring full-complementary-symmetry output using load line limiting: (a) basic amplifier circuit, (b) power-supply circuit.

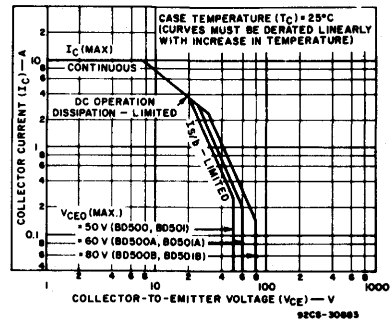


Fig. 4 - Maximum operating areas for all types.

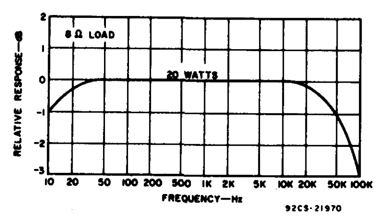


Fig. 6 - Typical frequency response.

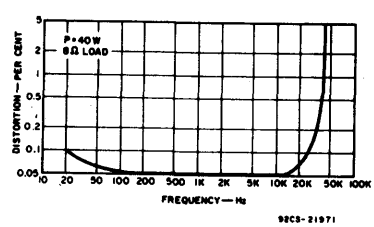


Fig. 7 - Typical total harmonic distortion as a function of frequency.

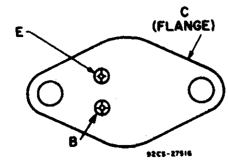
Silicon Transistors for 70-, 120-, 200-, and 300-W Quasi-Complementary-Symmetry Audio Amplifiers

The RCA-BD550, BD550A, and BD550B are silicon n-p-n transistors especially suitable for applications in audio-amplifier circuits, in which they may be used as either driver or output unit.

These devices, together with a variety of other transistors that serve as input devices, V_{BE} amplifiers for biasing, current sources, load-line limiters (for overload protection), and predrivers, may be used to develop several hundred watts of audio output power in quasi-complementary-symmetry audio amplifier configurations that employ parallel output transistors. Circuit examples, a recommended complement of transistors, and performance data are shown for 70-, 120-, 200-, and 300-W amplifiers.

The BD-550-series is supplied in the JEDEC TO-204MA hermetic steel case.

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BD550	BD550A	BD550B	
V_{CBO}	130	200	275	V
V_{CEO}	110	175	250	V
$V_{CER}(R_{BE} = 100\ \Omega)$	130	200	275	V
V_{EBO}		5		V
I_C		7		A
I_B		2		A
P_T				
At $T_C \leqslant 25^{\circ}C$		150		W
At $T_C > 25^{\circ}C$		See Fig. 1		
T_{stg}, T_J		−65 to 200		°C
T_L				
At distance ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230		°C

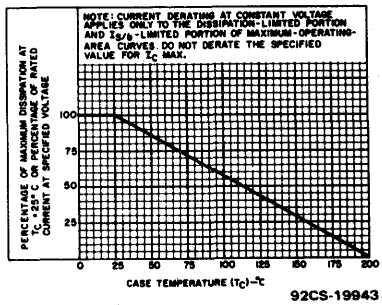


Fig. 1 – Derating curve for all types.

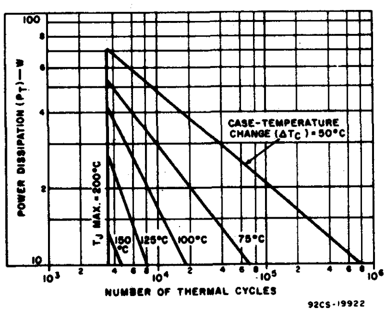


Fig. 2 – Thermal-cycling ratings for all types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS	BD550▲ Min.	BD550▲ Max.	BD550A● Min.	BD550A● Max.	BD550B● Min.	BD550B● Max.	UNITS
I_{CER} $R_{BE} = 100\ \Omega$	V_{CE} = 110 V	–	1	–	–	–	–	mA
	V_{CE} = 175 V	–	–	–	1	–	–	
	V_{CE} = 250 V	–	–	–	–	–	1	
I_{CEO}	V_{CE} = 95 V	–	5	–	–	–	–	mA
	V_{CE} = 150 V	–	–	–	5	–	–	
	V_{CE} = 200 V	–	–	–	–	–	5	
I_{EBO}	V_{EB} = 5 V	–	1	–	1	–	1	mA
V_{CEO}	I_C = 0.2 A	110	–	175	–	250	–	V
V_{CER}	I_C = 0.2 A; R_{BE} = 100 Ω	130	–	200	–	275	–	V
f_T	I_C = 0.2 A; V_{CE} = 10 V	5 typ.		5 typ.		5 typ.		MHz
h_{FE}	I_C = 4 A; V_{CE} = 4 V	15	75	–	–	–	–	
	I_C = 2 A; V_{CE} = 4 V	–	–	15	75	10	50	
$V_{CE}(sat)$	I_C = 4 A; I_B = 0.5 A	–	2	–	–	–	–	V
	I_C = 2 A; I_B = 0.25 A	–	–	–	2	–	2	
V_{BE}	I_C = 4 A; V_{CE} = 4 V	0.75	1.75	–	–	–	–	V
	I_C = 2 A; V_{CE} = 4 V	–	–	1	2	1	2	
$I_{S/b}$	V_{CE} = 80 V; t = 1 S	1.87	–	–	–	–	–	A
	V_{CE} = 100 V; t = 1 S	–	–	1.5	–	–	–	
	V_{CE} = 140 V; t - 1 S	–	–	–	–	1.07	–	

▲ For characteristics curbes and test conditions, refer to published data for prototype RCA8638D (File 1060).

● For characteristics curves and test conditions, refer to published data for prototype 2N5240 (File 321).

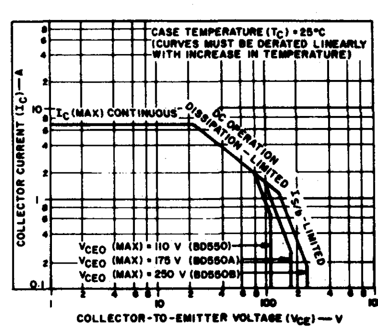


Fig. 3 – Maximum operating areas for all types.

BD550 Series

70-Watt Amplifier

The 70-watt amplifier shown in Figs. 4 and 5 uses two BD550 transistors as output devices, and operates on a 90-volt split power supply. It is designed for direct coupling to an 8 ohm load. Figs. 6 and 7 show typical distortion characteristics for the amplifier.

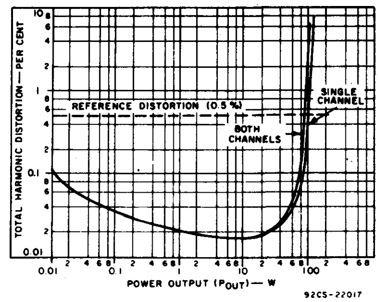


Fig. 6 – Typical total harmonic distortion as a function of power output at 1 kHz, for the 70-watt amplifier.

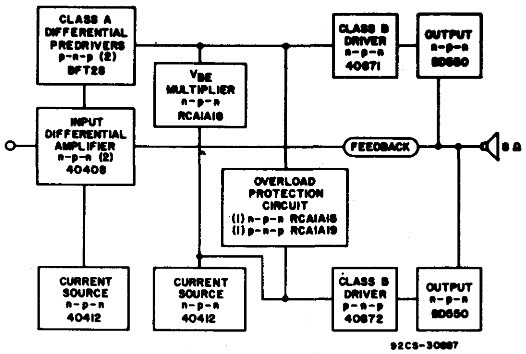


Fig. 4 – Block diagram and transistor complement for 70-watt quasi-complementary-symmetry audio amplifier with epitaxial-base output transistors.

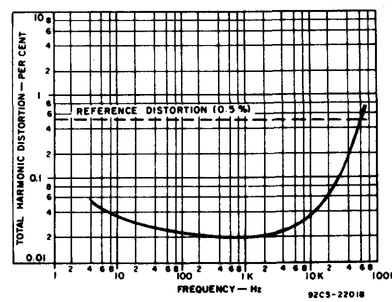
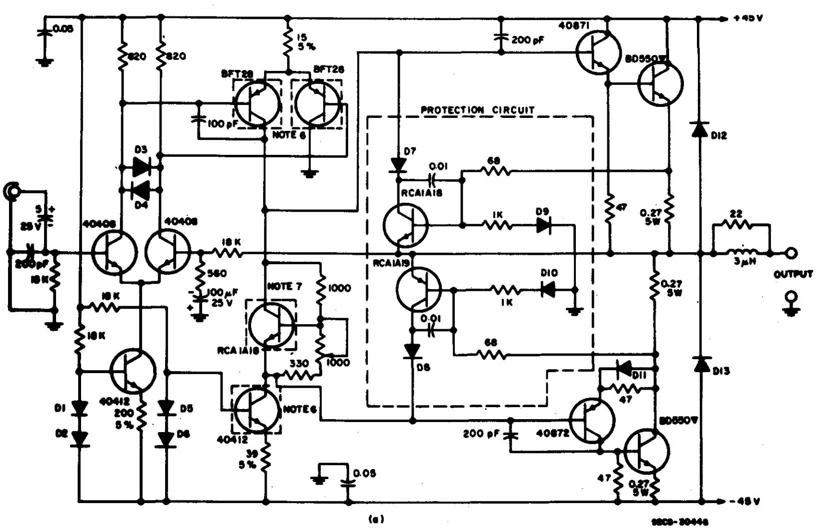


Fig. 7 – Typical total harmonic distortion as a function of frequency at 35 W, for the 70-watt amplifier.



NOTES:
1. D1-D8,D11-1N5391, D9,D10,D12,D13-1N5393
2. Resistors are 1/2-watt, ±10%, unless otherwise specified; values are in ohms.
3. Non-inductive resistors.
4. Capacitances are in μF unless otherwise specified
5. 80°C thermal cutout attached to heat sink of output devices.
6. Mount each device on TO-39 heat sink.
7. Attach TO-39 heat sink cap to device and mount on same heat sink with the output devices.
▼8. Provide heat sink of approx. 1°C/W per output device with a contact thermal resistance of 0.5°C/W max. and T_A = 45°C max.

92CM-30446

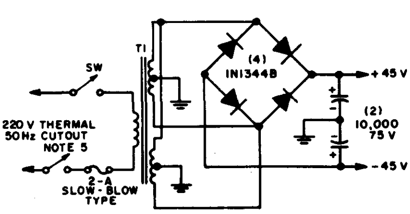


Fig. 5 – 70-watt amplifier circuit featuring quasi-complementary-symmetry output employing epitaxial-base construction output transistors: (a) basic amplifier circuit, (b) power-supply circuit.

Typical Performance Data for 70-W Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

Power:	
Rated power (8-Ω load, at rated distortion)	70 W
Typical power (16-Ω load)	40 W
Total Harmonic Distortion:	
Rated distortion	0.5 %
IM Distortion:	
10 dB below continuous power output at 60 Hz and 7 kHz (4:1)	<0.2%
IHF Power Bandwidth:	
3 dB below rated continuous power at rated distortion	5 Hz to 50 kHz
Bandwidth at 1 W	5 Hz to 100 kHz
Sensitivity:	
At continuous power-output rating	600 mV
Hum and Noise:	
Below continuous power output:	
Input shorted	100 dB
Input open	85 dB
With 2 kΩ resistance on 20-ft. cable on input	97 dB
Input Resistance	18 kΩ

120-Watt Amplifier

The 120-watt amplifier shown in Figs. 8 and 9 uses four BD550A transistors as parallel units in the amplifier output stages, and operates on a 130-volt split power supply. It is intended for direct coupling to an 8 ohm load, but may be used on 4 ohm or 16 ohm loads as shown in the Typical Performance Data; Figs. 10 and 11 show typical distortion characteristics for the amplifier.

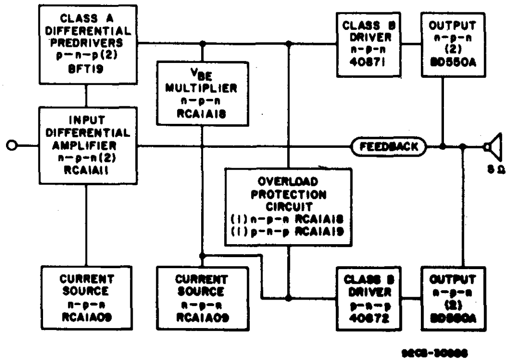
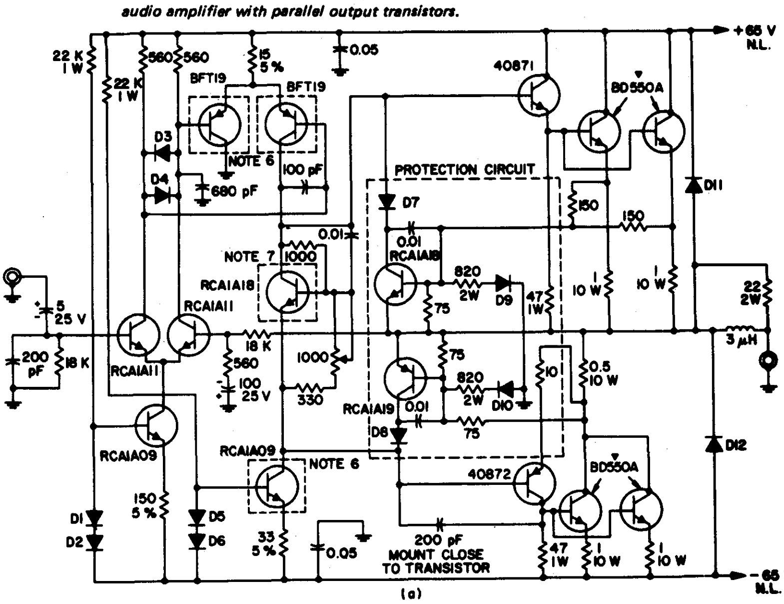
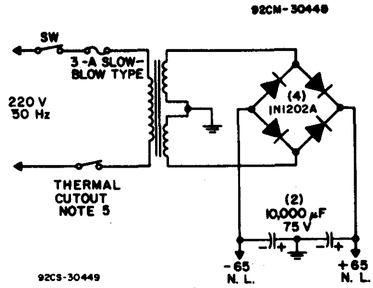


Fig. 8 – Block diagram and transistor-complement for 120-W quasi-complementary-symmetry audio amplifier with parallel output transistors.





NOTES:
1. D1-D8 – 1N5391; D9,D10 – 1N914B; D11, D12 – 1N5393
2. Resistors are 1/2-watt, ±10%, unless otherwise specified; values are in ohms.
3. Non-inductive resistors.
4. Capacitances are in μF unless otherwise specified.
5. 95°C thermal cutout attached to heat sink of output devices.
6. Mount each device on TO-39 heat sink.
7. Attach TO-39 heat sink cap to device and mount on same heat sink with the otuput devices.
▼8. Provide heat sink of approx. 1 C/W per output device with a contact thermal resistance of 0.5 C/W max. and T_A = 45 C max.

92CM-30448

Fig. 9 – 120-watt amplifier circuit featuring quasi-complementary-symmetry output circuit with parallel output transistors: (a) basic amplifier circuit, (b) power-supply circuit.

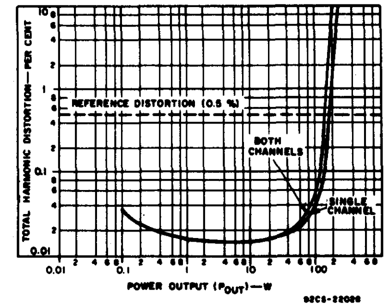


Fig. 10 – Typical total harmonic distortion as a function of power output for single channel (8Ω) and both channels driven at 1 kHz for 120-W amplifier.

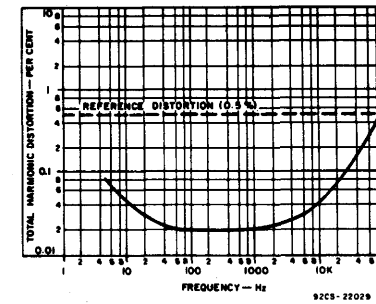


Fig. 11 – Typical total harmonic distortion as a function of frequency for 60-W output for 120-W amplifier.

Typical Performance Data for 120-W Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

Power:	
Rated power (8-Ω load, at rated distortion)	120 W
Typical power (4-Ω load)	120 W●
Typical power (16-Ω load)	70 W
Total Harmonic Distortion:	
Rated Distortion	0.5%
IM Distortion:	
10 dB below continuous power output at 60 Hz and 7 kHz (4:1)	0.2%
Sensitivity:	
At continuous power output rating	.900 mV
Input Resistance	18 kΩ
IHF Power Bandwidth:	
3 dB below rated continuous power at rated distortion	5 Hz to 50 kHz
Hum and Noise:	
Below continuous power output:	
Input shorted	104 dB
Input open	88 dB
With 1 kΩ resistance on 20-ft cable on input	104 dB

●With a 90 V split power supply and 4-BD550 substituted for 4-BD550A.

BD550 Series

200-Watt Amplifier

The 200-watt amplifier shown in Figs. 12 and 13 uses eight BD550B transistors, two as drivers and six as parallel units in the amplifier output stages, and operates on a 160-volt split power supply. It is intended for direct coupling to an 8 ohm load, but may be used on 4-ohm or 16-ohm loads as shown in the Typical Performance Data. Figs. 14 and 15 show the typical distortion characteristics for the amplifier.

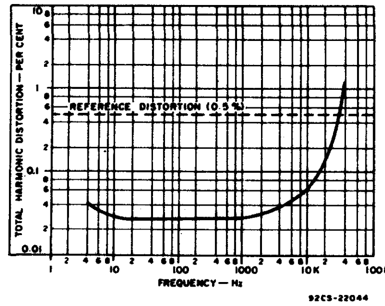


Fig. 14 – Typical total harmonic distortion as a function of frequency at 100-W output for 200-W amplifier.

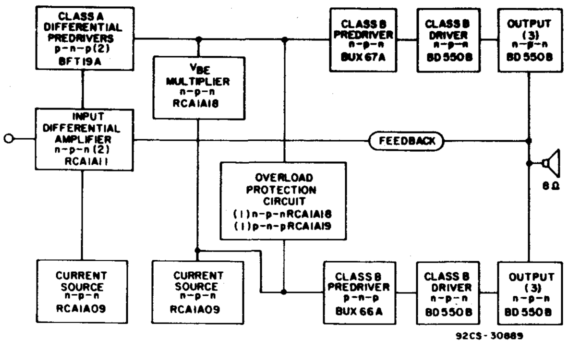


Fig. 12 – Block diagram and transistor complement for 200-W quasi-complementary-symmetry audio amplifier with parallel output transistors.

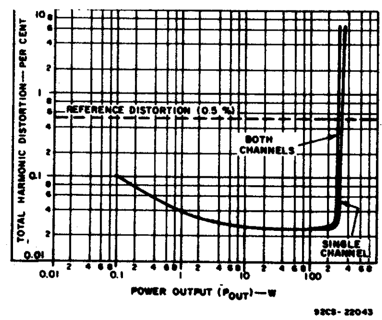
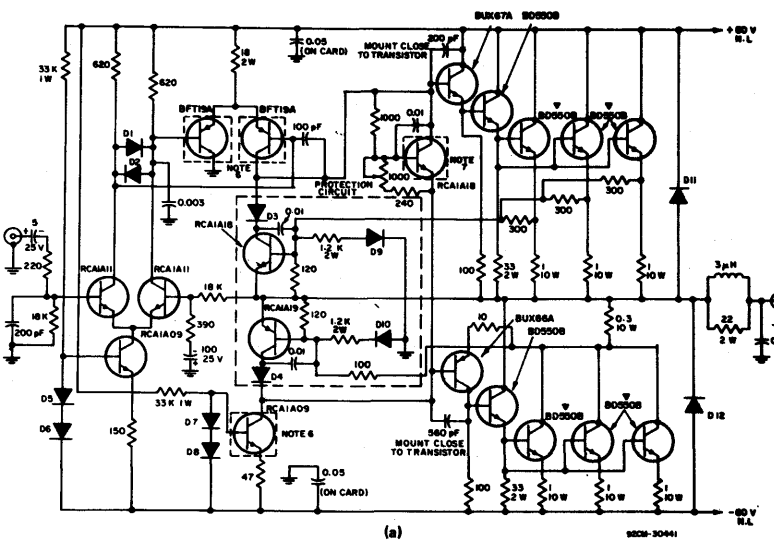
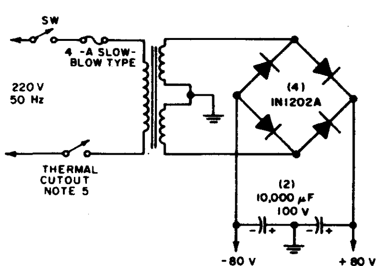


Fig. 15 – Typical total harmonic distortion as a function of power output for single channel and both channels driven at 1 kHz for 200-W amplifier.



NOTES:
1. D1-D8 – 1N5391; D9,D10 – 1N5316; D11, D12 – 1N5393
2. Resistors are 1/2-watt, ±10%, unless otherwise specified; values are in ohms.
3. Non-inductive resistors.
4. Capacitances are in μF unless otherwise specified.
5. 80°C thermal cutout attached to heat sink of output devices.
6. Mount each device on TO-39 heat sink.
7. Attach TO-39 heat sink cap to device and mount on same heat sink with the output devices.

▼8. Provide heat sink of approx. 1°C/W per output device with a contact thermal resistance of 0.5°C/W max. and T_A = 45°C max.



92CM-30441

Fig. 13 – 200-watt amplifier circuit featuring quasi-complementary-symmetry output circuit with parallel output transistors: (a) basic amplifier circuit, (b) power-supply circuit.

Typical Performance Data for 200-W Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

Power:	
Rated power (8-Ω load, at rated distortion)	200 W
Typical power (4-Ω load)	200 W•
Typical power (16-Ω load)	120 W
Total Harmonic Distortion:	
Rated distortion	0.5%
IM Distortion:	
10 dB below continuous power output at 60 Hz and 7 kHz (4:1)	0.2%
Sensitivity:	
At continuous power output rating	900 mV
Input Resistance	18 kΩ
IHF Power Bandwidth:	
3 dB below rated continuous power at rated distortion	5 Hz to 35 kHz
Hum and Noise:	
Below continuous power output:	
Input shorted	96 dB
Input open	84 dB
With 2 kΩ resistance on 20-ft cable on input	94 dB

• With a 110-V split power supply and 8-BD550A substituted for 8-BD550B.

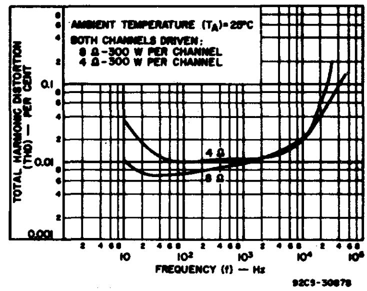
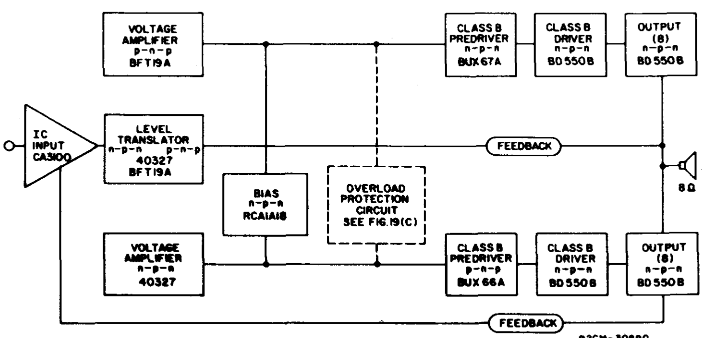


Fig. 17 – Typical total harmonic distortion as a function of frequency for 300-W amplifier.

300-Watt Amplifier

The 300-watt amplifier shown in Figs. 16 and 19 uses two BD550B transistors as drivers and sixteen BD550B transistors as parallel units in the amplifier output stages, and operates on a 172-volt split power supply. It is intended for direct coupling to an 8 ohm load, but may be used on 4 ohm or 16 ohm loads as shown in the typical performance data (Figs. 17, 18, 20, and 21).



Ratings and characteristics of type CA3100 are given in RCA data bulletin File No. 625.

Fig. 16 – Block diagram and transistor complement for 300-W quasi-complementary-symmetry audio amplifier with parallel output transistors.

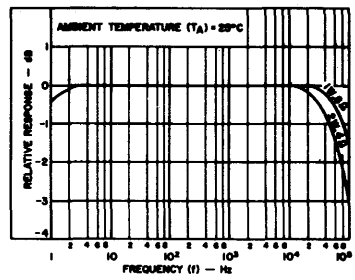


Fig. 18 – Typical frequency response for 300-W amplifier.

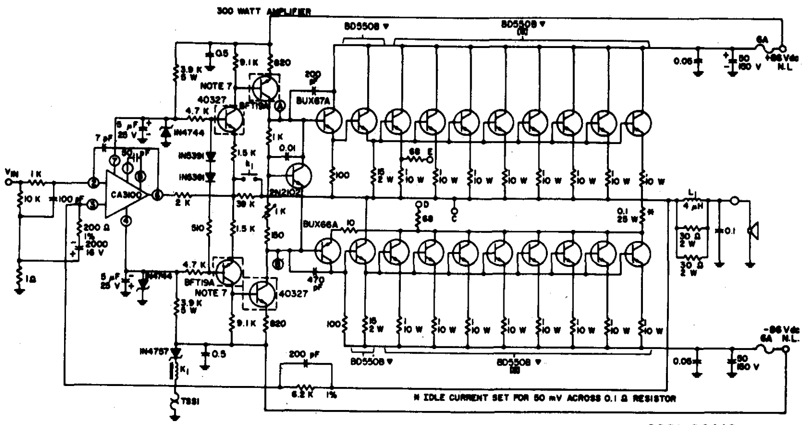
Typical Performance Data for 300-W Audio Amplifier

Measured at a line voltage of 220 V, T_A = 25°C, and a frequency of 1 kHz, unless otherwise specified.

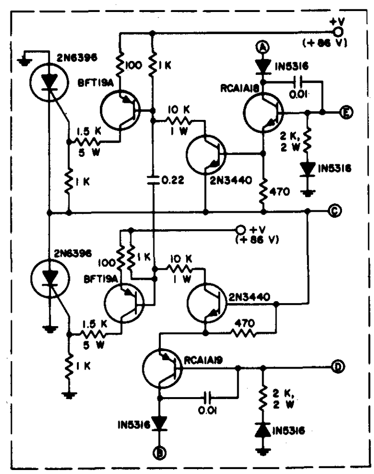
Rated Power (8-Ω load at rated distortion)	300 W
Typical power (4-Ω load)	300 W■
Typical power (16-Ω load	160 W
Total Harmonic Distortion (THD)	See Figs. 17 and 21
Intermodulation Distortion (IMD)	See Fig. 20
Sensitivity	1.6 V for 300 W
Input Impedance	10 kΩ
Hum and Noise:	
Below rated power output:	
Open input	104 dB
Shorted input	112 dB
Phase Shift	+1° at 20 Hz, –13° at 20 kHz
Slew Rate	35 V/μs
Rise Time	2.5 μs
Damping Factor	200

■ With 120 V split power supply and 18-BD550A substituted for 18-BD550B.

BD550 Series



(a) 92CL-30443

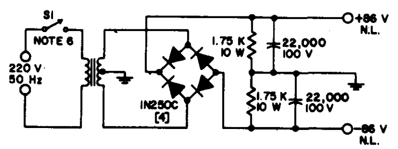


(c) 92CS-30879

NOTES:

1. Resistors are 1/2-watt, ±5% carbon, unless otherwise specified; values are in ohms.
2. Non-inductive resistors.
3. Capacitances are in μF unless otherwise specified.
4. K1 – Relay, single-pole, single-throw, normally closed, with 24-V, 3 mA coil.
5. TSS1 – 70°C thermal cutout attached to heat sink for output devices.
6. S1 – 10-A circuit breaker.
7. Common heat sink – 175 cm^2 minimum.
▼8. Provide heat sink of approx. 1°C/W per output device with a contact thermal resistance of 0.5°C/W max. and T_A = 45°C max.

92CL-30443



(b) 92CS-30880

Fig. 19 – 300-W audio amplifier circuit featuring quasi-complementary symmetry with parallel output transistors: (a) basic amplifier circuit, (b) power-supply circuit, and (c) protection circuit.

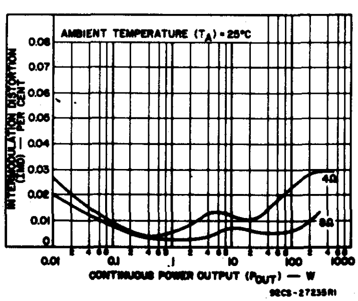


Fig. 20 – Typical intermodulation distortion as a function of power at 60 Hz and 7 kHz with both channels driven for 300-W amplifier.

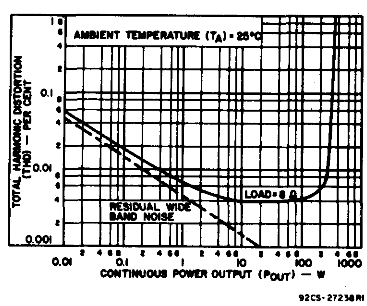


Fig. 21 – Typical total harmonic distortion as a function of power at 1 kHz, both channels driven, for 300-W amplifier.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D, BDX34, BDX34A, BDX34B, BDX34C

10-Ampere N-P-N and P-N-P Darlington Power Transistors

40-60-80-100-120 Volts, 70 Watts

Gain of 750 at 4 A (BDX33, BDX33A, BDX34, BDX34A)

Gain of 750 at 3 A (BDX33B, BDX33C, BDX33D, BDX34B, BDX34C)

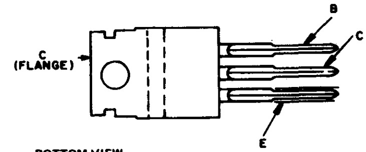
Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

These RCA devices are monolithic silicon n-p-n and p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. The BDX33, BDX33A, BDX33B, and BDX33C n-p-n transistors are complementary to the BDX34, BDX34A, BDX34B, and BDX34C p-n-p devices.

All these transistors are supplied in the JEDEC TO-220AB package.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BDX33 BDX34	BDX33A BDX34A	BDX33B BDX34B	BDX33C BDX34C♦	BDX33D	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	45	60	80	100	120	V
COLLECTOR-TO-EMITTER VOLTAGE:							
With external base-to-emitter resistance (R_{BE}) = 100Ω, sustaining	$V_{CER}(sus)$	45	60	80	100	120	V
With base open, sustaining	$V_{CEO}(sus)$	45	60	80	100	120	V
With base reverse-biased V_{BE} = −1.5 V	$V_{CEX}(sus)$	45	60	80	100	120	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	5	5	5	5	V
CONTINUOUS COLLECTOR CURRENT	I_C	10	10	10	10	10	A
CONTINUOUS BASE CURRENT	I_B	0.25	0.25	0.25	0.25	0.25	A
TRANSISTOR DISSIPATION:	P_T						
At case temperatures up to 25°C		70	70	70	70	70	W
At case temperatures above 25°C		Derate linearly 0.56					W/°C
TEMPERATURE RANGE:							
Storage and Operating (Junction)		−65 to + 150					°C
LEAD TEMPERATURE (During Soldering):							
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235					°C

♦ For p n p devices, voltage and current values are negative.

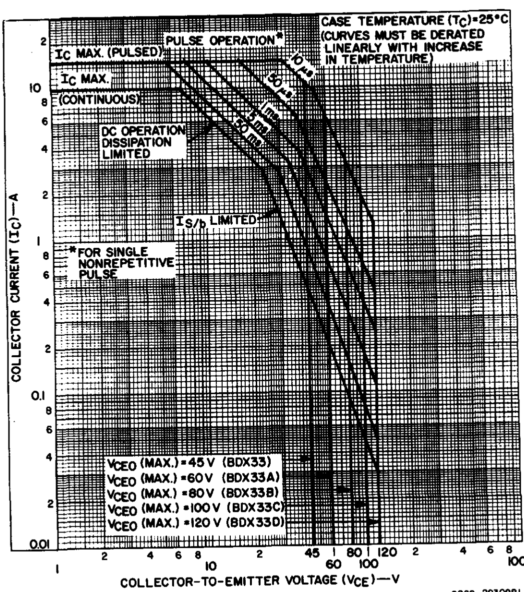


Fig. 1 — Maximum operating areas for BDX33-series types.

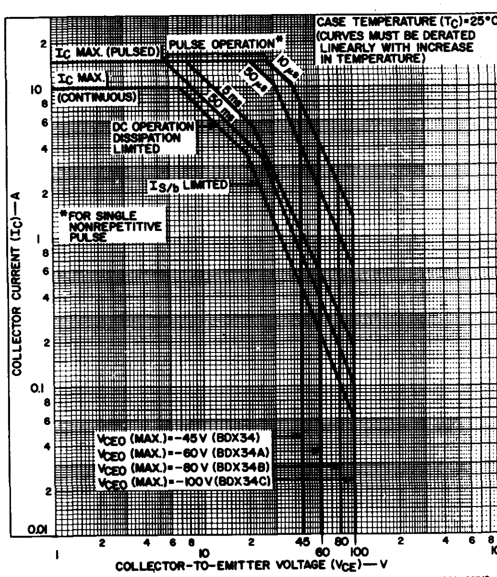


Fig. 2 — Maximum operating areas for BDX34-series types.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D, BDX34, BDX34A, BDX34B, BDX34C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT A·dc I_C	I_B	LIMITS BDX33 BDX34♦ Min.	Max.	BDX33A BDX34A♦ Min.	Max.	BDX33B BDX34B♦ Min.	Max.	BDX33C BDX34C♦ Min.	Max.	BDX33D BDX33D♦ Min.	Max.	UNITS
I_{CEO} With base open		60			0	–	–	–	–	–	–	–	–	–	0.5	mA
		50			0	–	–	–	–	–	–	–	0.5	–	–	
		40			0	–	–	–	–	–	0.5	–	–	–	–	
		30			0	–	–	–	0.5	–	–	–	–	–	–	
		20			0	–	0.5	–	–	–	–	–	–	–	–	
I_{CEO} T_C = 100°C		60			0	–	–	–	–	–	–	–	–	–	10	
		50			0	–	–	–	–	–	–	–	10	–	–	
		40			0	–	–	–	–	–	10	–	–	–	–	
		30			0	–	–	–	10	–	–	–	–	–	–	
		20			0	–	10	–	–	–	–	–	–	–	–	
I_{CBO}	120					–	–	–	–	–	–	–	–	–	1	
	100					–	–	–	–	–	–	–	1	–	–	
	80					–	–	–	–	–	1	–	–	–	–	
	60					–	–	–	1	–	–	–	–	–	–	
	45					–	1	–	–	–	–	–	–	–	–	
I_{CBO} T_C = 100°C	120					–	–	–	–	–	–	–	5	–	–	
	100					–	–	–	–	–	–	–	–	–	5	
	80					–	–	–	–	–	5	–	–	–	–	
	60					–	–	–	5	–	–	–	–	–	–	
	45					–	5	–	–	–	–	–	–	–	–	
I_{EBO}			–5	0		–	10	–	10	–	10	–	10	–	10	mA
$V_{CEO}(sus)$				0.1*	0	–	–	–	–	–	–	–	–	120	–	V
				0.1*	0	–	–	–	–	–	–	100	–	–	–	
				0.1*	0	45	–	60	–	80	–	–	–	–	–	
$V_{CER}(sus)$ (R_{BE}) = 100Ω				0.1*		–	–	–	–	–	–	–	–	120	–	
				0.1*		–	–	–	–	–	–	100	–	–	–	
				0.1*		45	–	60	–	80	–	–	–	–	–	
$V_{CEV}(sus)$			–1.5	0.1*		–	–	–	–	–	–	–	–	120	–	
			–1.5	0.1*		–	–	–	–	–	–	100	–	–	–	
			–1.5	0.1*		45	–	60	–	80	–	–	–	–	–	
h_{FE}		3		3*		–	–	–	–	750	–	750	–	750	–	
		3		4*		750	–	750	–	–	–	–	–	–	–	
V_{BE}		3		3*		–	–	–	–	–	2.5	–	2.5	–	2.5	V
		3		4*		–	2.5	–	2.5	–	–	–	–	–	–	
$V_{CE}(sat)$				3*	0.006	–	–	–	–	–	2.5	–	2.5	–	2.5	V
				4*	0.008	–	2.5	–	2.5	–	–	–	–	–	–	
V_F				8		–	4	–	4	–	4	–	4	–	4	V
h_{fe} f = 1 kHz		5		1		1000	–	1000	–	1000	–	1000	–	1000	–	
h_{fe} f = 1.0 MHz		5		1		20	–	20	–	20	–	20	–	20	–	
$E_{S/b}$[b] R_{BE} = 100Ω L = 12 mH, types BDX33 types			1.5	4.5		120	–	120	–	120	–	120	–	120	–	mJ
L = 3 mH, BDX34 types			1.5	4.5		30	–	30	–	30	–	30	–	30	–	
$I_{S/b}$ tp = 0.5 s nonrep. BDX33 types		25				2.8	–	2.8	–	2.8	–	2.8	–	2.8	–	A
		36				1	–	1	–	1	–	1	–	1	–	
BDX34 types		–20				–3.5	–	–3.5	–	–3.5	–	–3.5	–	–3.5	–	
		–33				–1	–	–1	–	–1	–	–1	–	–1	–	
$R_{\theta JC}$						–	1.78	–	1.78	–	1.78	–	1.78	–	1.78	°C/W

♦ For p-n-p devices, voltage and current values are negative.
* Pulsed: Pulse duration = 300 μs, duty factor = 1.8%
[b] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

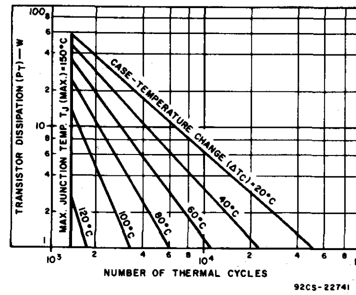


Fig. 3 — Thermal-cycling rating chart for all types.

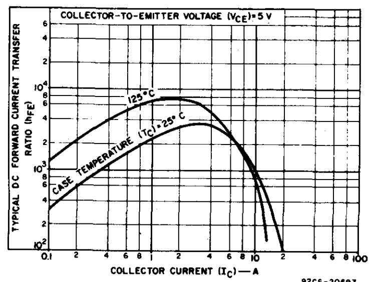


Fig. 4 — Typical dc-beta characteristics for BDX33-series types.

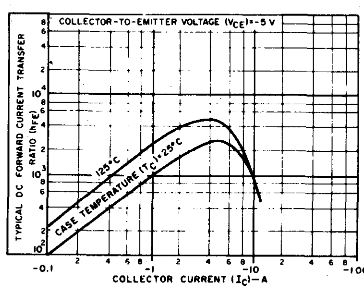


Fig. 5 — Typical dc-beta characteristics for BDX34-series types.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D, BDX34, BDX34A, BDX34B, BDX34C

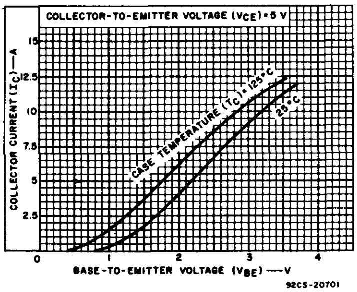


Fig. 6 – Typical transfer characteristics for BDX33-series types.

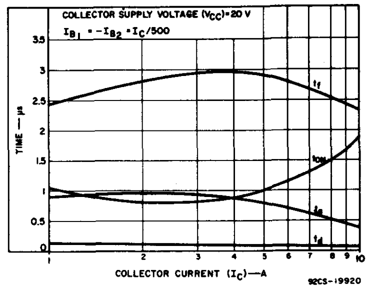


Fig. 7 – Typical saturated switching-time characteristics for BDX33-series types.

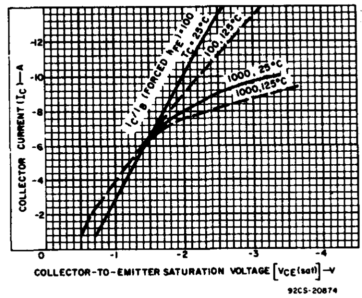


Fig. 8 – Typical saturation characteristics for BDX34-series types.

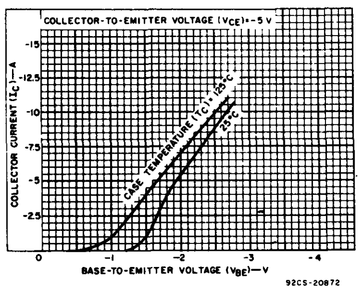


Fig. 9 – Typical transfer characteristics for BDX34-series types.

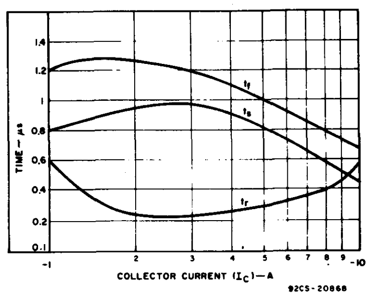


Fig. 10 – Typical saturated switching-time characteristics for BDX34-series types.

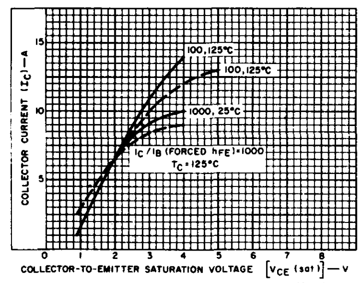


Fig. 11 – Typical saturation characteristics for BDX33-series types.

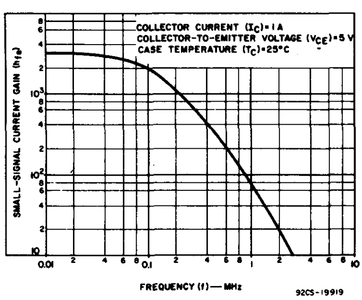


Fig. 12 – Typical small-signal gain for BDX33-series types.

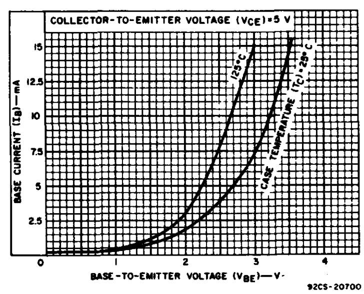


Fig. 13 – Typical input characteristics for BDX33-series types.

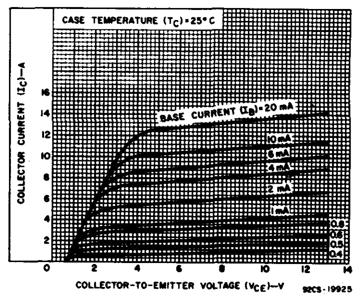


Fig. 14 – Typical output characteristics for BDX33-series types.

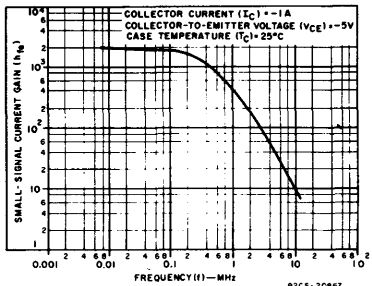


Fig. 15 – Typical small-signal gain for BDX34-series types.

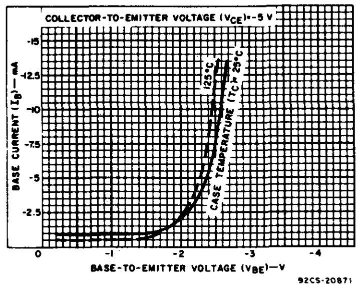


Fig. 16 – Typical input characteristics for BDX34-series types.

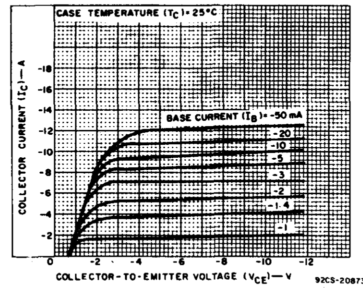


Fig. 17 – Typical output characteristics for BDX34-series types.

BDX83, BDX83A, BDX83B, BDX83C

15-Ampere N-P-N Darlington Power Transistors

40-60-80-100 Volts, 125 Watts

Gain of 1000 at 5 Amperes

The RCA-BDX83, BDX83A, BDX83B, and BDX83C are *monolithic silicon Darlington* transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

The BDX83-series types are supplied in the JEDEC TO-3 hermetic steel package.

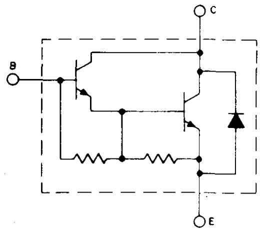


Fig. 1 – Schematic diagram for all types.

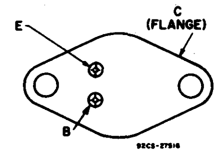
Features:

- **Operates from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:

- **Power switching**
- **Hammer drivers**
- ***Series and shunt regulators***
- **Audio amplifiers**

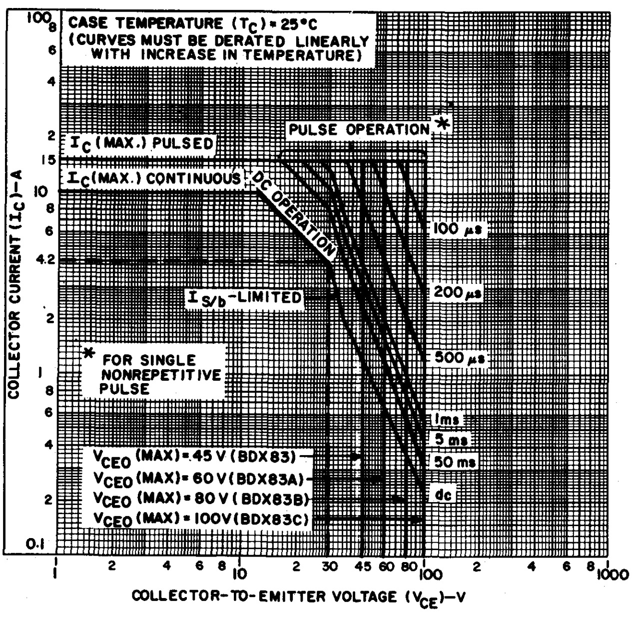
TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BDX83	BDX83A	BDX83B	BDX83C	
V_{CBC}	45	60	80	100	V
$V_{CEO(sus)}$	45	60	80	100	V
V_{EBO}	5	5	5	5	V
I_C	10	10	10	10	A
I_{CM}	15	15	15	15	A
I_B	0.25	0.25	0.25	0.25	A
P_T					
$T_C \leq 25^oC$	125	125	125	125	W
$T_C > 25^oC$	Derate linearly at 0.714 W/^oC				
T_{stg}, T_J	–65 to +200				^oC
T_L					
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235				^oC



92CM-29144

Fig. 2 – Maximum operating area for all types.

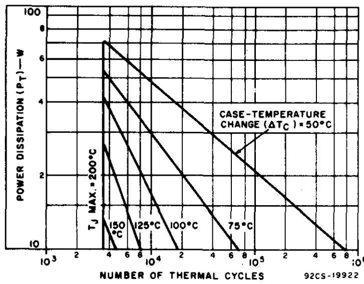


Fig. 3 – Thermal-cycling rating chart for all types.

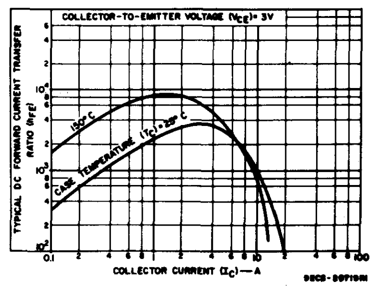


Fig. 4 – Typical dc-beta characteristics for all types.

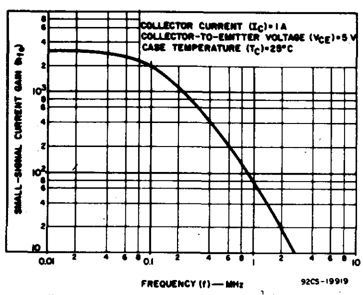


Fig. 5 – Typical small-signal gain for all types.

BDX83, BDX83A, BDX83B, BDX83C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CE}	V_{EB}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS: BDX83 Min.	BDX83 Max.	BDX83A Min.	BDX83A Max.	UNITS
I_{CEO}	20				0	–	1	–	–	
	30				0	–	–	–	1	
I_{CEV}	45		−1.5			–	0.5	–	–	mA
	60		−1.5			–	–	–	0.5	
T_C = 150°C	45		−1.5			–	3	–	–	
	60		−1.5			–	–	–	3	
I_{EBO}		5		0		–	5	–	5	mA
$V_{CEO}(sus)$				0.1[a]	0	45	–	60	–	V
h_{FE}	3			1[a]		750	–	750	–	
	3			5[a]		1000	–	1000	–	
	3			10[a]		250	–	250	–	
V_{BE}	3			5[a]		–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	
$V_{CE}(sat)$				5[a]	0.01[a]	–	2	–	2	V
V_F				−10		–	4	–	4	
h_{fe} f = 1 kHz	5			1		1000	–	1000	–	
$\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	
$E_{S/b}$[b] L = 12 mH, R_{BE} = 100 Ω			−1.5	4.5		120	–	120	–	mJ
$I_{S/b}$ t = 1 s, non rep.	35					2.2	–	–	–	A
	50					–	–	0.9	–	
	30					4.16	–	4.16	–	
$R_{\theta JC}$						–	1.4	–	1.4	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = \frac{1}{2}LI^2$ where L is a series load or leakage inductance, and I is the peak collector current.

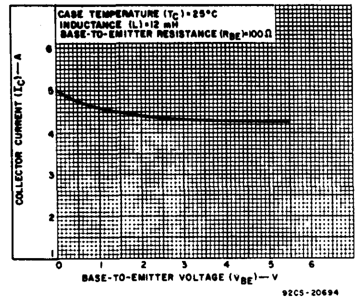


Fig. 6 – Minimum values of reverse-bias second-breakdown characteristic ($E_{S/b}$) for all types.

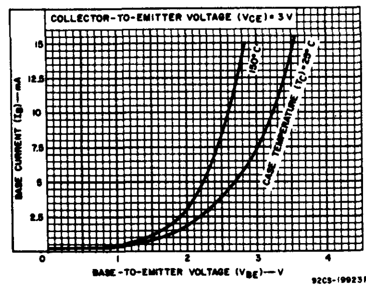


Fig. 7 – Typical input characteristics for all types.

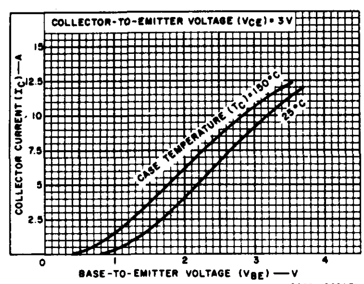


Fig. 8 – Typical transfer characteristics for all types.

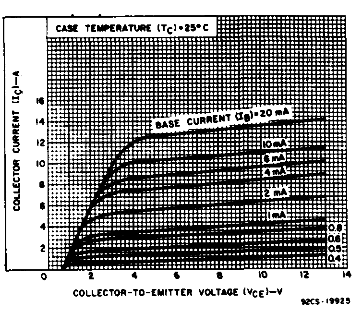


Fig. 9 – Typical output characteristics for all types.

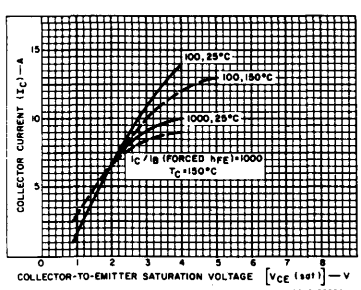


Fig. 10 – Typical saturation characteristics for all types.

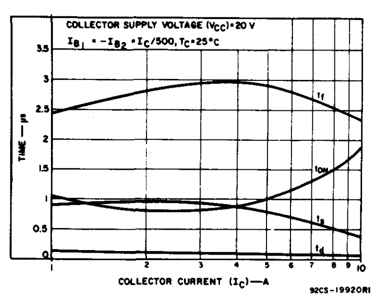


Fig. 11 – Typical saturated switching time characteristics for all types.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC SYMBOL	TEST CONDITIONS					LIMITS				UNITS
	VOLTAGE V dc			CURRENT A dc		BDX83B		BDX83C		
	V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	40				0	–	1	–	–	mA
	50				0	–	–	–	1	
I_{CEV}	80		−1.5			–	0.5	–	–	
	100		−1.5			–	–	–	0.5	
T_C = 150°C	80		−1.5			–	3	–	–	
	100		−1.5			–	–	–	3	
I_{EBO}		5		0		–	5	–	5	mA
V_{CEO}(sus)				0.1[a]	0	80	–	100	–	V
h_{FE}	3			1[a]		750	–	750	–	
	3			5[a]		1000	–	1000	–	
	3			10[a]		250	–	250	–	
V_{BE}	3			5[a]		–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	
V_{CE}(sat)				5[a]	0.01[a]	–	2	–	2	V
V_F				−10		–	4	–	4	
h_{fe} f = 1 kHz	5			1		1000	–	1000	–	
$\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	
$E_{S/b}$[b] L = 12 mH, R_{BE} = 100 Ω			−1.5	4.5		120	–	120	–	mJ
$I_{S/b}$ t = 1 s, non rep.	70					0.37	–	–	–	A
	85					–	–	0.25	–	
	30					4.16	–	4.16	–	
$R_{\theta JC}$						–	1.4	–	1.4	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = ½LI^2$ where L is a series load or leakage inductance, and I is the peak collector current.

BDY29

Hometaxial-Base High-Current Silicon N-P-N Transistor

Rugged Silicon N-P-N Devices for Applications in Industrial and Commercial Equipment

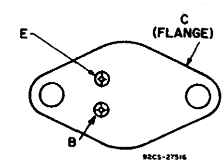
Features:

- High dissipation capability
- High V_{CEX} ratings
- 15-A specification for h_{FE} and V_{CE}(sat)
- Low saturation voltage with high beta

The RCA-BDY29 is a hometaxial-base silicon n-p-n transistor intended for a wide variety of high-power high-current applications. Typical applications for the BDY29 include power-switching circuits, audio amplifiers, series- and shunt-regulators, driver and output stages, dc-to-dc converters, inverters, and solenoid (hammer)/relay driver service.

The device is supplied in the popular JEDEC TO-3 package.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	100	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With −1.5 V (V_{BE}) & R_{BE} = 100 Ω	V_{CEX}	90	V
With base open	V_{CEO}	75	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	30	A
PEAK COLLECTOR CURRENT	I_{CM}	30	A
CONTINUOUS BASE CURRENT	I_B	7.5	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		220	W
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
PIN TEMPERATURE (During soldering):			
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS					LIMITS		UNITS
		VOLTAGE V dc			CURRENT A dc		BDY29		
		V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	
Collector Cutoff Current: With emitter open	I_{CBO}	100					–	1	mA
With base-emitter junction reverse-biased	I_{CEX}		100	−1.5			–	1	mA
With base-emitter junction reverse-biased & T_C = 150°C	I_{CEX}		100	−1.5			–	10	mA
With base open	I_{CEO}		60			0	–	2	mA
Emitter Cutoff Current	I_{EBO}			−7	0		–	2	mA
DC Forward Current Transfer Ratio	h_{FE}		2		15[a]		15	60	
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse-biased (R_{BE}) = 100 Ω	V_{CEX}(sus)			−1.5	0.2		90	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}(sus)				0.2		85	–	V
With base open	V_{CEO}(sus)				0.2	0	75	–	V
Base-to-Emitter Voltage	V_{BE}		4		30[a]		–	3.5	V
Collector-to-Emitter Saturation Voltage	V_{CE}(sat)				15[a]	1.5	–	1.2	V
Second-Breakdown Collector Current: With base forward-biased and 1-s, nonrepetitive pulse	$I_{S/b}$[b]		60				3.66	–	A
Second-Breakdown Engergy: With base reverse-biased and L = 40 mH, R_{BE} = 100 Ω	$E_{S/b}$[c]			−1.5	5		500	–	mJ
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio: f = 0.05 MHz	$\|h_{fe}\|$		4		1		4	16 (Typ.)	
Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio: f = 1 kHz	h_{fe}		4		1		40	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						–	0.8	°C/W

[a]Pulsed; pulse duration = 300 μs, rep. rate = 60 Hz; duty factor ≤ 2%.

[b]$I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased for transistor operation in the active region.

[c]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = 1/2LI^2$, where L is a series load or leakage inductance and I is the peak collector current.

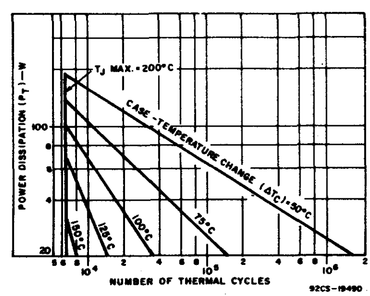


Fig. 1 — Thermal-cycling rating chart.

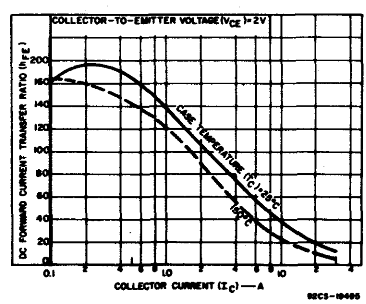


Fig. 2 — Typical dc beta characteristics.

BDY29

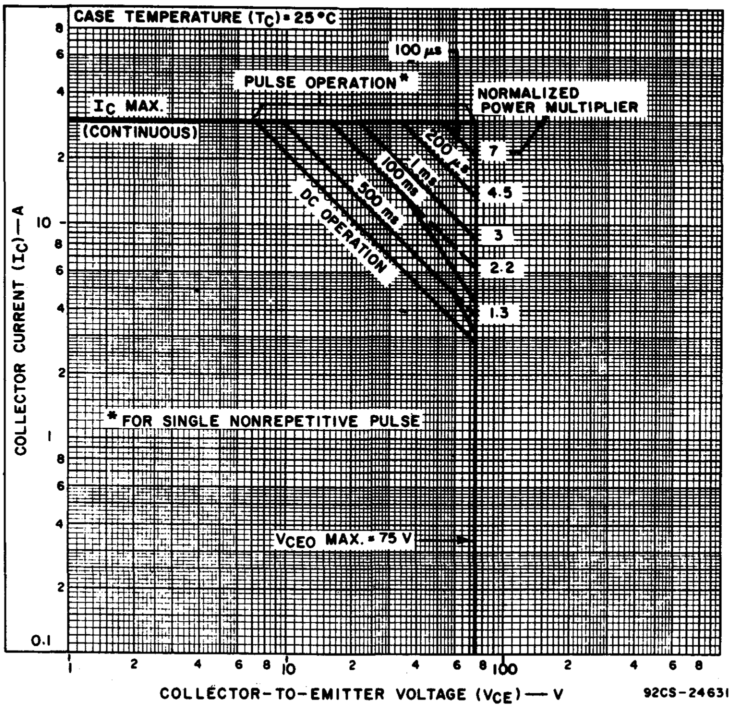


Fig. 3 – Maximum operating areas.

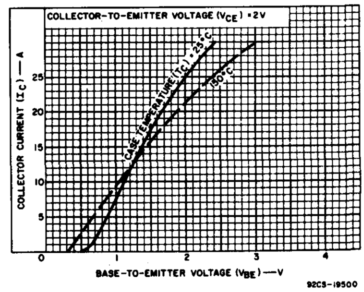


Fig. 4 – Typical transfer characteristics.

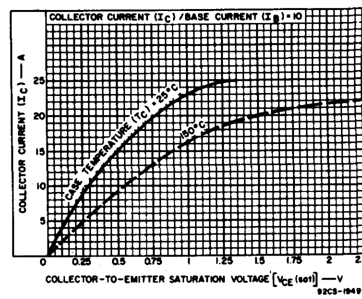


Fig. 5 – Typical saturation-voltage characteristics.

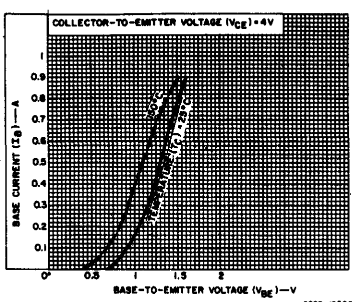


Fig. 6 – Typical input characteristics.

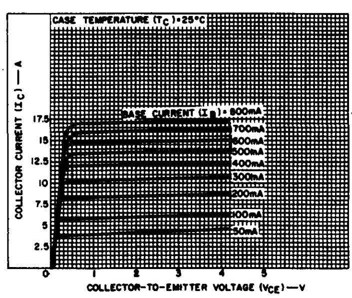


Fig. 7 – Typical output characteristics.

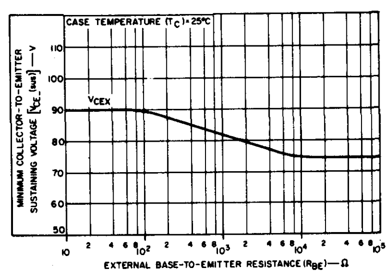


Fig. 8 – Sustaining voltage vs. base-to-emitter resistance.

BDY37

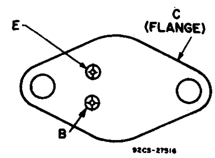
Hometaxial-Base, High-Current Silicon N-P-N Transistor

Rugged High-Voltage Device for Applications in Industrial and Commercial Equipment

Features:
- High dissipation capability – 150 W
- 8-A specification for h_{FE}, V_{BE}, and V_{CE}(sat)
- V_{CEX} – 160 V min.
- Low saturation voltage with high beta

The RCA-BDY 37 is a hometaxial-base silicon n-p-n transistor intended for a wide variety of high-voltage high-current applications. Typical applications include power-switching circuits, audio amplifiers, series- and shunt-regulator driver and output stages, dc-to-dc converters, inverters, and solenoid (hammer)/relay driver service. The BDY 37 employs the popular JEDEC TO-3 package.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	160	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	140	V
With reverse bias (V_{BE}) of −1.5 V	V_{CEX}	160	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	V
COLLECTOR CURRENT:			
Continuous	I_C	16	A
Peak	I_{CM}	30	A
BASE CURRENT:			
Continuous	I_B	4	A
Peak	I_{BM}	15	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		150	W
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to +200	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		230	°C

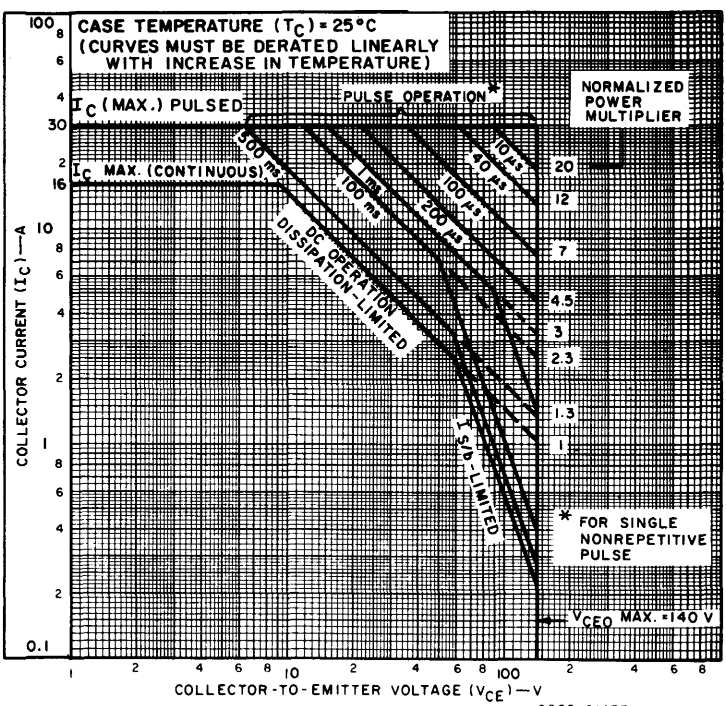


Fig. 1 – Maximum operating areas.

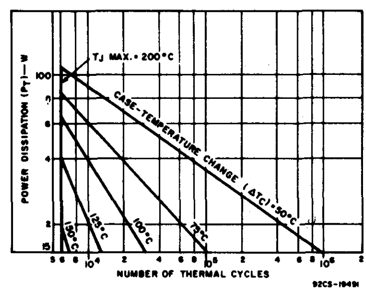


Fig. 2 – Thermal-cycling rating chart.

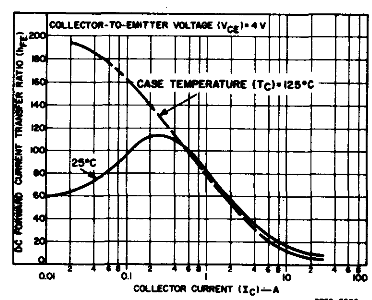


Fig. 3 – Typical dc beta characteristics.

BDY37

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS							LIMITS		UNITS
		VOLTAGE V dc				CURRENT A dc			BDY37		
		V_{CB}	V_{CE}	V_{EB}	V_{BE}	I_C	I_E	I_B	Min.	Max.	
Collector-Cutoff Current: With emitter open	I_{CBO}	140					0		–	2	mA
With base-emitter junction reverse-biased	I_{CEX}		140		−1.5				–	2	mA
With base-emitter junction reverse-biased and T_C = 150°C	I_{CEX}		140		−1.5				–	10	mA
With base open	I_{CEO}		120					0	–	10	mA
Emitter-Cutoff Current	I_{EBO}			7		0			–	5	mA
DC Forward-Current Transfer Ratio	h_{FE}		4			8[a]			15	60	
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse-biased (R_{BE} = 100 Ω)	$V_{CEX}(sus)$				−1.5	0.1			160	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$					0.2[a]			150	–	V
With base open	$V_{CEO}(sus)$					0.2[a]		0	140	–	V
Base-to-Emitter Voltage	V_{BE}		4			8[a]			–	2.2	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					8[a]		0.8	–	1.4	V
Second-Breakdown Collector Current: With base forward-biased and 1-s nonrepetitive pulse	$I_{S/b}$[b]		60						2.5	–	A
Second-Breakdown Energy: With base reverse-biased and L = 40 mH, R_{BE} = 100 Ω	$E_{S/b}$[c]				−1.5	2.5			0.125	–	J
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 50 kHz)	$\lvert h_{fe} \rvert$		4			1			4	–	
Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (f = 1 kHz)	h_{fe}		4			1			40	–	
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$								–	1.17	°C/W

[a] Pulsed; pulse duration = 300 μs, rep. rate = 60 Hz, duty factor ≤ 2%.

[b] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

[c] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

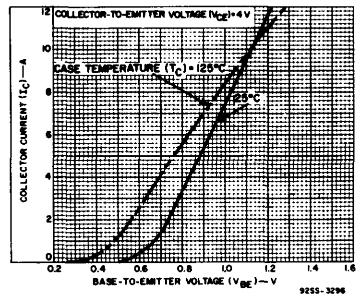


Fig. 4 – Typical transfer characteristics.

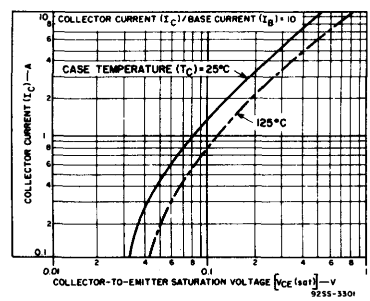


Fig. 5 – Typical staturation-voltage characteristics.

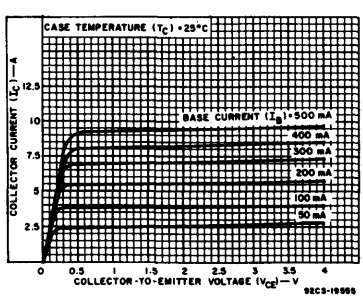


Fig. 6 – Typical output characteristics.

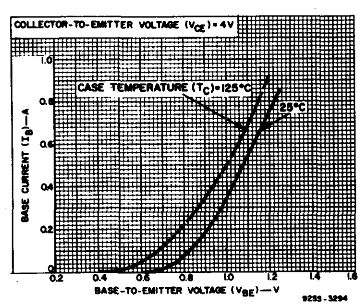


Fig. 7 – Typical input characteristics.

BDY71

Hometaxial-Base, Medium-Power Silicon N-P-N Transistor

For Intermediate-Power Applications in Industrial and Commercial Equipment

The RCA-BDY71 is a hometaxial-base silicon n-p-n transistor intended for a wide variety of medium- to high-power applications. It is supplied in the JEDEC TO-66 hermetic package.

Applications:

- Power switching circuits
- Series- and shunt-regulator driver and output stages
- High-fidelity amplifiers
- Solenoid drivers

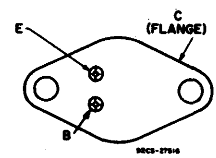
Features:

- Maximum safe-area-of-operation curves for dc and pulse operation
- V_{CEV}(sus) = 90 V min
- Low saturation voltage: V_{CE}(sat) = 1.0 V at I_C = 0.5 A

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BDY71	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	90	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	55	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}(sus)	60	V
With base reverse-biased (V_{BE} = -1.5 V)	V_{CEV}(sus)	90	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	4	A
CONTINUOUS BASE CURRENT	I_B	2	A
TRANSISTOR DISSIPATION:	P_T		
At case temperature up to 25°C		29	W
At temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
PIN TEMPERATURE (During Soldering):			
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235	°C

TERMINAL DESIGNATIONS



JEDEC TO-66

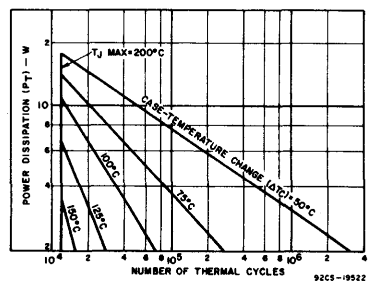


Fig. 2 — Thermal-cycling rating chart.

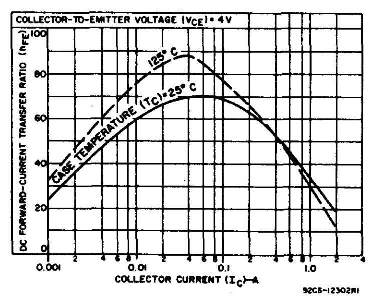


Fig. 3 — Typical dc beta characteristics.

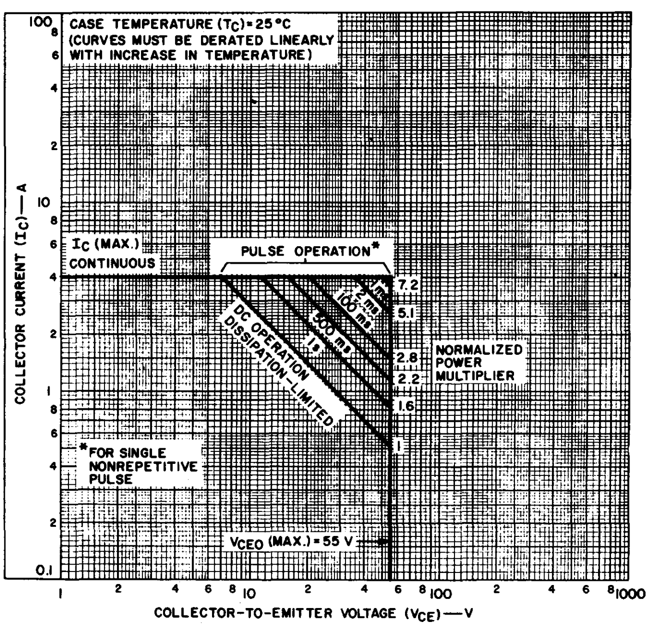


Fig. 1 — Maximum operating areas for BDY71.

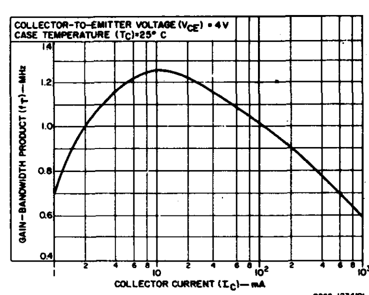


Fig. 4 — Typical gain-bandwidth product.

BDY71

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	TEST CONDITIONS VOLTAGE V dc V_{BE}	TEST CONDITIONS CURRENT A dc I_C	TEST CONDITIONS CURRENT A dc I_B	LIMITS BDY71 Min.	LIMITS BDY71 Max.	UNITS
Collector-Cutoff Current: With base open	I_{CEO}	30			0	–	0.5	mA
With base-emitter junction reverse-biased	I_{CEX}	90	−1.5			–	1	mA
at T_C = 150°C	I_{CEX}	90	−1.5			–	6	mA
Emitter-Cutoff Current	I_{EBO}		−7		0	–	1	mA
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.1[a]	0	55	–	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$			0.1[a]		60	–	V
DC Forward-Current Transfer Ratio	h_{FE}	4 4		3[a] 0.5[a]		5 80	– 200	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			0.5[a] 3[a]	0.05[a] 1[a]	– –	1 6	V
Base-to-Emitter Voltage	V_{BE}	4		0.5		–	1.7	V
Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio Cutoff Frequency	f_{hfe}	4		0.1		0.03	–	MHz
Gain-Bandwidth Product: f = 0.4 MHz	f_T			0.2		800	–	kHz
Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio: f = 1 kHz	h_{fe}	4		0.1		25	–	
Forward-Bias Second Breakdown Collector Current: t = 1-s nonrepetitive	$I_{S/b}$	55				525	–	mA
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					6.3	–	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

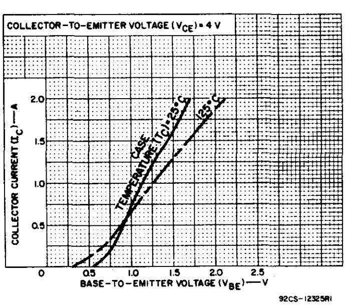


Fig. 5 – Typical transfer characteristics.

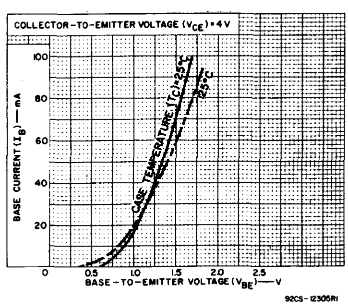


Fig. 6 – Typical input characteristics.

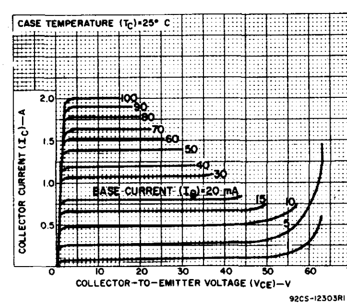


Fig. 7 – Typical output characteristics.

BFT19, BFT19A, BFT19B

P N P

High-Voltage Silicon ~~N-P-N~~ Transistors

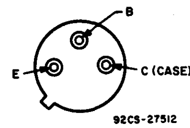
For High-Speed Switching and Linear-Amplifier Applications in Military, Industrial and Commercial Equipment

Features:
- Maximum safe-area-of-operation curves
- High voltage ratings:
  V_{CBO} = −400 V max. (BFT19B); −300 V max. (BFT19A); −200 V max. (BFT19)
  $V_{CEO}(sus)$ = −350 V max. (BFT19B); −250 V max. (BFT19A); −150 V max. (BFT19)

RCA-BFT19, BFT19A, and BFT19B are silicon p-n-p transistors with high breakdown voltages, high frequency response, and fast switching speeds. These transistors differ in their voltage ratings. They are supplied in the JEDEC TO-39 hermetic package.

Typical applications include high-voltage differential and operational amplifiers; high-voltage inverters, and high-voltage, low-current switching and series regulators.

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BFT19	BFT19A	BFT19B	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−200	−300	−400	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:					
With base open	$V_{CEO}(sus)$	−150	−250	−350	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$	−200	−300	−400	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	−5	−5	−5	V
COLLECTOR CURRENT (Continuous)	I_C	−1	−1	−1	A
BASE CURRENT (Continuous)	I_B	−0.5	−0.5	−0.5	A
TRANSISTOR DISSIPATION:	P_T				
At case temperatures up to 25°C		5	5	5	W
At case temperatures above 25°C		Derate linearly to 200°C			
At ambient temperatures up to 25°C		1	1	1	W
At ambient temperatures above 25°C		Derate linearly at 5.7 mW/°C			
TEMPERATURE RANGE:					
Storage and Operating (Junction)		← −65 to 200 →			°C
PIN TEMPERATURE (During Soldering):					
At distance ≥ 1/32 in. (0.8 mm) from case for 10 s max.		← 255 →			°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS VOLTAGE V dc			CURRENT mA			LIMITS BFT19		BFT19A		BFT19B		UNITS
		V_{CB}	V_{CE}	V_{EB}	I_C	I_E	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current: With emitter open	I_{CBO}	−100 −200 −300					0 0 0	– – –	−100 – –	– – –	– −100 –	– – –	– – −100	µA
Emitter-Cutoff Current	I_{EBO}			−5	0			–	−100	–	−100	–	−100	µA
DC Forward-Current Transfer Ratio	h_{FE}		−10 −10 −10		−10 −30 −50			20 25 20	– – –	20 25 20	– – –	20 25 20	– – –	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$				−10		0	−150[a]	–	−250[a]	–	−350[a]	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$				−10			−200[a]	–	−300[a]	–	−400[a]	–	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				−30		−3	–	−1.8	–	−1.8	–	−1.8	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				−10 −30		−1 −3	– –	−1 −2.5	– –	−1 −2.5	– –	−1 −2.5	V
Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (at 1 kHz)	h_{fe}		−10		−5			25	–	25	–	25	–	
Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio (at 5 MHz)	$\|h_{fe}\|$		−10		−30			5	–	5	–	5	–	
Common-Base, Short-Circuit, Input Capacitance (at 1 MHz)	C_{ib}			−5	0			–	75	–	75	–	75	pF
Output Capacitance (at 1 MHz)	C_{ob}	−10				0		–	15	–	15	–	15	pF
Second-Breakdown Collector Current: With base forward biased	$I_{S/b}$	−100						−50	–	−50	–	−50	–	mA
Thermal Resistance: (Junction-to-Case)	$R_{\theta JC}$							–	35	–	35	–	35	°C/W

[a] CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

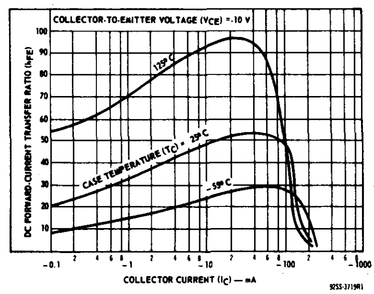


Fig. 1 — Typical dc beta characteristics.

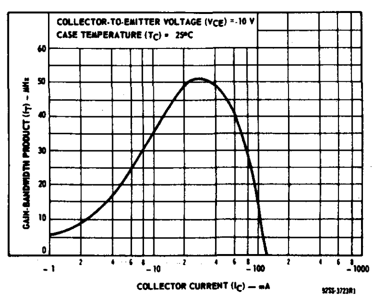


Fig. 2 — Typical gain-bandwidth product.

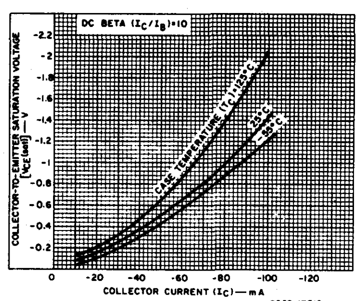


Fig. 5 — Typical collector-to-emitter saturation voltage.

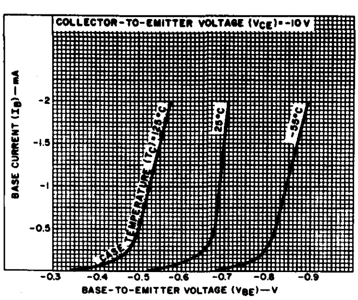


Fig. 3 — Typical input characteristics.

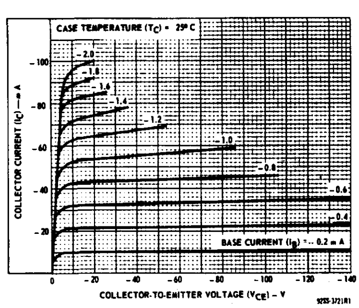


Fig. 4 — Typical output characteristics.

BFT19, BFT19A, BFT19B

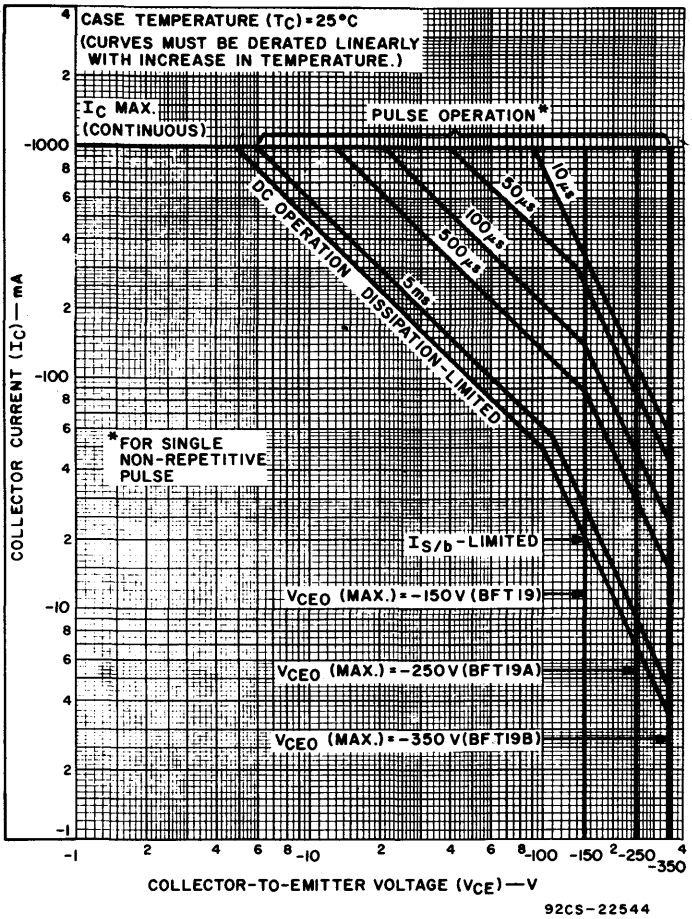


Fig. 6 — Maximum operating areas for all types.

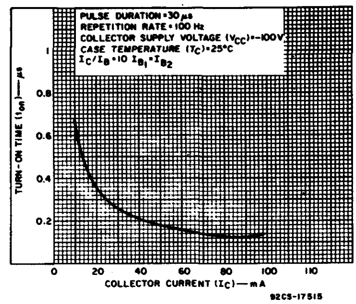


Fig. 7 — Typical turn-on time characteristics.

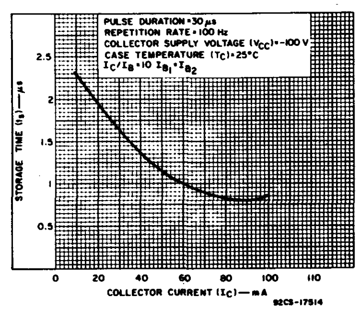


Fig. 8 — Typical storage-time characteristic.

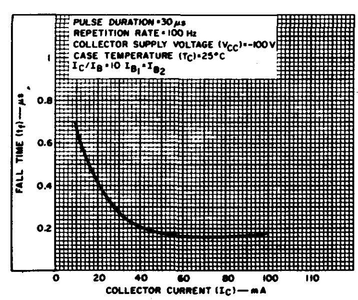


Fig. 10 — Typical fall-time characteristic.

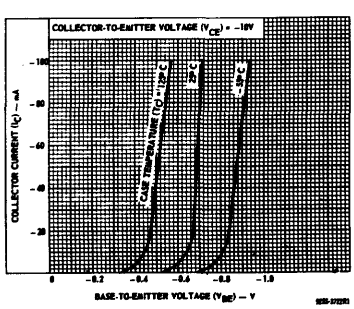


Fig. 9 — Typical transfer characteristics.

BFT28, BFT28A, BFT28B, BFT28C,

High-Voltage Silicon P-N-P Transistors

For High-Speed Switching and Linear-Amplifier
Applications in Military, Industrial and Commercial Equipment

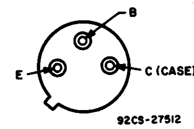
The RCA-BFT28, BFT28A, BFT28B and BFT28C are silicon p-n-p transistors with high breakdown voltages, high frequency response, and fast switching speeds. They are supplied in the JEDEC TO-39 hermetic package.

These transistors differ primarily in their voltage ratings. Typical applications include high-voltage differential and operational amplifiers; high-voltage inverters; and high-voltage, low-current switching and series regulators.

Features:

- **Maximum safe-area-of-operation curves**
- **High voltage ratings:**
  V_{CBO} = −150 V max. (BFT 28); −200 V max. (BFT28A); −250 V max. (BFT 28 B); −300 V max. (BFT28C)
  $V_{CEO(sus)}$ = −100 V max. (BFT 28); −150 V max. (BFT28A); −200 V max. (BFT28B); −250 V max. (BFT28C)

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

		BFT28	BFT28A	BFT28B	BFT28C	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	−150	−200	−250	−300	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$	−150	−200	−250	−300	V
With base open	$V_{CEO(sus)}$	−100	−150	−200	−250	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	−4	−4	−4	−4	V
COLLECTOR CURRENT	I_C	−1	−1	−1	−1	A
BASE CURRENT	I_B	−0.5	−0.5	−0.5	−0.5	A
TRANSISTOR DISSIPATION:						
At case temperatures up to 25°C		5	5	5	5	W
At case temperatures above 25°C		Derate linearly to 200°C				
At ambient temperatures up to 50°C		1	1	1	1	W
At ambient temperatures above 50°C ..... Derate linearly at		5.7	5.7	5.7	5.7	mW/°C
TEMPERATURE RANGE:						
Storage and Operating (Junction)		−65 to +200				°C
LEAD TEMPERATURE (During soldering):						
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		255				°C

ELECTRICAL CHARACTERISTICS, ***At Case Temperature (T_C) = 25°C***

CHARACTERISTIC	SYMBOL	TEST CONDITIONS					LIMITS								UNITS
		VOLTAGE V dc			CURRENT mA dc		BFT28		BFT28A		BFT28B		BFT28C		
		V_{CB}	V_{CE}	V_{EB}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current: With emitter open	I_{CBO}	−50					–	−1	–	–	–	–	–	–	μA
		−75					–	–	–	−1	–	–	–	–	
		−150					–	–	–	–	–	−5	–	−5	
Emitter-Cutoff Current	I_{EBO}			−4	0		–	−100	–	−100	–	−100	–	−100	μA
DC Forward-Current Transfer Ratio	h_{FE}		−10		−10[c]		20	–	20	–	20	–	20	–	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$				−10	0	−100[a]	–	−150[a]	–	−200[a]	–	−250[a]	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER(sus)}$				−10		−150[a]	–	−200[a]	–	−250[a]	–	−300[a]	–	V
Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$				−30[c]	−3	–	−1.5	–	−1.5	–	−1.5	–	−1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$				−10[c]	−1	–	−0.6	–	−0.6	–	−5	–	−5	V
Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio: f = 1 kHz	h_{fe}		−10		−5		25	–	25	–	25	–	25	–	
Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio: f = 5 MHz	$\|h_{fe}\|$		−10		−30		5	–	5	–	5	–	5	–	
Common-Base, Short-Circuit, Input Capacitance: f = 1 MHz	C_{ib}			−5	0		–	75	–	75	–	75	–	75	pF
Output Capacitance: f = 1 MHz	C_{ob}	−10					–	15	–	15	–	15	–	15	pF
Forward-Bias, Second-Breakdown Collector Current: 0.4-s non-repetitive pulse	$I_{S/b}$[b]		−80				−62.5	–	−62.5	–	−62.5	–	−62.5	–	mA
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$						–	35	–	35	–	35	–	35	°C/W

[a]CAUTION: The sustaining voltages $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.
[b]$I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage.
[c]Pulsed, pulse duration = 300 μs; duty factor ≤ 2%.

BFT28, BFT28A, BFT28B, BFT28C

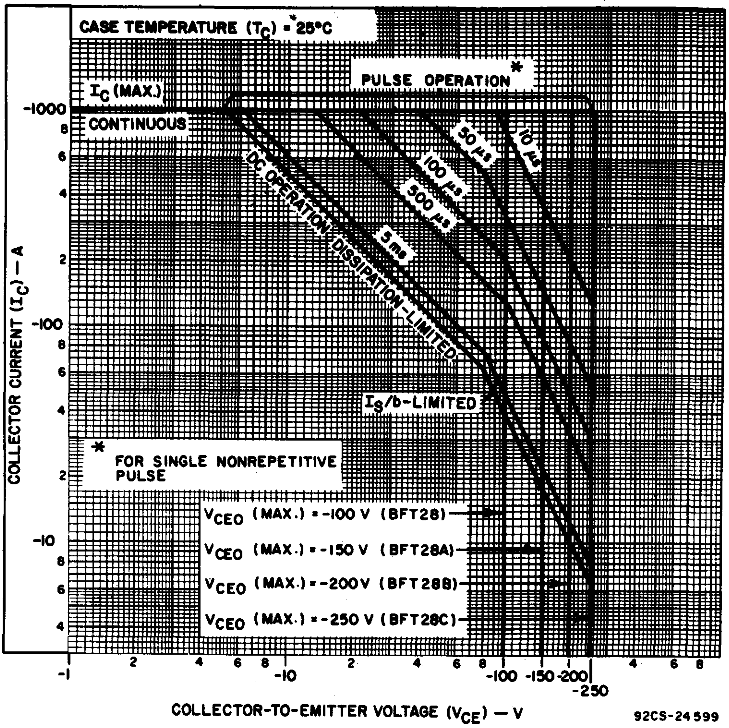


Fig. 1 — Maximum safe operating areas.

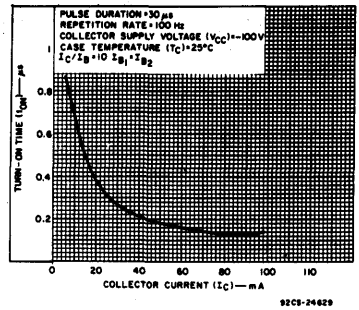


Fig. 2 — Typical turn-on time characteristic for all types.

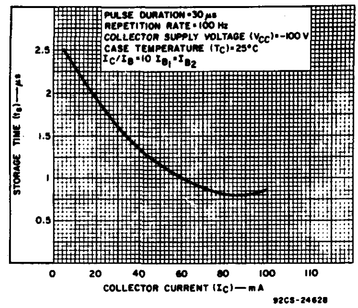


Fig. 3 — Typical storage-time characteristic for all types.

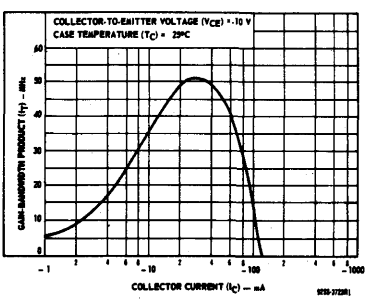


Fig. 4 — Typical gain-bandwidth product for all types.

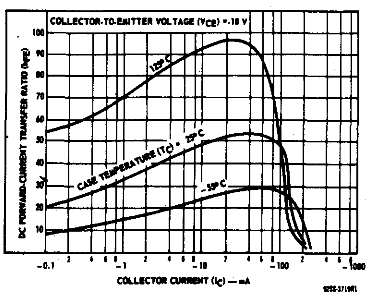


Fig. 5 — Typical dc beta characteristics for all types.

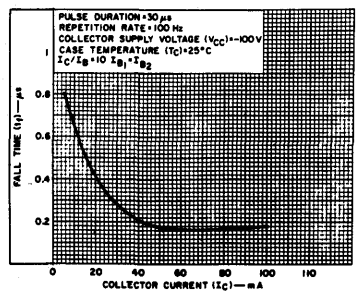


Fig. 6 — Typical fall-time characteristic for all types.

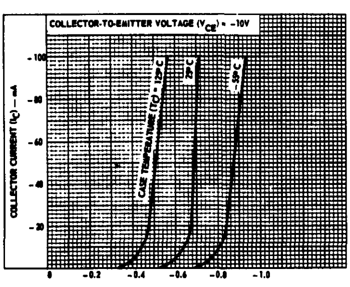


Fig. 7 — Typical transfer characteristics for all types.

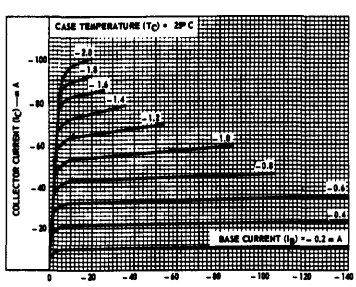


Fig. 8 — Typical output characteristics for all types.

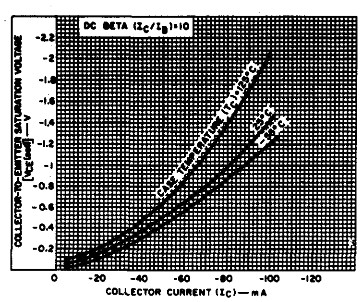


Fig. 9 — Typical collector-to-emitter saturation voltage for all types.

BU106

Epitaxial-Base Silicon N-P-N Transistor

For Horizontal Deflection for Small-Screen Black-and-White TV

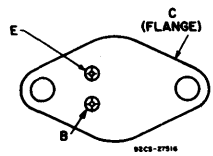
Features:

- Maximum safe-area-of-operation curves
- Low saturation voltages
- High voltage ratings
- High dissipation rating

BU106 is a silicon n-p-n transistor with a pi-nu epitaxial-layer construction. This device is supplied in a JEDEC TO-3 hermetic package. The BU106 is primarily intended for use in horizontal-deflection output stages in small-screen black-and-white television receivers.

This transistor is supplied in the JEDEC TO-3 hermetic package.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	325	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With base open	$V_{CEO}(sus)$	140	V
With base reverse-biased (V_{BE}) between –2 V ~ 8 V	$V_{CEV}(sus)$	325	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	8	V
CONTINUOUS COLLECTOR CURRENT	I_C	7	A
PEAK COLLECTOR CURRENT		10	A
CONTINUOUS BASE CURRENT	I_B	4	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C and V_{CE} up to 40 V		75	W
At case temperatures up to 25°C and V_{CE} above 40 V		See Fig. 3	
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage and Operating (Junction)		–65 to +200	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc: V_{CE}	V_{EB}	V_{BE}	CURRENT A dc: I_C	I_B	I_E	LIMITS BU106: MIN.	MAX.	UNITS
Collector Cutoff Current: With base open	I_{CEO}	100				0		–	2	mA
With base-emitter junction reverse-biased	I_{CEV}	325		–1.5				–	2	mA
With base-emitter junction reverse-biased and T_C = 100°C	I_{CEV}	325		–1.5				–	5	mA
Emitter-Cutoff Current	I_{EBO}		8		0			–	10	mA
Collector-to-Emitter Sustaining Voltage (See Figs. 4 and 5): With base open	$V_{CEO}(sus)$				0.1[a]	0		140	–	V
With base-emitter junction reverse-biased	$V_{CEV}(sus)$			–2	0.05[a]			325	–	V
Emitter-to-Base Voltage	V_{EBO}				0.01			8	–	V
DC Forward-Current Transfer Ratio	h_{FE}	5			4[a]			8	–	
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				4[a]	0.5		–	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				4[a]	0.5		–	5	V
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward Current Transfer Ratio (f = 1 MHz)	$\|h_{fe}\|$	10			0.2			3	–	
Common Base Output Capacitance (f = 1 MHz)	C_{ob}	V_{CB} = 10					0	150	–	pF
Forward-Bias Second Break-down Collector Current (1-s non-repetitive pulse)	$I_{S/b}$	40						1.85	–	A
Switching Time: Storage (V_{CC} = 40 V)	t_s				4	0.5[c]		–	3	μs
Turn-off (V_{CC} = 40 V)[d]	t_{OFF}	2			0.1			–	1.5	μs
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	10			5			–	2.34	°C/W

[a] Pulsed; pulse duration ≤ 350 μs, Duty factor = 2%.
[b] CAUTION: The sustaining voltages $V_{CEO}(sus)$, and $V_{CEV}(sus)$, MUST NOT be measured on a curve tracer.
[c] I_{B1} = I_{B2} = value shown.
[d] Turn-off is measured when V_{CE} has reached a value of 2 V and I_C has decreased to 100 mA.

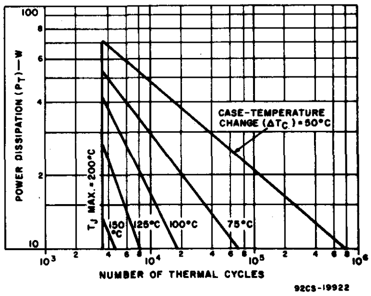


Fig. 1 – Thermal-cycling rating chart.

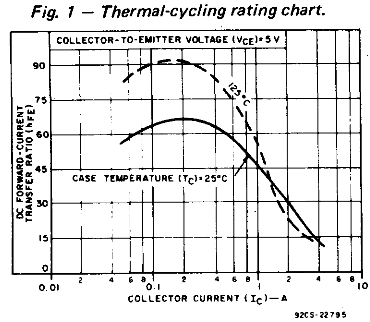


Fig. 2 – Typical dc beta characteristics.

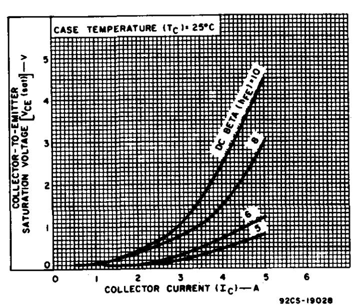


Fig. 3 – Typical saturation voltage characteristics.

BU106

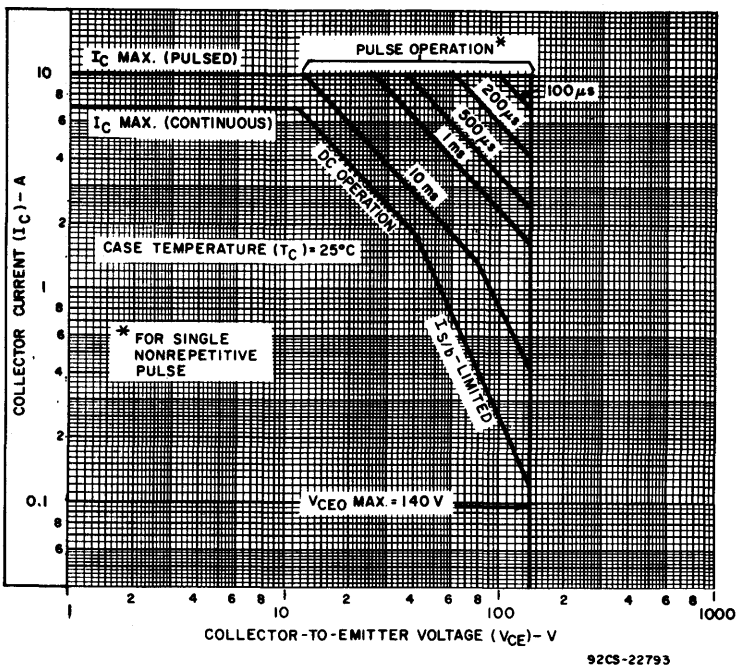


Fig. 4 — Maximum operating areas.

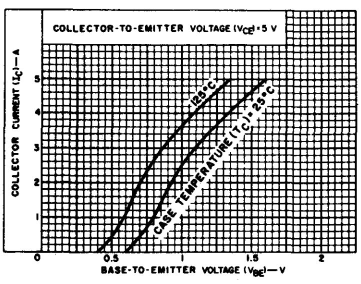


Fig. 5 — Typical transfer characteristics.

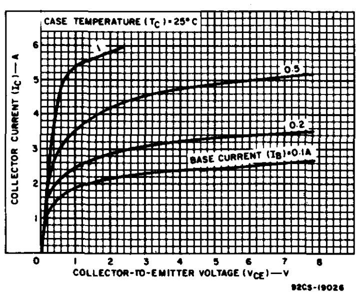


Fig. 6 — Typical output characteristics.

BU126, BU133

High-Voltage, Power-Switching Silicon N-P-N Transistors

TV Colour/Monochrome Receiver Power Supplies –90° and 110° Deflection Angles

Features:

- **Fast switching speed**
- **Hermetic steel package – JEDEC TO-3**
- **Epitaxial pi-nu construction**

The RCA-BU126 and BU133 are silicon epitaxial-collector n-p-n power switching transistors intended for use in switched-mode power supplies of 90° and 110° colour and black-and-white TV receivers.

These devices are hermetically sealed in a steel JEDEC TO-3 package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BU126	BU133	
V_{CES}	750	750	V
V_{CEV}			
$V_{BE} = -1.5$ V	750	750	V
$V_{CEO}(sus)$	300	250	V
V_{EBO}	6	6	V
I_C	3	3	A
I_{CM}	6	6	A
I_B	2	2	A
P_T			
Up to 25°C	80	80	W
Above 25°C	Derate linearly to 200°C		
T_J, T_{stg}	–65 to 200		°C
T_L At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235		°C

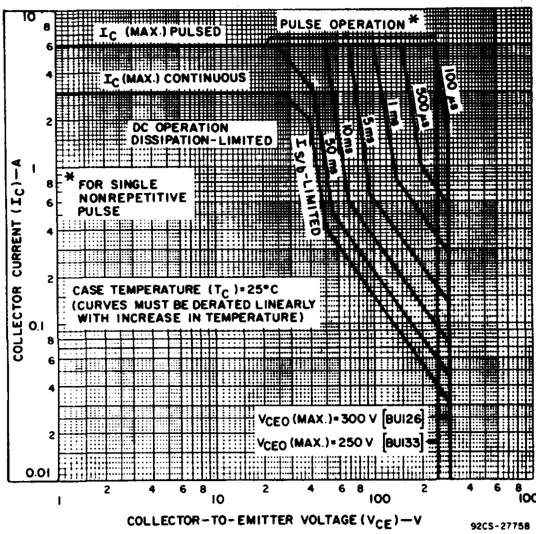


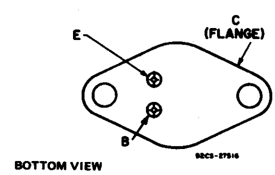
Fig. 1 – Maximum operating areas for BU126, BU133.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

SYMBOL	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		BU126		BU133		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CES}	750	0			–	500	–	500	µA
T_C = 125°C	750	0			–	2	–	2	mA
I_{EBO}		–6			–	5	–	5	mA
h_{FE}	5		1a		15	60	15	80	
$V_{CEO}(sus)$			0.1[a]	0	300[b]	–	250[b]	–	V
$V_{BE}(sat)$			4[a]	1	–	1.5	–	1.5	V
$V_{CE}(sat)$			2.5[a] 4[a]	0.25 1	– –	10 5	– –	10 5	V
$I_{S/b}$ t = 1 s nonrep.	40 200				2 50	– –	2 50	– –	V mA
f_T	10		0.2		3.5 typ.		3.5 typ.		MHz
t_s V_{CC} = 50 V			2.5	0.25[c]	1.5 typ.	2.4	1.5 typ.	2.4	µs
t_f V_{CC} = 50 V[d]			2.5	0.25[c]	0.5 typ.	0.9	0.5 typ.	0.9	µs
$R_{\theta JC}$					–	2.18	–	2.18	°C/W

[a] Pulsed: pulse duration = 300 µs, rep. rate = 50 Hz, duty factor = 2%
[b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
[c] $I_{B_1} = I_{B_2}$
[d] Fall-time characteristics measured in a typical switched-mode power supply show an average value of 0.16 µs.

TERMINAL DESIGNATIONS



JEDEC TO-3

BU207, BU208, BU208A

High-Voltage, High-Current Silicon N-P-N Power-Switching Transistors

For Horizontal-Deflection Circuit Application in TV Receivers

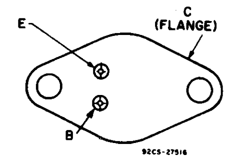
The RCA BU207, BU208 and BU208A are silicon n-p-n power switching transistors. These types utilize a trimetal metallization-process to achieve a balanced-current distribution throughout the chip.

They are intended for horizontal-deflection circuit application in black and white and color television receivers, and for other applications where a combination of high-current handling capability, ruggedness, and fast-switching speeds are required.

Features:

- Al-Ti-Ni Metalization – Clip Construction
- Ion Implantation for Stringent Control of Diffusion and Electrical Parameters
- Hard Glass-Passivation
- Fast Switching Speeds
- Low Saturation Voltages
- Wide Safe-Area-of-Operation
- Low Thermal Resistance

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BU207	BU208	BU208A	
V_{CES}	1300	1500	1500	V
$V_{CEO}(sus)$	600	700	700	V
V_{EBO}		5		V
I_C		5		A
I_{CM}		7.5		A
I_{BM}		4		A
$-I_{BM}$		−3.5		A
P_T				
T_C up to 95°C		12.5		W
T_C above 95°C, Derate Linearly		0.625		W/°C
T_{stg}, T_J		−65 to 115		°C
T_L				
At distance ⩾ 1/16 in. (1.39 mm) from seating plane for 10 s max.		230		°C

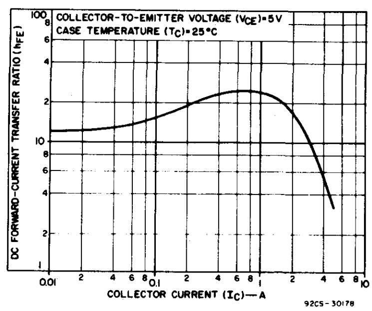


Fig. 2 – Typical dc beta characteristic as a function of collector current.

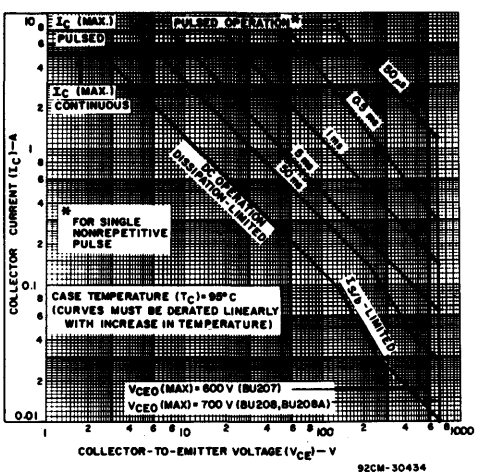


Fig. 1 – Maximum operating areas for all types (T_C = 95°C).

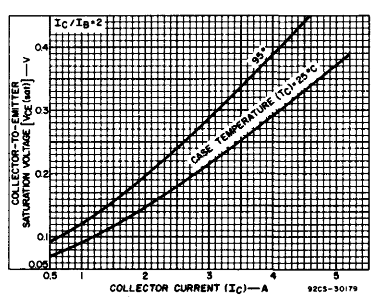


Fig. 3 – Typical collector-to-emitter saturation voltage as a function of collector current.

BU207, BU208, BU208A

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARAC-TERISTIC	TEST CONDITIONS VOLTAGE V dc		CURRENT A dc		LIMITS BU207		BU208		BU208A		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CES}	1300			0	–	1	–	–	–	–	mA
	1500			0	–	–	–	1	–	1	mA
I_{EBO}		4	0		–	0.5	–	0.5	–	0.5	mA
$V_{CEO}(sus)$			0.1[b]	0	600[a]	–	700[a]	–	700[a]	–	V
V_{EBO}				0.1	5	–	5	–	5	–	V
h_{FE}	5		4.5[b]		2.25	–	2.25	–	2.5	–	
$V_{BE}(sat)$			4.5[b]	2	0.9[c]	1.5	0.9[c]	1.5	0.9[c]	1.5	V
$V_{CE}(sat)$			4.5[b]	2	1.5[c]	5	1.5[c]	5	–	1	V
f_T	5		0.1		1 (Typ.)		1 (Typ.)		1 (Typ.)		MHz
C_{ob}	10[d]				160 (Typ.)		160 (Typ.)		160 (Typ.)		pF
t_s			4.5	1.8	10 (Typ.)		10 (Typ.)		10 (Typ.)		µs
t_f			4.5	1.8	0.6 (Typ.)		0.6 (Typ.)		0.6 (Typ.)		µs
$R_{\theta JC}$					–	1.6	–	1.6	–	1.6	°C/W

a CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer. $V_{CEO}(sus)$ should be measured by a pulse method with the test conditions I_C = 100 mA, L = 25 µH, I_B = 0.

b Pulsed; pulse duration = 300 µs, duty factor ≤ 2%.

c Typical value

d V_{CB}

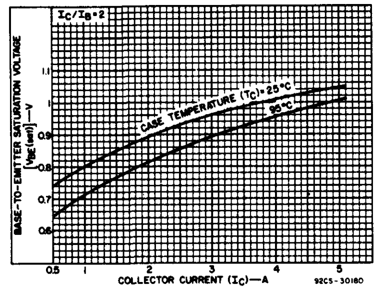


Fig. 4 – Typical base-to-emitter saturation voltage as a function of collector current.

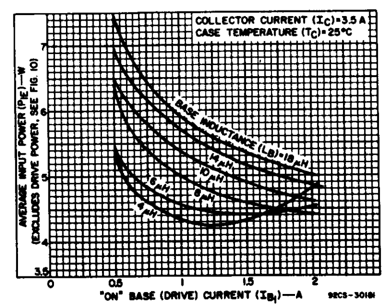


Fig. 5 – Guide for optimizing "drive" conditions at 3.5A in test circuit, Fig. 1. See also Guide for Optimizing 'ON' and 'OFF' Base (Drive) Current Conditions p.4.

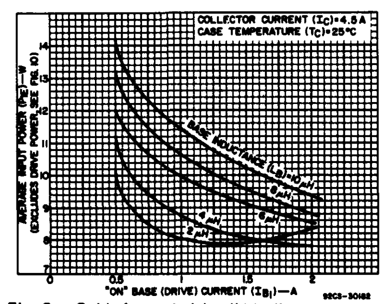


Fig. 6 – Guide for optimizing "drive" conditions at 4.5A in test circuit, Fig. 1. See also "Guide for Optimizing 'ON' and 'OFF' Base (Drive) Current Conditions".

Guide for Optimizing "ON" and "OFF" Base (Drive) Current Conditions

Two very important conditions, both of which must be satisfied, provide the key to reliable and efficient operation of a horizontal-deflection circuit. The first condition is complete collector saturation. This is accomplished by supplying sufficient "on" base (drive) current, I_{B_1}, to assure total saturation of the lowest-gain devices at end of scan current, I_{CM}, and yet not over-driving higher-gain devices. Component tolerances must also be taken into account while selecting I_{B_1}.

The second condition and possibly the most important is the removal of excessive carriers in the high-resistivity collector region at I_{CM} to eliminate dissipation from collector current fall-time "tailing". This is accomplished by selecting the proper amount of series base inductance, L_B, to slow down the decay of reverse-base current, sometimes referred to as di_{B_2}/dt, inherent in low-impedance circuits. This enables complete recombination of excess carriers in the collector region while current in the base region is still flowing.

The proper value for L_B can easily be determined from Figure 6 and 7 after I_{B_1}, I_{CM}, and transistor dc beta range at maximum collector, h_{FE}, have been established. Care should be taken to assure that the combination of a low I_{B_1} and high L_B does not cause the transistor to pull out of saturation before the unit is completely turned off causing dynamic saturation losses or that a high I_{B_1} and a low L_B does not cause high dissipation due to collector current turn-off "tailing".

Figures 5 and 6 show that, once I_{CM} has been established, a value for L_B and I_{B_1} can be selected, that will result in low dissipation and reliable operation for various ranges of h_{FE}/I_{B_1}. Once I_{B_1} has been selected, figure 10 may be used as a guide to determine the proper di_{B_2}/dt value over a range of collector current.

BU207, BU208, BU208A

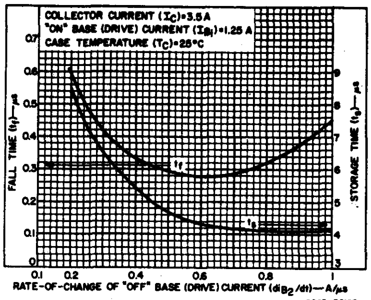


Fig. 7 — Typical fall time and storage time characteristics as a function of "off" base (drive) current (I_C = 3.5A).

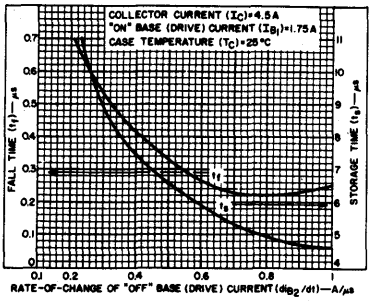


Fig. 8 — Typical fall time and storage time characteristics as a function of "off" base (drive) current (I_C = 4.5A).

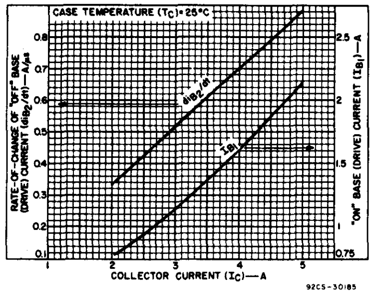


Fig. 9 — Typical "off" base and "on" base (drive) current as a function of collector current. See also "Guide for Optimizing 'ON' and 'OFF' Base (Drive) Current Conditions".

BUX16, BUX16A, BUX16B, BUX16C

High-Voltage, High-Power Silicon N-P-N Power Transistors

For Switching and Linear Applications in Industrial, and Commercial Equipment

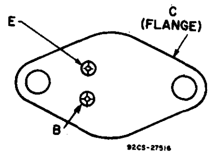
The RCA BUX16-series devices are multiple epitaxial silicon n-p-n power transistors employing a new overlay construction with several emitter sites. All devices employ the popular JEDEC TO-3 package; they differ in breakdown-voltage, leakage-current, and current-gain values.

The high breakdown-voltage ratings and exceptional second-breakdown capabilities of these transistors make them especially suitable for use in series regulators, power amplifiers, inverters, deflection circuits, switching regulators, and high-voltage bridge amplifiers.

Features:

- **High voltage ratings:** $V_{CER}(sus)$ up to 400 V, $R_{BE} \leq 50\ \Omega$; $V_{CEO}(sus)$ up to 350 V
- **High power dissipation rating:** P_T = 100 W at V_{CE} = 135 V, T_C = 25°C
- **For switching applications where circuit values and operating conditions require a transistor with a high second breakdown rating ($I_{S/b}$) (limit line begins at 135 V)**
- **Maximum area-of-operation curves for dc and pulse operation**

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BUX16	BUX16A	BUX16B	BUX16C	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	250	325	375	425	V
COLLECTOR-TO-EMITTER VOLTAGE:						
With base reverse-biased (V_{BE}) = −1.5 V	V_{CEV}	250	325	375	425	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER}(sus)$	225	300	350	400	V
With base open	$V_{CEO}(sus)$	200	250	300	350	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	V
CONTINUOUS COLLECTOR CURRENT	I_C	5	5	5	5	A
CONTINUOUS BASE CURRENT	I_B	2	2	2	2	A
TRANSISTOR DISSIPATION:						
At case temperatures up to 25°C and V_{CE} up to 135 V		100	100	100	100	W
At case temperatures up to 25°C and V_{CE} above 135 V		See Fig. 1				
At case temperatures above 25°C		Derate linearly to 200°C				
TEMPERATURE RANGE:						
Storage and operating (Junction)		−65 to 200				°C
PIN TEMPERATURE (During soldering):						
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	T_P	230				°C

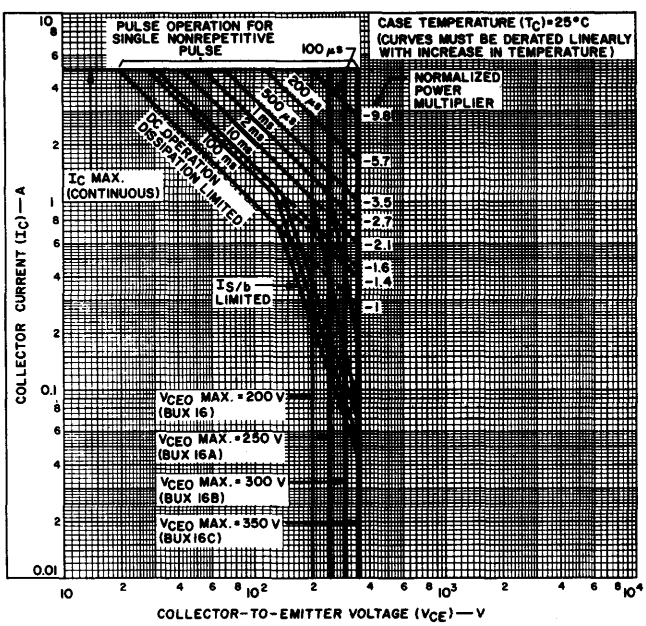


Fig. 1 — Maximum operating areas for all types.

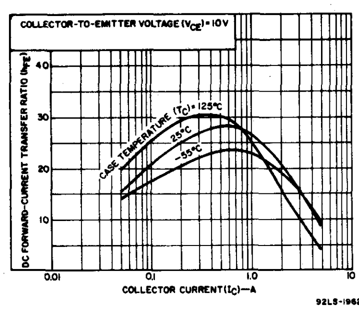


Fig. 2 — Typical dc beta vs. collector current for all types.

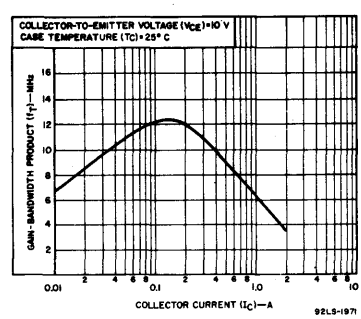


Fig. 3 — Typical gain-bandwidth product vs. collector current for all types.

BUX16, BUX16A, BUX16B, BUX16C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS								UNITS
		VOLTAGE V dc		CURRENT A dc		BUX16		BUX16A		BUX16B		BUX16C		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector Cutoff Current: With base reverse-biased	I_{CEV}	250 325 375 425	−1.5 −1.5 −1.5 −1.5	– – – –	– – – –	– – – –	5 – – –	– – – –	– 5 – –	– – – –	– – 2 –	– – – –	– – – 2	mA
With base reverse-biased T_C = 150°C	I_{CEV}	250	−1.5	–	–	–	8	–	8	–	3	–	3	mA
With base open	I_{CEO}	175 250	– –	– –	0 0	– –	5 –	– –	2 –	– –	– 5	– –	– 2	mA
Emitter Cutoff Current: V_{EB} = 5 V	I_{EBO}	–	–	0	–	–	5	–	5	–	2	–	2	mA
Collector-to-Emitter Sustaining Voltage[a] With base open	$V_{CEO}(sus)$	–	–	0.2	0	200	–	250	–	300	–	350	–	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER}(sus)$	–	–	0.2	–	225	–	300	–	350	–	400	–	V
Emitter-to-Base Voltage	V_{EBO}	–	–	0	0.02	6	–	6	–	6	–	6	–	V
DC Forward-Current Transfer Ratio	h_{FE}	10 10 10	– – –	0.4[b] 2[b] 4.5[b]	– – –	15 15 5	130 – –	15 15 5	130 – –	15 12 5	130 – –	15 12 5	130 – –	
Base-to-Emitter Voltage	V_{BE}	10	–	2[b]	–	–	3	–	3	–	3	–	3	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	– –	– –	2[b] 4.5[b]	0.25 1.125	– –	2.5 5	– –	2.5 5	– –	2.5 5	– –	2.5 5	V
Gain-Bandwidth Product	f_T	10	–	0.2	–	5	–	5	–	5	–	5	–	MHz
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio[c] (at 1 MHz)	$\|h_{fe}\|$	10	–	0.2	–	5	–	5	–	5	–	5	–	
Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio (at 1 kHz)	h_{fe}	10	–	4	–	20	–	20	–	20	–	20	–	
Output Capacitance (at 1 MHz): V_{CB} = 10 V, I_E = 0	C_{obo}	–	–	–	–	–	150	–	150	–	150	–	150	pF
Second-Breakdown Collector Current[d]: (With base forward-biased) Pulse duration (nonrepetitive) = 1 s	$I_{S/b}$	135	–	–	–	0.75	–	0.75	–	0.75	–	0.75	–	A
Second-Breakdown Energy[e]: (With base reverse-biased) L = 150 μH, R_{BE} = 50 Ω	$E_{S/b}$	–	−4	4	–	1.2	–	1.2	–	1.2	–	1.2	–	mJ
Thermal Resistance: Junction-to-case	$R_{\theta JC}$	–	–	–	–	–	1.75	–	1.75	–	1.75	–	1.75	°C/W

[a] *CAUTION:* Sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ *MUST NOT* be measured on a curve tracer.

[b] Pulsed, pulse duration ≤ 350 μs, duty factor = 2%.

[c] Measured at a frequency where $|h_{fe}|$ is decreasing at approximately 6 dB per octave.

[d] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased for transistor operation in the active region.

[e] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias connections. $E_{S/b}$ = ½ LI^2 where L is a series load or leakage inductance, and I is the peak collector current.

BUX16, BUX16A, BUX16B, BUX16C

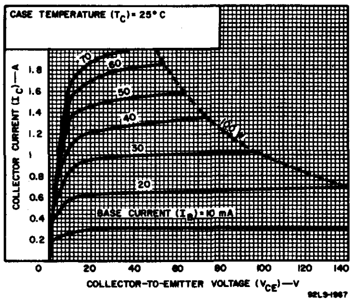


Fig. 4 – Typical output characteristics for all types.

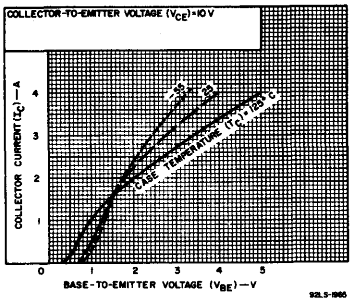


Fig. 5 – Typical transfer characteristics for all types.

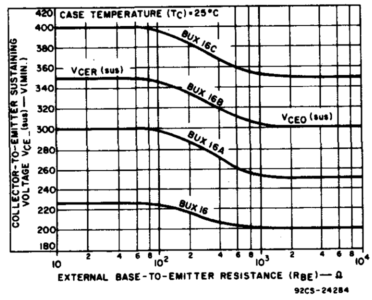


Fig. 6 – Sustaining voltage vs base-to-emitter resistance for all types.

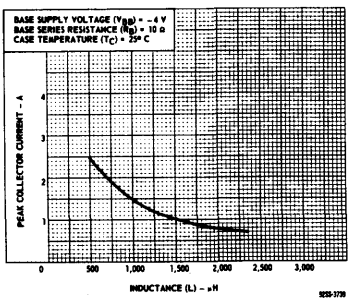


Fig. 7 – Typical reverse-bias, second-breakdown characteristic for all types.

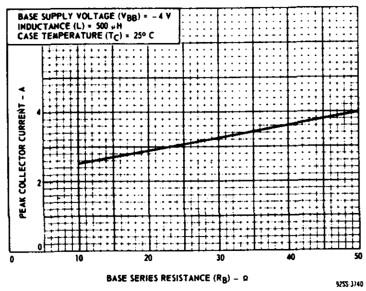


Fig. 8 – Typical reverse-bias, second-breakdown characteristic for all types.

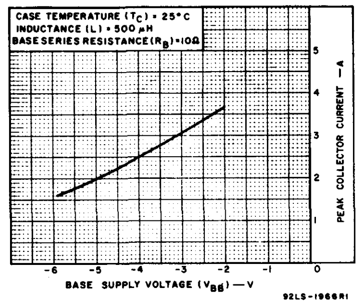


Fig. 9 – Typical reverse-bias, second-breakdown characteristic for all types.

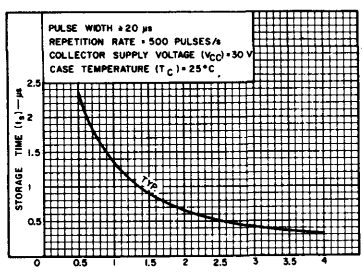


Fig. 10 – Saturated switching time (storage) vs. collector current for all types.

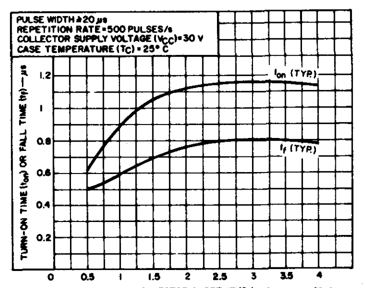


Fig. 11 – Saturated switching times (turn-on and fall) vs. collector current for all types.

BUX17, BUX17A, BUX17B, BUX17C

Silicon N-P-N Switching Transistors

For Switching Applications in Industrial and Commercial Equipment

The RCA-BUX17, BUX17A, BUX17B, and BUX17C are multiple epitaxial silicon n-p-n power transistors utilizing a multiple-emitter-site structure. Multiple-epitaxial construction maximizes the volt-ampere characteristic of the device and provides fast switching speeds. Multiple-emitter-site design assures uniform current flow throughout the structure, which produces a high $I_{S/b}$ and a large safe-operation area.

These devices use the popular JEDEC TO-3 package; they differ mainly in voltage ratings and leakage-current limits.

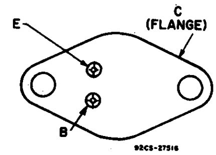
The exceptional second-breakdown capabilities and high voltage-breakdown ratings make these transistors especially suitable for off-line inverters, switching regulators, motor controls, and deflection-circuit applications.

The high breakdown voltages, low saturation voltages, and fast-switching capability of these devices make them especially suitable for inverter circuits operating directly off the rectified 115-V power line or in a bridge configuration operating from the rectified 220-V line.

Features:

- High voltage ratings:
  V_{CBO} = 250 V (BUX17)
  = 350 V (BUX17A)
  = 400 V (BUX17B)
  = 450 V (BUX17C)
- High dissipation rating: P_T = 150 W
- Low saturation voltages
- Maximum safe-area-of-operation curves

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BUX17	BUX17A	BUX17B	BUX17C	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	250	350	400	450	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With base open	$V_{CEO(sus)}$	150	250	300	350	V
With reverse bias (V_{BE}) = 0 V (with base-emitter shorted)	$V_{CEX(sus)}$	250	350	400	450	V
With external base-to-emitter resistance (R_{BE}) ≤ 50 Ω	$V_{CER(sus)}$	175	275	325	375	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	V
COLLECTOR CURRENT:						
Continuous	I_C	10	10	10	10	A
Peak	I_{CM}	30	30	30	30	A
CONTINUOUS BASE CURRENT	I_B	10	10	10	10	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C and V_{CE} up to 30 V		150	150	150	150	W
At case temperatures up to 25°C and V_{CE} above 30 V			See Fig. 1			
At case temperatures above 25°C			Derate linearly to 200°C			
TEMPERATURE RANGE:						
Storage & Operating (Junction)			−65 to +200			°C
PIN TEMPERATURE (During soldering):						
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.			230			°C

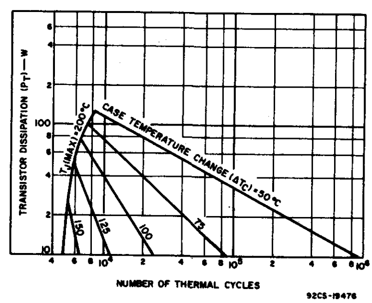


Fig. 2 — Thermal-cycling rating chart for all types.

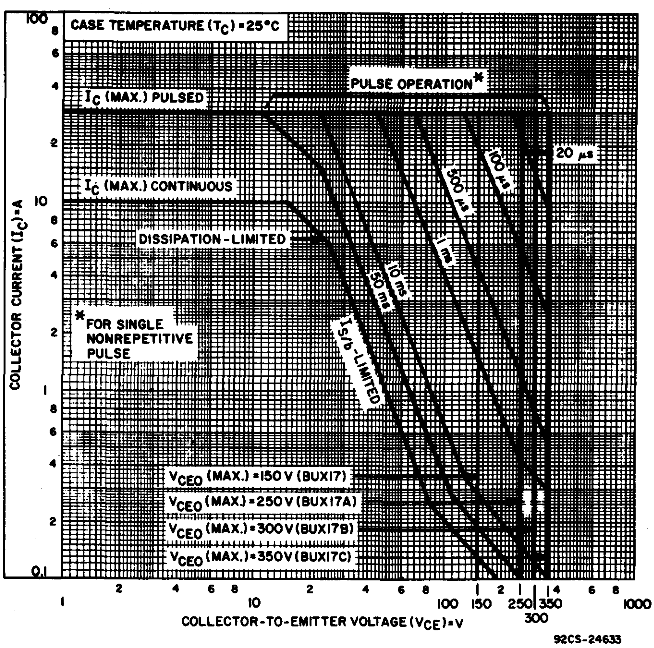


Fig. 1 — Maximum operating areas for all types.

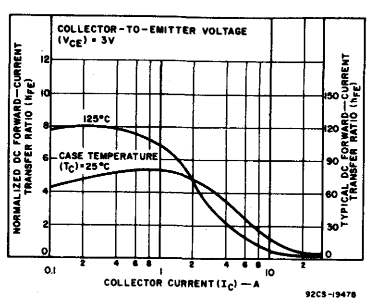


Fig. 3 — Typical normalized dc beta characteristics for all types.

BUX17, BUX17A, BUX17B, BUX17C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS				LIMITS								UNITS
		VOLTAGE V dc		CURRENT A dc		BUX17		BUX17A		BUX17B		BUX17C		
		V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 50 Ω	I_{CER}	175 275 325 375				– – – –	10 – – –	– – – –	– 10 – –	– – – –	– – 10 –	– – – –	– – – 10	mA
With base-emitter junction reverse-biased	I_{CEV}	250 350 400 450	–1.5 –1.5 –1.5 –1.5			– – – –	10 – – –	– – – –	– 10 – –	– – – –	– – 5 –	– – – –	– – – 5	mA
At T_C = 125°C		250 350 400 450	–1.5 –1.5 –1.5 –1.5			– – – –	20 – – –	– – – –	– 20 – –	– – – –	– – 10 –	– – – –	– – – 10	mA
Emitter Cutoff Current	I_{EBO}		–6	0		–	2	–	2	–	2	–	2	mA
DC Forward-Current Transfer Ratio	h_{FE}	3 3 3		4[a] 8 10[a]		20 – 7	– – –	20 – 7	– – –	15 7 –	– – –	15 7 –	– – –	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$			0.2[a]		150[b]	–	250[b]	–	300[b]	–	350[b]	–	V
With external base-to-emitter resistance (R_{BE}) = 50 Ω	$V_{CER}(sus)$			0.2[a]		175[b]	–	275[b]	–	325[b]	–	375[b]	–	V
Base-to-Emitter Voltage	V_{BE}	3 3		8[a] 10[a]		– –	– 4	– –	– 4	– –	3.5 –	– –	3.5 –	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			8[a] 10[a]	1.5 2	– –	– 3	– –	– 3	– –	2 –	– –	2 –	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			8[a] 10[a]	1.5 2	– –	– 2	– –	– 2	– –	3 –	– –	3 –	V
Magnitude of Common-Emitter, Small-Signal, Short-Circuit, Forward-Current Transfer Ratio: f = 1 MHz	$\|h_{fe}\|$	10		1		2.5	8	2.5	8	2	8	2.5	8	
Forward-bias Second Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	25				6	–	6	–	6	–	6	–	A
Second-Breakdown Energy: With base reverse-biased, and R_{BE} = 50 Ω, L = 40 μH	$E_{S/b}$		–4	10		2	–	2	–	2	–	2	–	mJ
Saturated Switching Time (V_{CC}= 200 V, I_{B1} = I_{B2}): Turn-on (t_d + t_r)	t_{ON}			8 10	1.5 2	– –	– 2	– –	– 2	– –	2 –	– –	2 –	μs
Storage	t_s			8 10	1.5 2	– –	– 3.5	– –	– 3.5	– –	3.5 –	– –	3.5 –	μs
Fall	t_f			8 10	1.5 2	– –	– 1	– –	– 1	–	1	–	1	μs
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	1.17	–	1.17	–	1.17	–	1.17	°C/W

[a]Pulsed; pulse duration ≤ 350 μs, duty factor = 2%.

[b]CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer.

BUX17, BUX17A, BUX17B, BUX17C

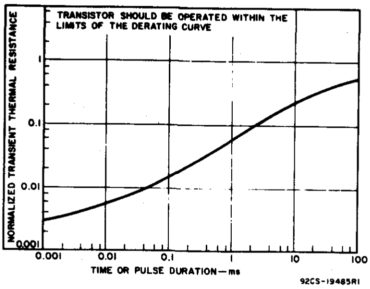


Fig. 4 – Typical thermal response characteristics for all types.

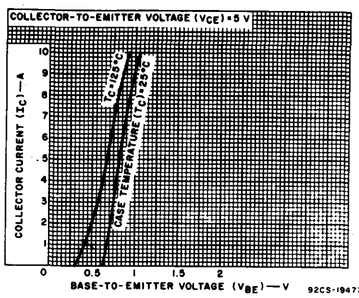


Fig. 5 – Typical transfer characteristics for all types.

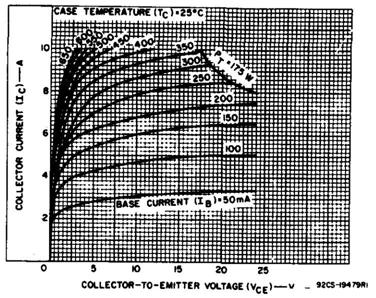


Fig. 6 – Typical output characteristics for all types.

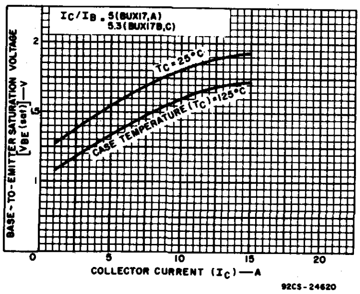


Fig. 7 – Typical base-to-emitter saturation-voltage characteristics for all types.

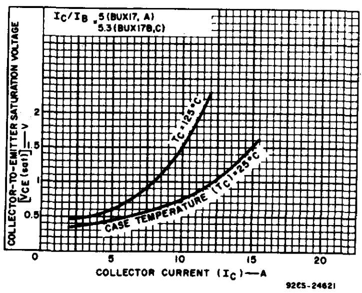


Fig. 8 – Typical collector-to-emitter saturation-voltage characteristics for all types.

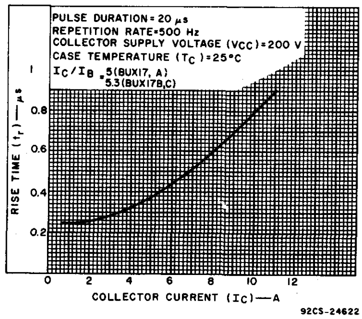


Fig. 9 – Typical rise-time characteristics for all types.

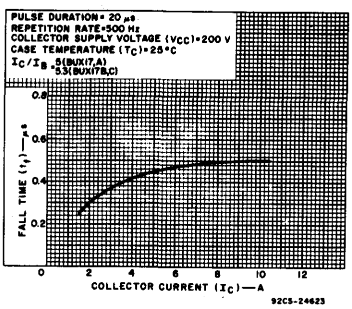


Fig. 10 – Typical fall-time characteristic for all types.

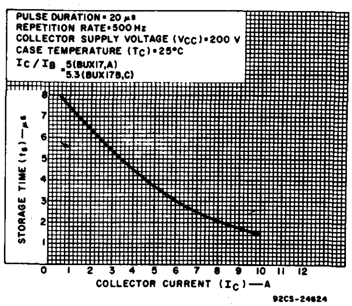


Fig. 12 – Typical inductive- and resistive-load fall-time characteristics for all types.

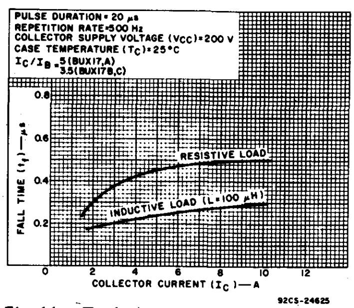


Fig. 11 – Typical storage-time characteristics for all types (with constant forced gain).

BUX18, BUX18A, BUX18B, BUX18C

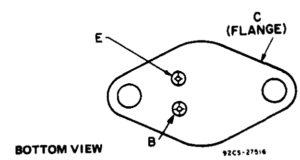
High-Voltage, High-Current Silicon N-P-N Power-Switching Transistors

For Off-Line Switching Applications

Features:

- Fast switching speed
- Hermetic steel package—JEDEC TO-3
- Epitaxial pi-nu construction

TERMINAL DESIGNATIONS



JEDEC TO-3

The RCA-BUX18, BUX18A, BUX18B, and BUX18C are epitaxial silicon n-p-n power-switching transistors with pi-nu construction. They are intended for use in off-line power supplies and for other applications in which a combination of high-current-handling capability, ruggedness, and fast switching speed is required. The devices are hermetically sealed in a steel JEDEC TO-3 package, and differ from each other in collector voltage ratings.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		BUX18	BUX18A	BUX18B	BUX18C	
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGES:						
With reverse bias, $V_{BE} = -1.5$ V	$V_{CEV}(sus)$	300	450	600	750	
With external base-to-emitter resistance ($R_{BE} = 100\Omega$)	$V_{CER}(sus)$	250	325	375	425	V
With base open	$V_{CEO}(sus)$	200	275	325	375	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	6	6	6	V
CONTINUOUS COLLECTOR CURRENT	I_C	8	8	8	8	A
PEAK COLLECTOR CURRENT	I_{CM}	12	12	12	12	A
CONTINUOUS BASE CURRENT	I_B	2	2	2	2	A
PEAK BASE CURRENT	I_{BM}	3	3	3	3	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		120	120	120	120	W
At case temperatures above 25°C		Derate linearly at 0.68 W/°C				°C
TEMPERATURE RANGE:						
Storage and Operating (Junction)		−65 to +200				°C
LEAD TEMPERATURE (During Soldering):						
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		235				°C

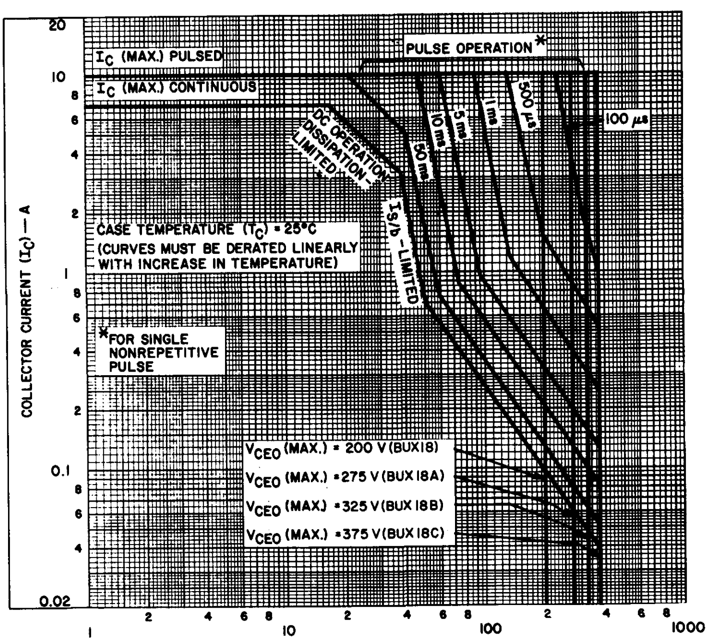


Fig. 1 – Maximum operating areas for all types.

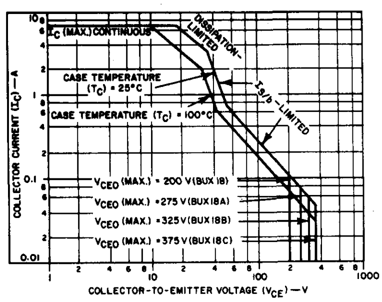


Fig. 2 – Maximum operating areas for all types at 25°C and 100°C.

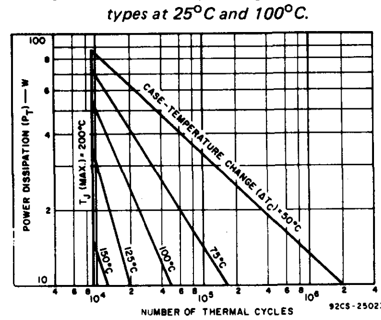


Fig. 3 – Thermal-cycling rating chart for all types.

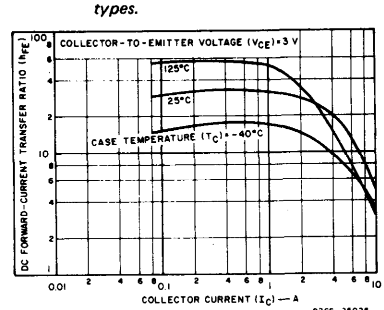


Fig. 4 – Typical dc beta characteristic for all types.

BUX18, BUX18A, BUX18B, BUX18C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CE}	VOLTAGE V dc V_{BE}	CURRENT A dc I_C	CURRENT A dc I_B	LIMITS: BUX18 Min.	BUX18 Max.	BUX18A Min.	BUX18A Max.	BUX18B Min.	BUX18B Max.	BUX18C Min.	BUX18C Max.	UNITS
Collector Cutoff Current: With external base-to-emitter resistance (R_{BE}) = 100 Ω	I_{CER}	200 275 325 400				– – – –	3 – – –	– – – –	– 3 – –	– – – –	– – 3 –	– – – –	– – – 3	mA
With base-to-emitter junction reverse-biased	I_{CEV}	300 450 600 750	−1.5 −1.5 −1.5 −1.5			– – – –	0.5 – – –	– – – –	– 0.5 – –	– – – –	– – 0.5 –	– – – –	– – – 0.5	mA
With base-to-emitter junction reverse-biased, and T_C = 100°C	I_{CEV}	300 450 600 750	−1.5 −1.5 −1.5 −1.5			– – – –	10 – – –	– – – –	– 10 – –	– – – –	– – 10 –	– – – –	– – – 10	mA
Emitter Cutoff Current	I_{EBO}		−6	0		–	3	–	3	–	3	–	3	mA
Emitter Cutoff Voltage	V_{EBO}			0	0.003	6	–	6	–	6	–	6	–	V
DC Forward-Current Transfer Ratio	h_{FE}	3 3 3 5		4[a] 5[a] 6[a] 1[a]		– – 7 15	– – – 100	– 7 – 15	– – – 100	10 – – 15	– – – 100	10 – – 15	– – – 100	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			0.2	0	200[b]	–	275[b]	–	325[b]	–	375[b]	–	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$			0.2		250[b]	–	325[b]	–	375[b]	–	425[b]	–	V
Forward-Biased Second-Breakdown Collector Current: t = 1 s, nonrepetitive	$I_{S/b}$	38 200				3.16 0.1	– –	3.16 0.1	– –	3.16 0.1	– –	3.16 0.1	– –	A
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$			6[a] 5[a] 4[a]	1.2 1 0.8	– – –	2.5 – –	– – –	– 2.5 –	– – –	– – 2.5	– – –	– – 2.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			6[a] 5[a] 4[a]	1.2 1 0.8	– – –	1.5 – –	– – –	– 1.5 –	– – –	– – 1.5	– – –	– – 1.5	V
Reverse-Bias Second-Breakdown Energy: R_{BE} = 3 kΩ, L = 40 μH	$E_{S/b}$		−1.5	3		180	–	180	–	180	—	180	–	mJ
Saturated Switching Time (I_{B1} = I_{B2}): Storage	t_s	V_{CC}= 200 V		4	0.8	–	2	–	2	–	2	–	2	μs
Fall	t_f	V_{CC} = 200 V		4	0.8	–	0.6	–	0.6	–	0.6	–	0.6	μs
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$					–	1.46	–	1.46	–	1.46	–	1.46	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽2%.

[b] CAUTION: Sustaining Voltages V_{CEO}(sus) and V_{CER}(sus), MUST NOT be measured on a curve tracer.

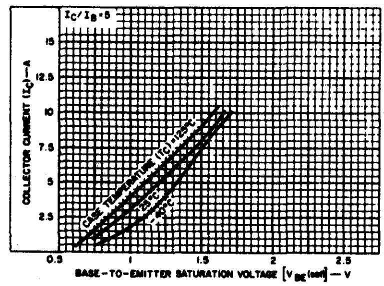


Fig. 5 — Typical collector-to-emitter saturation-voltage characteristics for all types.

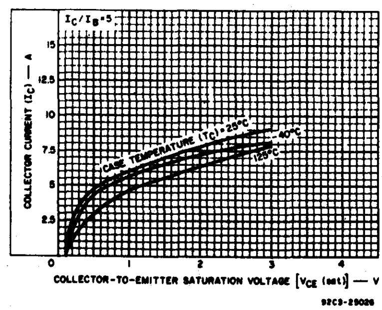


Fig. 6 — Typical base-to-emitter saturation-voltage characteristics for all types.

BUX66, BUX66A, BUX66B, BUX66C, BUX67, BUX67A, BUX67B, BUX67C
High-Voltage Silicon N-P-N and P-N-P Transistors

For High-Speed Switching and Linear-Amplifier Applications

The RCA-BUX66-series types are silicon p-n-p transistors; the RCA-BUX67-series types are silicon n-p-n transistors. All of these devices feature high breakdown voltage and fast switching speeds. They are intended for a wide variety of applications in ac/dc commercial equipment.

Typical applications include high-voltage operational and linear amplifiers, high-voltage switches, switching regulators, converters, and inverters.

The BUX66, BUX66A, BUX66B, and BUX66C are p-n-p complements to the n-p-n types BUX67, BUX67A, BUX67B, and BUX67C. All are supplied in the JEDEC TO-66 hermetic package.

Features:

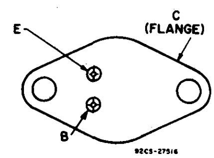
- **High voltage ratings:**
- **Large safe-operating area**
- **Thermal-cycling rating**
- **100-percent tested to assure freedom from second breakdown in both forward- and reverse-bias conditions when operated within specified limits**
- **Economy types for ac/dc circuits**
- **Fast turn-on time at high collector current**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX66♦ BUX67	BUX66A♦ BUX67A	BUX66B♦ BUX67B	BUX66C♦ BUX67C	
V_{CBO}	200	300	350	400	V
V_{CEV}(sus) V_{BE} = −1.5 V	200	300	350	400	V
V_{CER}(sus) R_{BE} = 100 Ω	175	275	325	375	V
V_{CEO}(sus)	150	250	300	350	V
V_{EBO}	6	6	6	6	V
I_C	2	2	2	2	A
I_{CM}	5	5	5	5	A
I_B	1	1	1	1	A
P_T					
Up to 25°C	35	35	35	35	W
Above 25°C, Derate linearly	0.2	0.2	0.2	0.2	W/°C
T_J, T_{stg}	−65 to 200				°C
T_L At distance 1/16 in. (1.58 mm) from seating plane for 10 s max.	235	235	235	235	°C

♦For p-n-p devices, voltage and current values are negative.

TERMINAL DESIGNATIONS



JEDEC TO-66

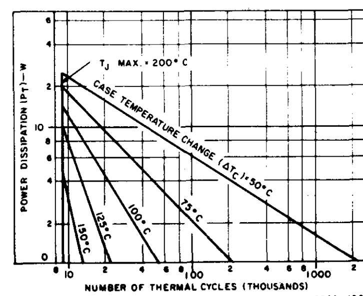


Fig. 1 — Thermal-cycling rating chart for BUX66-series types.

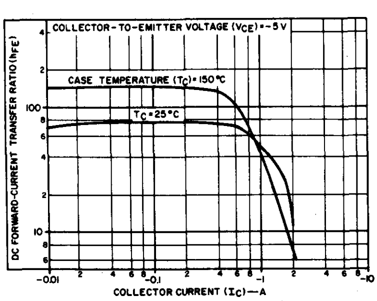


Fig. 2 — Typical dc beta characteristics for BUX66-series types.

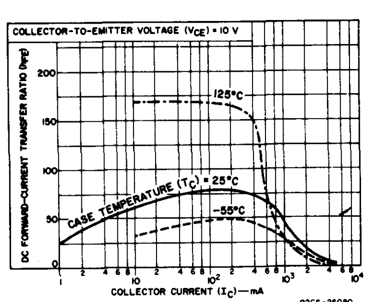


Fig. 3 — Typical dc beta characteristics for BUX67-series types.

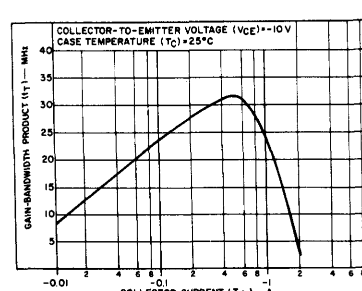


Fig. 4 — Typical gain-bandwidth product for BUX66-series types.

BUX66, BUX66A, BUX66B, BUX66C, BUX67, BUX67A, BUX67B, BUX67C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS♦ VOLTAGE V dc		CURRENT A dc		LIMITS BUX66♦ BUX67		BUX66A♦ BUX67A		BUX66B♦ BUX67B		BUX66C♦ BUX67C		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}	150			0	–	10	–	10	–	–5	–	–5	
I_{CEX}	200	–1.5			–	8	–	–	–	–	–	–	
	300	–1.5			–	–	–	8	–	–	–	–	
	350	–1.5			–	–	–	–	–	–8	–	–	
	400	–1.5			–	–	–	–	–	–	–	–8	mA
T_C = 100°C	200	–1.5			–	10	–	–					
	300	–1.5			–	–	–	10					
	350	–1.5			–	10	–	–	–	–10	–	–	
	400	–1.5			–	–	–	10	–	–	–	–10	
I_{EBO}		–6	0		–	1	–	1	–	1	–	1	mA
h_{FE}	5		1[a]		10	150	10	150	10	150	10	150	
$V_{CEO(sus)}$			0.2[a]	0	150[c]	–	250[c]	–	–300[c]	–	–350[c]	–	
$V_{CER(sus)}$ R_{BE} = 50 Ω			0.2		175[c]	–	275[c]	–	–325[c]	–	–375[c]	–	V
$V_{BE(sat)}$			1[a]	0.15	–	1.5	–	1.5	–	–1.5	–	–1.5	V
$V_{CE(sat)}$			1[a]	0.15	–	2.5	–	2.5	–	–2.5	–	–2.5	V
C_{obo} V_{CB} = 10 V, f = 1 MHz, BUX67 Types			0		–	120	–	120	–	220	–	220	pF
BUX66 Types			0		–	200	–	200	–	220	–	220	
$I_{S/b}$ t = 1 s, nonrep.	40				875	–	875	–	–875	–	–875	–	mA
$E_{S/b}$ L = 100 µH, R_{BE} = 20 Ω		–4			50	–	200	–	200	–	50	–	µJ
$\|h_{fe}\|$ f = 5 MHz, BUX67 Types	10		0.2		2	–	2	–	2	–	2	–	
BUX66 Types	–10		–0.2		4	–	4	–	4	–	4	–	
t_r V_{CC} = 200 V, BUX67 Types			1	0.1[b]	–	3	–	3	–	3	–	3	
BUX66 Types			–1	–0.10[b]	–	0.6	–	0.6	–	0.6	–	0.6	
t_s V_{CC} = 200 V, BUX67 Types			1	0.1[b]	–	4	–	4	–	4	–	4	µs
BUX66 Types			–1	–0.10[b]	–	2.5	–	2.5	–	2.5	–	2.5	
t_f V_{CC} = 200 V, BUX67 Types			1	0.1[b]	–	3	–	3	–	3	–	3	
BUX66 Types			–1	–0.10[b]	–	0.6	–	0.6	–	0.6	–	0.6	
$R_{\theta JC}$						5	–	5	–	5	–	5	°C/W

[a] Pulsed: Pulse duration = 300 µs; duty factor ≤ 2%. [b] $I_{B1} = I_{B2}$ ♦For p-n-p devices, voltage and current values are negative.

[c] Sustaining voltages, $V_{CEO(sus)}$ and $V_{CER(sus)}$ MUST NOT be measured on a curve tracer.

BUX66, BUX66A, BUX66B, BUX66C, BUX67, BUX67A, BUX67B, BUX67C

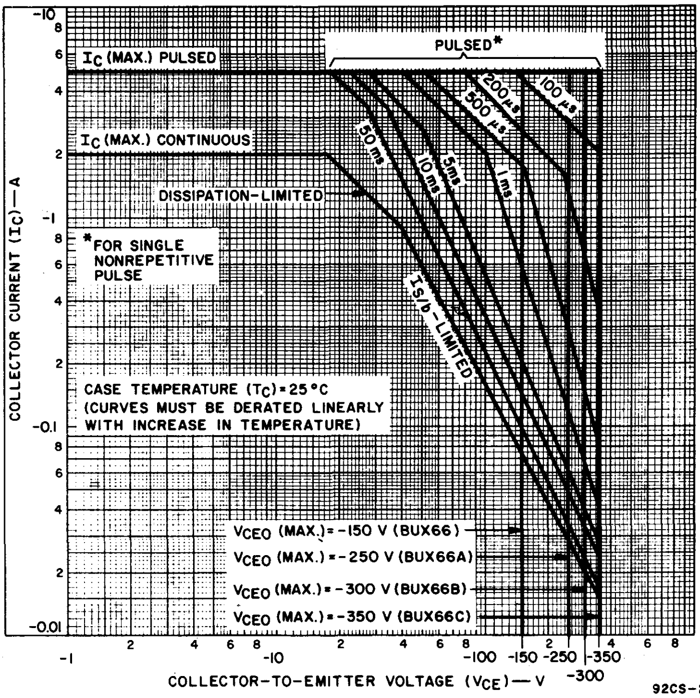


Fig. 5 – Maximum operating areas for BUX66-series types.

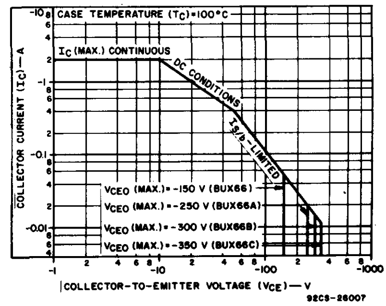


Fig. 7 – Maximum operating areas for BUX66-series at $T_C = 100°C$.

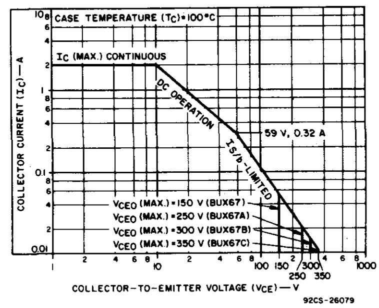


Fig. 8 – Maximum operating areas for BUX67-series at $T_C = 100°C$.

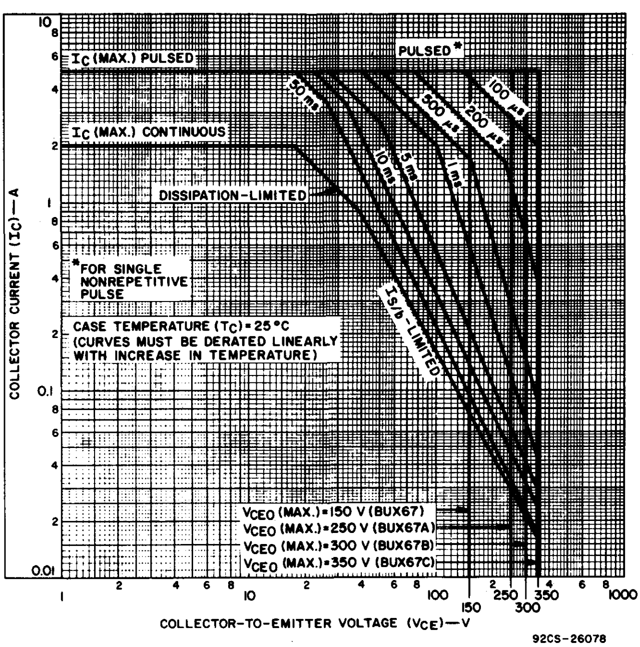


Fig. 6 – Maximum operating areas for BUX67-series types at $T_C = 25°C$.

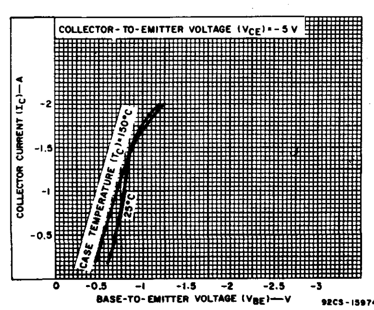


Fig. 9 – Typical transfer characteristics for BUX66-series types.

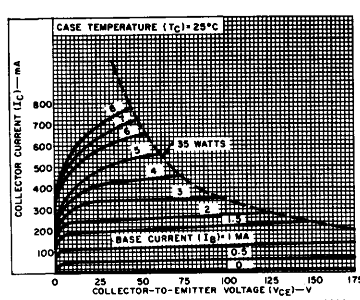


Fig. 10 – Typical output characteristics for BUX67-series types.

BUX66, BUX66A, BUX66B, BUX66C, BUX67, BUX67A, BUX67B, BUX67C

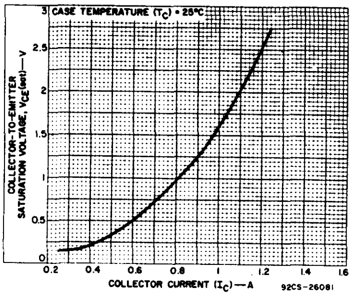


Fig. 11 – Typical saturation-voltage characteristic for BUX67-series types.

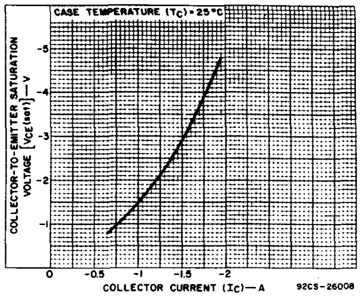


Fig. 12 – Typical saturation-voltage characteristic for BUX66-series types.

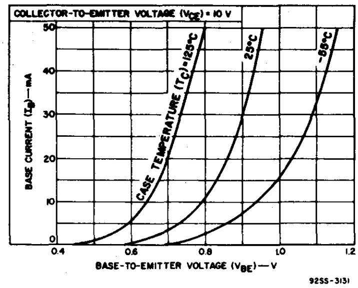


Fig. 13 – Typical input characteristics for BUX67-series types.

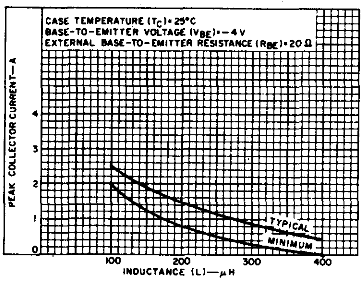


Fig. 14 – Reverse-bias second-breakdown characteristics for BUX67-series types.

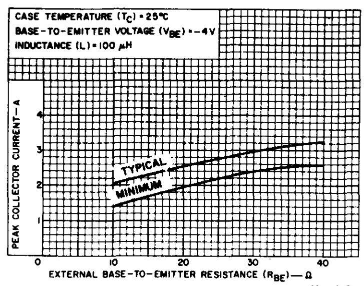


Fig. 15 – Reverse-bias second-breakdown characteristics for BUX67-series types.

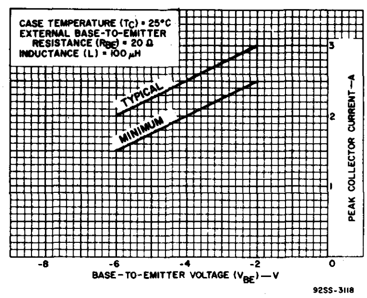


Fig. 16 – Reverse-bias second-breakdown characteristics for BUX67-series types.

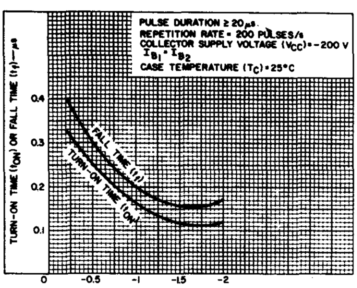


Fig. 17 – Typical turn-on time and fall-time characteristics for BUX66-series types.

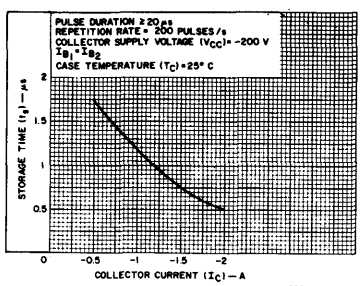


Fig. 18 – Typical storage-time characteristic for BUX66-series types.

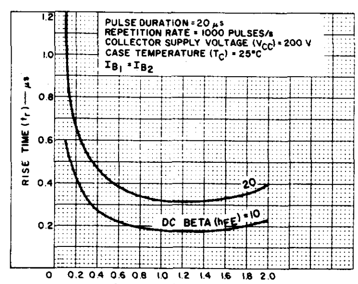


Fig. 19 – Typical rise time vs. collector current for BUX67-series types.

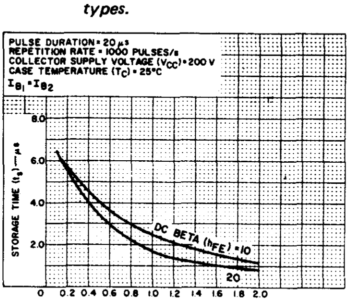


Fig. 20 – Typical storage time vs. collector current for BUX67-series types.

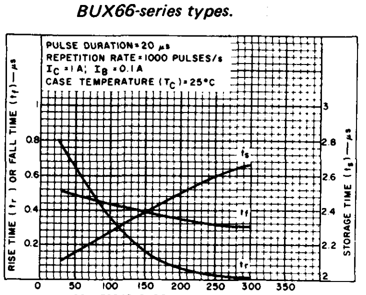


Fig. 21 – Typical rise time, fall time, and storage time vs. collector supply voltage for BUX67-series types.

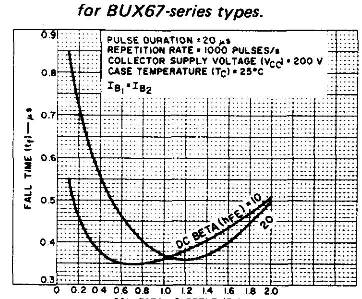


Fig. 22 – Typical fall time vs. collector current for BUX67-series types.

MJ15001, MJ15002

Complementary N-P-N/P-N-P Silicon Power Transistors

Rugged Devices, Broadly Applicable For Industrial and Commercial Use

The RCA-MJ15001 and MJ15002 are ballasted epitaxial-base silicon transistors featuring high gain at high current. The MJ15001 n-p-n transistor complements the MJ15002 p-n-p transistor. These types are supplied in the JEDEC TO-204MA packages.

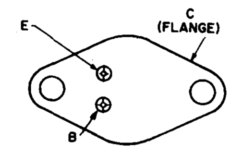
Features:

- **High-dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **f_T = 2 MHz**
- **High gain at high current**

Applications:

- ***Series and shunt regulators***
- **High-fidelity amplifiers**
- **Power-switching circuits**
- ***Solenoid drivers***

TERMINAL DESIGNATIONS



JEDEC TO-204MA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	MJ15001	MJ15002	
V_{CBO}	140	−140	V
V_{CEO}	140	−140	V
V_{EBO}	5	−5	V
I_C	15	−15	A
I_B	5	−5	A
I_E	20	−20	A
P_T			
At $T_C \geqslant 25°$	200	−200	W
At $T_C > 25°C$	1.14		W/°C
T_{stg}, T_J	−65 to 200		°C
T_L			
At distance ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230		°C

ELECTRICAL CHARACTERISTICS, at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTICS	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		MJ15001		MJ15002		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEX}	140	1.5			–	1	–	−1	mA
T_C = 150°C	140	1.5			–	2	–	−2	mA
I_{CEO}	140			0	–	2.5	–	−2.5	mA
I_{EBO}		5	0		–	1	–	−1	mA
$V_{CEO}(sus)^a$			0.2	0	140	–	−140	–	V
h_{FE}^a	2		4		25	150	25	150	
V_{BE}	2		4		–	2	–	−2	V
$V_{CE}(sat)$			4	0.4	–	1	–	−1	V
f_T f = 0.5 MHz	10		0.5		2	–	2	–	MHz
$I_{S/b}$ tp · 1s	40 100				5 0.5	– –	−5 −0.5	– –	A
C_{ob} V_{CB} = 10 V f = 1 MHz					–	1000	–	1000	pF
$R_{\theta JC}$					–	0.875	–	0.875	°C/W

[a] CAUTION: Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.

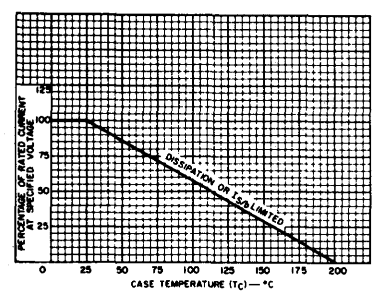


Fig. 1 — Current derating curve for both types.

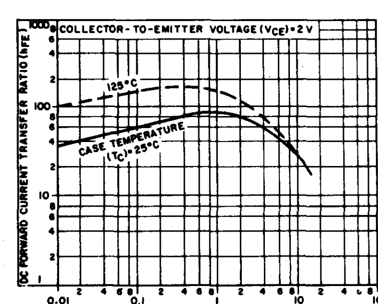


Fig. 2 — Typical dc beta characteristics as a function of collector current for MJ15001.

MJ15001, MJ15002

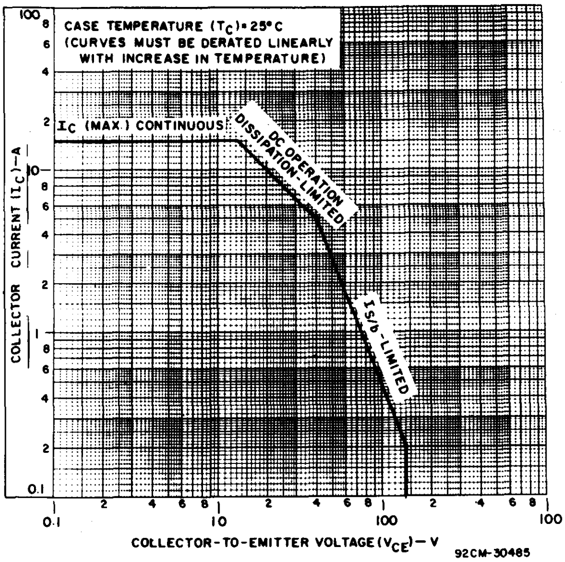


Fig. 3 — Maximum operating area for both types.

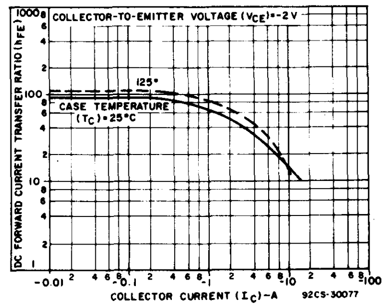


Fig. 4 — Typical dc beta characteristics as a function of collector current for MJ15002.

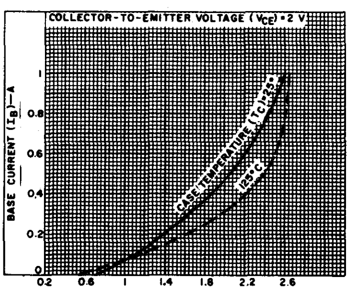


Fig. 5 — Typical input characteristics for MJ15001.

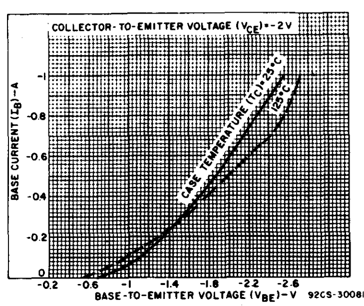


Fig. 6 — Typical input characteristics for MJ15002.

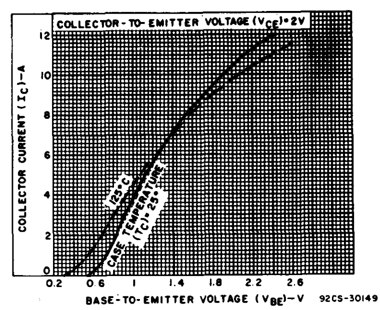


Fig. 7 — Typical transfer characteristics for MJ15001.

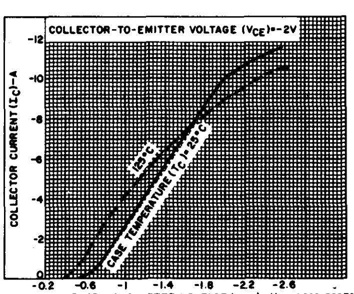


Fig. 8 — Typical transfer characteristics for MJ15002.

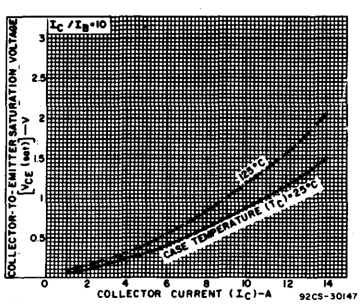


Fig. 9 — Typical saturation voltage characteristics for MJ15001.

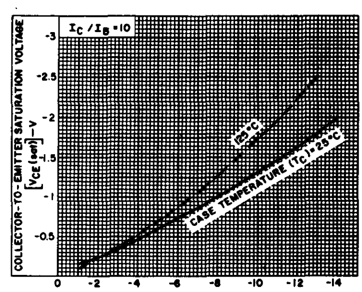


Fig. 10 — Typical saturation voltage characteristics for MJ15002.

MJ15003, RCA3773, RCA8638C, RCA8638D, RCA8638E

Silicon N-P-N Epitaxial-Base High-Power Transistors

Rugged Devices, Broadly Applicable For Industrial and Commercial Use

The RCA3773, MJ15003, RCA8638C, RCA-8638D, and RCA8638E are ballasted epi-taxial-base silicon n-p-n transistors featuring high gain at high current. They may be used as complements to the p-n-p types 2N6609, MJ15004, RCA9116C, RCA9116D, and RCA-9116E, respectively.

They differ in voltage ratings and in the currents at which the parameters are controlled. All are supplied in the steel JEDEC TO-204MA packages.

Features:

- **High-dissipation capability**
- **Low saturation voltages**
- **Maximum safe-area-of-operation curves**
- **f_T = 2 MHz**
- **High gain at high current**

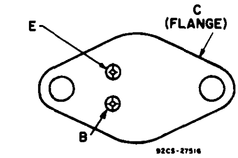
Applications:

- **Series and shunt regulators**
- **High-fidelity amplifiers**
- **Power-switching circuits**
- **Solenoid drivers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA3773	MJ15003	RCA8638C	RCA8638D	RCA8638E	
V_{CBO}	160	140	140	120	100	V
$V_{CEX}(sus)$ V_{BE} = −1.5 V; R_{BE} = 100 Ω	160	–	–	–	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω	150	150	150	130	110	V
$V_{CEO}(sus)$	140	140	140	120	100	V
V_{EBO}	7	—	5	—	—	V
I_C	—	—	20	—	—	A
I_B	—	—	5	—	—	A
P_T At $T_C \leq 25°C$	150	250	200	200	200	W
At $T_C > 25°C$ Derate linearly	0.857	1.43	—	1.14	—	W/°C
T_{stg}, T_J	—	—	−65 to 200	—	—	°C
T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	—	—	230	—	—	°C

TERMINAL DESIGNATIONS



JEDEC TO-204MA

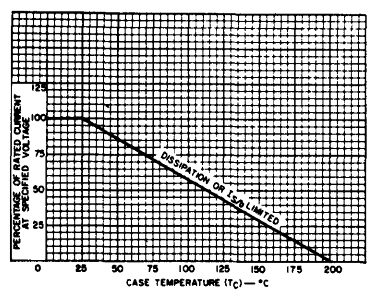


Fig. 2 – Current derating curve for all types.

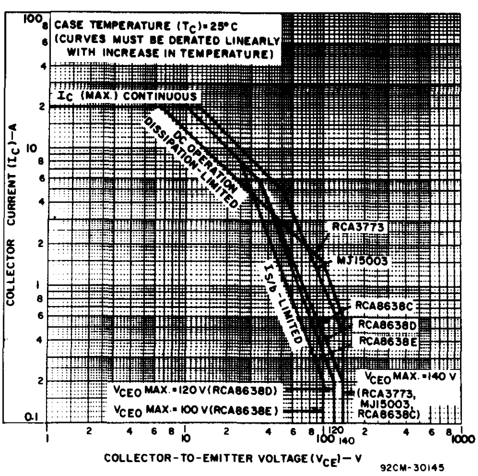


Fig. 1 – Maximum operating areas for all types.

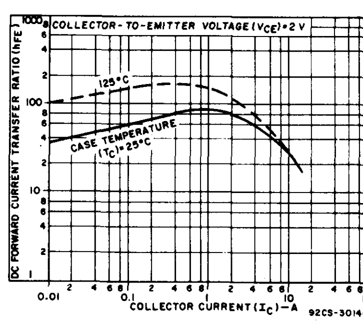


Fig. 3 – Typical dc beta characteristics as a function of collector current for all types.

MJ15003, RCA3773, RCA8638C, RCA8638D, RCA8638E

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified (Cont'd)*

CHARACTERISTIC	TEST CONDITIONS			LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc	RCA8638C		RCA8638D		RCA8638E		
	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO}	140[a]			–	1	–	–	–	–	
	120[a]			–	–	–	1	–	–	
	100[a]			–	–	–	–	–	1	
I_{CEX}	140	1.5		–	1	–	–	–	–	
	120	1.5		–	–	–	1	–	–	
I_{CEX} T_C = 150°C	140	1.5		–	5	–	–	–	–	
	120	1.5		–	–	–	5	–	–	mA
I_{CEO} I_B = 0	70			–	1	–	–	–	–	
	60			–	–	–	1	–	–	
I_{EBO}	5			–	1	–	1	–	1	
h_{FE}	2		5[c]	25	150	25	150	–	–	
	2		7.5[c]	–	–	–	–	10	100	
	2		10[c]	10	–	10	–	–	–	
V_{CER}(sus)[b] $R_{BE} \leq 100\Omega$			0.2	150	–	130	–	110	–	
V_{CEO}(sus)[b]			0.2	140	–	120	–	100	–	
V_{EBO} I_E = 1 mA			0	5	–	5	–	5	–	V
V_{BE}	2		7.5[c]	–	–	–	–	–	3	
	2		5[c]	–	2	–	2	–	–	
V_{CE}(sat) I_B = 0.75A			7.5[c]	–	–	–	–	–	1.5	
= 0.5A			5[c]	–	1	–	1	–	–	
$I_{S/b}$ t_p = 1 s nonrep.	35			5.71	–	5.71	–	–	–	A
	25			–	–	–	–	8	–	
$\|h_{fe}\|$ f = 0.5 MHz	10		0.5	4	–	4	–	4	–	
f_T				2	–	2	–	2	–	MHz
C_{ob} f = 0.1 MHz	10[a]			–	500	–	500	–	500	pF
$R_{\theta JC}$	10		10	–	0.875	–	0.875	–	0.875	°C/W

[a] V_{CB}

[b] **CAUTION**: Sustaining voltages V_{CEX}(sus), V_{CER}(sus), and V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.

[c] Pulsed; pulse duration = 300 μs, duty factor = 1.8%.

MJ15003, RCA3773, RCA8638C, RCA8638D, RCA8638E

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		CURRENT A dc	LIMITS: RCA3773		LIMITS: MJ15003		UNITS
	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	
I_{CBO}	160[a] 140[a]			– –	4 2	– –	– 1	mA
I_{CEX}	140	−1.5		–	1	–	0.1	mA
I_{CEX} T_C = 150°C	140	−1.5		–	5	–	2	mA
I_{CEO} I_B = 0	140 120			– –	– 1	– –	0.25 –	mA
I_{EBO}	7 5			– –	1 –	– –	– 0.1	mA
h_{FE}	4 4 2 2		8[c] 16[c] 5[c] 10[c]	15 5 – –	60 – – –	– – 25 10	– – 150 –	
$V_{CEX}(sus)$[b] R_{BE} = 100Ω		−1.5	0.2	160	–	–	–	V
$V_{CER}(sus)$[b] $R_{BE} \leqslant$ 100Ω			0.2	150	–	150	–	V
$V_{CEO}(sus)$[b]			0.2	140	–	140	–	V
V_{EBO} I_E = 1 mA			0	7	–	5[d]	–	V
V_{BE}	4 2		8[c] 5[c]	– –	2.2 –	– –	– 2	V
$V_{CE}(sat)$ I_B = 3.2A = 0.8A = 0.5A			16[c] 8[c] 5[c]	– – –	4 1.4 –	– – –	– – 1	V
$I_{S/b}$ t_p = 1 s nonrep.	100 50			1.5 –	– –	1 5	– –	A
$\|h_{fe}\|$ f = 0.5 MHz	10		0.5	4	–	4	–	
f_T				2	–	2	–	MHz
h_{fe} f = 1 kHz	4		1	40	–	–	–	
C_{ob} f = 0.1 MHz	10[a]			–	500	–	500	pF
$R_{\theta JC}$	10		10	–	1.17	–	0.7	°C/W

[a] V_{CB}

[b] **CAUTION**: Sustaining voltages $V_{CEX}(sus)$, $V_{CER}(sus)$, and $V_{CEO}(sus)$ *MUST NOT* be measured on a curve tracer.

[c] Pulsed; pulse duration = 300 μs, duty factor = 1.8%.

[d] Measured at I_E = −0.1 mA.

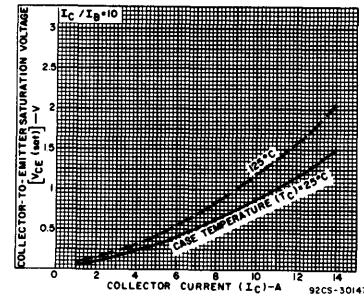


Fig. 4 – Typical saturation voltage characteristics for all types.

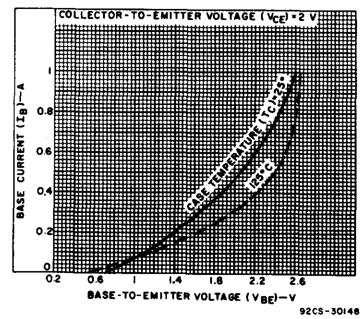


Fig. 5 – Typical input characteristics for all types.

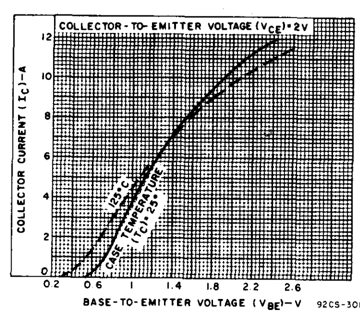


Fig. 6 – Typical transfer characteristics for all types.

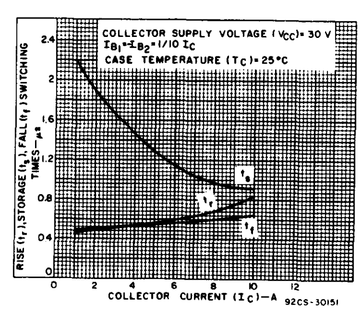


Fig. 7 – Typical saturated-switching times for all types.

RCA1A01–RCA1A11, RCA1A15–RCA1A19

Silicon Transistors for Audio-Frequency Linear-Amplifier Applications

"RCA1A-Series" n-p-n and p-n-p silicon transistors are especially characterized for audio-amplifier applications. They are particularly useful as input devices, V_{BE} multipliers for biasing, current sources, load-line-limiting (protection) circuits, predrivers, and in some instances as complementary drivers. Other applications for these devices include audio power amplifiers, linear modulators, servo amplifiers, and operational amplifiers. The units are supplied in the JEDEC TO-39 package.

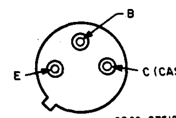
N-P-N TYPES

RCA1A01 RCA1A11
RCA1A03 RCA1A15
RCA1A06 RCA1A17
RCA1A07 RCA1A18
RCA1A09

P-N-P TYPES

RCA1A02 RCA1A10
RCA1A04 RCA1A16
RCA1A05 RCA1A19
RCA1A08

TERMINAL DESIGNATIONS



92CS-27512

JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*		RCA1A01	RCA1A02	RCA1A03	RCA1A04	RCA1A05	RCA1A06	RCA1A07	RCA1A08	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	–	–	95	–95	–75	75	50	–50	V
COLLECTOR-TO-EMITTER VOLTAGE:										
With base open	V_{CEO}	70	–50	–	–	–	–	40	–40	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	–	–	95	–95	–75	75	50•	–50▲	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	–4	4	–4	–4	4	3	–5	V
COLLECTOR CURRENT	I_C	1	–1	2	–2	–1	1	1	–1	A
BASE CURRENT	I_B	0.5	–0.5	1	–1	–0.5	0.5	0.05	–0.05	A
TRANSISTOR DISSIPATION:	P_T									
At case temperatures up to 25°C		5	7	10	10	5	5	5	7	W
At case temperatures above 25°C		← See Fig. 1 →								
TEMPERATURE RANGE:										
Storage & Operating (Junction)		← –65 to +200 →								°C
PIN TEMPERATURE (During Soldering):										
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		← 230 →								°C

•R_{BE} = 10 Ω ▲R_{BE} = 300 Ω

MAXIMUM RATINGS, *Absolute-Maximum Values:*		RCA1A09	RCA1A10	RCA1A11	RCA1A15	RCA1A16	RCA1A17	RCA1A18	RCA1A19	
COLLECTOR-TO-EMITTER VOLTAGE:										
With base open	V_{CEO}	175	–175	175	100	–100	90	10	–10	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	–6	6	5	–5	4	4	–4	V
COLLECTOR CURRENT	I_C	1	–1	1	1	–1	1	1	–1	A
BASE CURRENT	I_B	0.5	–0.5	0.5	0.5	–0.1	0.5	0.5	–0.5	A
TRANSISTOR DISSIPATION:	P_T									
At case temperatures up to 25°C		10	10	10	10	10	5	7	7	W
At case temperatures above 25°C		← See Fig. 1 →								
TEMPERATURE RANGE:										
Storage & Operating (Junction)		← –65 to +200 →								°C
PIN TEMPERATURE (During Soldering):										
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		← 230 →								°C

Type RCA1A01
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEO}	V_{CE} = 60 V, I_B = 0	–	1	μA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 100 mA	70	–	V
f_T	V_{CE} = 4 V, I_C = 50 mA	120	–	MHz
h_{FE}	I_C = 10 mA, V_{CE} = 4 V	40	200	
$V_{CE}(sat)$	I_C = 150 mA, I_B = 15 mA	–	1.4	V
V_{BE}	I_C = 10 mA, V_{CE} = 4 V	–	1	V

For characteristics curves and test conditions, refer to published data for prototype 2N2102

Type RCA1A02
Package: JEDEC TO-39
Construction: Silicon p-n-p, epitaxial planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEO}	V_{CE} = –40 V, I_B = 0	–	–1	μA
I_{EBO}	V_{EB} = –4 V, I_C = 0	–	–1	mA
V_{CEO}	I_C = –0.1 A	–50	–	V
f_T	V_{CE} = –4 V, I_C = –50 mA	60	–	MHz
h_{FE}	I_C = –0.1 mA, V_{CE} = –10 V	30	200	
V_{BE}	I_C = –0.1 mA, V_{CE} = –10 V	–	–0.8	V

For characteristics curves and test conditions, refer to published data for prototype 2N4036

RCA1A01–RCA1A11, RCA1A15–RCA1A19

Type RCA1A03
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 85 V, R_{BE} = 100Ω	–	10	μA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	0.1	mA
V_{CER}	I_C = 0.1 A, R_{BE} = 100Ω	95	–	V
f_T	I_C = 0.1 A, V_{CE} = 4 V	50	–	MHz
h_{FE}	I_C = 300 mA, V_{CE} = 4 V	70	300	
$V_{CE}(sat)$	I_C = 300 mA, I_B = 30 mA	–	0.8	V
V_{BE}	I_C = 300 mA, V_{CE} = 4 V	–	1.4	V
$I_{S/b}$	V_{CE} = 50 V, t = 0.4 s	0.2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5320

Type RCA1A04
Package: JEDEC TO-39
Construction: Silicon p-n-p, epitaxial-planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = –85 V, R_{BE} = 100Ω	–	–10	μA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	–0.1	mA
V_{CER}	I_C = –0.1 A, R_{BE} = 100Ω	–95	–	V
f_T	I_C = –0.1 A, V_{CE} = –4 V	50	–	MHz
h_{FE}	I_C = –300 mA, V_{CE} = –4 V	70	300	
$V_{CE}(sat)$	I_C = –300 mA, I_B = –30 mA	–	–0.8	V
V_{BE}	I_C = –300 mA, V_{CE} = –4 V	–	–1.4	V
$I_{S/b}$	V_{CE} = –35 V, t = 0.4 s	–0.285	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5322

Type RCA1A05
Package: JEDEC TO-39
Construction: Silicon p-n-p epitaxial planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = –65 V, R_{BE} = 100Ω	–	–10	μA
I_{EBO}	V_{EB} = –4 V, I_C = 0	–	–0.1	mA
V_{CER}	I_C = –0.1 A, R_{BE} = 100Ω	–75	–	V
f_T	I_C = –50 mA, V_{CE} = –4 V	60		MHz
h_{FE}	I_C = –150 mA, V_{CE} = –4 V	50	250	
$V_{CE}(sat)$	I_C = –150 mA, I_B = –15 mA	–	–0.8	V
V_{BE}	I_C = –150 mA, V_{CE} = –4 V	–	–1.4	V
$I_{S/b}$	V_{CE} = –65 V, t = 0.4 s	–0.1	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N4036

Type RCA1A06
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 65V, R_{BE} = 100Ω	–	10	μA
I_{EBO}	V_{EB} = 4V, I_C = 0	–	0.1	mA
V_{CER}	I_C = 100 mA, R_{BE} = 100Ω	75	–	V
f_T	I_C = 50 mA, V_{CE} = 4 V	120	–	MHz
h_{FE}	I_C = 150 mA, V_{CE} = 4V	50	250	
$V_{CE}(sat)$	I_C = 150 mA, I_B = 15 mA	–	0.8	V
V_{BE}	I_C = 150 mA, V_{CE} = 4V	–	1.4	V
$I_{S/b}$	V_{CE} = 65V, t = 0.4 s	0.077	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N2102

Type RCA1A07
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEO}	V_{CE} = 40 V	–	10	μA
I_{EBO}	V_{EB} = 3 V, I_C = 0	–	0.1	mA
V_{CEO}	I_C = 100 mA	40	–	V
V_{CER}	I_C = 100 mA, R_{BE} = 10Ω	50	–	V
f_T	V_{CE} = 10 V, I_C = 50 mA	120	–	MHz
h_{FE}	I_C = 3 mA, V_{CE} = 10 V	50	250	
$V_{CE}(sat)$	I_C = 20 mA, I_B = 1 mA	–	1	V
$V_{BE}(sat)$	I_C = 20 mA, I_B = 1 mA	–	1.3	V

For characteristics curves and test conditions, refer to published data for prototype 2N2102

Type RCA1A08
Package: JEDEC TO-39
Construction: Silicon p-n-p, epitaxial planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = –40 V, R_{BE} = 330Ω	–	–10	μA
I_{EBO}	V_{EB} = –5 V	–	–0.1	mA
V_{CEO}	I_C = –100 mA, I_B = 0	–40	–	V
V_{CER}	I_C = –100 mA, R_{BE} = 330Ω	–50	–	V
f_T	V_{CE} = –10 V, I_C = –50 mA	60	–	MHz
h_{FE}	I_C = –50 mA, V_{CE} = –1.5 V	70	250	
$V_{CE}(sat)$	I_C = –100 mA, I_B = –5 mA	–	–1.4	V
$V_{BE}(sat)$	I_C = –100 mA, I_B = –5 mA	–	–1.4	V
$I_{S/b}$	V_{CE} = –35 V, t = 0.05 s	–0.12	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N4036

RCA1A01–RCA1A11, RCA1A15–RCA1A19

Type RCA1A09
Package: JEDEC TO-39
Construction: Silicon n-p-n, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = 90 V, I_B = 0	–	10	μA
I_{EBO}	V_{EB} = 6 V, I_C = 0	–	100	μA
V_{CEO}	I_C = 10 mA, I_B = 0	175	–	V
f_T	I_C = 10 mA, V_{CE} = 10 V	15	–	MHz
h_{FE}	I_C = 10 mA, V_{CE} = 10 V	20	100	
$V_{CE}(sat)$	I_C = 50 mA, I_B = 4 mA	–	0.5	V
V_{BE}	I_C = 10 mA, V_{CE} = 10 V	–	0.9	V
$I_{S/b}$	V_{CE} = 150 V, t = 1 s	0.065	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N3439

Type RCA1A10
Package: JEDEC TO-39
Construction: Silicon p-n-p

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = −120 V, I_B = 0	–	−10	μA
I_{EBO}	V_{EB} = −6 V, I_C = 0	–	−100	μA
V_{CEO}	I_C = −10 mA, I_B = 0	−175	–	V
f_T	I_C = −10 mA, V_{CE} = −10 V	15	–	MHz
h_{FE}	I_C = −10 mA, V_{CE} = −10 V	40	250	
$V_{CE}(sat)$	I_C = −10 mA, I_B = −1 mA	–	−2	V
V_{BE}	I_C = −10 mA, V_{CE} = −10 V	–	−0.8	V
$I_{S/b}$	V_{CE} = −150 V, t = 1 s	−0.04	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5415

Type RCA1A11
Package: JEDEC TO-39
Construction: Silicon n-p-n, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = 90 V, I_B = 0	–	10	μA
I_{EBO}	V_{EB} = 6 V, I_C = 0	–	100	μA
V_{CEO}	I_C = 10 mA, I_B = 0	175	–	V
f_T	I_C = 10 mA, V_{CE} = 10 V	15	–	MHz
h_{FE}	I_C = 1 mA, V_{CE} = 10 V	40	250	
V_{BE}	I_C = 1 mA, V_{CE} = 10 V	0.5	0.7	V

For characteristics curves and test conditions, refer to published data for prototype 2N3439

Type RCA1A15
Package: JEDEC TO-39
Construction: Silicon n-p-n, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = 90 V	–	10	μA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 10 mA, I_B = 0	100	–	V
f_T	V_{CE} = 10 V, I_C = 10 mA	15	–	MHz
h_{FE}	I_C = 10 mA, V_{CE} = 10 V	20	100	
$V_{CE}(sat)$	I_C = 10 mA, I_B = 1 mA	–	1	V
V_{BE}	I_C = 10 mA, V_{CE} = 10 V	–	1	V
$I_{S/b}$	V_{CE} = 50 V, t = 0.4 s	0.2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N3440

Type RCA1A16
Package: JEDEC TO-39
Construction: Silicon p-n-p, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = −90 V	–	−10	μA
I_{EBO}	V_{EB} = −5 V, I_C = 0	–	−1	mA
V_{CEO}	I_C = −10 mA, I_B = 0	−100	–	V
f_T	V_{CE} = −10 V, I_C = −10 mA	15	–	MHz
h_{FE}	I_C = −10 mA, V_{CE} = −10 V	40	250	
$V_{CE}(sat)$	I_C = −10 mA, I_B = −1 mA	–	−1	V
V_{BE}	I_C = −10 mA, V_{CE} = −10 V	–	−1	V
$I_{S/b}$	V_{CE} = −50 V, t = 0.4 s	−0.2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5416

Type RCA1A17
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CEO}	V_{CE} = 80 V, I_B = 0	–	1	μA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 100 mA, I_B = 0	90	–	V
f_T	V_{CE} = 4 V, I_C = 50 mA	120	–	MHz
h_{FE}	I_C = 10 mA, V_{CE} = 4V	40	200	
$V_{CE}(sat)$	I_C = 150 mA, I_B = 15 mA	–	1.4	V
V_{BE}	I_C = 10 mA, V_{CE} = 4 V	–	1	V

For characteristics curves and test conditions, refer to published data for prototype 2N2102

RCA1A01–RCA1A11, RCA1A15–RCA1A19

Type RCA1A18
Package: JEDEC TO-39
Construction: Silicon n-p-n, planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEO}	V_{CE} = 5 V, I_B = 0	–	10	μA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 10 mA, I_B = 0	10	–	V
f_T	I_C = 50 mA, V_{CE} = 4 V	120	–	MHz
h_{FE}	I_C = 10 mA, V_{CE} = 4 V	40	250	
$V_{CE}(sat)$	I_C = 10 mA, I_B = 0.5 mA	–	1	V
V_{BE}	I_C = 10 mA, V_{CE} = 4 V	–	0.78	V

For characteristics curves and test conditions, refer to published data for prototype 2N2102

Type RCA1A19
Package: JEDEC TO-39
Construction: Silicon p-n-p, epitaxial planar

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CEO}	V_{CE} = −5 V, I_B = 0	–	−10	μA
I_{EBO}	V_{EB} = −4 V, I_C = 0	–	−1	mA
V_{CEO}	I_C = −10 mA, I_B = 0	−10	–	V
f_T	I_C = −50 mA, V_{CE} = −4 V	60	–	MHz
h_{FE}	I_C = −10 mA, V_{CE} = −4 V	40	250	
$V_{CE}(sat)$	I_C = −10 mA, I_B = −0.5 mA	–	−1	V
V_{BE}	I_C = −10 mA, V_{CE} = −4 V	–	−0.78	V

For characteristics curves and test conditions, refer to published data for prototype 2N4036

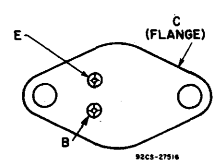
RCA1B01

Silicon Transistor for 70-Watt Quasi-Complementary-Symmetry Audio Amplifiers with Hometaxial-Base Output Transistors

RCA1B01 is an n-p-n hometaxial-base silicon transistor in a JEDEC TO-3 package. This device is particularly suitable for audio-output use, and can be driven by either the RCA1A03 n-p-n or RCA1A04 p-n-p transistor.

The 70-watt amplifier shown in Fig. 4 uses the RCA1B01 in conjunction with seven TO-39 transistors, eleven diodes, and an 84-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. This amplifier is most useful for instrumentation applications where ruggedness and raw power are essential.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1B01	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	95	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	95	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	V
COLLECTOR CURRENT	I_C	15	A
BASE CURRENT	I_B	7	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		115	W
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max		230	°C

Type RCA1B01
Package: JEDEC TO-3
Construction: Silicon n-p-n, hometaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CER}	V_{CE} = 85 V, R_{BE} = 100Ω	–	0.5	mA
I_{EBO}	V_{EB} = 4 V, I_C = 0	–	1	mA
V_{CER}	I_C = 0.2A, R_{BE} = 100Ω	95	–	V
f_T	V_{CE} = 4 V, I_C = 1 A	0.8	–	MHz
h_{FE}	I_C = 4 A, V_{CE} = 4 V	20	70	
$V_{CE}(sat)$	I_C = 4 A, I_B = 0.4 A	–	1	V
V_{BE}	I_C = 4 A, V_{CE} = 4 V	–	1.4	V
$I_{S/b}$	V_{CE} = 60 V, t = 1 s	1.95	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N3055 (Hometaxial).

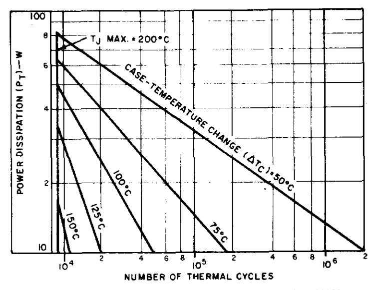
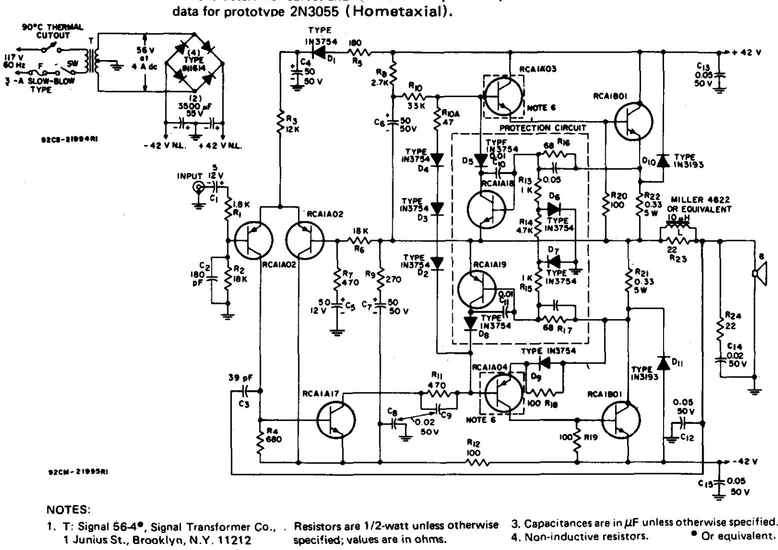


Fig. 2 — Thermal-cycling ratings for RCA1B01.



NOTES:
1. T: Signal 56-4*, Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212
2. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
3. Capacitances are in µF unless otherwise specified.
4. Non-inductive resistors.
* Or equivalent.

Fig. 1 — 70-Watt amplifier circuit featuring quasi-complementary-symmetry output employing hometaxial-base output transistors.

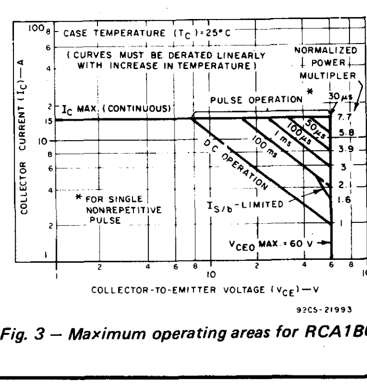
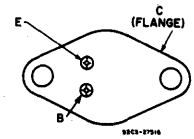


Fig. 3 — Maximum operating areas for RCA1B01.

RCA1B04, RCA1B05, RCA1B09

Silicon Transistors for 100-, 120-, 200-, and 300-W Quasi-Complementary-Symmetry Audio Amplifiers with Parallel Output Transistors

TERMINAL DESIGNATIONS



JEDEC TO-3

The RCA1B04, RCA1B05, and RCA1B09 are silicon n-p-n pi-nu transistors in a JEDEC TO-3 package. They are especially suitable for applications in audio-amplifier circuits, in which they may be used as either driver or output unit.

These devices, together with a variety of other transistors that serve as input devices, V_{BE} amplifiers for biasing, current sources, load-line limiters (for overload protection), and predrivers, may be used to develop several hundred watts of audio output power in quasi-complementary-symmetry audio-amplifier configurations that employ parallel output transistors. Circuit examples, data are shown for 100-, 120-, 200-, and 300-W amplifiers.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA1B04	RCA1B05 RCA1B09	
V_{CBO}	225	275	V
V_{CEO}	200	250	V
V_{CER} R_{BE} = 100 Ω	225	275	V
V_{EBO}	5		V
I_C	7		V
I_B	2		A
P_T			
At $T_C \leq 25^{\circ}C$	150		W
At $T_C > 25^{\circ}C$	Derate linearly to 200 °C		
T_{stg}, T_J	−65 to 200		°C
T_L			
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230		°C

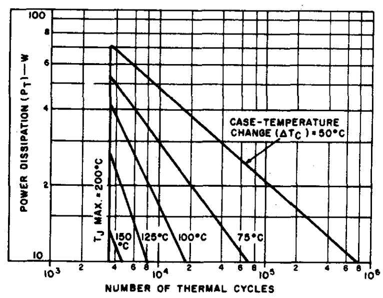


Fig. 1 – Thermal-cycling ratings for RCA1B04 and RCA1B05.

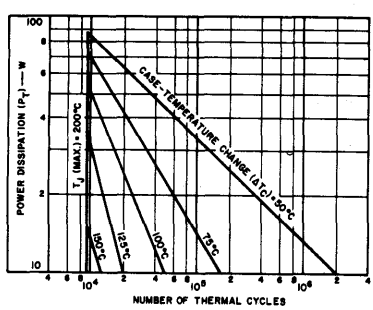


Fig. 2 – Thermal-cycling rating chart for RCA1B09.

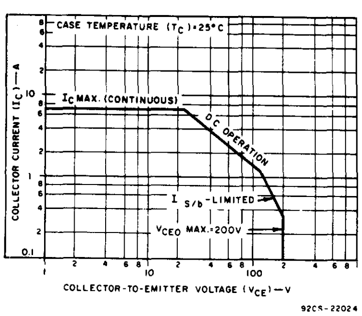


Fig. 3 – Maximum operating areas for RCA1B04.

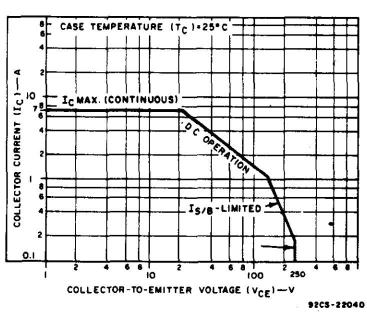


Fig. 4 – Maximum operating areas for RCA1B05.

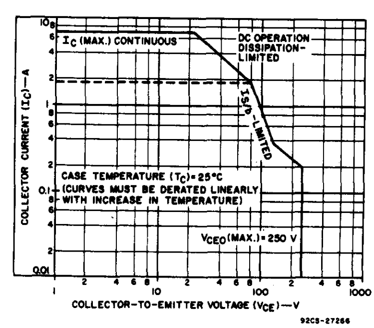


Fig. 5 – Maximum operating areas for RCA1B09.

RCA1B04, RCA1B05, RCA1B09

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS	LIMITS RCA1B04▲ Min.	RCA1B04▲ Max.	RCA1B05* Min.	RCA1B05* Max.	RCA1B09** Min.	RCA1B09** Max.	UNITS
I_{CER}	V_{CE} = 120 V, R_{BE} = 100 Ω	–	1	–	–	–	–	mA
	V_{CE} = 200 V, R_{BE} = 100 Ω	–	–	–	1	–	1	
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	–	1	–	1	mA
V_{CEO}	I_C = 0.2 A, I_B = 0	200	–	250	–	250	–	V
V_{CER}	I_C = 0.2 A, R_{BE} = 100 Ω	225	–	275	–	275	–	V
f_T	I_C = 0.2 A, V_{CE} = 10 V	5	–	5	–	–	–	MHz
	I_C = 1 A, V_{CE} = 15 V	–	–	–	–	5	–	
h_{FE}	I_C = 2 A, V_{CE} = 5 V	15	75	15	75	40	–	
$V_{CE(sat)}$	I_C = 2 A, I_B = 0.255 A	–	2	–	2	–	–	V
	I_C = 2 A, I_B = 0.2 A	–	–	–	–	–	1	
V_{BE}	I_C = 2 A, V_{CE} = 5 V	0.75	1.75	0.75	1.75	–	1	V
$I_{S/b}$	V_{CE} = 120 V, t = 1 s	1.25	–	–	–	–	–	A
	V_{CE} = 140 V, t = 1 s	–	–	1.07	–	–	–	
	V_{CE} = 80 V, t = 1 s	–	–	–	–	1.875	–	

▲ For characteristics curves and test conditions, refer to published data for prototype 2N5239
* For characteristics curves and test conditons, refer to published data for prototype 2N5240
** For characteristics curves and test conditions, refer to published data for prototype 2N6510

100-W Amplifier

The 100-W amplifier shown in Figs. 6 and 7 uses two RCA1B09 transistors as drivers and four RCA1B05 transistors as parallel units in the amplifier output stages, and operates on a 104-V split power supply.

This 100-W amplifier [DC-Coupled (Fig.6) or AC-Coupled (Fig.7)] is conservatively designed to provide excellent high-power performance into an 8-Ω load. With the exception of the RCA-CA3100 Linear Integrated Circuit for front end, this amplifier is entirely push-pull for improved high-frequency distortion and slew rate. Additional circuit features include new thermal overload protection and instant turn-on with no undesirable transients.

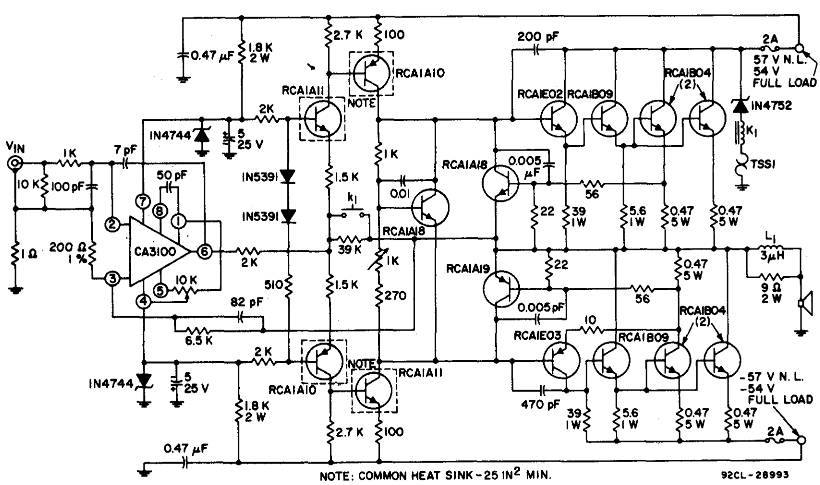
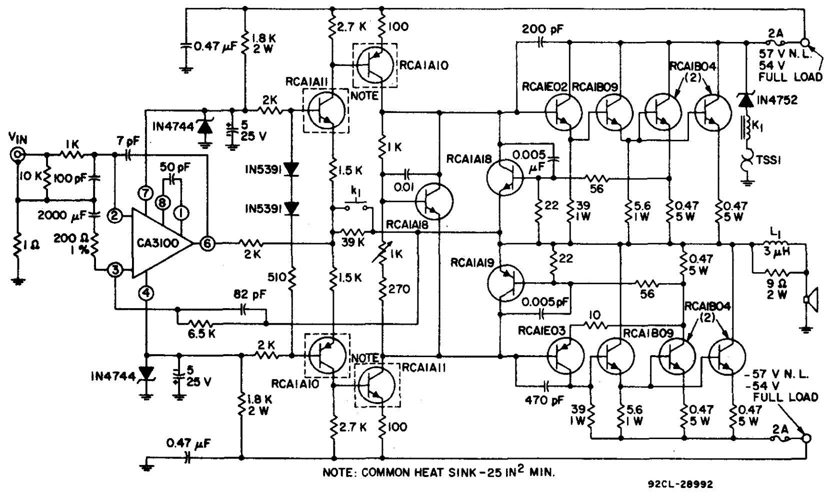


Fig. 6 — 100-W dc-coupled audio amplifier circuit featuring parallel output transistors.

RCA1B04, RCA1B05, RCA1B09



OUTPUT HEAT SINK – 1°C/W PER OUTPUT TRANSISTOR

SET IDLING CURRENT FOR 150 – 200 mA THROUGH 2-A FUSE.

NOTES:
1. All resistors 1/2 W, 5% carbon unless specified.
2. All capacitances in μF unless specified.
3. All resistors are non-inductive.
4. K-1 Relay, single-pole, single-throw, normally closed, with 24 V, 3 mA coil.
5. TSS1 - 70°C thermal cutout, Elmwood Sensor Part No. 3450-157-37, or equivalent.

Fig. 7 – 100-W ac-coupled audio amplifier circuit featuring parallel output transistors.

NOTE:
Power Transformer: Signal BO-8 (Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212), or equivalent.

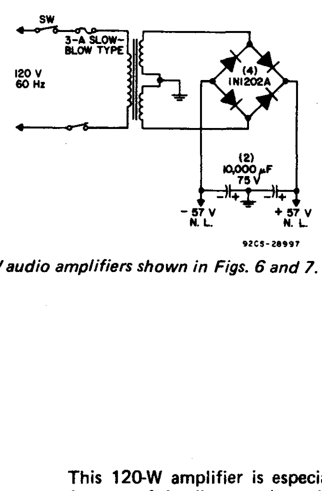


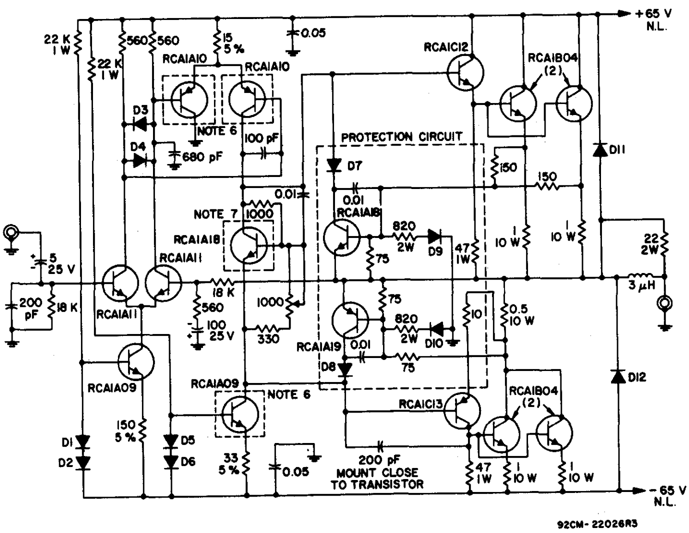
Fig. 8 – Power supply for 100-W audio amplifiers shown in Figs. 6 and 7.

120-W Amplifier

The 120-W amplifier shown in Fig. 9 uses four RCA1B04 transistors as parallel units in the amplifier output stages, and operates on a 130-V split power supply.

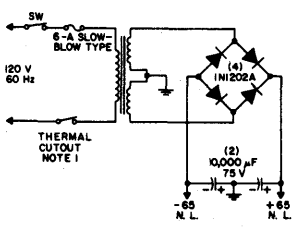
This 120-W amplifier is especially designed for top-of-the line quadrasonic use in applications requiring 1/2 kW of quadrasonic sound with excellent tonal quality. The amplifier output is directly coupled to an 8-Ω speaker.

RCA1B04, RCA1B05, RCA1B09



NOTES:
1. D1-D8 – 1N5391; D9,D10 – 1N914B; D11, D12 – 1N5393
2. Resistors are 1/2 W ± 10% unless otherwise specified; values are in ohms
3. Capacitances are in μF unless otherwise specified.
4. Non-inductive resistors
5. Provide approx. 1°C/W heat sinking per output device based on mounting with mica washer and ZnO thermal compound (Dow Corning No.340, or equivalent) with T_A = 45°C max.
6. Mount on heat sink, Wakefield No. 209-AB, or equivalent. (Alternatively, this type may be obtained with a factory-attached integral heat sink).
7. Attach heat sink cap (Wakefield No.260-6SH5E, or equivalent) on device and mount on same heat sink with output transistor.

Fig. 9 – 120-W audio-amplifier circuit featuring parallel output transistors.



NOTES:
1. 93°C thermal cutout (attached to heat sink for output transistors (Elmwood Sensor part No. 2455-88-4), or equivalent.
2. Power transformer: Signal 88-6, Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212, or equivalent.
   Use 125-V primary tap.

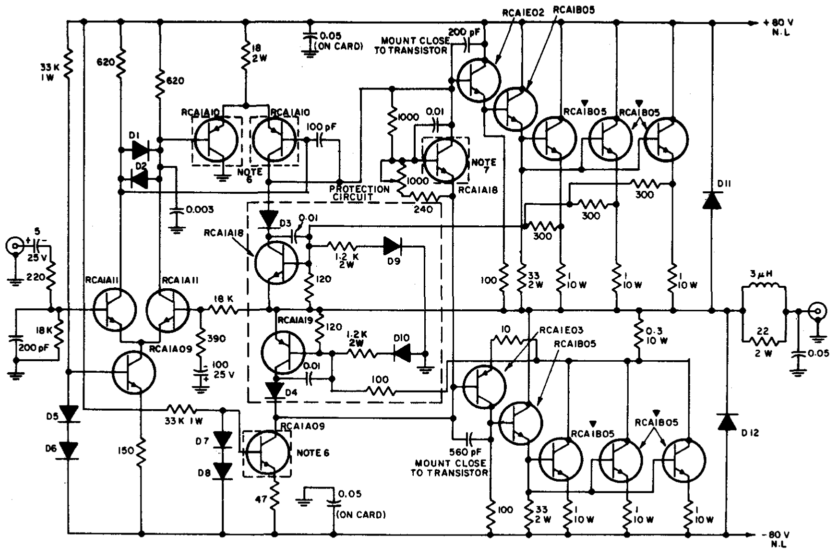
Fig. 10 – Power supply for 120-W audio amplifier circuit shown in Fig. 9.

200-W Amplifier

The 200-W amplifier shown in Fig. 11 uses eight RCA 1B05 transistors, two as drivers and six as parallel units in the amplifier output stages, and operates on a 160-V split power supply.

This 200-W amplifier is especially designed to feature ruggedness in combination with high power output and excellent high fidelity performance. The amplifier output is directly coupled to an 8-Ω speaker.

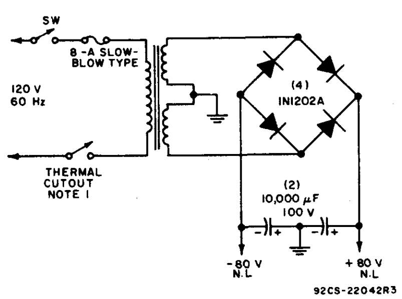
RCA1B04, RCA1B05, RCA1B09



NOTES:

1. D1-D8 – 1N5391; D9, D10 – 1N5316; D11, D12 – 1N5393.
2. Resistors are 1/2W ± 10% unless otherwise specified, values are in ohms.
3. Capacitances are in µF unless otherwise specified.
4. Non-inductive resistors.
5. ▼ Provide approx. 1°C/W heat sinking per output device based on mounting with mica washer and ZnO thermal compound (Dow Corning No. 340, or equivalent) with T_A = 45°C max.
6. Mount on heat sink, Wakefield No. 209-AB, or equivalent. (Alternately, this type may be obtained with a factory-attached integral heat sink.)
7. Attach heat sink cap (Wakefield No. 260-6SHSE, or equivalent) on device and mount on same heat sink with output transistor.

Fig. 11 – 200-W audio amplifier circuit featuring paralle output transistors.



NOTES:

1. 90°C thermal cutout attached to heat sink for output transistors.
2. Power transformer: Signal 120-8 (Signal Tranformer Co., 1 Junius St., Brooklyn, N.Y. 11212), or equivalent. Use 125-V primary tap.

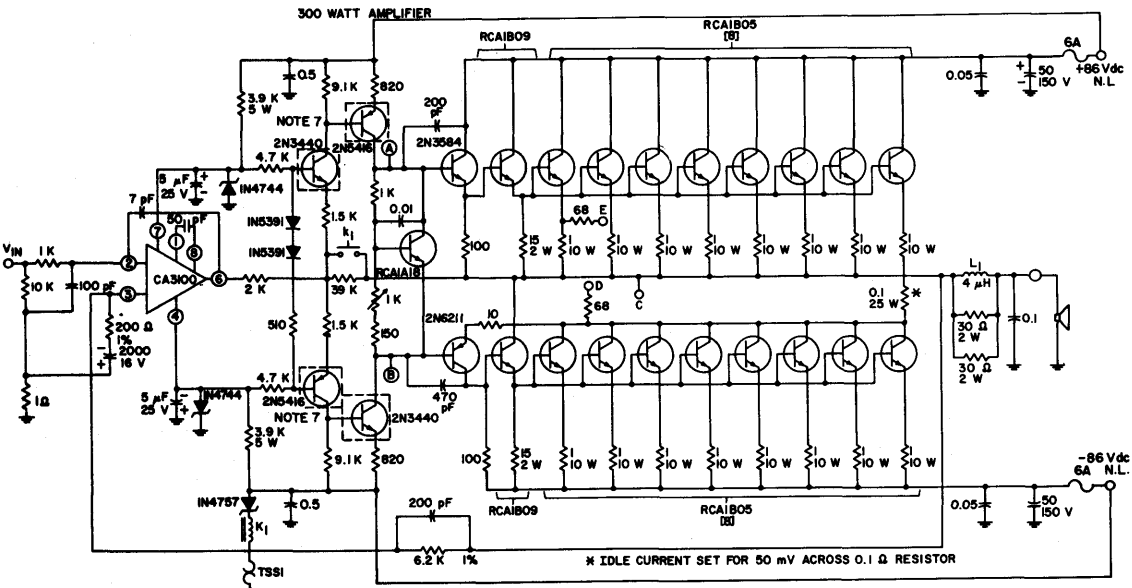
Fig. 12 – Power supply for 200-W audio amplifier circuit shown in Fig. 11.

300-W Amplifier

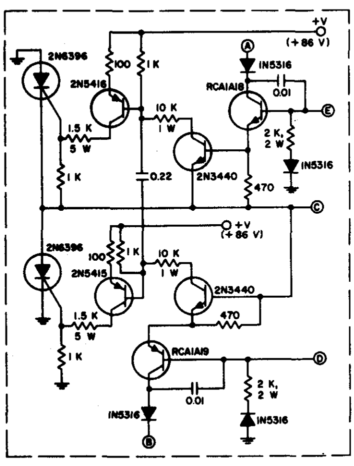
The 300-W amplifier shown in Fig. 13 uses two RCA1B09 transistors as drivers and sixteen RCA1B05 transistors as parallel units in the amplifier output stages, and operates on a 172-V split power supply.

This 300-W amplifier is conservatively designed to provide excellent high-power performance into either 8-Ω or 4-Ω loads. With the exception of the RCA-CA3100 linear integrated circuit for the front end, this amplifier is entirely push-pull for improved high-frequency distortion and slew rate. Additional circuit features include new thermal overload and reactive overload protection and instant turn-on with no undesirable transients.

RCA1B04, RCA1B05, RCA1B09



(a)



(b)

NOTES:

1. All resistors 1/2 W, 5% carbon unless specified.
2. All capacitances in microfarads unless specified.
3. All resistors are non-inductive.
4. K1-Relay, single-pole, single-throw, normally closed, with 24-V, 3 mA coil.
5. TSS1-70°C thermal cutout, Elmwood Sensor Part No. 3450-157-37, or equivalent.
6. For dc-coupled version, delete 2,000-μF capacitor, add 10-kΩ potentiometer – see 100-W amplifier circuit Fig.9 (a).
7. Common heat sink – 25 in.^{2} minimum.

Fig. 13 – 300-W audio amplifier circuit featuring parallel output transistors: (a) basic amplifier circuit, (b) protection circuit.

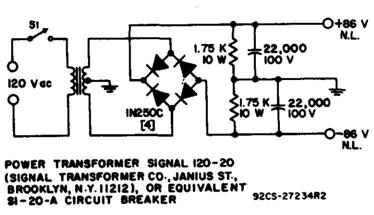


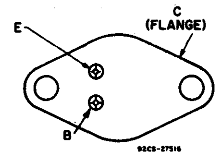
Fig. 14 – Power supply for 300-W audio-amplifier circuit shown in Fig. 13.

RCA1B06

Silicon Transistor for 70-Watt Quasi-Complementary-Symmetry Audio Amplifiers with Pi-Nu Output Transistors

RCA1B06 is an n-p-n pi-nu silicon transistor in a JEDEC TO-3 package. This device is especially characterized for audio-amplifier applications, and can be driven by either RCA1C03 or RCA1C04, n-p-n and p-n-p types, respectively. The 70-watt amplifier shown in Fig. 1 uses the RCA1B06 output device in conjunction with eleven other discrete transistors, thirteen diodes, and a 90-volt split power supply. The amplifier output is directly coupled in an 8-ohm speaker. The high-frequency RCA1B06 output transistors used in the amplifier circuit produce excellent transient response at a high power level.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1B06	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	100	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	120	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	6	V
COLLECTOR CURRENT	I_C	7	A
BASE CURRENT	I_B	2	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		150	W
At case temperatures above 25°C		Derate linearly to 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		230	°C

Type RCA1B06
Package: JEDEC TO-3
Construction: Silicon n-p-n, epitaxial, multiple-emitter-site, pi-nu

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 90 V, R_{BE} = 100Ω	–	1	mA
V_{CEO}	I_C = 0.2 A, I_B = 0	100	–	V
f_T	I_C = 0.2 A, V_{CE} = 10 V	5	–	MHz
h_{FE}	I_C = 4 A, V_{CE} = 4 V	10	50	
V_{CE}(sat)	I_C = 4 A, I_B = 0.8 A	–	2	V
V_{BE}	I_C = 4 A, V_{CE} = 4 V	–	2	V
$I_{S/b}$	V_{CE} = 80 V, t = 1 s	1.87	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5840

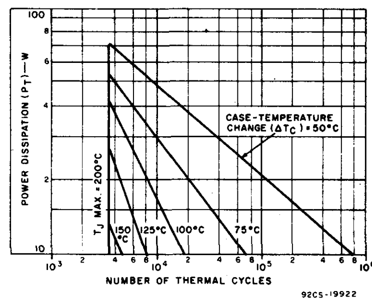


Fig. 2 – Thermal-cycling ratings for RCA1B06.

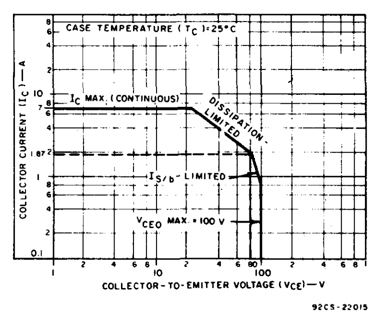
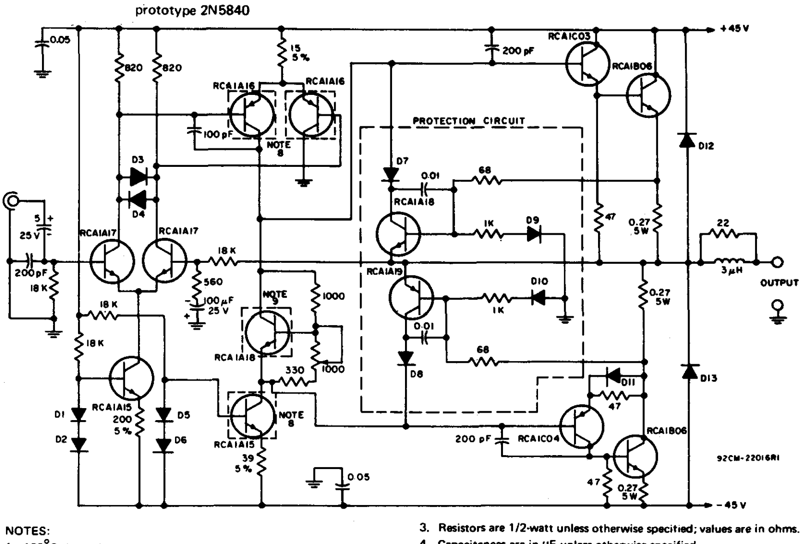


Fig. 3 – Maximum operating areas for RCA1B06.



NOTES:
1. 100°C thermal cutout attached to heat sink for output transistors (Elmwood Sensor part No. 2455-88-4).*
2. Power transformer: Signal 120-2 (parallel secondary),* Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212.
3. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
4. Capacitances are in μF unless otherwise specified.
5. Non-inductive resistors.
6. D1-D8, D11-1N5391
D9, D10, D12, D13-1N5393

* Or equivalent.

Fig. 1 – 70-Watt amplifier circuit featuring quasi-complementary-symmetry output employing pi-nu construction output transistors.

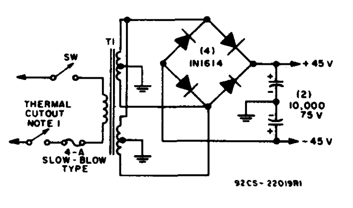
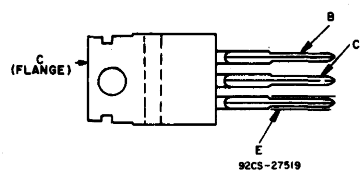


Fig. 4 – Power supply for 70-watt audio-amplifier shown in Fig. 3.

RCA1C03, RCA1C04, RCA1C12, RCA1C13

Silicon Transistors for Audio-Frequency Linear-Amplifier Applications

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

N-P-N Types	P-N-P Types
RCA1C03	RCA1C04
RCA1C12	RCA1C13

RCA1C03, RCA1C04, RCA1C12, and RCA1C13 are complementary silicon n-p-n and p-n-p transistors especially characterized for audio-amplifier applications. These devices, singly or in pairs in complementary- or quasi-complementary-symmetry circuits, are particularly useful as drivers or pre-drivers. They may also be used in audio power amplifiers, linear modulators, servo amplifiers, and operational amplifiers. The units are supplied in the JEDEC TO-220AB version of the plastic VERSAWATT package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*		RCA1C03	RCA1C04	RCA1C12	RCA1C13	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	−120	140	−140	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:						
With base open	V_{CEO}	100	−100	120	−120	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	120	−120	140	−140	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	−5	5	−5	V
CONTINUOUS COLLECTOR CURRENT	I_C	4	−4	4	−4	A
CONTINUOUS BASE CURRENT	I_B	2	−2	2	−2	A
TRANSISTOR DISSIPATION:	P_T					
At case temperatures up to 25°C		40	40	40	40	W
At case temperatures above 25°C		← Derate linearly to 150°C →				
TEMPERATURE RANGE:						
Storage and Operating (Junction)		← −65 to +150 →				°C
PIN TEMPERATURE (During Soldering):						
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		← 230 →				°C

Type RCA1C03
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 110 V, R_{BE} = 100Ω	–	1	mA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 0.1 A, I_B = 0	100	–	V
f_T	I_C = 0.5 A, V_{CE} = 4 V	4	–	MHz
h_{FE}	I_C = 1 A, V_{CE} = 4 V	50	250	
$V_{CE(sat)}$	I_C = 1 A, I_B = 0.1 A	–	1	V
V_{BE}	I_C = 1 A, V_{CE} = 4 V	–	1.5	V
$I_{S/b}$	V_{CE} = 40 V, t = 0.4 s	1	–	A

For charachersistics curves and test conditions, refer to published data for prototype 2N6293.

Type RCA1C04
Package: JEDEC TO-220AB
Construction: Silicon p-n-p, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = −110 V, R_{BE} = 100Ω	–	−1	mA
I_{EBO}	V_{EB} = −5 V, I_C = 0	–	−1	mA
V_{CEO}	I_C = −0.1 A, I_B = 0	−100	–	V
f_T	I_C = −0.5 A, V_{CE} = −4 V	10	–	MHz
h_{FE}	I_C = −1 A, V_{CE} = −4 V	50	250	
$V_{CE(sat)}$	I_C = −1 A, I_B = −0.1 A	–	−1	V
V_{BE}	I_C = −1 A, V_{CE} = −4 V	–	−1.5	V
$I_{S/b}$	V_{CE} = −40 V, t = 0.4 s	−1	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6476.

Type RCA1C12
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 90 V, R_{BE} = 100 Ω	–	100	μA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 0.1 A, I_B = 0	120	–	V
V_{CER}	I_C = 0.1 A, R_{BE} = 100 Ω	140	–	V
f_T	I_C = 0.5 A, V_{CE} = 4 V	4	–	MHz
h_{FE}	I_C = 1 A, V_{CE} = 2 V	40	250	
V_{BE}	I_C = 1 A, V_{CE} = 2 V	–	1.2	V
$I_{S/b}$	V_{CE} = 60 V, t = 0.4 s	0.66	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6474.

Type RCA1C13
Package: JEDEC TO-220AB
Construction: Silicon p-n-p, epitaxial

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = −90 V, R_{BE} = 100 Ω	–	−100	μA
I_{EBO}	V_{EB} = −5 V, I_C = 0	–	−1	mA
V_{CEO}	I_C = −0.1 A, I_B = 0	−120	–	V
V_{CER}	I_C = −0.1 A, R_{BE} = 100 Ω	−140	–	V
f_T	I_C = −0.5 A, V_{CE} = −4 V	10	–	MHz
h_{FE}	I_C = −1 A, V_{CE} = −2 V	40	250	
V_{BE}	I_C = −1 A, V_{CE} = −2 V	–	−1.2	V
$I_{S/b}$	V_{CE} = −60 V, t = 0.4 s	−0.66	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6476.

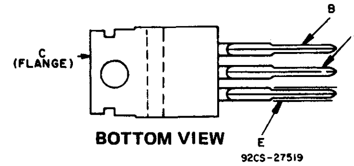
RCA1C05, RCA1C06

Silicon Transistors for 25-Watt Full-Complementary-Symmetry Audio Amplifiers

RCA1C05 and RCA1C06 are n-p-n and p-n-p epitaxial-base silicon power transistors, respectively. These complementary output devices for audio applications are provided in the JEDEC TO-220AB plastic package.

The 25-watt audio-amplifier circuit shown in Fig. 4 uses RCA1C05 and RCA1C06 as output devices in conjunction with seven TO-39 discrete transistors, ten diodes, and a 52-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. The full-complementary-symmetry output stage provides excellent high-frequency performance at moderate cost.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1C05	RCA1C06	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	−60	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	50	−50	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	60	−60	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	−5	V
COLLECTOR CURRENT	I_C	7	−7	A
BASE CURRENT	I_B	3	−3	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		40	40	W
At case temperatures above 25°C		Derate linearly to 150°C		
TEMPERATURE RANGE:				
Storage & Operating (Junction)		−65 to +150		°C
PIN TEMPERATURE (During Soldering):				
At distances ≥1/32 in. (0.8 mm) from case of 10 s max.		230		°C

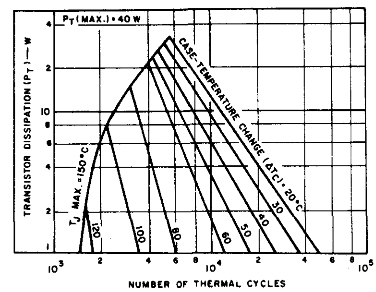


Fig. 1 — Thermal-cycling ratings for RCA1C05 and RCA1C06.

Type RCA1C05
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, epitaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 50 V, R_{BE} = 100Ω	–	1	mA
I_{EBO}	V_{BE} = 5 V, I_C = 0	–	1	mA
V_{CER}	I_C = 0.1 A, R_{BE} = 100Ω	60	–	V
f_T	I_C = 0.1 A, V_{CE} = 4 V	4	–	MHz
h_{FE}	I_C = 3 A, V_{CE} = 4 V	20	120	
V_{CE}(sat)	I_C = 3 A, I_B = 0.3 A	–	1	V
V_{BE}	I_C = 3 A, V_{CE} = 4 V	–	1.5	V
$I_{S/b}$	V_{CE} = 20 V, t = 0.5 s	2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6292

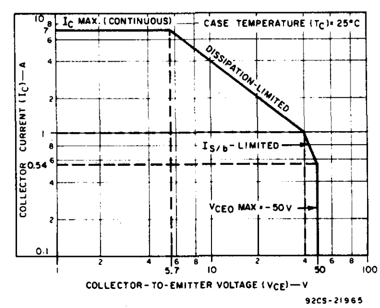


Fig. 2 — Maximum operating areas for RCA1C05.

Type RCA1C06
Package: JEDEC TO-220AB
Construction: Silicon p-n-p, epitaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = −50 V, R_{BE} = 100Ω	–	−1	mA
I_{EBO}	V_{EB} = −5 V, I_C = 0	–	−1	mA
V_{CER}	I_C = −0.1 A, R_{BE} = 100Ω	−60	–	V
f_T	I_C = −0.1 A, V_{CE} = −4 V	10	–	MHz
h_{FE}	I_C = −3 A, V_{CE} = −4 V	20	120	
V_{CE}(sat)	I_C = −3 A, I_B = −0.3 A	–	−1	V
V_{BE}	I_C = −3 A, V_{CE} = −4 V	–	−1.5	V
$I_{S/b}$	V_{CE} = −20 V, t = 0.5 s	−2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6107 (File 488).

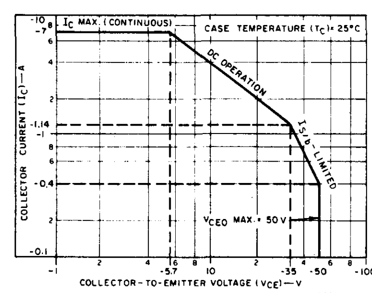


Fig. 3 — Maximum operating areas for RCA1C06.

RCA1C05, RCA1C06

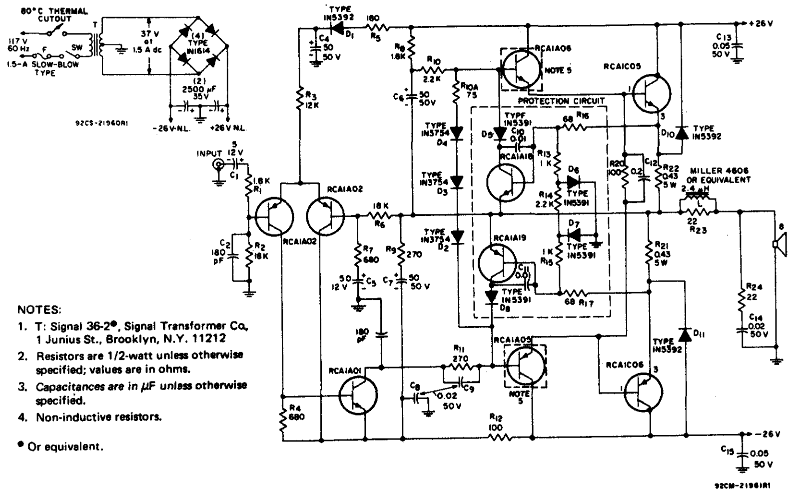
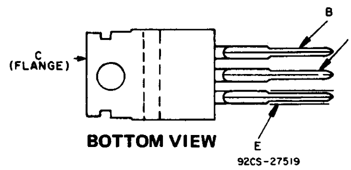


Fig. 4 – 25-watt amplifier circuit featuring true-complementary-symmetry output with load line limiting.

RCA1C07, RCA1C08

TERMINAL DESIGNATIONS



JEDEC TO-220AB

Silicon Transistors for 40-Watt Full-Complementary-Symmetry Audio Amplifiers

RCA1C07 and RCA1C08 are n-p-n and p-n-p epitaxial-base silicon power transistors, respectively, especially suitable for audio-output applications. These devices are provided in the economical JEDEC TO-220AB version of the VERSAWATT package.

The 40-watt amplifier shown in Fig. 3 uses the RCA1C07 and RCA1C08 in conjunction with seven TO-39 transistors, ten diodes, and a 64-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. The high-frequency performance of this 40-watt amplifier will provide excellent reproduction for the most critical listener.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1C07	RCA1C08	
COLLECTOR-TO-BASE-VOLTAGE	V_{CBO}	75	−75	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	65	−65	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	75	−75	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	−5	V
COLLECTOR CURRENT	I_C	10	−10	A
BASE CURRENT	I_B	4	−4	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		75	75	W
At case temperatures above 25°C		Derate linearly to 150°C		
TEMPERATURE RANGE:				
Storage & Operating (Junction)		◄— −65 to 150 —►		°C
PIN TEMPERATURE (During Soldering):				
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		◄— 230 —►		°C

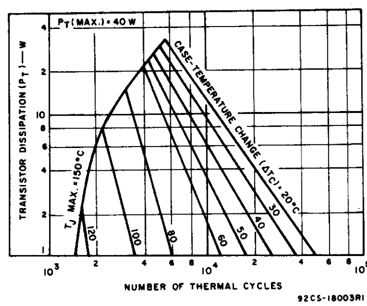


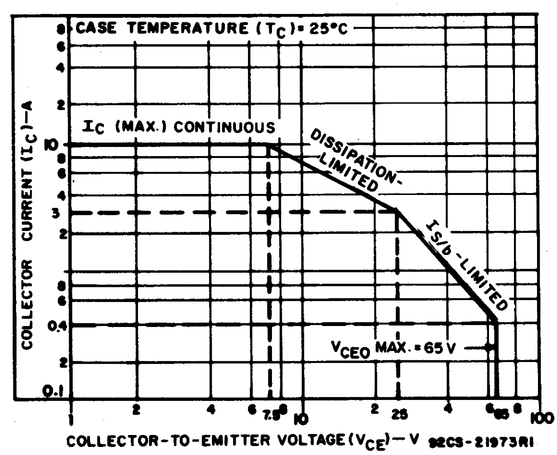
Fig. 1 – Thermal-cycling ratings for RCA1C07 and RCA1C08.

Type RCA1C07
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, epitaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 65V, R_{BE} = 100Ω	–	1	mA
I_{EBO}	V_{BE} = 5V, I_C = 0	–	1	mA
V_{CER}	I_C = 0.1A, R_{BE} = 100Ω	75	–	V
f_T	I_C = 1 A, V_{CE} = 4V	5	–	MHz
h_{FE}	I_C = 4A, V_{CE} = 4V	20	120	
$V_{CE(sat)}$	I_C = 4A, I_B = 0.4 A	–	1	V
V_{BE}	I_C = 4A, V_{CE} = 4V	–	1.5	V
$I_{S/b}$	V_{CE} = 30V, t = 0.5 s	2.5	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6292



♦ For p-n-p device, voltage and current are negative.

Fig. 2 – Maximum operating areas for RCA1C07 and RCA1C08.

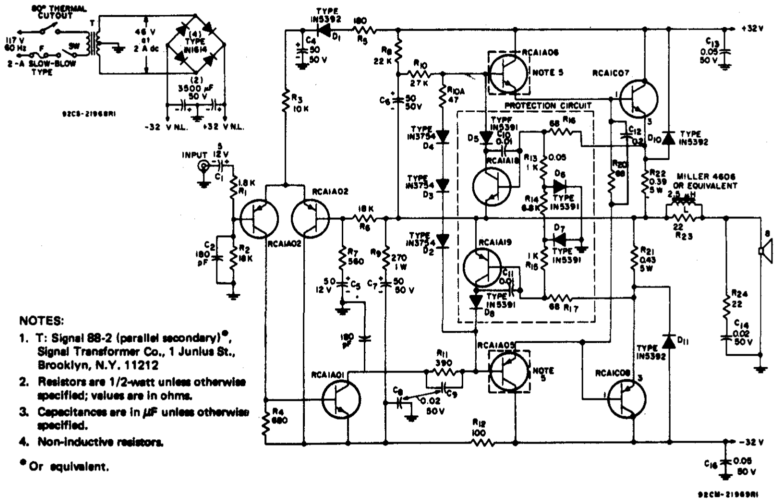
Type RCA1C08
Package: JEDEC TO-220AB
Construction: Silicon p-n-p, epitaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = −65V, R_{BE} = 100Ω	–	−1	mA
I_{EBO}	V_{EB} = −5V, I_C = 0	–	−1	mA
V_{CER}	I_C = −0.1A, R_{BE} = 100Ω	−75	–	V
f_T	I_C = −1 A, V_{CE} = −4V	5	–	MHz
h_{FE}	I_C = −4A, V_{CE} = −4V	20	120	
$V_{CE(sat)}$	I_C = −4A, I_B = −0.4A	–	−1	V
V_{BE}	I_C = −4A, V_{CE} = −4V	–	−1.5	V
$I_{S/b}$	V_{CE} = −30V, t = 0.5 s	−2.5	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6107 (File 488).

RCA1C07, RCA1C08



NOTES:

1. T: Signal 88-2 (parallel secondary)*, Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212
2. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
3. Capacitances are in μF unless otherwise specified.
4. Non-inductive resistors.

*Or equivalent.

Fig. 3 – 40-Watt amplifier circuit featuring full-complementary-symmetry output using load line limiting.

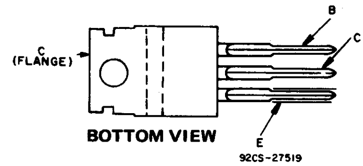
RCA1C09

Silicon Transistor for 40-Watt Quasi-Complementary-Symmetry Audio Amplifiers

RCA1C09 is an n-p-n, hometaxial-base silicon transistor packaged in the JEDEC TO-220AB (VERSAWATT) case. Two of these devices, driven in the class-B mode by the RCA1A06 and RCA1A05 silicon n-p-n and p-n-p transistors, can be used as output devices in audio-amplifier applications.

The 40-watt amplifier shown in Fig. 3 uses two RCA1C09 transistors as output units in conjunction with seven TO-39 transistors, 11 diodes, and a 64-volt split power supply. The amplifier output is directly coupled to an 8-ohm speaker. This 40-watt amplifier features ruggedness and economy in the mid-power range.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1C09	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	75	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	65	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	75	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	V
COLLECTOR CURRENT	I_C	10	A
BASE CURRENT	I_B	4	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		75	W
At case temperatures above 25°C		Derate linearly to 150°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 150	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		230	°C

Type RCA1C09
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, hometaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CER}	V_{CE} = 65 V, R_{BE} = 100Ω	–	1	mA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CER}	I_C = 0.2 A, R_{BE} = 100Ω	75	–	V
f_T	I_C = 0.5 A, V_{CE} = 4 V	0.8	–	MHz
h_{FE}	I_C = 4 A, V_{CE} = 4 V	20	120	
$V_{CE}(sat)$	I_C = 4 A, I_B = 0.4 A	–	1	V
V_{BE}	I_C = 4 A, V_{CE} = 4 V	–	1.5	V
$I_{S/b}$	V_{CE} = 40 V, t = 0.5 s	1.87	–	A

For characteristics curves and test conditions, refer to published

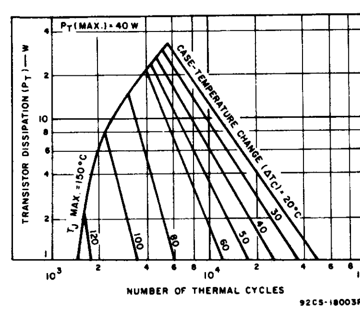
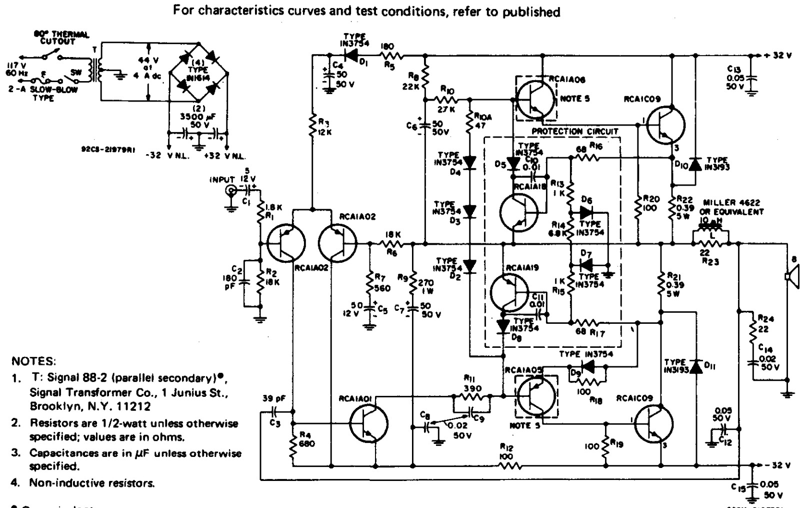


Fig. 2 — Thermal-cycling ratings for RCA1C09.



NOTES:
1. T: Signal 88-2 (parallel secondary)•, Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212
2. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
3. Capacitances are in μF unless otherwise specified.
4. Non-inductive resistors.

• Or equivalent.

Fig. 1 — 40-Watt amplifier circuit featuring quasi-complementary-symmetry output.

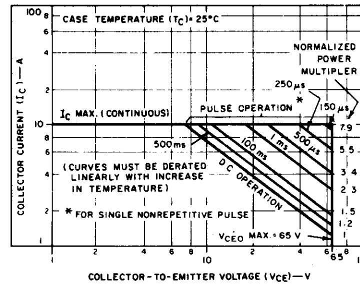


Fig. 3 — Maximum operating areas for RCA1C09.

RCA1C10, RCA1C11

Silicon Transistors for 12-Watt True-Complementary-Symmetry Audio Amplifers

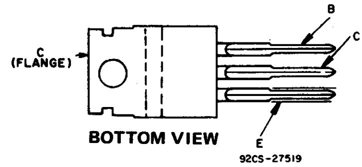
RCA1C10 and RCA1C11 are n-p-n and p-n-p epitaxial-base silicon power transistors, respectively, especially characterized for audio-output service. To enhance circuit economics, they are provided in the JEDEC TO-220AB version of the VERSAWATT plastic package.

The 12-watt audio amplifier circuit shown in Fig. 4 uses RCA1C10 and RCA1C11 as output devices in conjunction with three discrete transistors, two diodes, and a single 36-volt power supply; the amplifier output is capacitively coupled to an 8-ohm speaker. The choice of a true-complementary-symmetry output stage provides excellent fidelity for a low-cost system.

The 12-watt amplifier circuit shown in Fig. 5 uses RCA1C10 and RCA1C11 discrete transistors, an integrated circuit, one diode, and a 36-volt split power supply; the amplifier output is directly coupled to an 8-ohm speaker. The integrated circuit-true-complementary-symmetry combination provides a high-quality, low-cost amplifier.

The RCA CA3094AT integrated circuit provides sufficient drive current for the complementary-symmetry output stage. Tone controls, bass and treble, with functions of "boost" and "cut" are incorporated into the feedback loop of the amplifier, resulting in excellent signal-to-noise ratio and freedom from distortion. Ratings and characteristics of type CA3094AT are given in RCA data bulletin File 598.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1C10	RCA1C11	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	40	–40	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	40	–40	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	50	–50	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	–5	V
COLLECTOR CURRENT	I_C	7	–7	A
BASE CURRENT	I_B	3	–3	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		40	40	W
At case temperatures above 25°C		Derate linearly to 150°C		
TEMPERATURE RANGE:				
Storage & Operating (Junction)		← –65 to 150 →		°C
PIN TEMPERATURE (During Soldering):				
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		← 230 →		°C

Type RCA1C10
Package: JEDEC TO-220AB
Construction: Silicon n-p-n, epitaxial-base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 35 V, R_{BE} = 100Ω	–	10	μA
I_{EBO}	V_{EB} = 5 V	–	1	mA
V_{CEO}	I_C = 0.1 A, I_B = 0	40	–	V
V_{CER}	I_C = 0.1 A, R_{BE} = 100Ω	50	–	V
f_T	V_{CE} = 4 V, I_C = 0.5 A	4	–	MHz
h_{FE}	I_C = 1.5 A, V_{CE} = 4 V	50	250	
$V_{CE}(sat)$	I_C = 1.5 A, I_B = 0.075 A	–	1	V
V_{BE}	I_C = 1.5 A, V_{CE} = 4 V	–	1.5	V
$I_{S/b}$	V_{CE} = 20 V, t = 0.4 s	2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6292

Type RCA1C11
Package: JEDEC TO-220AB
Construction: Silicon p-n-p, epitaxial base

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = –35 V, R_{BE} = 100Ω	–	–10	μA
I_{EBO}	V_{EB} = –5 V	–	–1	mA
V_{CEO}	I_C = –0.1 A, I_B = 0	–40	–	V
V_{CER}	I_C = –0.1 A, R_{BE} = 100Ω	–50	–	V
f_T	V_{CE} = –4 V, I_C = –0.5 A	10	–	MHz
h_{FE}	I_C = –1.5 A, V_{CE} = –4 V	50	250	
$V_{CE}(sat)$	I_C = –1.5 A, I_B = –0.075 A	–	–1	V
V_{BE}	I_C = –1.5 A, V_{CE} = –4 V	–	–1.5	V
$I_{S/b}$	V_{CE} = –20 V, t = 0.4 s	–2	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6107

RCA1C10, RCA1C11

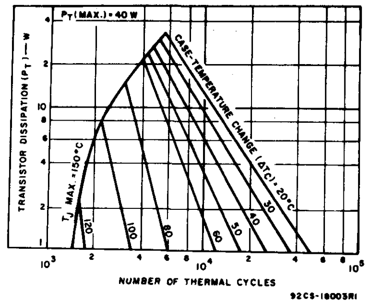


Fig. 1 – Thermal-cycling ratings for RCA1C10 and RCA1C11.

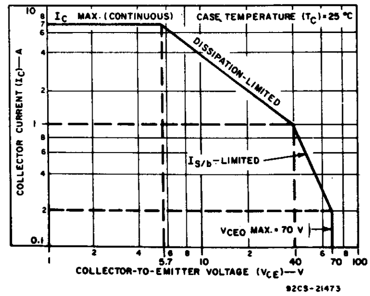


Fig. 2 – Maximum operating areas for RCA1C10.

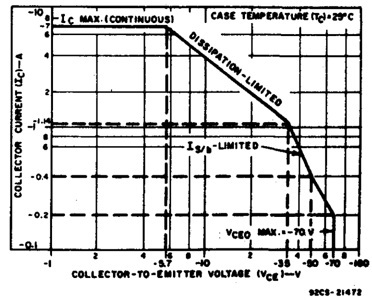
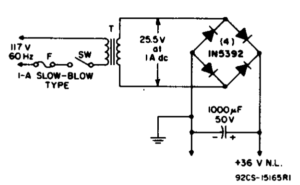
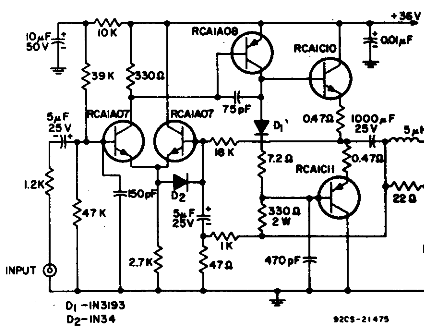


Fig. 3 – Maximum operating areas for RCA1C11.

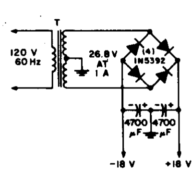


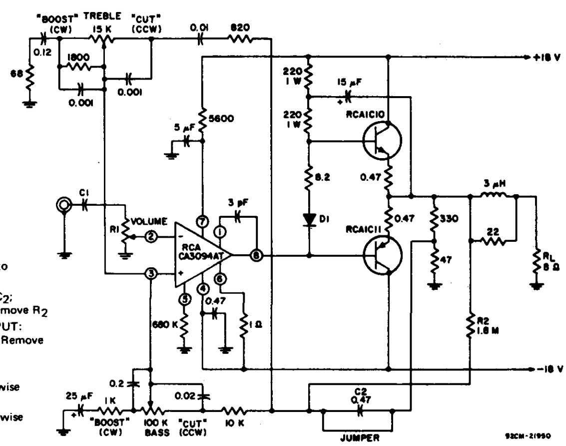


NOTES:

1. T: Thordarson 23V118, Stancor TP4, Triad F-93X, or equivalent (for Stereo Amplifiers).
2. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
3. Capacitances are in µF unless otherwise specified.
4. Non-inductive resistors.

Fig. 4 – 12-watt amplifier circuit featuring complementary-symmetry output.





NOTES:

1. T: Stancor No. P-8609 (120 V AC to 26.8 V CT @ 1 A) or equivalent
2. FOR STANDARD INPUT: Short C_2; R_1 = 250 K; C_1 = 0.047 µF; Remove R_2
3. FOR CERAMIC-CARTRIDGE INPUT: C_1 = 0.0047 µF; R_1 = 2.5 MΩ; Remove Jumper from C_2; Leave R_2.
4. D1 1N5392
5. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
6. Capacitances are in µF unless otherwise specified.
7. Non-inductive resistors.

Fig. 5 – 12-watt amplifier circuit featuring an integrated-circuit driver and a true-complementary-symmetry output stage.

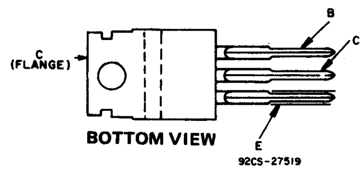
RCA1C14

Silicon Transistor for 25-Watt Quasi-Complementary-Symmetry Audio Amplifiers

RCA1C14 is an n-p-n hometaxial-base silicon power transistor provided in the JEDEC TO-220AB package. This device is ideally suited for use in the output stage of quasi-complementary-symmetry audio amplifiers

The 25-watt audio-amplifier circuit shown in Fig. 2 uses two RCA1C14 transistors in conjunction with seven TO-39 low-level audio transistors, 11 diodes, and a 52-volt split supply. The amplifier output is directly coupled to an 8-ohm speaker. Ruggedness and economy are features of this high fidelity amplifier.

TERMINAL DESIGNATIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1C14	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	40	V
With external base-to-emitter resistance (R_{BE}) = 100Ω	V_{CER}	60	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	V
COLLECTOR CURRENT	I_C	7	A
BASE CURRENT	I_B	3	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		50	W
At case temperatures above 25°C		Derate linearly to 150°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 150	°C
PIN TEMPERATURE (During Soldering):			
At distances ≥1/32 in. (0.8 mm) from case for 10 s max.		230	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS		UNITS
		MIN.	MAX.	
I_{CER}	V_{CE} = 50 V, R_{BE} = 100Ω	–	0.5	mA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 1 A, I_B = 0	40	–	V
V_{CER}	I_C = 0.1 A, R_{BE} = 100Ω	60	–	V
f_T	I_C = 0.5 A, V_{CE} = 4 V	0.8	–	MHz
h_{FE}	I_C = 3 A, V_{CE} = 4 V	20	70	
$V_{CE}(sat)$	I_C = 3 A, I_B = 0.3A	–	1	V
V_{BE}	I_C = 3 A, V_{CE} = 4 V	–	1.4	V
$I_{S/b}$	V_{CE} = 40 V, t=0.5 s	1.25	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N5495

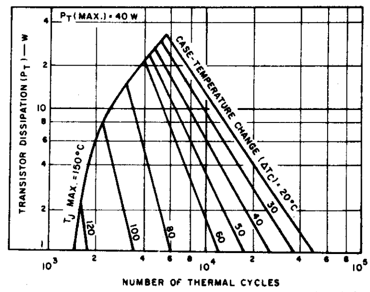


Fig. 1 — Thermal-cycling ratings for RCA1C14.

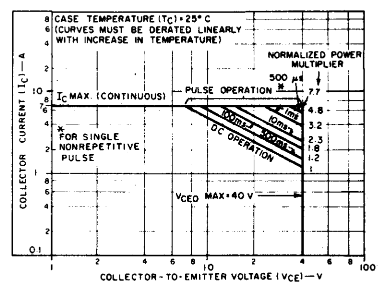
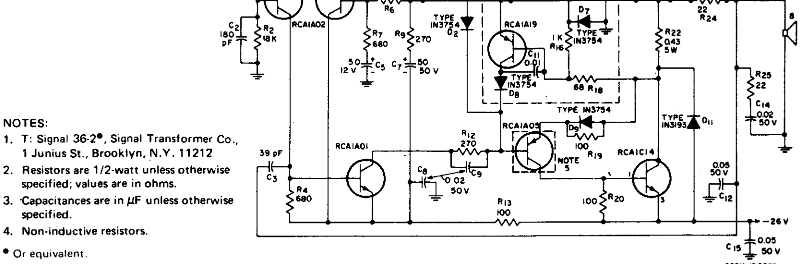


Fig. 3 — Maximum operating areas for RCA1C14.



NOTES:
1. T: Signal 36-2•, Signal Transformer Co., 1 Junius St., Brooklyn, N.Y. 11212
2. Resistors are 1/2-watt unless otherwise specified; values are in ohms.
3. Capacitances are in µF unless otherwise specified.
4. Non-inductive resistors.

• Or equivalent.

Fig. 2 — 25-watt amplifier circuit featuring quasi-complementary-symmetry output.

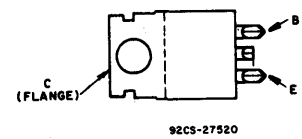
RCA1C15, RCA1C16

Silicon Transistors for 20-Watt Full-Complementary-Symmetry Audio Amplifiers with Darlington Output Transistors

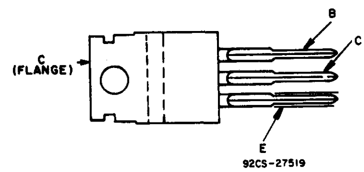
The RCA1C15 and RCA1C16 are complementary silicon n-p-n and p-n-p Darlington transistors. They are especially suitable for use as output devices in audio applications. These transistors are provided in the economical JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request.

The 20-watt audio amplifier shown in Fig. 5 uses the RCA1C15 and RCA1C16 as output devices in conjunction with seven discrete transistors, eight diodes, and an integrated circuit. With the exception of the RCA CA3140B linear integrated circuit for the front end, this amplifier is entirely push-pull for improved high-frequency distortion and slew rate.

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220AA



BOTTOM VIEW
JEDEC TO-220AB

MAXIMUM RATINGS,
Absolute-Maximum Values:

	RCA1C15	RCA1C16	
V_{CBO}	80	−80	V
$V_{CEO}(sus)$	80	−80	V
$V_{CER}(sus)$ $R_{BE} = 100\ \Omega$	80	−80	V
$V_{CEV}(sus)$ V_{BE}=1.5 V reverse bias	80	−80	V
V_{EBO}	5	−5	V
I_C	10	−10	A
I_{CM}	15	−15	A
I_B	0.25	−0.25	A
P_T At $T_C \leqslant 25^oC$	65	65	W
At $T_C > 25^oC$ derate linearly	0.52		W/°C
T_{stg}, T_J	−65 to +150		°C
T_L At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235		°C

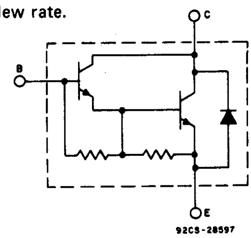


Fig. 1 – Schematic diagram for RCA1C15.

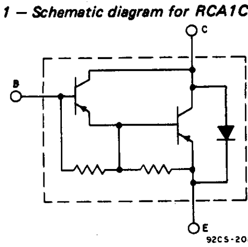


Fig. 2 – Schematic diagram for RCA1C16.

Type: RCA1C15, RCA1C16 **Package: JEDEC TO-220**

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C, unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS●	LIMITS RCA1C15* Min.	Max.	RCA1C16** Min.	Max.	UNITS
I_{CEO}	V_{CE} = 80 V, I_B = 0	–	1	–	−1	mA
I_{CEV}	V_{CE} = 80 V, V_{BE} = −1.5 V	–	0.3	–	−0.3	mA
T_C = 125°C	V_{CE} = 80 V, V_{BE} = −1.5 V	–	3	–	−3	mA
I_{EBO}	V_{BE} = 5 V, I_C = 0	–	5	–	−10	mA
$V_{CEO}(sus)$	I_C = 0.2 A, I_B = 0	80	–	−80	–	V
$V_{CER}(sus)$	I_C = 0.2 A, R_{BE} = 100 Ω	80	–	−80	–	V
$V_{CEV}(sus)$	I_C = 0.2 A, V_{BE} = −1.5 V	80	–	−80	–	V
h_{FE}	I_C = 3 A, V_{CE} = 5 V	1000	20,000	1000	20,000	
$V_{CE}(sat)$	I_C = 5 A, I_B = 0.01 A	–	2	–	−2	V
V_{BE}	I_C = 3 A, V_{CE} = 5 V	–	2.8	–	−2.8	V
V_F	I_C = −10 A	–	4	–	4	V
$\|h_{fe}\|$	I_C = 1 A, V_{CE} = 5 V, f = 1 MHz	20	–	20	–	
$I_{S/b}$	V_{CE} = 25 V, t = 1 s	2.6	–	−2.6	–	A

● For RCA1C16, reverse polarity of voltage and current.
* For characteristics curves and test conditions, refer to published data for prototype 2N6388
** For characteristics curves and test conditions, refer to published data for prototype 2N6668.

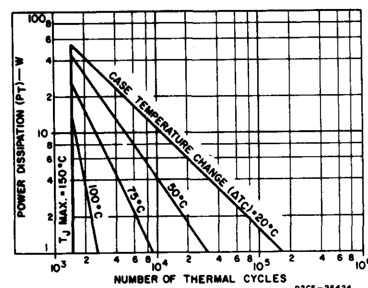


Fig. 3 – Thermal-cycling rating chart for both types.

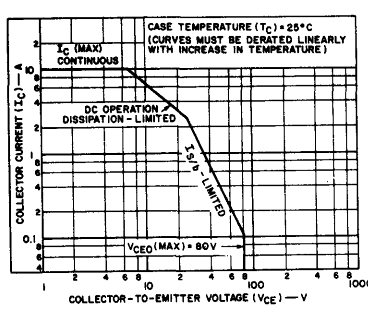
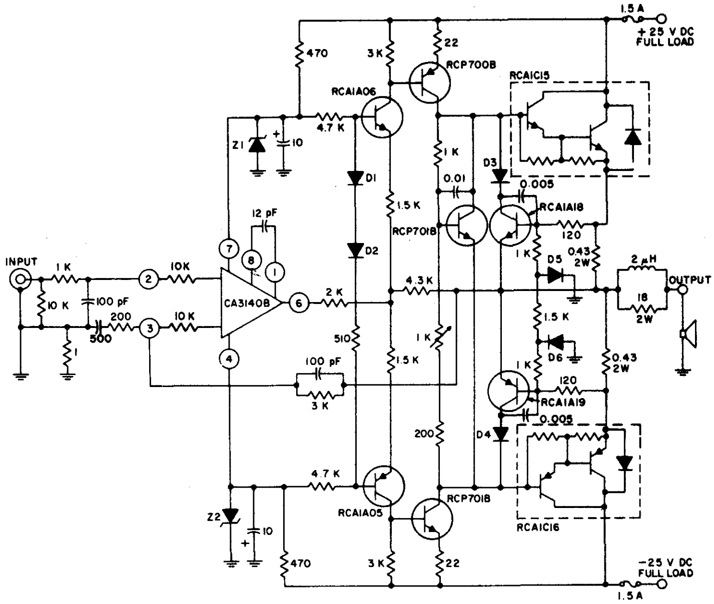
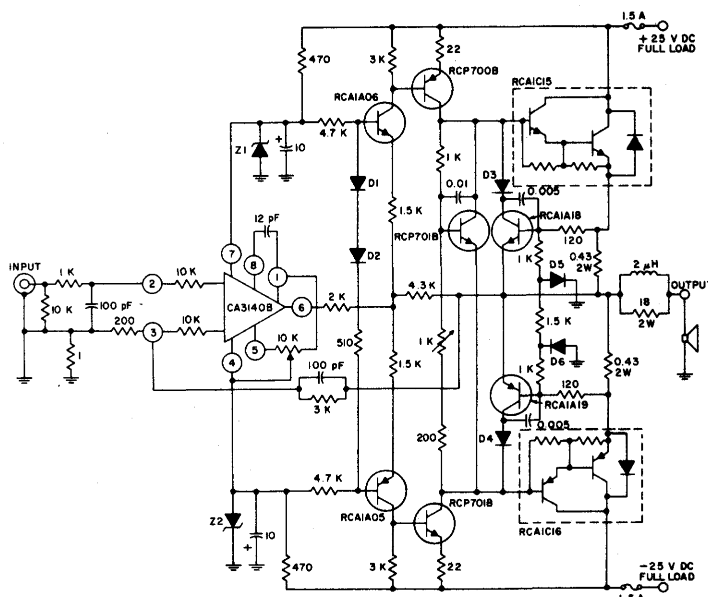


Fig. 4 – Maximum operating areas for both types.

RCA1C15, RCA1C16



(a) Amplifier with ac coupling 92CL-29288



(b) Amplifier with dc coupling 92CL-29289

NOTES:

1. D1–D2 = D1300A; D4–D6 = 1N914
2. Z1–Z2 = 1N4744
3. Resistors are 1/2-watt, ±10% unless otherwise specified; values are in ohms
4. Capacitances are in μF unless otherwise specified
5. Non-inductive resistors
6. Heat sink for output transistors should be 1.3°C/W (Wakefield No. 421, or equivalent)

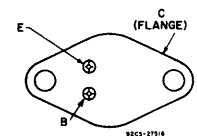
Fig. 5 – 20-watt audio-amplifier circuit featuring full-complementary-symmetry with Darlington output transistors.

RCA1E02, RCA1E03

Silicon Transistors for Audio-Frequency Linear-Amplifier Applications

RCA1E02 and RCA1E03 are silicon n-p-n and p-n-p transistors, respectively. These complementary devices are especially characterized for audio-amplifier applications. They may be used singly or as a complementary pair in complementary- or quasi-complementary-symmetry circuits, and are particularly useful as drivers or predrivers. They may also be used in audio power amplifiers, linear modulators, servo amplifiers, and operational amplifiers. The units are supplied in the JEDEC TO-66 package.

TERMINAL DESIGNATIONS



JEDEC TO-66

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA1E02	RCA1E03	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	200	−200	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	175	−175	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	V_{CER}	200	−200	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	5	−5	V
COLLECTOR CURRENT	I_C	2	−2	A
BASE CURRENT	I_B	1	−1	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		35	35	W
At case temperatures above 25°C		Derate linearly to 200°C		
TEMPERATURE RANGE:				
Storage and Operating (Junction)		← −65 to +200 →		°C
PIN TEMPERATURE (During Soldering):				
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.		← 230 →		°C

Type RCA1E02
Package: JEDEC TO-66
Construction: Silicon n-p-n

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = 120 V, R_{BE} = 100 Ω	–	100	μA
I_{EBO}	V_{EB} = 5 V, I_C = 0	–	1	mA
V_{CEO}	I_C = 0.1 A, I_B = 0	175	–	V
V_{CER}	I_C = 0.1 A, R_{BE} = 100 Ω	200	–	V
h_{FE}	I_C = 0.3 A, V_{CE} = 2 V	30	150	
V_{BE}	I_C = 0.3 A, V_{CE} = 2 V	–	1	V
$I_{S/b}$	V_{CE} = 80 V, t = 0.4 s	0.4	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N3583

Type RCA1E03
Package: JEDEC TO-66
Construction: Silicon p-n-p

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS	LIMITS MIN.	LIMITS MAX.	UNITS
I_{CER}	V_{CE} = −120 V, R_{BE} = 100 Ω	–	−100	μA
I_{EBO}	V_{EB} = −5 V, I_C = 0	–	−1	mA
V_{CEO}	I_C = −0.1 A, I_B = 0	−175	–	V
V_{CER}	I_C = −0.1 A, R_{BE} = 100 Ω	−200	–	V
h_{FE}	I_C = −0.3 A, V_{CE} = −2 V	30	150	
V_{BE}	I_C = −0.3 A, V_{CE} = −2 V	–	−1	V
$I_{S/b}$	V_{CE} = −80 V, t = 0.4 s	−0.25	–	A

For characteristics curves and test conditions, refer to published data for prototype 2N6211

RCA410

High-Voltage, High-Power Silicon N-P-N Transistors

For Switching and Linear Applications in Military, Industrial, and Commercial Equipment

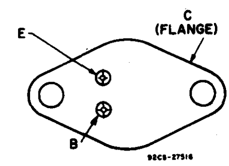
Features:

- Maximum safe-area-of-operation curves
- Low saturation voltage: $V_{CE}(sat)$ = 0.8 V (max.)
- High voltage rating: $V_{CEO}(sus)$ = 200 V
- High dissipation rating: P_T = 125 W

RCA-410 is an epitaxial silicon n-p-n power transistor utilizing a multiple-emitter-site structure. This device employs the popular JEDEC TO-3 package.

Featuring high breakdown-voltage ratings and low saturation-voltage values, the RCA-410 is especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

TERMINAL DESIGNATIONS



JEDEC TO-3

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	200	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE		
With base open, $V_{CEO}(sus)$	200	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	V
COLLECTOR CURRENT:		
Continuous, I_C	7	A
Peak	10	A
BASE CURRENT (Continuous), I_B	2	A
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25°C and V_{CE} up to 75 V	125	W
At case temperatures up to 25°C and V_{CE} above 75 V	See Fig. 2.	
At case temperatures above 25°C and V_{CE} above 75 V	See Figs. 1 & 2.	
TEMPERATURE RANGE:		
Storage & Operating (Junction)	−65 to +200	°C
PIN TEMPERATURE (During Soldering):		
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230	°C

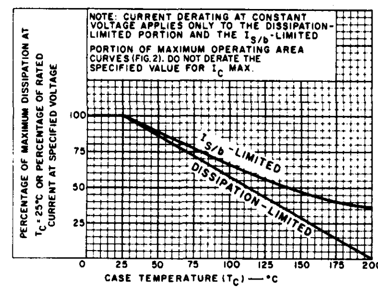


Fig.1—Dissipation and current derating curves.

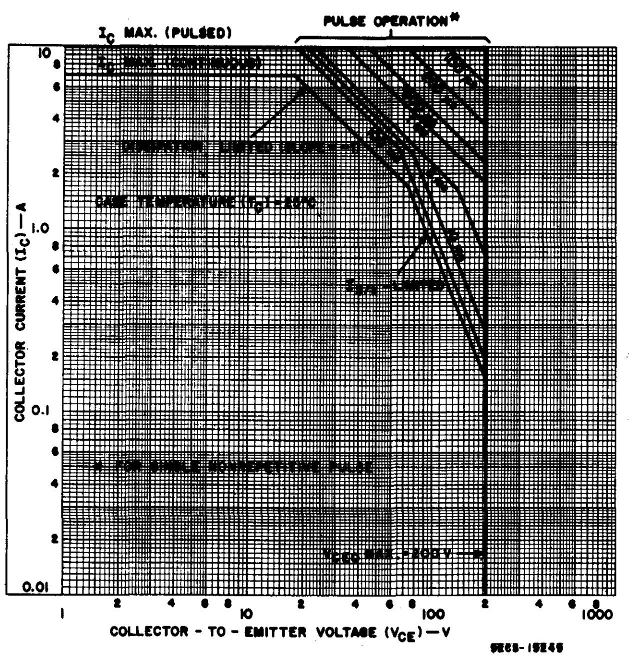


Fig.2—Maximum operating areas.

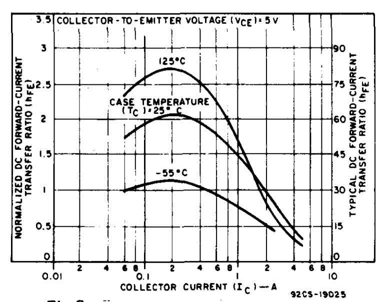


Fig.3— Typical dc beta characteristics.

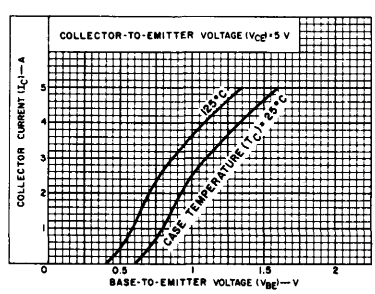


Fig.4— Typical transfer characteristics.

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	Test Conditions: DC Collector Voltage (V) V_{CE}	DC Emitter or Base Voltage (V) V_{EB}	DC Emitter or Base Voltage (V) V_{BE}	DC Current (A) I_C	DC Current (A) I_B	Limits Min.	Limits Typ.	Limits Max.	Units
Collector-Cutoff Current: With base open	I_{CEO}	300					–	–	0.25	mA
With base-emitter junction reverse-biased	I_{CEV}	300		-1.5			–	-	0.25	mA
With base-emitter junction reverse-biased & T_C 125°C	I_{CEV}	300		-1.5			–	–	0.5	mA
Emitter-Cutoff Current	I_{EBO}		5				-	-	5.0	mA
DC Forward-Current Transfer Ratio	h_{FE}	5 5			1.0[a] 2.5[a]		30 10		90	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$[b]				0.1		300[b]			V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				1.0[a]	0.1	-	0.9	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				1.0[a]	0.1	-	0.2	0.8	V
Second-Breakdown Collector Current (With base forward-biased) Pulse duration (non-repetitive) 1 s	$I_{S/b}$[c]	150					0.3			A
Gain-Bandwidth Product	f_T	10			0.2		-	2.5		MHz
Switching Time, Rise	t_r				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.35	-	µs
Storage	t_s				1.0	0.1 (I_{B1}) -0.5 (I_{B2})	-	1.4	-	µs
Fall	t_f				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.15	-	µs
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10			5		-	-	1.4	°C/W

[a] Pulsed; pulse duration ≤ 350 µs, duty factor = 2%. [b] CAUTION The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.

[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

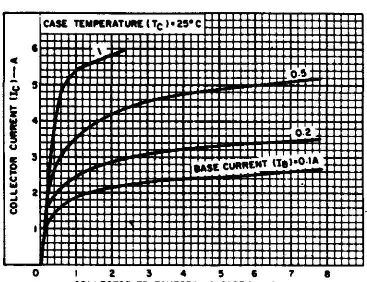


Fig.5— Typical output characteristics.

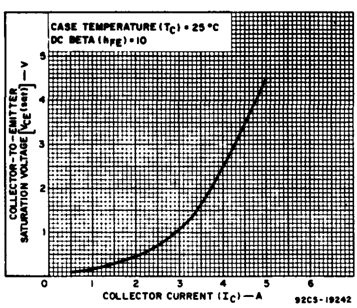


Fig.6— Typical saturation voltage characteristic.

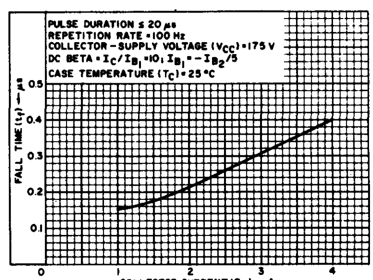


Fig.7— Typical fall time vs. collector current.

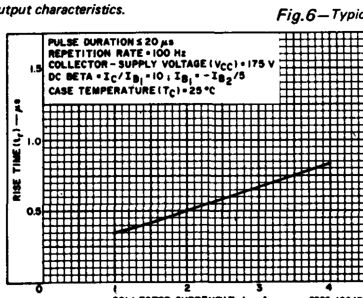


Fig.8— Typical rise time vs. collector current.

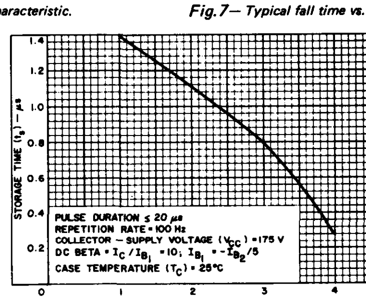


Fig.9— Typical storage time vs. collector current.

RCA411

High-Voltage, High-Power Silicon N-P-N Power Transistor

For Switching and Linear Applications in Military, Industrial, and Commercial Equipment

RCA-411 is an epitaxial silicon n-p-n power transistor utilizing a multiple-emitter-site structure. This device employs the popular JEDEC TO-3 package.

Featuring high breakdown-voltage ratings and low saturation-voltage values, the RCA-411 is especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

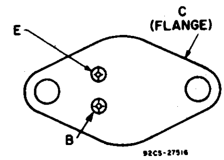
Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltage: $V_{CE}(sat)$ = 0.8 V (max.)**
- **High voltage rating: $V_{CEO}(sus)$ = 300 V**
- **High dissipation rating: P_T = 125 W**

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	300	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE: With base open, $V_{CEO}(sus)$	300	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	V
COLLECTOR CURRENT: Continuous, I_C	7	A
Peak	10	A
BASE CURRENT (Continuous), I_B	2	A
TRANSISTOR DISSIPATION, P_T: At case temperatures up to 25°C and V_{CE} up to 75 V	125	W
At case temperatures up to 25°C and V_{CE} above 75 V	See Fig. 2.	
At case temperatures above 25°C and V_{CE} above 75 V	See Figs. 1 & 2.	
TEMPERATURE RANGE: Storage & Operating (Junction)	−65 to +200	°C
PIN TEMPERATURE (During Soldering): At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-3

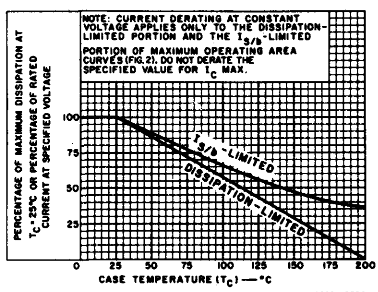


Fig. 1—Dissipation and current derating curves.

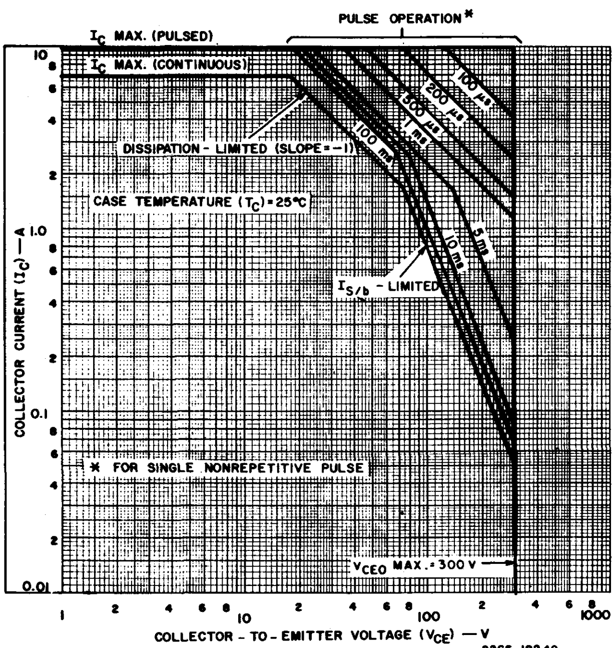


Fig.2—Maximum operating areas.

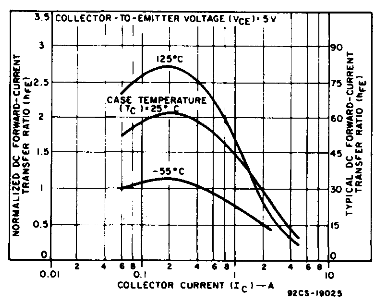


Fig.3— Typical dc beta characteristics.

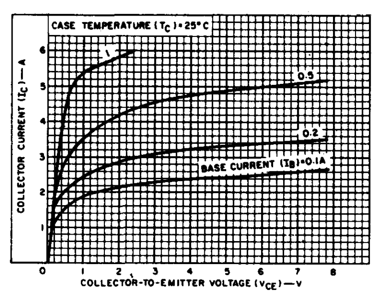


Fig.4— Typical output characteristics.

RCA411

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	Test Conditions					Limits			Units
		DC Collector Voltage (V)	DC Emitter or Base Voltage (V)		DC Current (A)					
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	
Collector-Cutoff Current: With base open	I_{CEO}	300					–	–	0.25	mA
With base-emitter junction reverse-biased	I_{CEV}	300		-1.5			–		0.25	mA
With base-emitter junction reverse-biased & T_C 125°C	I_{CEV}	300		-1.5			–	–	0.5	mA
Emitter-Cutoff Current	I_{EBO}		5				-	-	5.0	mA
DC Forward-Current Transfer Ratio	h_{FE}	5 5			1.0[a] 2.5[a]		30 10		90	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$[b]				0.1		300[b]			V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				1.0[a]	0.1	-	0.9	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				1.0[a]	0.1		0.2	0.8	V
Second-Breakdown Collector Current (With base forward-biased) Pulse duration (non-repetitive) 1 s	$I_{S/b}$[c]	150					0.3			A
Gain-Bandwidth Product	f_T	10			0.2		–	2.5		MHz
Switching Time: Rise	t_r				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.35	-	µs
Storage	t_s				1.0	0.1 (I_{B1}) -0.5 (I_{B2})	-	1.4	-	µs
Fall	t_f				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.15	-	µs
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10			5			-	1.4	°C/W

[a] Pulsed; pulse duration ≤ 350 µs, duty factor = 2%. [b]CAUTION The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

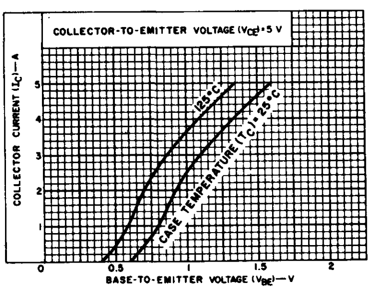


Fig.5— Typical transfer characteristics.

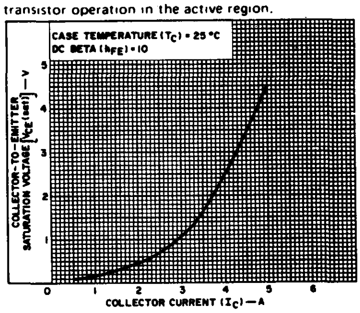


Fig.6— Typical saturation voltage characteristic.

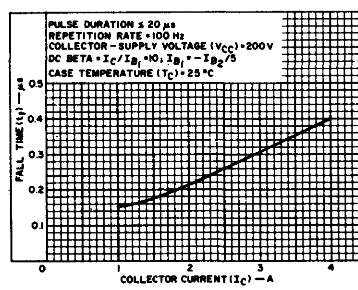


Fig.7— Typical fall time vs. collector current.

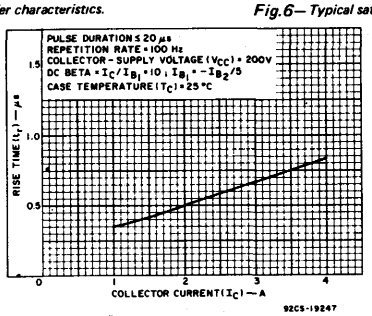


Fig.8— Typical rise time vs. collector current.

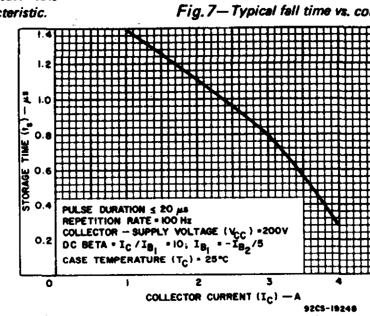


Fig.9— Typical storage time vs. collector current.

RCA413

High-Voltage, High-Power Silicon N-P-N Power Transistor

For Switching and Linear Applications in
Military, Industrial, and Commercial Equipment

Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltage: $V_{CE}(sat)$ = 0.8 V (max.)**
- **High voltage rating: $V_{CEO}(sus)$ = 325 V**
- **High dissipation rating: P_T = 125 W**

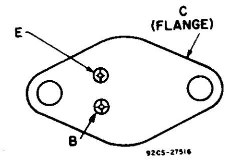
RCA-413 is an epitaxial silicon n-p-n power transistor utilizing a multiple-emitter-site structure. This device employs the popular JEDEC TO-3 package.

Featuring high breakdown-voltage ratings and low saturation-voltage values, the RCA-413 is especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	400	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE		
With base open, $V_{CEO}(sus)$	325	V
COLLECTOR-TO-EMITTER BREAKDOWN VOLTAGE:		
With base open, $V_{(BR)CEO}$	400	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	V
COLLECTOR CURRENT:		
Continuous, I_C	7	A
Peak	10	A
BASE CURRENT (Continuous), I_B	2	A
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25°C and V_{CE} up to 75 V	125	W
At case temperatures up to 25°C and V_{CE} above 75 V	See Fig. 2.	
At case temperatures above 25°C and V_{CE} above 75 V	See Figs. 1 & 2.	
TEMPERATURE RANGE:		
Storage & Operating (Junction)	−65 to +200	°C
PIN TEMPERATURE (During Soldering):		
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-3

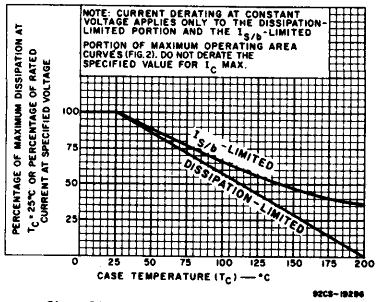


Fig.1—Dissipation and current derating curves.

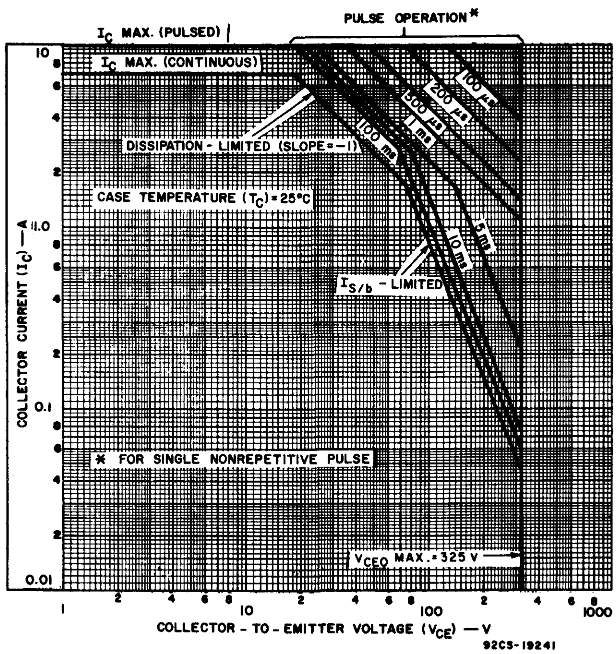


Fig.2—Maximum operating areas.

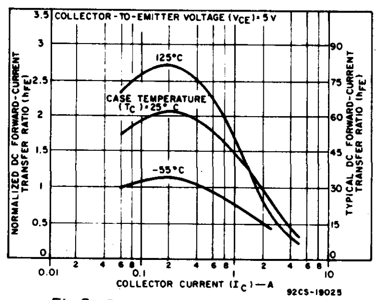


Fig.3— Typical dc beta characteristics.

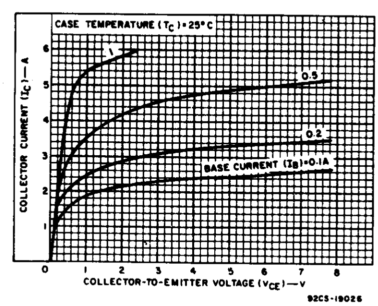


Fig.4— Typical output characteristics.

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	Test Conditions: DC Collector Voltage (V) V_{CE}	DC Emitter or Base Voltage (V) V_{EB}	V_{BE}	DC Current (A) I_C	I_B	Limits Min.	Typ.	Max.	Units
Collector-Cutoff Current With base open	I_{CEO}	300					–	–	0.25	mA
With base-emitter junction reverse-biased	I_{CEV}	300		-1.5			–	·	0.25	
With base-emitter junction reverse-biased & T_C 125°C	I_{CEV}	300		-1.5			–	–	0.5	
Emitter-Cutoff Current	I_{EBO}		5				–	-	5.0	mA
DC Forward-Current Transfer Ratio	h_{FE}	5 5			1.0[a] 2.5[a]		30 10		90 -	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$[b]				0.1		300[b]			V
Base to Emitter Saturation Voltage	$V_{BE}(sat)$				1.0[a]	0.1	–	0.9	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				1.0[a]	0.1	·	0.2	0.8	V
Second-Breakdown Collector Current (With base forward-biased) Pulse duration (non-repetitive) 1 s	$I_{S/b}$[c]	150					0.3		-	A
Gain-Bandwidth Product	f_T	10			0.2		–	2.5	·	MHz
Switching Time Rise	t_r				1.0	0.1 (I_{B1}) -0.5 (I_{B2})	·	0.35	–	µs
Storage	t_s				1.0	0.1 (I_{B1}) -0.5 (I_{B2})	–	1.4	–	
Fall	t_f				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.15	–	
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10			5		·	-	1.4	°C/W

[a] Pulsed; pulse duration ≤ 350 µs, duty factor = 2%. [b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

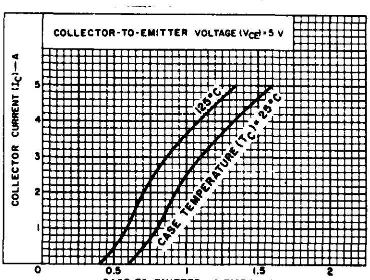


Fig.5— Typical transfer characteristics.

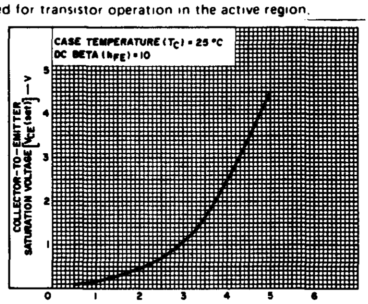


Fig.6— Typical saturation voltage characteristic.

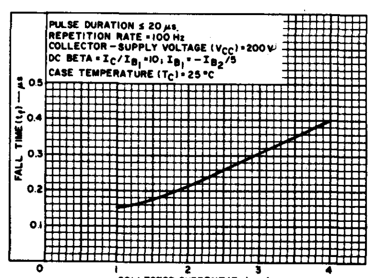


Fig.7— Typical fall time vs. collector current.

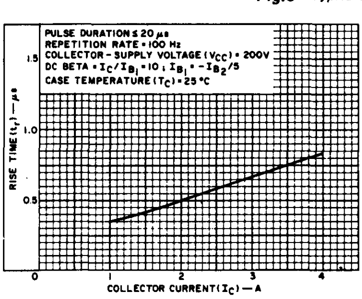


Fig.8— Typical rise time vs. collector current.

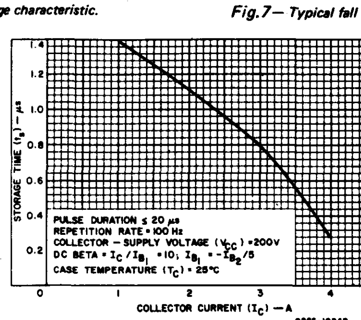


Fig.9— Typical storage time vs. collector current.

RCA423

High-Voltage, High-Power Silicon N-P-N Power Transistor

For Switching and Linear Applications in Military, Industrial, and Commercial Equipment

RCA-423 is an epitaxial silicon n-p-n power transistor utilizing a multiple-emitter-site structure. This device employs the popular JEDEC TO-3 package.

Featuring high breakdown-voltage ratings and low saturation-voltage values, the RCA-423 is especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

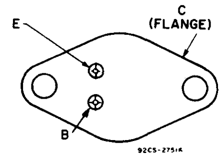
Features:

- **Maximum safe-area-of-operation curves**
- **Low saturation voltage: $V_{CE}(sat)$ = 0.8 V (max.)**
- **High voltage rating: $V_{CEO}(sus)$ = 325 V**
- **High dissipation rating: P_T = 125 W**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	400	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:		
With base open, $V_{CEO}(sus)$	325	V
COLLECTOR-TO-EMITTER BREAKDOWN VOLTAGE:		
With base open, $V_{(BR)CEO}$	400	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	V
COLLECTOR CURRENT:		
Continuous, I_C	7	A
Peak	10	A
BASE CURRENT (Continuous), I_B	2	A
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25°C and V_{CE} up to 75 V	125	W
At case temperatures up to 25°C and V_{CE} above 75 V	See Fig. 2.	
At case temperatures above 25°C and V_{CE} above 75 V	See Figs. 1 & 2.	
TEMPERATURE RANGE:		
Storage & Operating (Junction)	−65 to +200	°C
PIN TEMPERATURE (During Soldering):		
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-3

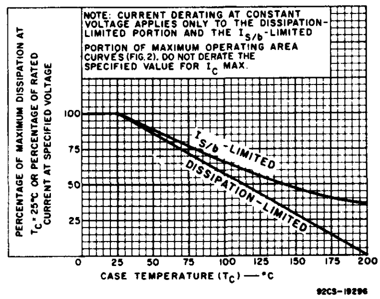


Fig. 1—Dissipation and current derating curves.

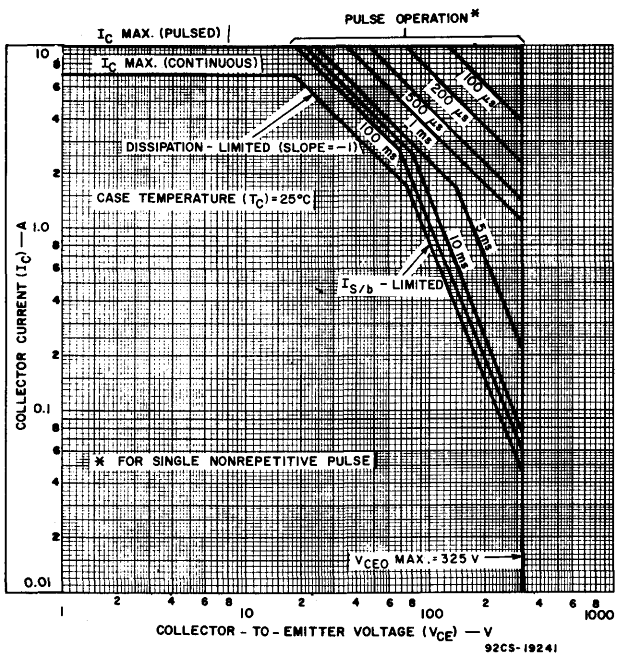


Fig.2—Maximum operating areas.

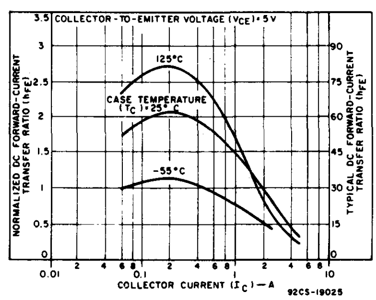


Fig.3—Typical dc beta characteristics.

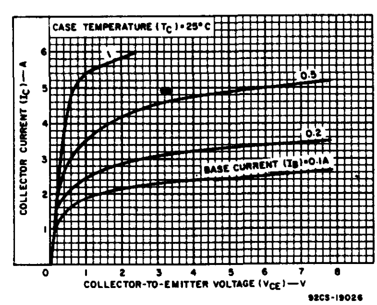


Fig.4—Typical output characteristics.

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	Test Conditions: DC Collector Voltage (V) V_{CE}	DC Emitter or Base Voltage (V) V_{EB}	V_{BE}	DC Current (A) I_C	I_B	Limits: Min.	Typ.	Max.	Units
Collector-Cutoff Current: With base open	I_{CEO}	300					–		0.25	mA
With base-emitter junction reverse-biased	I_{CEV}	300		1.5					0.25	mA
With base-emitter junction reverse-biased & T_C 125°C	I_{CEV}	300		1.5			–	–	0.5	mA
Emitter-Cutoff Current	I_{EBO}		5						5.0	mA
DC Forward-Current Transfer Ratio	h_{FE}	5 5			1.0[a] 2.5[a]		30 10		90	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$[b]				0.1		300[b]			V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				1.0[a]	0.1		0.9	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				1.0[a]	0.1		0.2	0.8	V
Second Breakdown Collector Current (With base forward biased) Pulse duration (non-repetitive) 1 s	$I_{S/b}$[c]	150					0.3			A
Gain-Bandwidth Product	f_T	10			0.2			2.5		MHz
Switching Time: Rise	t_r				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.35	–	µs
Storage	t_s				1.0	0.1 (I_{B1}) -0.5 (I_{B2})	–	1.4	–	µs
Fall	t_f				1.0	0.1 (I_{B1}) -0.5 (I_{B2})		0.15		µs
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10			5			–	1.4	°C/W

[a] Pulsed, pulse duration ≤ 350 µs, duty factor = 2%. [b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

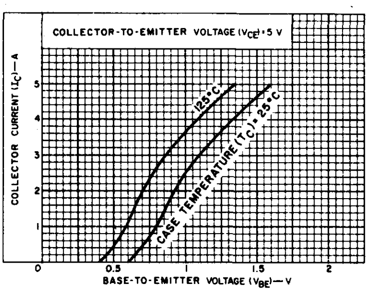


Fig.5—Typical transfer characteristics.

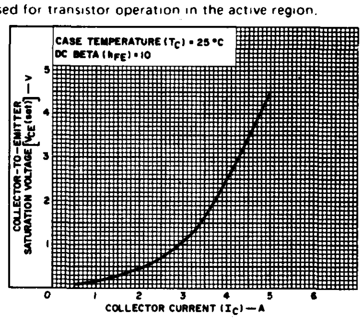


Fig.6—Typical saturation voltage characteristic.

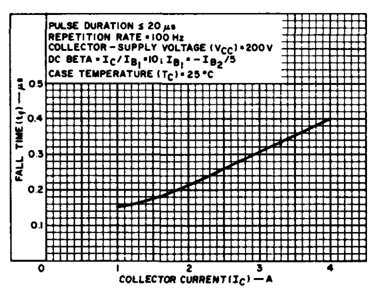


Fig.7—Typical fall time vs. collector current.

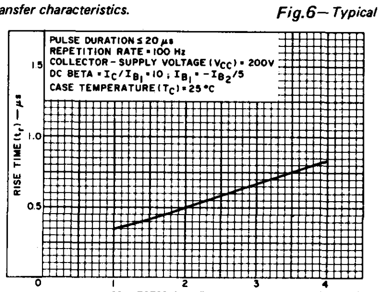


Fig.8—Typical rise time vs. collector current.

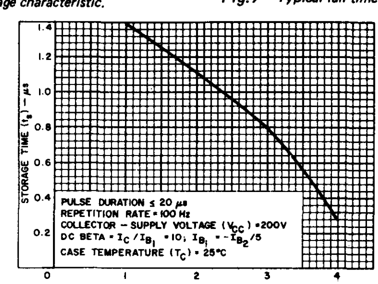


Fig.9—Typical storage time vs. collector current.

RCA431

High-Voltage, High-Power Silicon N-P-N Power Transistor

For Switching and Linear Applications in Military, Industrial, and Commercial Equipment

Features:

- Maximum safe-area-of operation curves
- Low saturation voltage: $V_{CE}(sat)$ = 0.7 V (max.)
- High voltage rating: $V_{CEO}(sus)$ = 325 V
- High dissipation rating: P_T = 125 W

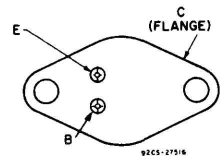
RCA-431 is an epitaxial silicon n-p-n power transistor utilizing a multiple-emitter-site structure. This device employs the popular JEDEC TO-3 package.

Featuring high breakdown-voltage ratings and low saturation-voltage values, the RCA-431 is especially suitable for use in inverters, deflection circuits, switching regulators, high-voltage bridge amplifiers, ignition circuits, and other high-voltage switching applications.

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	400	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE		
With base open, $V_{CEO}(sus)$	325	V
COLLECTOR-TO-EMITTER BREAKDOWN VOLTAGE:		
With base open, $V_{(BR)CEO}$	400	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	V
COLLECTOR CURRENT:		
Continuous, I_C	7	A
Peak	10	A
BASE CURRENT (Continuous), I_B	2	A
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25°C and V_{CE} up to 75 V	125	W
At case temperatures up to 25°C and V_{CE} above 75 V	See Fig. 2.	
At case temperatures above 25°C and V_{CE} above 75 V	See Figs. 1 & 2.	
TEMPERATURE RANGE:		
Storage & Operating (Junction)	−65 to +200	°C
PIN TEMPERATURE (During Soldering):		
At distances ≥ 1/32 in. (0.8 mm) from case for 10 s max.	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-3

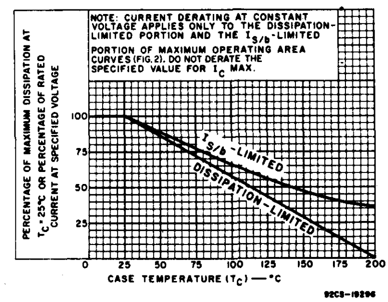


Fig.1—Dissipation and current derating curves.

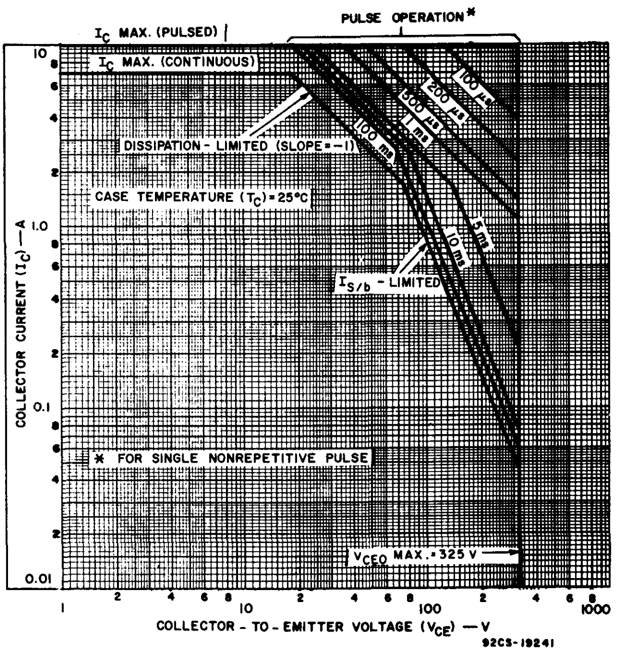


Fig.2—Maximum operating areas.

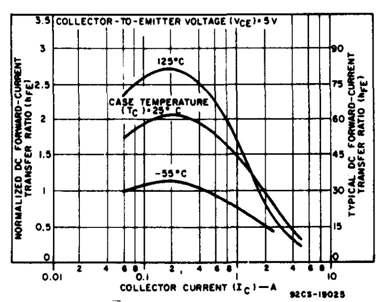


Fig.3—Typical dc beta characteristics.

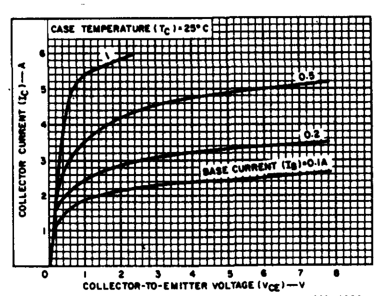


Fig.4— Typical output characteristics.

RCA431

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	Test Conditions: DC Collector Voltage (V)	DC Emitter or Base Voltage (V)		DC Current (A)		Limits			Units
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	
Collector-Cutoff Current: With base open	I_{CEO}	300					–	–	0.25	mA
With base-emitter junction reverse-biased	I_{CEV}	300		–1.5			–	–	0.25	mA
With base-emitter junction reverse-biased & T_C 125°C	I_{CEV}	300		–1.5			–	–	0.5	mA
Emitter-Cutoff Current	I_{EBO}		5				–	–	5.0	mA
DC Forward-Current Transfer Ratio	h_{FE}	5 5			1.0[a] 2.5[a]		30 10		90 –	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$[b]				0.1		300[b]			V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				1.0[a]	0.1	–	0.9	1.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				1.0[a]	0.1	–	0.2	0.8	V
Second-Breakdown Collector Current (With base forward-biased) Pulse duration (non-repetitive) 1 s	$I_{S/b}$[c]	150					0.3		–	A
Gain-Bandwidth Product	f_T	10			0.2		–	2.5	–	MHz
Switching Time: Rise	t_r				1.0	0.1 (I_{B1}) –0.5 (I_{B2})	–	0.35	–	μs
Storage	t_s				1.0	0.1 (I_{B1}) –0.5 (I_{B2})	–	1.4	–	μs
Fall	t_f				1.0	0.1 (I_{B1}) –0.5 (I_{B2})		0.15	–	μs
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$	10			5		–	–	1.4	°C/W

[a] Pulsed; pulse duration ≤350 μs, duty factor = 2%. [b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

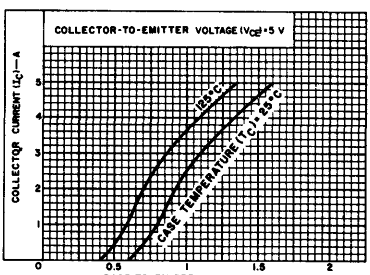


Fig.5— Typical transfer characteristics.

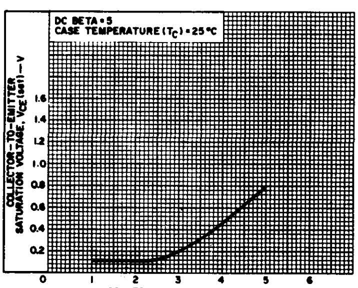


Fig.6— Saturation voltage vs. collector current.

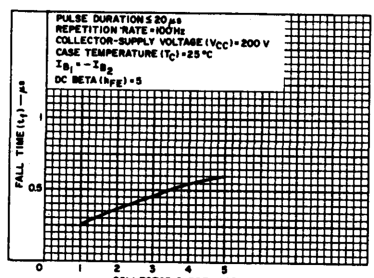


Fig.7— Typical fall-time characteristic.

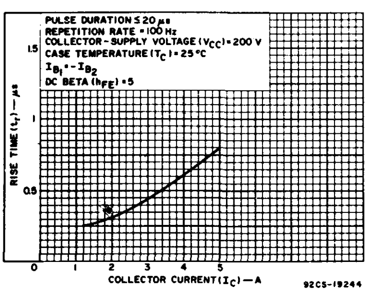


Fig.8— Typical rise-time characteristic.

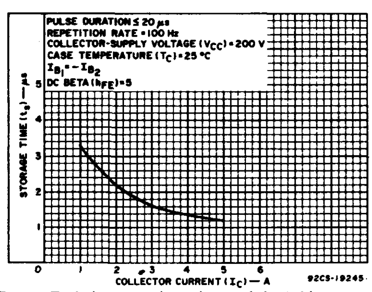


Fig.9— Typical storage-time characteristic (with constant forced gain).

RCA8766 Series

10-Ampere N-P-N Monolithic Darlington Power Transistors

350, 400, 450 Volts, 150 Watts
Gain of 100 at 4, 6A

The RCA-8766 Series● are monolithic n-p-n silicon Darlington transistors designed for automotive electronic power applications. The pi-nu construction of these devices provides good forward- and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

The devices in the series differ primarily in voltage ratings and in the current at which the dc gain is specified.

The RCA-8766 Series are supplied in the JEDEC TO-3 hermetic steel package.

● Formerly RCA Dev. Nos. TA8766 Series.

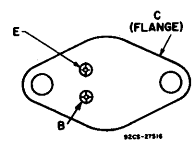
Features:
- **Operates from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:
- **Power switching**
- **Solenoid drivers**
- **Automotive Ignition**
- **Series and shunt regulators**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA8766 RCA8766A	RCA8766B RCA8766C	RCA8766D RCA8766E	
V_{CBO}	350	400	450	V
$V_{CER}(sus)$				
$R_{BE} = 50\ \Omega$	350	400	450	V
$V_{CEO}(sus)$	350	400	450	V
V_{EBO}	5	5	5	V
I_C	10	10	10	A
I_{CM}	15	15	15	A
I_B	1	1	1	A
P_T				
$T_C \leq 25°C$	150	150	150	W
$T_C > 25°C$	derate linearly 1			°C/W
T_{stg}, T_J	−65 to +175			°C
T_L				
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235			°C

TERMINAL DESIGNATIONS



JEDEC TO-3

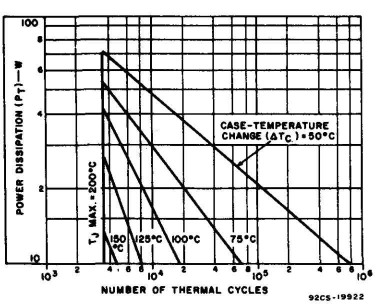


Fig. 1 — Thermal-cycling rating chart for all types.

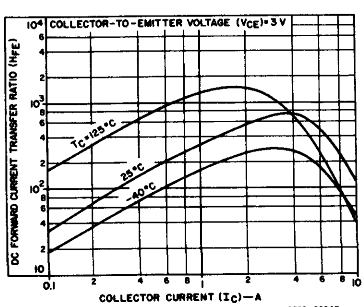


Fig. 2 — Typical DC beta characteristics for all types.

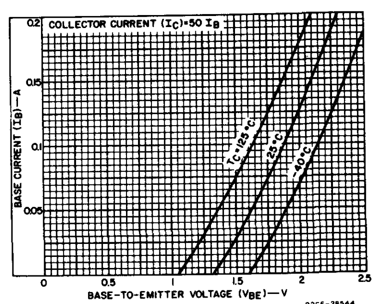


Fig. 3 — Typical input characteristics for all types.

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS			LIMITS						UNITS
	VOLTAGE V dc	CURRENT A dc		RCA8766 RCA8766A		RCA8766B RCA8766C		RCA8766D RCA8766E		
	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CER} R_{BE} = 50 Ω	350			–	1	–	–	–	–	mA
	400			–	–	–	1	–	–	
	450			–	–	–	–	–	1	
T_C = 150°C	350			–	10	–	–	–	–	
	400			–	–	–	10	–	–	
	450			–	–	–	–	–	10	
I_{EBO} V_{BE} = −5 V		0		–	60	–	60	–	60	mA
$V_{CEO}(sus)$		0.2[a]	0	350	–	400	–	450	–	V
h_{FE}										
RCA8766	3	6[a]		100	–	–	–	–	–	
RCA8766A	3	4[a]		100	–	–	–	–	–	
RCA8766B	3	6[a]		–	–	100	–	–	–	
RCA8766C	3	4[a]		–	–	100	–	–	–	
RCA8766D	3	6[a]		–	–	–	–	100	–	
RCA8766E	3	4[a]		–	–	–	–	100	–	
V_{BE}										
RCA8766	3	6[a]		–	2.5	–	–	–	–	V
RCA8766A	3	4[a]		–	2.5	–	–	–	–	
RCA8766B	3	6[a]		–	–	–	2.5	–	–	
RCA8766C	3	4[a]		–	–	–	2.5	–	–	
RCA8766D	3	6[a]		–	–	–	–	–	2.5	
RCA8766E	3	4[a]		–	–	–	–	–	2.5	
$V_{CE}(sat)$										
RCA8766		6[a]	0.2[a]	–	1.5	–	–	–		V
RCA8766A		4[a]	0.133[a]	–	1.5	–	–	–		
RCA8766B		6[a]	0.2[a]	–	–	–	1.5	–		
RCA8766C		4[a]	0.133[a]	–	–	–	1.5	–	–	
RCA8766D		6[a]	0.2[a]	–	–	–	–	–	1.5	
RCA8766E		4[a]	0.133[a]	–	–	–	–	–	1.5	
All Types		8[a]	0.5[a]	–	2.5	–	2.5	–	2.5	
V_F		7[a]		–	2	–	2	–	2	V
$\|h_{fe}\|$ f = 1 MHz	5	1		10	–	10	–	10	–	
$I_{S/b}$ t = 1 s, nonrep.	30			5	–	5	–	5	–	A
$R_{\theta JC}$				–	1	–	1	–	1	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

RCA8766 Series

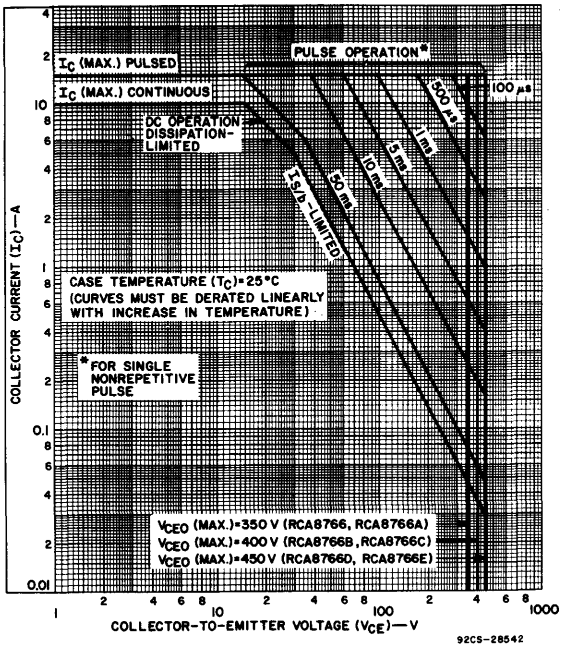


Fig. 4 – Maximum operating areas for all types.

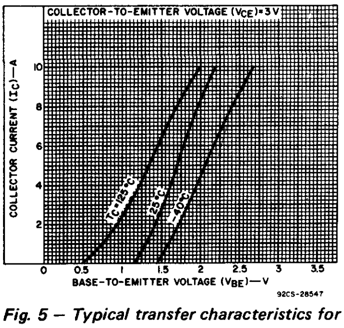


Fig. 5 – Typical transfer characteristics for all types.

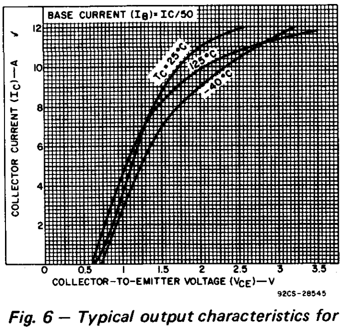


Fig. 6 – Typical output characteristics for all types.

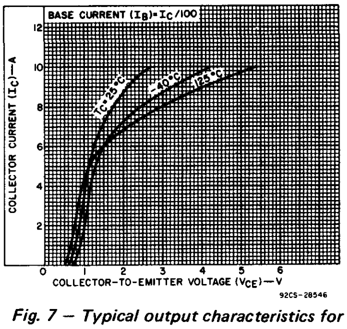


Fig. 7 – Typical output characteristics for all types.

RCP111, RCP113, RCP115, RCP117 Series

High-Voltage, Medium-Power Silicon N-P-N Power Transistors

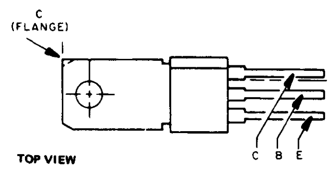
For TV Video Output and Linear-Amplifier Applications

The RCP111-, RCP113, RCP115-, and RCP117-series power transistors are double-diffused, epitaxial-collector silicon n-p-n transistors with planar junctions and field-shield construction. These transistors are designed especially for TV applications such as RGB output, chroma output, and video output. They are also suitable for use in regulators, audio output and amplifier circuits, and electrostatic deflection in display circuits. The devices are supplied in the JEDEC TO-202AB VERSATAB molded plastic package.

Features:

- Thermal-cycling ratings
- Maximum safe-area-of-operation curves
- High gain-bandwidth product: f_T = 80 MHz typ.

TERMINAL DESIGNATIONS



JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCP111D RCP113D	RCP111C RCP113C	RCP111B RCP113B	RCP111A RCP113A	RCP115B RCP117B	RCP115 RCP117	
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:								
With base open	$V_{CEO}(sus)$	350	300	250	200	250	100	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	7	5	5	V
CONTINUOUS COLLECTOR CURRENT	I_C	150	150	150	150	150	150	mA
CONTINUOUS BASE CURRENT	I_B	50	50	50	50	50	50	mA
TRANSISTOR DISSIPATION:	P_T							
At case temperatures up to 25°C		6.25	6.25	6.25	6.25	6.25	6.25	W
At ambient temperatures up to 25°C		1.56	1.56	1.56	1.56	1.56	1.56	W
For pulse operation		See Fig. 7						
TEMPERATURE RANGE:								
Storage & Operating (Junction)		−65 to 150						°C
LEAD TEMPERATURE (During Soldering):								
At distances ≥ 1/16 in. (1.39 mm) from case for 10 s max.		230						°C

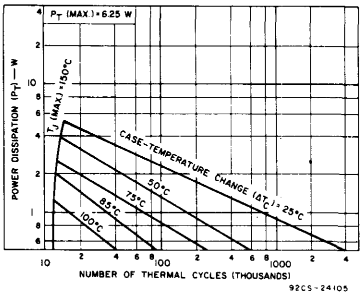


Fig. 1 — Thermal-cycling rating chart for all types.

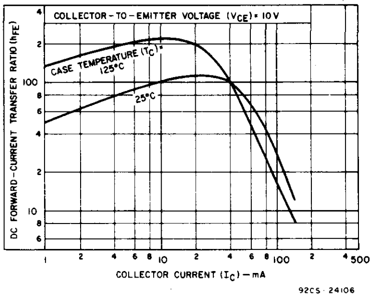


Fig. 2 — Typical dc beta characteristics for all types.

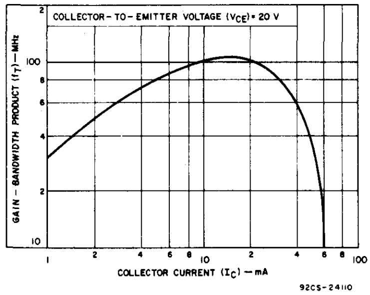


Fig. 3 — Typical gain-bandwidth product for all types.

RCP111, RCP113, RCP115, RCP117 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature, T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc			CURRENT mA dc		LIMITS RCP111A RCP113A		RCP111B RCP113B		RCP111C RCP113C		RCP111D RCP113D		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CBO}	350					–	–	–	–	–	–	–	1	μA
	300					–	–	–	–	–	1	–	–	
	250					–	–	–	1	–	–	–	–	
	200					–	1	–	–	–	–	–	–	
I_{CEO}		250			0	–	–	–	–	–	–	–	5	μA
		200			0	–	–	–	–	–	5	–	–	
		175			0	–	–	–	5	–	–	–	–	
		150			0	–	5	–	–	–	–	–	–	
I_{EBO}			6	0		–	10	–	10	–	10	–	10	μA
h_{FE} RCP111 Series		10		25[a]		50	300	50	300	50	300	50	300	
		10		1[a]		25	–	25	–	25	–	25	–	
RCP113 Series		10		25[a]		30	150	30	150	30	150	30	150	
		10		1[a]		15	–	15	–	15	–	15	–	
$V_{CEO}(sus)$[b]				20[a]	0	200	–	250	–	300	–	350	–	V
V_{BE}		10		25[a]		–	0.8	–	0.8	–	0.8	–	0.8	V
$V_{(BR)EBO}$ (I_E = 1 mA)				0		7	–	7	–	7	–	7	–	V
$V_{CE}(sat)$				25[a]	2.5	–	1	–	1	–	1	–	1	V
$\|h_{fe}\|$ (f = 20 MHz)		20		15		4 (typ.)		(4 typ.)		4 (typ.)		4 (typ.)		
f_T		20		15		80 (typ.)		80 (typ.)		80 (typ.)		80 (typ.)		MHz
$I_{S/b}$ (t = 0.05 s)		100				100	–	100	–	100	–	100	–	mA
C_{cb} (I_E = 0)	20			25		–	2.25	–	2.25	–	2.25	–	2.25	pF
$R_{\theta JC}$						–	20	–	20	–	20	–	20	°C/W
$R_{\theta JA}$						–	80	–	80	–	80	–	80	

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

[b] CAUTION: Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.

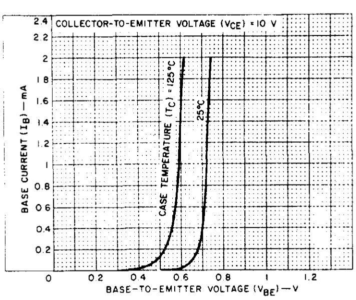


Fig. 4 – Typical input characteristics for all types.

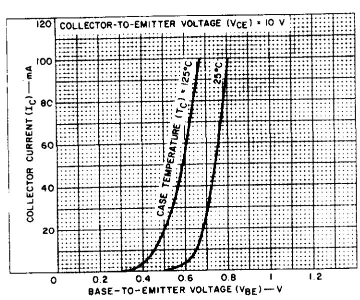


Fig. 5 – Typical transfer characteristics for all types.

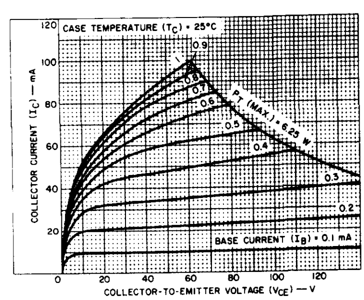


Fig. 6 – Typical output characteristics for all types.

RCP111, RCP113, RCP115, RCP117 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature, T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc I_C	I_B	LIMITS: RCP115 MIN.	MAX.	RCP115B MIN.	MAX.	RCP117 MIN.	MAX.	RCP117B MIN.	MAX.	UNITS
I_{CBO}	250 100					– –	– 50	– –	50 –	– –	– 50	– –	50 –	μA
I_{CEO}		175 70			0 0	– –	– 100	– –	100 –	– –	– 100	– –	100 –	μA
h_{FE}		10 10		25[a] 1[a]		50 10	– –	50 10	– –	20 10	– –	20 10	– –	
$V_{CEO}(sus)$[b]				20[a]	0	100	–	250	–	100	–	250	–	V
V_{BE}		10		25[a]		–	1.5	–	1.5	–	1.5	–	1.5	V
$V_{(BR)EBO}$ (I_E = 1 mA)				0		5	–	5	–	5	–	5	–	V
$V_{CE}(sat)$				25[a]	5	–	2	–	2	–	2	–	2	V
$\|h_{fe}\|$ (f = 20 MHz)		20		15		4 (typ.)		4 (typ.)		4 (typ.)		4 (typ.)		
f_T		20		15		80 (typ.)		80 (typ.)		80 (typ.)		80 (typ.)		MHz
$I_{S/b}$ (t = 0.05 s)		75				130	–	130	–	130	–	130	–	mA
C_{cb} (I_E = 0)		20		25		–	2.25	–	2.25	–	2.25	–	2.25	pF
$R_{\theta JC}$						–	20	–	20	–	20	–	20	°C/W
$R_{\theta JA}$						–	80	–	80	–	80	–	80	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ≤2%.

[b] CAUTION: Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.

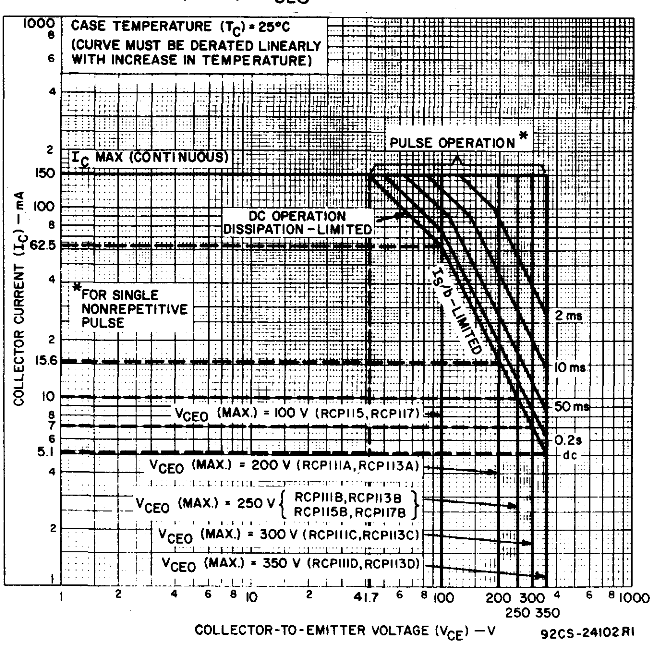


Fig. 7 — Maximum operating areas for all types.

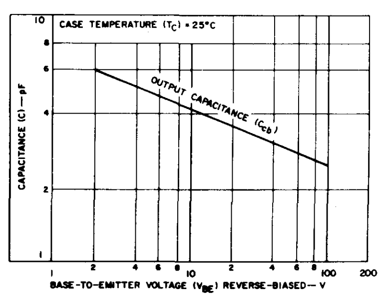


Fig. 8 — Typical junction capacitance vs. reverse-bias base-to-emitter voltage.

RCP131, RCP133, RCP135, RCP137 Series

High-Voltage, Medium-Power Silicon N-P-N Power Transistors

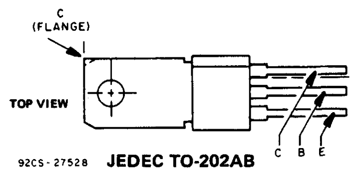
For TV Video Output, Horizontal Driver, and Linear-Amplifier Applications

The RCP131-, RCP133-, RCP135-, and RCP137-series devices are double-diffused, epitaxial-collector silicon n-p-n power transistors with planar junctions and field-shield construction. These transistors are designed especially for TV applications such as horizontal driver, chroma output, and video output. They are also suitable for use in regulators, audio output and amplifier circuits, and electrostatic deflection in display circuits. The devices are supplied in the VERSATAB JEDEC TO-202AB, plastic package.

Features:

- **Thermal-cycling ratings**
- **Maximum safe-area-of-operation curves**
- **High gain-bandwidth product: f_T = 30 MHz min.**

TERMINAL DESIGNATIONS



JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCP131A RCP133A	RCP131B RCP133B	RCP131C RCP133C	RCP131D RCP133D	RCP135 RCP137	RCP135B RCP137B	
V_{CEO}(sus)	200	250	300	350	100	250	V
V_{EBO}	7	7	7	7	5	5	V
I_C	1	1	1	1	1	1	A
I_B	0.5	0.5	0.5	0.5	0.5	0.5	A
P_T:							
$T_C \leq 25°C$	10	10	10	10	10	10	W
$T_A \leq 25°C$	1.75	1.75	1.75	1.75	1.75	1.75	W
For pulse operation	See Fig. 1						
T_{stg}, T_J	−65 to 150						°C
T_L: During soldering at distance ≥ 1/16 in. (1.39 mm) from case for 10 s max.	230						°C

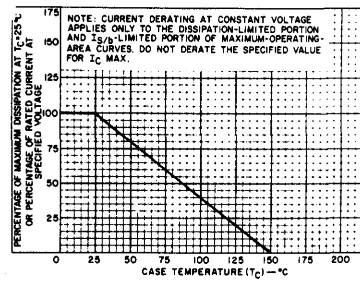


Fig. 2—Dissipation derating curve at case temperature for all types.

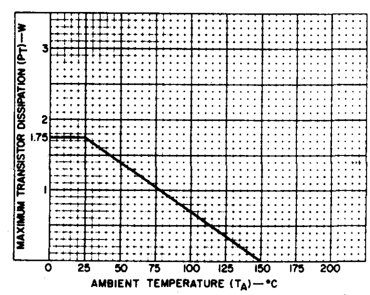


Fig. 3—Dissipation derating curve at ambient temperature for all types.

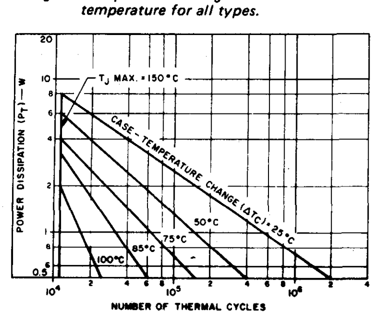


Fig. 4—Thermal-cycling rating chart for all types.

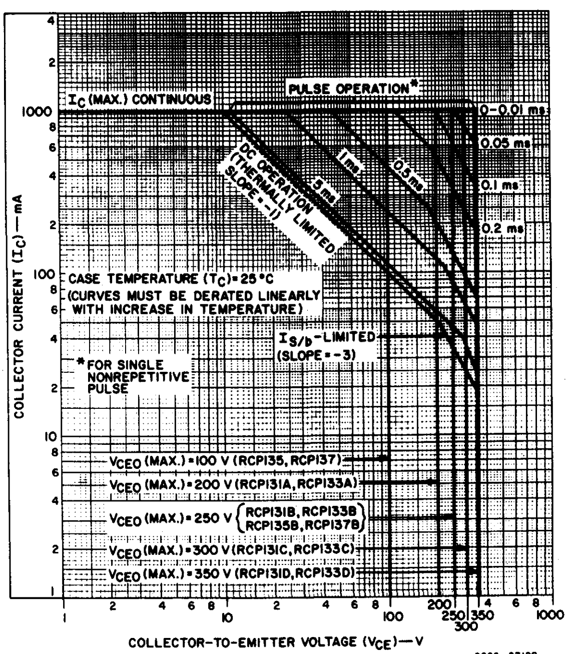


Fig. 1—Maximum operating areas for all types.

RCP131, RCP133, RCP135, RCP137 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc I_C	I_B	LIMITS RCP131A, RCP133A, RCP131C, RCP133C, RCP135, RCP137 Min.	Max.	RCP131B, RCP133B, RCP131D, RCP133D, RCP135B, RCP137B Min.	Max.	UNITS
I_{CBO} (I_E = 0)										
RCP131A, RCP133A	200					–	5	–	–	µA
RCP131B, RCP133B	250					–	–	–	5	µA
RCP131C, RCP133C	300					–	5	–	–	µA
RCP131D, RCP133D	350					–	–	–	5	µA
RCP135, RCP137	100					–	50	–	–	µA
RCP135B, RCP137B	250					–	–	–	50	µA
I_{CEO}										
RCP131A, RCP133A		150			0	–	10	–	–	µA
RCP131B, RCP133B		175			0	–	–	–	10	µA
RCP131C, RCP133C		200			0	–	10	–	–	µA
RCP131D, RCP133D		250			0	–	–	–	10	µA
RCP135, RCP137		50			0	–	100	–	–	µA
RCP135B, RCP137B		125			0	–	–	–	100	µA
I_{EBO} (RCP131, RCP133-series only)			–6	0		–	10	–	10	µA
h_{FE}										
RCP131-series		10		50[a]		50	300	50	300	
RCP133-series		10		50[a]		30	150	30	150	
RCP135-series		10		50[a]		50	–	50	–	
RCP137-series		10		50[a]		20	–	20	–	
V_{CEO}(sus)										
RCP131A, RCP133A				20[a]	0	200[b]	–	–	–	V
RCP131B, RCP133B				20[a]	0	–	–	250[b]	–	V
RCP131C, RCP133C				20[a]	0	300[b]	–	–	–	V
RCP131D, RCP133D				20[a]	0	–	–	350[b]	–	V
RCP135, RCP137				20[a]	0	100[b]	–	–	–	V
RCP135B, RCP137B				20[a]	0	–	–	250[b]	–	V
V_{BE}										
RCP131, RCP133-series		10		50[a]		–	1	–	1	V
RCP135, RCP137-series		10		50[a]		–	1.5	–	1.5	V
$V_{(BR)EBO}$ (I_E = 1 mA)										
RCP131, RCP133-series				0		7	–	7	–	V
RCP135, RCP137-series				0		5	–	5	–	V
V_{CE}(sat)										
RCP131, RCP133-series				50[a]		–	1	–	1	V
RCP135, RCP137-series				50[a]	5	–	5	–	5	V
$\|h_{fe}\|$ (f = 3 MHz)		20		20		10	–	10	–	
f_T		20		20		30	–	30	–	MHz
$I_{S/b}$ (t = 0.4 s)		100				100	–	100	–	mA
C_{ob} (f = 1 MHz)		20				–	8	–	8	pF
$R_{\theta JC}$						–	12.5	–	12.5	°C/W
$R_{\theta JA}$						–	71.4	–	71.4	°C/W

[a] Pulsed, pulse duration = 300 µs, duty factor ≤ 2%.

[b] CAUTION: Sustaining voltage, V_{CEO}(sus), MUST NOT be measured on a curve tracer.

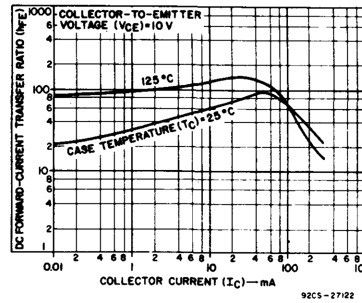


Fig. 5 - Typical dc beta characteristics for all types.

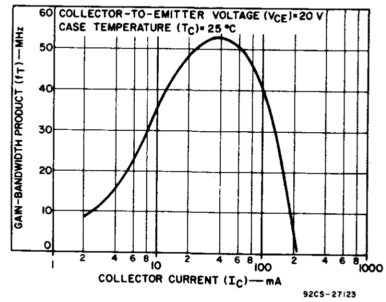


Fig. 6 - Typical gain-bandwidth product for all types.

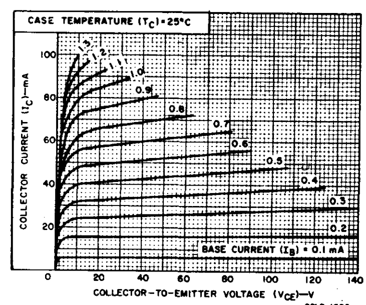


Fig. 7 - Typical output characteristics for all types.

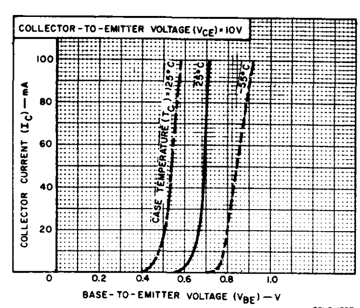


Fig. 8 - Typical transfer characteristics for all types.

RCP700, RCP702, RCP704, RCP706 Series
RCP701, RCP703, RCP705, RCP707 Series

General-Purpose, Medium- Power Silicon N-P-N and P-N-P Planar Transistors

Features

- Maximum safe-area-of-operation curves specified for dc operation
- Planar construction for low noise and low leakage
- High gain at high current
- Fast switching time
- Thermal-cycling ratings
- Types in RCP700, RCP702, RCP704, and RCP706 series are p-n-p complements of n-p-n types in RCP701, RCP703, RCP705, and RCP707 series

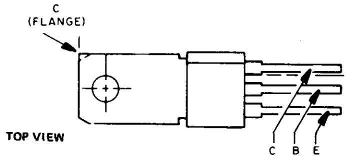
The RCA-RCP700-, RCP702-, RCP704-, and RCP706-series power transistors are double-diffused, epitaxial-planar silicon p-n-p transistors. The RCA-RCP701-, RCP703-, RCP 705-, and RCP707-series power transistors are double-diffused, epitaxial-planar silicon n-p-n transistors.

All of these devices are intended for a wide variety of large-signal, general-purpose applications such as complementary vertical deflection, TV sound output, regulators, and driver and output stages of audio amplifiers.

The RCP700-, RCP702-, RCP704-, and RCP706-series types are p-n-p complements of the n-p-n devices in the RCP701, RCP703, RCP705, and RCP707 series.

These are supplied in the JEDEC TO-202AB molded plastic package.

TERMINAL DESIGNATIONS



JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCP700D RCP702D RCP701D RCP703D	RCP700C RCP702C RCP701C RCP703C	RCP700B RCP702B RCP701B RCP703B	RCP700A RCP702A RCP701A RCP703A	RCP704B RCP706B RCP705B RCP707B	RCP704♦ RCP706♦ RCP705 RCP707	
V_{CBO}	125	105	85	55	85	45	V
$V_{CEO}(sus)$	100	80	60	40	60	30	V
V_{EBO}	5						V
I_C	2						A
I_B	1						A
P_T:							
$T_C \leq 25^oC$	10						W
$T_C > 25^oC$	Derate linearly 0.08 W/°C						
$T_A \leq 25^oC$	1.75						W
$T_A > 25^oC$	Derate linearly 0.014 W/°C						
T_{stg}, T_J	−65 to 150						°C
T_L At distance 1/8 in.(3.17 mm) from case for 10 s max.	230						°C

♦For p-n-p devices, voltage and current values are negative.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*
RCP700 and RCP702 Series, P-N-P Types

CHARAC-TERISTIC SYMBOL	TEST CONDITIONS					LIMITS								UNITS
	VOLTAGE V dc			CURRENT A dc		RCP700A RCP702A		RCP700B RCP702B		RCP700C RCP702C		RCP700D RCP702D		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E=0$	−50 −70					– –	−0.5 –	– –	– −0.5	– –	−0.5 –	– –	– −0.5	μA
I_{CEO}		−30 −45			0 0	– –	−100 –	– –	– −100	– –	−100 –	– –	– −100	μA
I_{CEV}		−55 −85	1.5 1.5			– –	−100 –	– –	– −100	– –	−100 –	– –	– −100	μA
I_{EBO}			5	0		–	−100	–	−100	–	−100	–	−100	μA
h_{FE} RCP700 series RCP702 series Both series		−4 −4 −4		−0.5[a] −0.5[a] −1[a]		50 30 10	250 150 –	50 30 10	250 150 –	50 30 10	250 150 –	50 30 10	250 150 –	
$V_{CEO}(sus)$[b]				−0.1[a]	0	−40	–	−60	–	−80	–	−100	–	V
$V_{BE}(sat)$				−0.5[a]	−0.05	–	−1.2	–	−1.2	–	−1.2	–	−1.2	V
V_{BE}		−4		−0.5[a]		–	−1.1	–	−1.1	–	−1.1	–	−1.1	V
$V_{CE}(sat)$				−0.5[a]	−0.05	–	−0.8	–	−0.8	–	−0.8	–	−0.8	V
$\|h_{fe}\|$ f=10 MHz		−4		−0.05		5	–	5	–	5	–	5	–	
f_T		−4		−0.05		50	–	50	–	50	–	50	–	MHz
$I_{S/b}$ With base forward biased		−35 −50				−285 –	– –	– −150	– –	−150	–	−150	–	mA
C_{obo} f=1 MHz	−10					20	40	20	40	20	40	20	40	pF
t_{ON}	(V_{CC}) −30			0.5	I_{B_1}=−0.05 I_{B_2}=0.05	–	100	–	100	–	100	–	100	ns
t_{OFF}	(V_{CC}) −30			0.5	I_{B_1}=−0.05 I_{B_2}=0.05	–	1000	–	1000	–	1000	–	1000	ns
$R_{\theta JC}$ $R_{\theta JA}$						– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%. [b] *CAUTION:* Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.

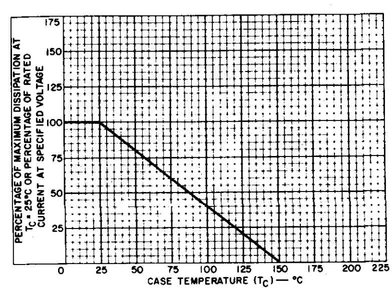


Fig. 1 - Dissipation derating curve for all types.

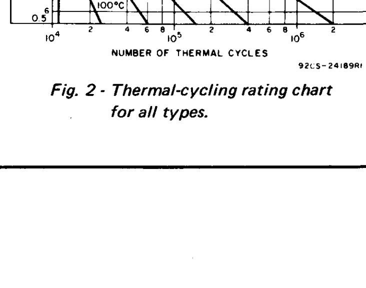


Fig. 2 - Thermal-cycling rating chart for all types.

RCP700, RCP702, RCP704, RCP706 Series
RCP701, RCP703, RCP705, RCP707 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*
RCP704, RCP705, RCP706, RCP707 Series N-P-N and P-N-P Types
RCP704 and RCP706 Series RCP705 and RCP707 Series

CHARACTERISTIC SYMBOL	TEST CONDITIONS♦					LIMITS								UNITS
	VOLTAGE V dc			CURRENT A dc		RCP704 RCP706		RCP704B RCP706B		RCP705 RCP707		RCP705B RCP707B		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E=0$	-40 -70					– –	-5 –	– –	– -5	– –	5 –	– –	– 5	μA
I_{CEO}		-22 -45			0 0	– –	-1000 –	– –	– -1000	– –	1000 –	– –	– 1000	μA
I_{CEV}		-45 -85	-1.5 -1.5			– –	-1000 –	– –	– -1000	– –	1000 –	– –	– 1000	μA
I_{EBO}			-5	0		–	-100	–	-100	–	100	–	100	μA
h_{FE} RCP704 RCP705 series RCP706 RCP707 series		 -4 -4		 -0.5[a] -0.5[a]		 50 20	 – –	 50 20	 – –	 50 20	 – –	 50 20	 – –	
$V_{CEO}(sus)$[b]				-0.1[a]	0	-30	–	-60	–	30	–	60	–	V
$V_{BE}(sat)$				-0.5[a]	-0.05	–	-1.6	–	-1.6	–	1.6	–	1.6	V
V_{BE}		-4		-0.5[a]		–	-1.5	–	-1.5	–	1.5	–	1.5	V
$V_{CE}(sat)$				-0.5[a]	-0.05	–	-1.2	–	-1.2	–	1.2	–	1.2	V
$\|h_{fe}\|$ f=10 MHz		-4		-0.05		5	–	5	–	5	–	5	–	
f_T		-4		-0.05		50	–	50	–	50	–	50	–	MHz
$I_{S/b}$ With base forward biased		 -20 -50				 -500 –	 – –	 – -200	 – –	 500 –	 – –	 – 120	 – –	mA
C_{obo} f=1 MHz	-10					20	40	20	40	8	25	8	25	pF
t_{ON}	(V_{CC}) -30			0.5	I_{B_1}=-0.05 I_{B_2}=0.05	–	100	–	100	–	80	–	80	ns
t_{OFF}	(V_{CC}) -30			0.5	I_{B_1}=-0.05 I_{B_2}=0.05	–	1000	–	1000	–	800	–	800	ns
$R_{\theta JC}$ $R_{\theta JA}$						– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	°C/W

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*
RCP701 and RCP703 Series, N-P-N Types

CHARACTERISTIC SYMBOL	TEST CONDITIONS					LIMITS								UNITS
	VOLTAGE V dc			CURRENT A dc		RCP701A RCP703A		RCP701B RCP703B		RCP701C RCP703C		RCP701D RCP703D		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E=0$	50 70					– –	0.5 –	– –	– 0.5	– –	0.5 –	– –	– 0.5	μA
I_{CEO}		30 45			0 0	– –	100 –	– –	– 100	– –	100 –	– –	– 100	μA
I_{CEV}		55 85	-1.5 -1.5			– –	100 –	– –	– 100	– –	100 –	– –	– 100	μA
I_{EBO}			-5	0		–	100	–	100	–	100	–	100	μA
h_{FE} RCP701 series RCP703 series Both series		 4 4 4		 0.5[a] 0.5[a] 1[a]		 50 30 10	 250 150 –	 50 30 10	 250 150 –	 50 30 10	 250 150 –	 50 30 10	 250 150 –	
$V_{CEO}(sus)$[b]				0.1[a]	0	40	–	60	–	80	–	100	–	V
$V_{BE}(sat)$				0.5[a]	0.05	–	1.2	–	1.2	–	1.2	–	1.2	V
V_{BE}		4		0.5[a]		–	1.1	–	1.1	–	1.1	–	1.1	V
$V_{CE}(sat)$				0.5[a]	0.05	–	0.8	–	0.8	–	0.8	–	0.8	V
$\|h_{fe}\|$ f=10 MHz		4		0.05		5	–	5	–	5	–	5	–	
f_T		4		0.05		50	–	50	–	50	–	50	–	MHz
$I_{S/b}$ With base forward biased		 20 50				 500 –	 – –	 – 200	 – –	 200	 –	 200	 –	mA
C_{obo} f=1 MHz	10					8	20	8	20	8	20	8	20	pF
t_{ON}	(V_{CC}) 30			0.5	I_{B_1}=0.05 I_{B_2}=-0.05	–	80	–	80	–	80	–	80	ns
t_{OFF}	(V_{CC}) 30			0.5	I_{B_1}=0.05 I_{B_2}=-0.05	–	800	–	800	–	800	–	800	ns
$R_{\theta JC}$ $R_{\theta JA}$						– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	– –	12.5 71.4	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.
[b] *CAUTION:* Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.
♦ For p-n-p devices, voltage and current values are negative.

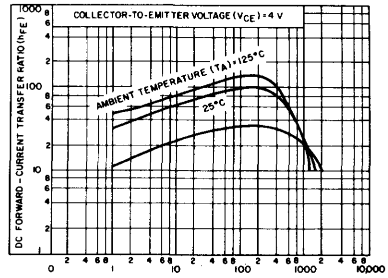


Fig. 3 - Typical static beta characteristics for RCP701, RCP703, RCP705, RCP707-series types.

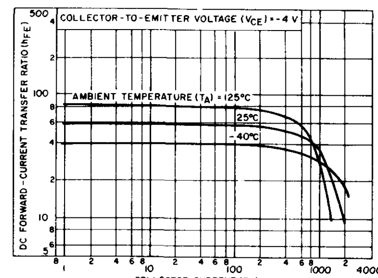


Fig. 4 - Typical static beta characteristics for RCP700, RCP702, RCP704, RCP706-series types.

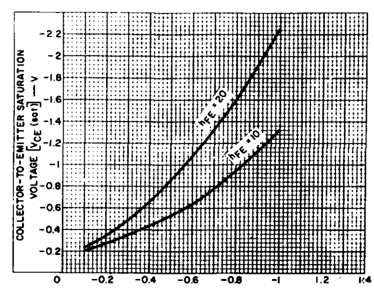


Fig. 5 - Typical saturation-voltage characteristics for RCP700, RCP702, RCP704, RCP706-series types.

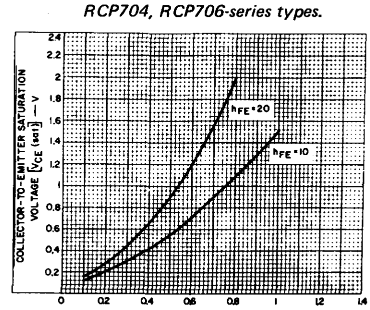


Fig. 6 - Typical saturation-voltage characteristics for RCP701, RCP703, RCP705, RCP707-series types.

RCP700, RCP702, RCP704, RCP706 Series
RCP701, RCP703, RCP705, RCP707 Series

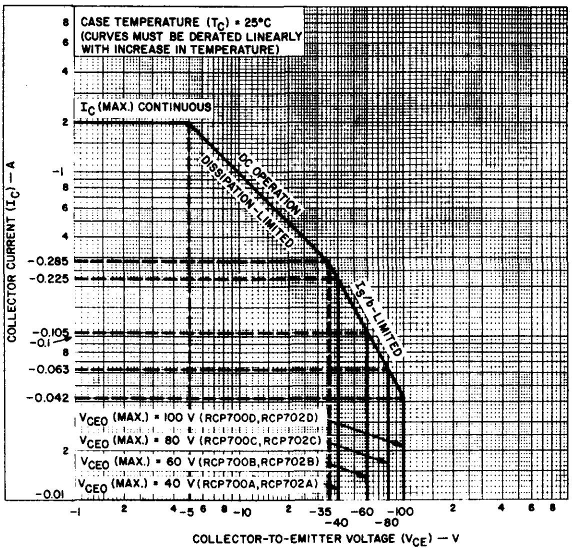


Fig. 7 - Maximum operating areas for RCP700-series and RCP702-series types.

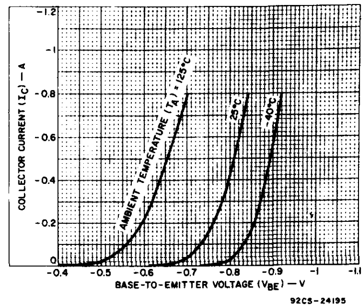


Fig. 8 - Typical transfer characteristics for RCP700, RCP702, RCP704, RCP706-series types.

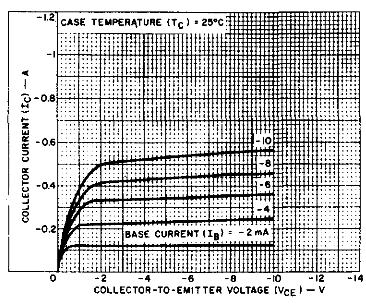


Fig. 9 - Typical output characteristics for RCP700, RCP702, RCP704, RCP706-series types.

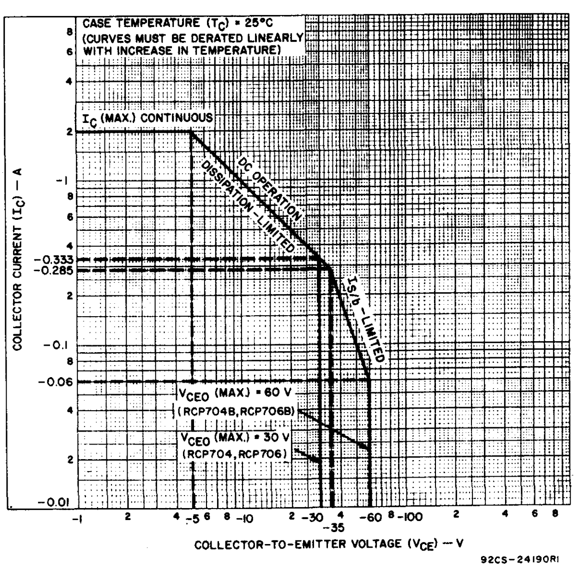


Fig. 10 - Maximum operating areas for RCP704-series and RCP706-series types.

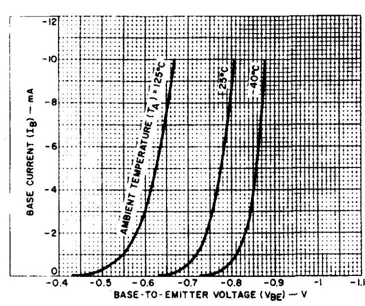


Fig. 11 - Typical input characteristics for RCP700, RCP702, RCP704, RCP706-series types.

RCP700, RCP702, RCP704, RCP706 Series
RCP701, RCP703, RCP705, RCP707 Series

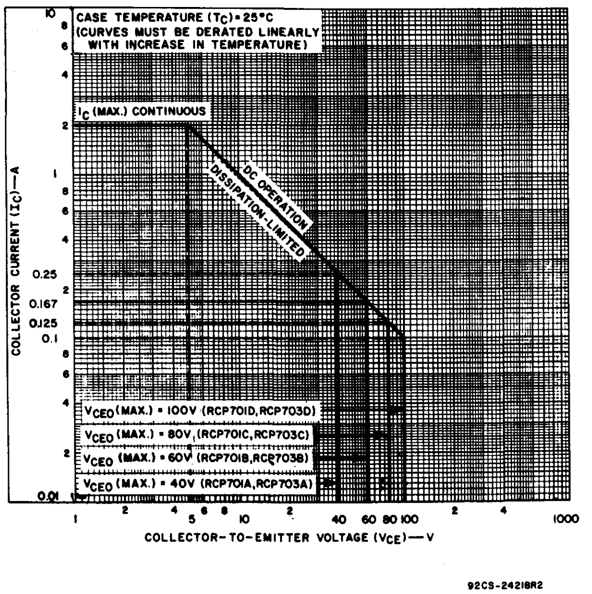


Fig. 12 - Maximum operating areas for RCP701-series and RCP703-series types.

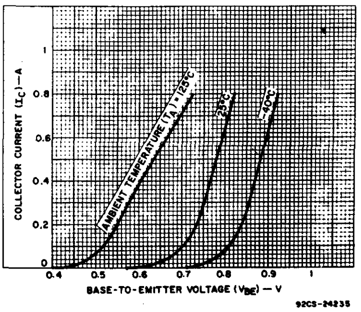


Fig. 13 - Typical transfer characteristics for RCP701, RCP703, RCP705, RCP707-series types.

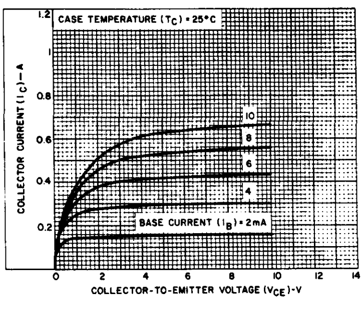


Fig. 14 - Typical output characteristics for RCP701, RCP703, RCP705, RCP707-series types.

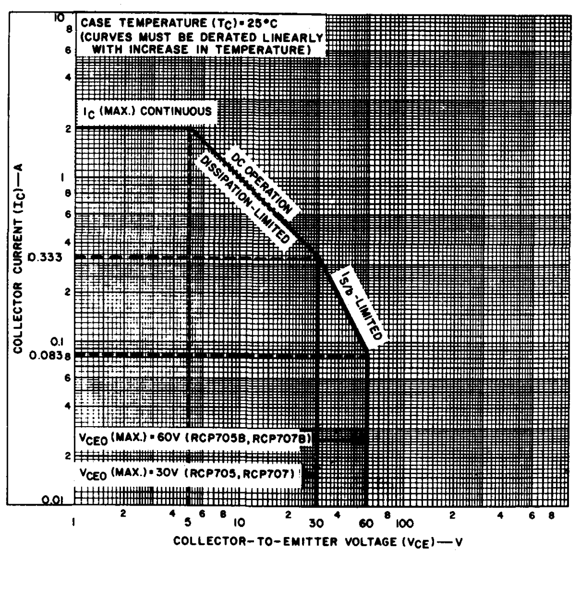


Fig. 15 - Maximum operating areas for RCP705-series and RCP707-series types.

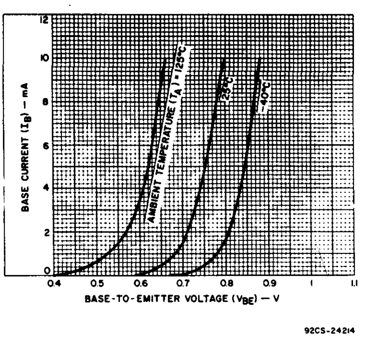


Fig. 16 - Typical input characteristics for RCP701, RCP703, RCP705, RCP707-series types.

RCS683, RCS683A, RCS683B

4-Ampere Monolithic N-P-N Darlington Power Transistors

40-60-80 Volts, 10 Watts
Gain of 1000 at 2 A

Features:
- Operates from 1C without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

The RCS683, RCS683A, and RCS683B• are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits; and their small package (TO-39) permits compact design.

• Formerly RCA Dev. Nos. TA8698C, TA8698B, and TA8698A, respectively.

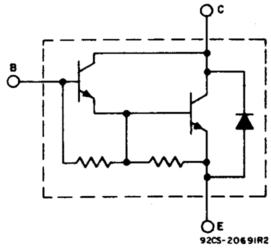
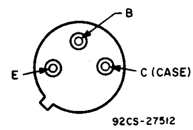


Fig. 1 – Schematic diagram for all types.

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCS683	RCS683A	RCS683B	
V_{CBO}	40	60	80	V
$V_{CER}(sus)$				
R_{BE} = 100 Ω	40	60	80	V
$V_{CEO}(sus)$	40	60	80	V
V_{CEX}				
V_{BE} = −1.5 V, R_{BB} = 100 Ω	40	60	80	V
V_{EBO}		5		V
I_C		4		A
I_{CM}		6		A
I_B		0.1		A
P_T				
$T_C \leq$ 25°C		10		W
$T_C >$ 25°C		derate linearly at 0.08		W/°C
T_{stg}		-65 to +200		°C
T_J		-65 to +150		°C
T_L				
At distances ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		°C

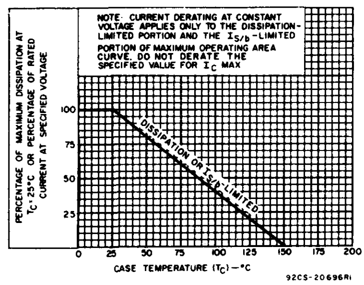


Fig. 2 – Derating curve.

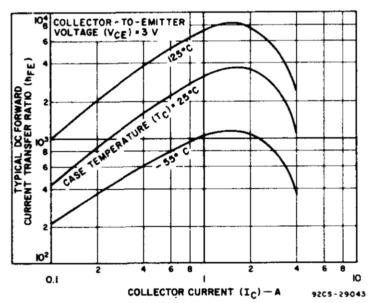


Fig. 4 – Typical DC beta characteristics.

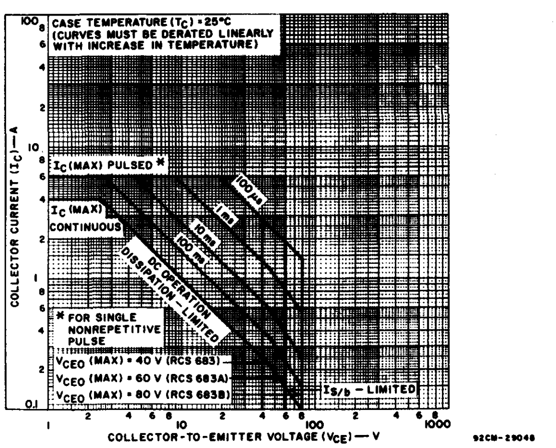


Fig. 3 – Maximum operating area.

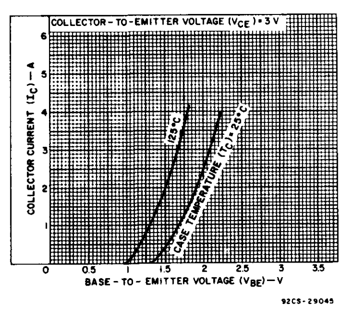


Fig. 5 – Typical transfer characteristics.

RCS683, RCS683A, RCS683B

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC SYMBOL	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		RCS683		RCS683A		RCS683B		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CEO}	40			0	–	1	–	–	–	–	
	60			0	–	–	–	1	–	–	
	80			0	–	–	–	–	–	1	
I_{CEV}	40	-1.5			–	0.15	–	–	–	–	
	60	-1.5			–	–	–	0.15	–	–	
	80	-1.5			–	–	–	–	–	0.15	mA
T_C = 125°C	40	-1.5			–	1.5	–	–	–	–	
	60	-1.5			–	–	–	1.5	–	–	
	80	-1.5			–	–	–	–	–	1.5	
I_{EBO}		-5	0		–	2	–	2	–	2	
$V_{CEO}(sus)$			0.1ᵃ	0	40	–	60	–	80	–	V
h_{FE}	3		2ᵃ		1000	–	1000	–	1000	–	
	3		4ᵃ		200	–	200	–	200	–	
V_{BE}	3		2ᵃ		–	2.4	–	2.4	–	2.4	
	3		4ᵃ		–	4	–	4	–	4	
$V_{CE}(sat)$			2ᵃ	0.004	–	1.6	–	1.6	–	1.6	V
			4ᵃ	0.04	–	2.8	–	2.8	–	2.8	
V_F			-4		–	3	–	3	–	3	
$\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	20	–	
C_{obo}	V_{CB} = 10			I_E = 0	–	60	–	60	–	60	pF
$E_{S/b}$ᵇ L = 12 mH, R_{BE} = 100 Ω		-1.5			30	–	30	–	30	–	mJ
$I_{S/b}$ t = 0.5 s non rep.	35				0.28	–	–	–	–	–	
	55				–	–	0.17	–	–	–	A
	75				–	–	–	–	0.11	–	
$R_{\theta JC}$					–	12.5	–	12.5	–	12.5	°C/W

ᵃ Pulsed: Pulse duration = 300 μs, duty factor = 2%.

ᵇ $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions.
$E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance, and I is the peak collector current.

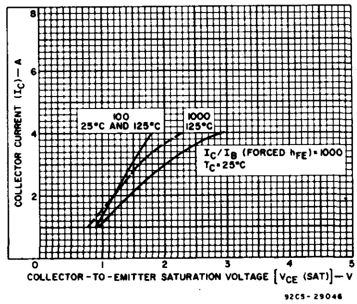


Fig. 6 — Typical saturation characteristics.

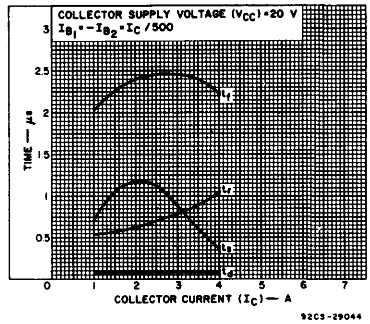


Fig. 7 — Typical saturated switching time characteristics.

TIP29, RCA29, RCS29 Series

Epitaxial-Base, Silicon N-P-N VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

The RCA-TIP29, RCA29 and RCS29-series are epitaxial-base, silicon n-p-n transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP30, RCA30 and RCS30-series.

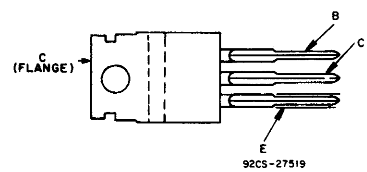
They differ from each other in voltage ratings.

The TIP29 and RCA29-series are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request. The RCA29-series are supplied in the JEDEC TO-213MA hermetic package.

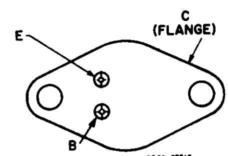
Features:

- **30 W at 25°C case temperature**
- **3 A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 200 mA**
- **Designed for complementary use with TIP30, RCA30 and RCS30-series p-n-p types**

TERMINAL CONNECTIONS



BOTTOM VIEW
JEDEC TO-220AB
TIP29 and RCA29-series



JEDEC TO-213MA
RCA29-series

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP29 RCA29 RCS29	TIP29A RCA29A RCS29A	TIP29B RCA29B RCS29B	TIP29C RCA29C RCS29C	
V_{CBO}	40	60	80	100	V
V_{CEO}	40	60	80	100	V
V_{EBO}	5	5	5	5	V
I_C	5	5	5	5	A
I_B	1	1	1	1	A
P_T:					
At $T_C \leq 25^\circ C$	30	30	30	30	W
At $T_A \leq 25^\circ C$	2	2	2	2	W
At $T_C > 25^\circ C$ TIP29 and RCA29-series Derate linearly		0.24			W/°C
RCS29-series Derate linearly		0.17			W/°C
T_{stg}, T_J TIP29 and RCA29-series		−65 to 150			°C
RCS29-series		−65 to 200			°C
T_L (During soldering):					
At distance 1/8 in. (3.17 mm) from case for 10s max. TIP29 and RCA29-series		235			°C
At a distance ≥ 1/32 inch (0.8 mm) from seating plane for 10s max. (RCS29-series)		235			°C

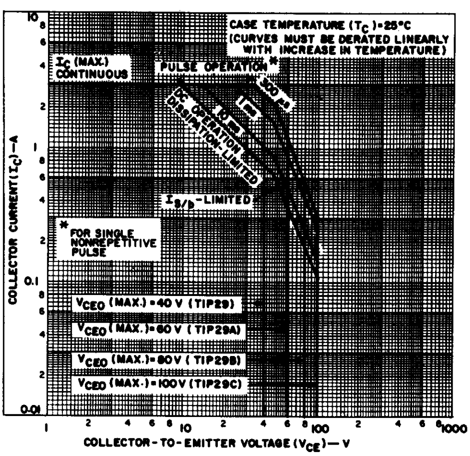


Fig. 1 – Maximum operating areas for TIP29-series.

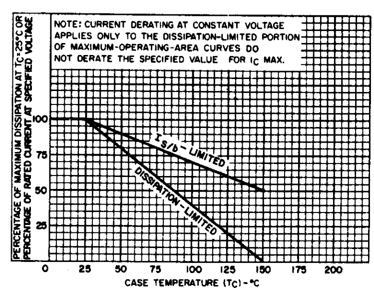


Fig. 2 – Derating curve for TIP29-series and RCA29-series.

TIP29, RCA29, RCS29 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST COND. VOLTAGE V dc V_{CE}	TEST COND. CURRENT A dc I_C	LIMITS TIP29 RCA29 RCS29 Min.	Max.	TIP29A RCA29A RCS29A Min.	Max.	TIP29B RCA29B RCS29B Min.	Max.	TIP29C RCA29C RCS29C Min.	Max.	Units
I_{CEO} I_B=0	30 60		– –	0.3 –	– –	0.3 –	– –	– 0.3	– –	– 0.3	mA
I_{CES} V_{EB}=0	40 60 80 100		– – – –	0.2 – – –	– – – –	– 0.2 – –	– – – –	– – 0.2 –	– – – –	– – – 0.2	mA
I_{EBO} V_{BE}=–5V		0	–	1	–	1	–	1	–	1	mA
V_{CEO}(sus) I_B=0		0.03[a]	40[b]	–	60[b]	–	80[b]	–	100[b]	–	V
h_{FE}	4 4	0.2[a] 1[a]	40 15	– 150	40 15	– 150	40 15	– 150	40 15	– 150	
V_{BE}	4	1[a]	–	1.3	–	1.3	–	1.3	–	1.3	V
V_{CE}(sat) I_B=0.125A		1[a]	–	0.7	–	0.7	–	0.7	–	0.7	V
h_{fe} f=1 kHz	10	0.2	20	–	20	–	20	–	20	–	
$\|h_{fe}\|$ f=1 MHz	10	0.2	3	–	3	–	3	–	3	–	
t_{ON} (t_d+t_r) V_{CC}=30V R_L=30Ω I_{B1}=I_{B2}=0.1A		1	0.4 (typ.)		0.4 (typ.)		0.4 (typ.)		0.4 (typ.)		µs
t_{OFF} (t_s+t_f) V_{CC}=30V R_L=30Ω I_{B1}=–I_{B2}=0.1A		1	1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		µs
$R_{\theta JC}$	TIP29 and RCA29-series		–	4.17	–	4.17	–	4.17	–	4.17	°C/W
	RCS29-series		–	5.83	–	5.83	–	5.83	–	5.83	°C/W
$R_{\theta JA}$	TIP29 and RCA29-series		–	62.5	–	62.5	–	62.5	–	62.5	°C/W
	RCS29-series		–	60	–	60	–		–	60	°C/W

[a] Pulsed, pulse duration = 300 µs, duty factor ≤ 2%.

[b] *CAUTION:* Sustaining voltage, V_{CEO}(sus), *MUST NOT* be measured on a curve tracer.

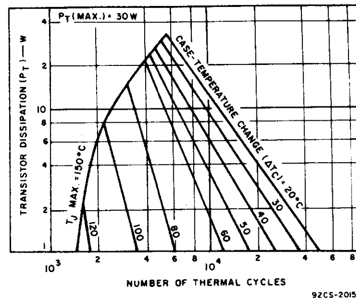


Fig. 3 — Thermal-cycling ratings for TIP29 and RCA29-series.

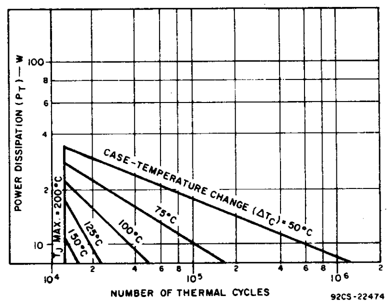


Fig. 4 — Thermal-cycling rating chart for RCS29-series.

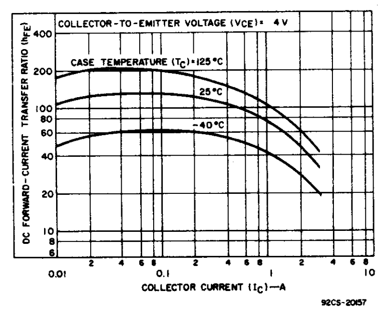


Fig. 5 — Typical dc beta characteristics for TIP29, TIP29A, TIP29B, RCA29, RCA29A, RCA29B; RCS29, RCS29A and RCS29B.

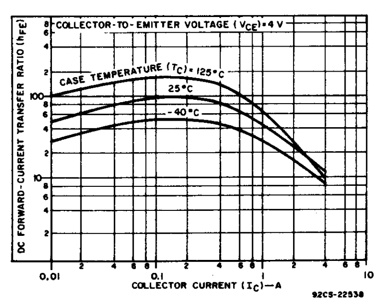


Fig. 6 — Typical dc beta characteristics for TIP29C, RCA29C and RCS29C.

TIP30, RCA30, RCS30 Series

Epitaxial-Base, Silicon P-N-P VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

The RCA-TIP30, RCA30 and RCS30-series are epitaxial-base, silicon p-n-p transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP29, RCA29 and RCS29-series.

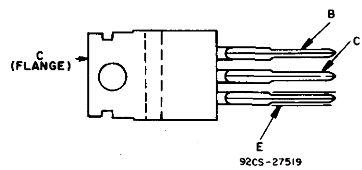
They differ from each other in voltage ratings.

The TIP30 and RCA30-series are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request. The RCS30-series are supplied in the JEDEC TO-213MA hermetic package.

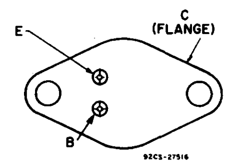
Features:

- **30 W at 25°C case temperature**
- **3 A rated collector current**
- **Min. f_T of 3 MHz at −10 V, −200 mA**
- **Designed for complementary use with TIP29, RCA29 and RCS29-series n-p-n types**

TERMINAL DESIGNATIONS



BOTTOM VIEW
JEDEC TO-220AB
TIP30 and RCA30-series



JEDEC TO-213MA
RCS30-series

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP RCA30 RCS30	TIP30A RCS30A RCS30A	TIP30B RCA30B RCS30B	TIP30C RCA30C RCS30C	
V_{CBO}	−40	−60	−80	−100	V
V_{CEO}	−40	−60	−80	−100	V
V_{EBO}	−5	−5	−5	−5	V
I_C	−5	−5	−5	−5	A
I_B	−1	−1	−1	−1	A
P_T:					
At $T_C \leq 25°C$	30	30	30	30	W
At $T_A \leq 25°C$	2	2	2	2	W
At $T_C > 25°C$ (TIP30 and RCA30-series) Derate linearly		0.24			W/°C
RCS30-series . . . Derate linearly		0.17			W/°C
T_{stg}, T_J TIP30 and RCA30-series		−65 to 150			°C
RCS30-series		−65 to 200			°C
T_L (During soldering):					
At distance 1/8 in. (3.17 mm) from case for 10s max. (TIP30 and RCA30-series)		235			°C
At a distance ≥ 1/32 inch (0.8 mm) from seating plane for 10s max. . . . (RCS30-series)		235			°C

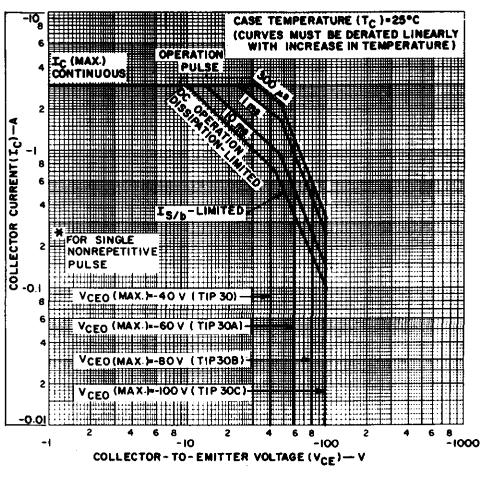


Fig. 1 — Maximum operating areas for TIP30-series.

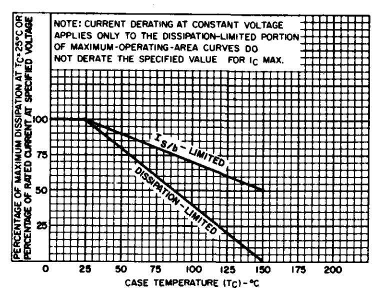


Fig. 2 — Derating curve to TIP30 and RCA30-series.

TIP30, RCA30, RCS30 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST COND. VOLTAGE V dc V_{CE}	TEST COND. CURRENT A dc I_C	LIMITS TIP30 RCA30 RCS30 Min.	Max.	TIP30A RCA30A RCS30A Min.	Max.	TIP30B RCA30B RCS30B Min.	Max.	TIP30C RCA30C RCS30C Min.	Max.	Units
I_{CEO} I_B=0	−30		–	−0.3	–	−0.3	–	–	–	–	mA
	−60		–	–	–	–	–	−0.3	–	−0.3	
I_{CES} V_{EB}=0	−40		–	−0.2	–	–	–	–	–	–	mA
	−60		–	–	–	−0.2	–	–	–	–	
	−80		–	–	–	–	–	−0.2	–	–	
	−100		–	–	–	–	–	–	–	−0.2	
I_{EBO} V_{BE}=5V		0	–	−1	–	−1	–	−1	–	−1	mA
$V_{CEO}(sus)$ I_B=0		−0.03[a]	−40[b]	–	−60[b]	–	−80[b]	–	−100[b]	–	V
h_{FE}	−4	−0.2[a]	40	–	40	–	40	–	40	–	
	−4	−1[a]	15	150	15	150	15	150	15	150	
V_{BE}	−4	−1[a]	–	−1.3	–	−1.3	–	−1.3	–	−1.3	V
$V_{CE}(sat)$ I_B= −0.125A		−1[a]	–	−0.7	–	−0.7	–	−0.7	–	−0.7	V
h_{fe} f=1 kHz	−10	−0.2	20	–	20	–	20	–	20	–	
$\|h_{fe}\|$ f=1 MHz	−10	−0.2	3	–	3	–	3	–	3	–	
t_{ON} (t_d+t_r) V_{CC}= −30V R_L=30Ω I_{B1}=$-I_{B2}$ =−0.1A		−1	0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		µs
t_{OFF} (t_s+t_f) V_{CC}= −30V R_L=30Ω I_{B1}=I_{B2} =−0.1A		−1	1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		µs
$R_{\theta JC}$	TIP31 and RCA31-series		–	4.17	–	4.17	–	4.17	–	4.17	°C/W
	RCS31-series		–	5.83	–	5.83	–	5.83	–	5.83	
$R_{\theta JA}$	TIP31 and RCA31-series		–	62.5	–	62.5	–	62.5	–	62.5	
	RCS31-series		–	60	–	60	–	60	–	60	

[a] Pulsed, pulse duration = 300 µs, duty factor ≤ 2%.

[b] *CAUTION:* Sustaining voltage, $V_{CEO}(sus)$, *MUST NOT* be measured on a curve tracer.

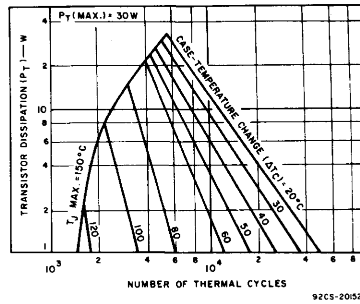


Fig. 3 — Thermal-cycling ratings for TIP30 and RCA30-series.

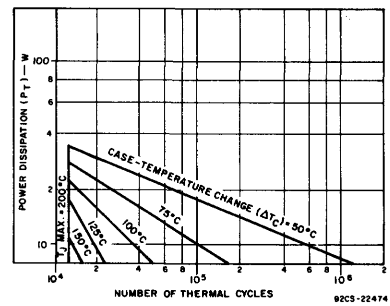


Fig. 4 — Thermal-cycling rating chart for RCS30-series.

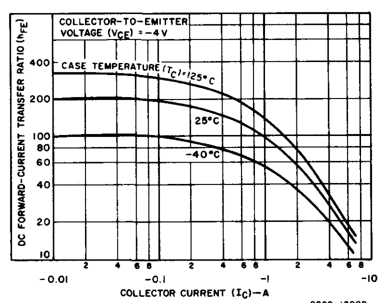


Fig. 5 — Typical dc beta characteristics for TIP30, TIP30A, TIP30B, RCA30, RCA30A, RCA30B, RCS30A and RCS30B.

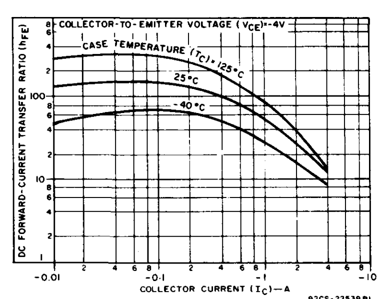


Fig. 6 — Typical dc beta characteristics for TIP30C, RCA30C, and RCS30C.

TIP31, RCA31, RCS31 Series

Epitaxial-Base, Silicon N-P-N VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

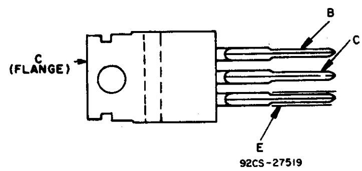
The RCA-TIP31, RCA31 and RCS31-series are epitaxial-base, silicon n-p-n transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP32, RCA32 and RCS32-series. They differ from each other in voltage ratings.

The TIP31 and RCS31-series are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request. The RCS31-series are supplied in the JEDEC TO-213MA hermetic package.

Features:

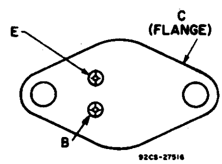
- **40 W at 25°C case temperature**
- **5 A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 500 mA**
- **Designed for complementary use with TIP32, RCA32 and RCS32-series p-n-p types**

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB
TIP31 and RCA31-series



JEDEC TO-213MA
RCS31-series

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP31 RCA31 RCS31	TIP31A RCA31A RCS31A	TIP31B RCA31B RCS31B	TIP31C RCA31C RCS31C	
V_{CBO}	40	60	80	100	V
V_{CEO}	40	60	80	100	V
V_{EBO}	5	5	5	5	V
I_C	5	5	5	5	A
I_B	1	1	1	1	A
P_T:					
At $T_C \leq 25°C$	40	40	40	40	W
At $T_A \leq 25°C$	2	2	2	2	W
At $T_C > 25°C$ (TIP31 and RCA31-series) Derate linearly		0.32			W/°C
RCS31-series . . . Derate linearly		0.23			W/°C
T_{stg}, T_J TIP31 and RCA31-series		−65 to 150			°C
RCS31-series		−65 to 200			°C
T_L (During soldering):					
At distance 1/8 in. (3.17 mm) from case for 10s max. (TIP31 and RCA31-series)		235			°C
At a distance ≥ 1/32 inch (0.8 mm) from seating plane for 10s max. (RCS31-series)		235			°C

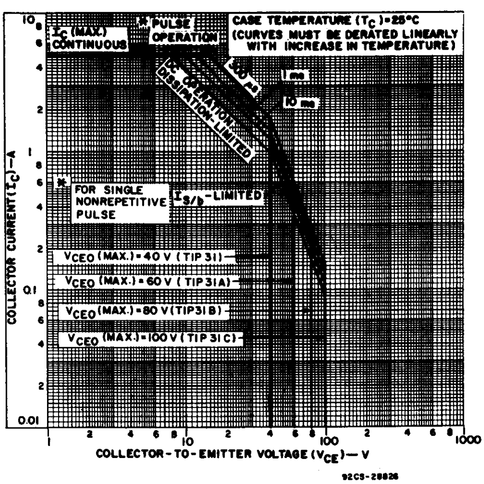


Fig. 1 — Maximum operating areas for TIP31-series.

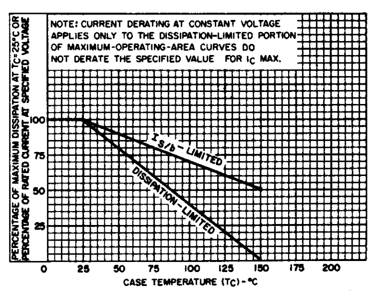


Fig. 2 — Derating curve for TIP31 and RCA31-series.

TIP31, RCA31, RCS31 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST COND. VOLTAGE V dc V_{CE}	TEST COND. CURRENT A dc I_C	TIP31 RCA31 RCS31 Min.	TIP31 RCA31 RCS31 Max.	TIP31A RCA31A RCS31A Min.	TIP31A RCA31A RCS31A Max.	TIP31B RCA31B RCS31B Min.	TIP31B RCA31B RCS31B Max.	TIP31C RCA31C RCS31C Min.	TIP31C RCA31C RCS31C Max.	Units
I_{CEO} I_B=0	30		–	0.3	–	0.3	–	–	–	–	mA
	60		–	–	–	–	–	0.3	–	0.3	
I_{CES} V_{EB}=0	40		–	0.2	–	–	–	–	–	–	mA
	60		–	–	–	0.2	–	–	–	–	
	80		–	–	–	–	–	0.2	–	–	
	100		–	–	–	–	–	–	–	0.2	
I_{EBO} V_{BE}=–5V		0	–	1	–	1	–	1	–	1	mA
V_{CEO}(sus) I_B=0		0.03[a]	40[b]	–	60[b]	–	80[b]	–	100[b]	–	V
h_{FE}	4	1[a]	25	–	25	–	25	–	25	–	
	4	3[a]	10	50	10	50	10	50	10	50	
V_{BE}	4	3[a]	–	1.8	–	1.8	–	1.8	–	1.8	V
V_{CE}(sat) I_B= 0.375A		3[a]	–	1.2	–	1.2	–	1.2	–	1.2	V
h_{fe} f=1 kHz	10	0.5	20	–	20	–	20	–	20	--	
$\|h_{fe}\|$ f=1 MHz	10	0.5	3	–	3	–	3	–	3	–	
t_{ON} (t_d+t_r) V_{CC}= 30V R_L=30Ω I_{B1}=I_{B2} =0.1A		1	0.4 (typ.)		0.4 (typ.)		0.4 (typ.)		0.4 (typ.)		μs
t_{OFF} (t_s+t_f) V_{CC}= 30V R_L=30Ω I_{B1}=–I_{B2} =0.1A		1	1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		1.2 (typ.)		μs
$R_{\theta JC}$	TIP31 and RCA31-series		—	3.125	–	3.125	–	3.125	–	3.125	°C/W
	RCS31-series		—	4.3	—	4.3	—	4.3	—	4.3	
$R_{\theta JA}$	TIP31 and RCA31-series		—	62.5	–	62.5	–	62.5	–	62.5	°C/W
	RCS31-series		—	60	—	60	—		—	60	

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽ 2%.

[b] *CAUTION:* Sustaining voltage, V_{CEO}(sus), ***MUST NOT*** be measured on a curve tracer.

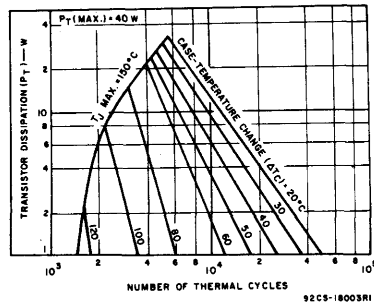


Fig. 3 – Thermal-cycling ratings for TIP31 and RCA31-series.

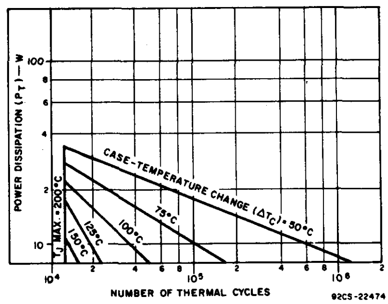


Fig. 4 – Thermal-cycling rating chart for RCS31-series

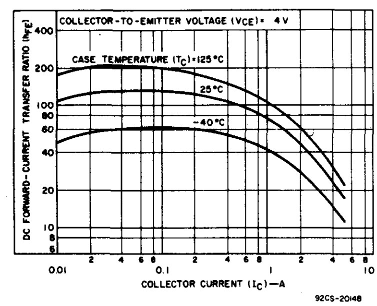


Fig. 5 – Typical dc beta characteristics for TIP31, TIP31A, TIP31B, RCA31, RCA31A, RCA31B, RCS31, RCS31A, and RCS31B.

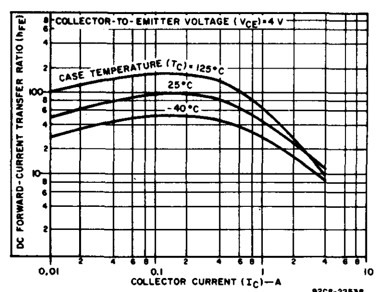


Fig. 6 – Typical dc beta characteristics for TIP31C, RCA31C and RCS31C.

TIP32, RCA32, RCS32 Series

Epitaxial-Base, Silicon P-N-P VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

The RCA-TIP32, RCA32 and RCS32-series are epitaxial-base, silicon p-n-p transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP31, RCA31 and RCS31-series.

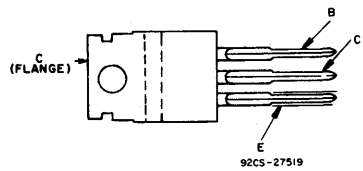
They differ from each other in voltage ratings.

The TIP32 and RCS32-series are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request. The RCS32-series are supplied in the JEDEC TO-213MA hermetic package.

Features:

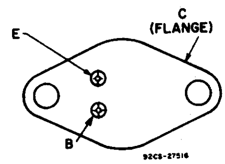
- **40 W at 25°C case temperature**
- **5 A rated collector current**
- **Min. f_T of 3 MHz at −10 V, −500 mA**
- **Designed for complementary use with TIP31, RCA31 and RCS31-series n-p-n types**

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB
TIP32 and RCA32-series



JEDEC TO-213MA
RCS32-series

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP32 RCA32 RCS32	TIP32A RCA32A RCS32A	TIP32B RCA32B RCS32B	TIP32C RCA32C RCS32C	
V_{CBO}	−40	−60	−80	−100	V
V_{CEO}	−40	−60	−80	−100	V
V_{EBO}	−5	−5	−5	−5	V
I_C	−5	−5	−5	−5	A
I_B	−1	−1	−1	−1	A
P_T:					
At $T_C \leq 25°C$	40	40	40	40	W
At $T_A \leq 25°C$	2	2	2	2	W
At $T_C > 25°C$ (TIP32 and RCA32-series) Derate linearly		0.32			W/°C
RCS32-series . . . Derate linearly		0.23			W/°C
T_{stg}, T_J TIP32 and RCA32-series		−65 to 150			°C
RCS32-series		−65 to 200			°C
T_L (During soldering):					
At distance 1/8 in. (3.17 mm) from case for 10s max. TIP32 and RCA32-series		235			°C
At a distance ≥ 1/32 inch (0.8 mm) from seating plane for 10s max. (RCS32-series)		235			°C

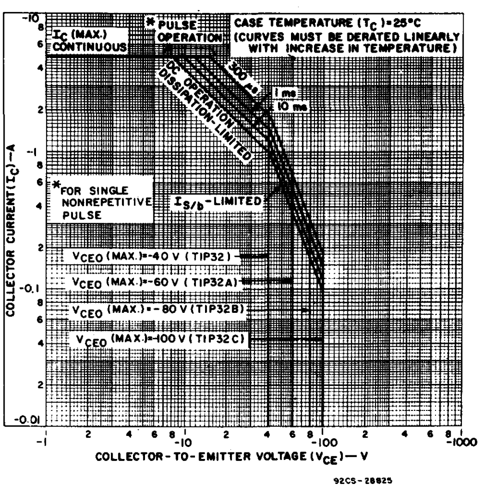


Fig. 1 — Maximum operating areas for TIP32-series.

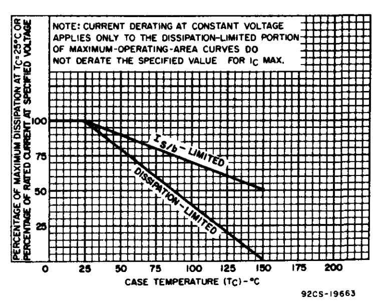


Fig. 2 — Derating curve for TIP32 and RCA32-series.

TIP32, RCA32, RCS32 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARAC-TERISTIC	TEST COND. VOLT-AGE V dc	TEST COND. CUR-RENT A dc	LIMITS TIP32 RCA32 RCS32		LIMITS TIP32A RCA32A RCS32A		LIMITS TIP32B RCA32B RCS32B		LIMITS TIP32C RCA32C RCS32C		Units
	V_{CE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO} I_B=0	−30 −60		– –	−0.3 –	– –	−0.3 –	– –	– −0.3	– –	– −0.3	mA
I_{CES} V_{EB}=0	−40 −60 −80 −100		– – – –	−0.2 – – –	– – – –	– −0.2 – –	– – – –	– – −0.2 –	– – – –	– – – −0.2	mA
I_{EBO} V_{BE}=5V		0	–	−1	–	−1	–	−1	–	−1	mA
V_{CEO}(sus) I_B=0		−0.03[a]	−40[b]	–	−60[b]	–	−80[b]	–	−100[b]	–	V
h_{FE}	−4 −4	−1[a] −3[a]	25 10	– 50	25 10	– 50	25 10	– 50	25 10	– 50	
V_{BE}	−4	−3[a]	–	−1.8	–	−1.8	–	−1.8	–	−1.8	V
V_{CE}(sat) I_B= −0.375A		−3[a]	–	−1.2	–	−1.2	–	−1.2	–	−1.2	V
h_{fe} f=1 kHz	−10	−0.5	20	–	20	–	20	–	20	–	
$\|h_{fe}\|$ f=1 MHz	−10	−0.5	3	–	3	–	3	–	3	–	
t_{ON} (t_d+t_r) V_{CC}= −30V R_L=30Ω I_{B1}=I_{B2} =−0.1A		−1	0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		µs
t_{OFF} (t_s+t_f) V_{CC}= −30V R_L=30Ω I_{B1}=−I_{B2} =−0.1A		−1	1 (typ.)		1 (typ.)		1 (typ.)		1 (typ.)		µs
$R_{\theta JC}$	TIP32 and RCA32-series		–	3.125	–	3.125	–	3.125	–	3.125	°C/W
$R_{\theta JC}$	RCS32-series		–	4.3	–	4.3	–	4.3	–	4.3	°C/W
$R_{\theta JA}$	TIP32 and RCA32-series		–	62.5	–	62.5	–	62.5	–	62.5	°C/W
$R_{\theta JA}$	RCS32-series		–	60	–	60	–		–	60	°C/W

[a] Pulsed, pulse duration = 300 µs, duty factor ⩽ 2%.

[b] *CAUTION:* Sustaining voltage, V_{CEO}(sus), *MUST NOT* be measured on a curve tracer.

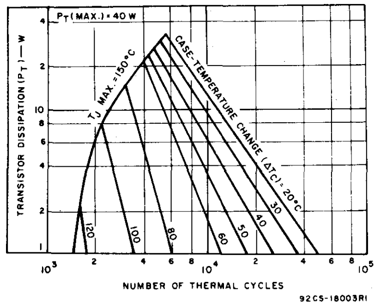


Fig. 3 – Thermal-cycling ratings for TIP32 and RCA32-series.

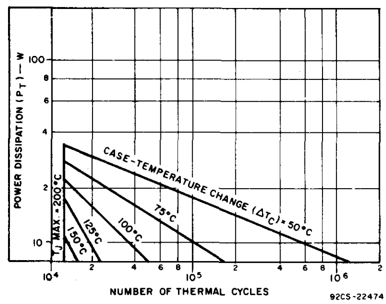


Fig. 4 – Thermal-cycling rating chart for RCS32-series.

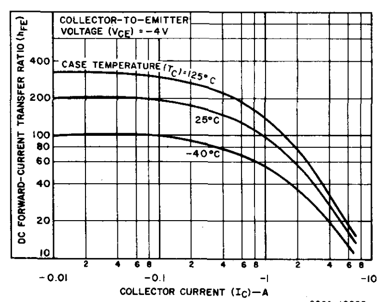


Fig. 5 – Typical dc beta characteristics for TIP32, TIP32A, TIP32B; RCA32, RCA32A, RCA32B, RCS32, RCS32A and RCS32B.

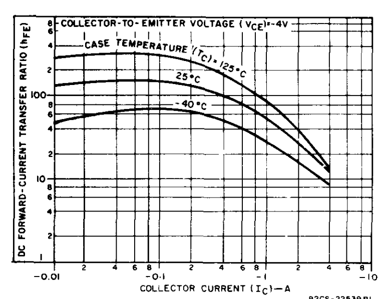


Fig. 6 – Typical dc beta characteristics for TIP32C, RCA32C and RCS32C.

TIP41, RCA41 Series

Epitaxial-Base, Silicon N-P-N VERSAWATT Transistors

For Power-Amplifier and High-Speed-Switching Applications

The RCA-TIP41 and RCA41-series are epitaxial-base, silicon n-p-n transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP42 and RCA42-series. They differ from each other in voltage ratings. They are supplied in the JEDEC TO-220AB straight lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request.

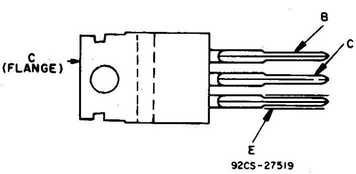
Features:

- **65 W at 25°C case temperature**
- **7-A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 500 mA**
- **Designed for complementary use with TIP42 and RCA42-series p-n-p types**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP41 RCA41	TIP41A RCA41A	TIP41B RCA41B	TIP41C RCA41C	
V_{CBO}	40	60	80	100	V
V_{CEO}	40	60	80	100	V
V_{EBO}	5	5	5	5	V
I_C	7	7	7	7	A
I_{CM}	10	10	10	10	A
I_B	3	3	3	3	A
P_T:					
At $T_C \leq 25°C$	65	65	65	65	W
At $T_A \leq 25°C$	2	2	2	2	W
At $T_C > 25°C$ Derate linearly at	0.52				W/°C
T_{stg}, T_J	−65 to 150				°C
T_L (During soldering): At distance 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

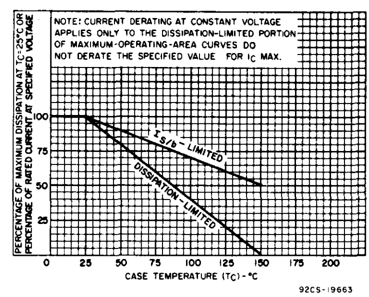


Fig. 2 — Derating curves for all types.

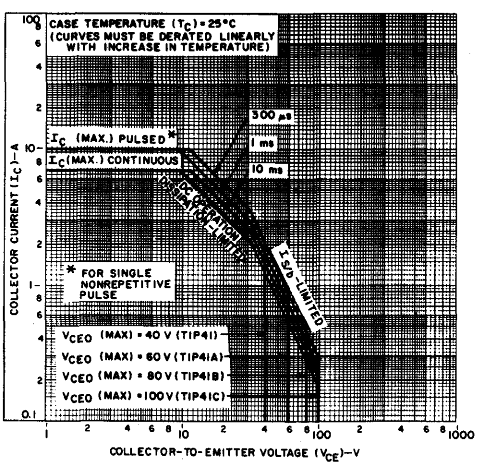


Fig. 1 — Maximum operating areas for all types.

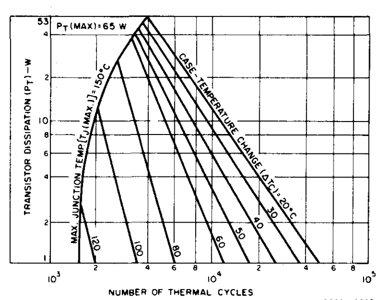


Fig. 3 — Thermal-cycling ratings for all types.

TIP41, RCA41 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARAC-TERISTIC	TEST CONDITIONS		LIMITS								Units
	Voltage V dc	Current A dc	TIP41 RCA41		TIP41A RCA41A		TIP41B RCA41B		TIP41C RCA41C		
	V_{CE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO} I_B=0	30		–	0.7	–	0.7	–	–	–	–	mA
	60		–	–	–	–	–	0.7	–	0.7	
I_{CES} V_{BE}=0	40		–	0.4	–	–	–	–	–	–	mA
	60		–	–	–	0.4	–	–	–	–	
	80		–	–	–	–	–	0.4	–	–	
	100		–	–	–	–	–	–	–	0.4	
I_{EBO} V_{BE}=−5 V		0	–	1	–	1	–	1	–	1	mA
V_{CEO}(sus) I_B=0		0.03[a]	40[b]	–	60[b]	–	80[b]	–	100[b]	–	V
h_{FE}	4	0.3[a]	30	–	30	–	30	–	30	–	
	4	3[a]	15	150	15	150	15	150	15	150	
V_{BE}	4	6[a]	–	2.2	–	2.2	–	2.2	–	2.2	V
V_{CE}(sat) I_B=0.6 A		6[a]	–	2	–	2	–	2	–	2	V
h_{fe} f=1 kHz	10	0.5	20	–	20	–	20	–	20	–	
$\|h_{fe}\|$ f=1 MHz	10	0.5	3	–	3	–	3	–	3	–	
t_{ON} ($t_d + t_r$) V_{CC}=30 V, R_L=5 Ω, I_{B1}=I_{B2}=0.6 A		6	0.6 (typ.)		0.6 (typ.)		0.6 (typ.)		0.6 (typ.)		μs
t_{OFF} ($t_s + t_f$) V_{CC}=30 V, R_L=5 Ω, I_{B1}=I_{B2}=0.6 A		6	1.4 (typ.)		1.4 (typ.)		1.4 (typ.)		1.4 (typ.)		μs
$R_{\theta JC}$			–	1.92	–	1.92	–	1.92	–	1.92	°C/W
$R_{\theta JA}$			–	62.5	–	62.5	–	62.5	–	62.5	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

[b] *CAUTION: Sustaining voltage, V_{CEO}(sus), MUST NOT be measured on a curve tracer.*

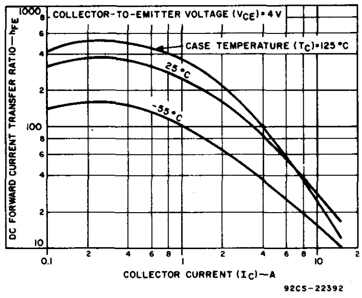


Fig. 4 — Typical dc beta characteristics for all types.

TIP42, RCA42 Series
Epitaxial-Base, Silicon P-N-P VERSAWATT Transistors

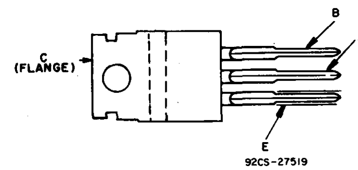
For Power-Amplifier and High-Speed-Switching Applications

The RCA-TIP42 and RCA42 series are epitaxial-base silicon p-n-p transistors intended for a wide variety of switching and amplifier applications, such as series and shunt regulators and driver and output stages of high-fidelity amplifiers. These power transistors are designed for complementary use with devices in the TIP41 and RCA41-series. They differ from each other in voltage ratings.

They are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request.

Features:
- **65 W at 25°C case temperature**
- **7 A rated collector current**
- **Min. f_T of 3 MHz at 10 V, 500 mA**
- **Designed for complementary use with TIP41 and RCA41-series n-p-n types**

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP42	TIP42A	TIP42B	TIP42C	
V_{CBO}	-40	-60	-80	-100	V
V_{CEO}	-40	-60	-80	-100	V
V_{EBO}	- 5	- 5	- 5	- 5	V
I_C	- 7	- 7	- 7	- 7	A
I_{CM}	-10	-10	-10	- 10	A
I_B	- 3	- 3	- 3	- 3	A
P_T:					
At $T_C \leq 25°C$	65	65	65	65	W
At $T_A \leq 25°C$	2	2	2	2	W
At $T_C > 25°C$ Derate linearly at	0.52				W/°C
T_{stg}, T_J	-65 to 150				°C
T_L (During soldering):					
At distance 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

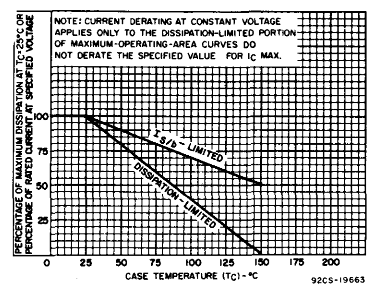


Fig. 2 — Derating curve for all types.

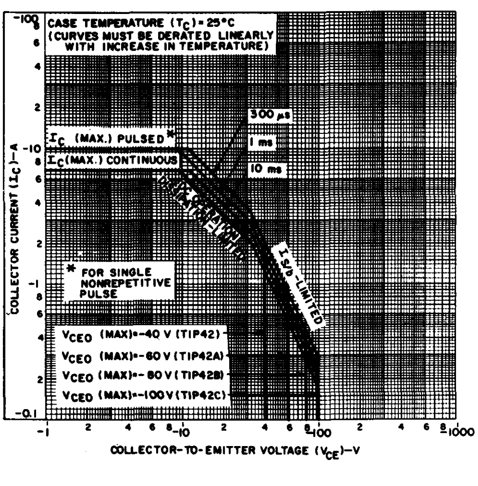


Fig. 1 — Maximum operating areas for all types.

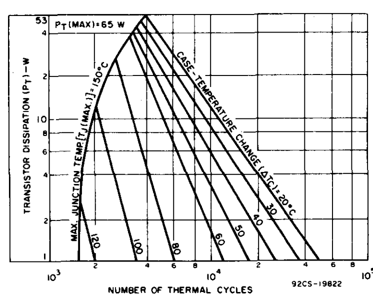


Fig. 3 — Thermal-cycling ratings for all types.

TIP42, RCA42 Series

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTICS	TEST COND. VOLTAGE V dc V_{CE}	TEST COND. CURRENT A dc I_C	TIP42 RCA42 Min.	TIP42 RCA42 Max.	TIP42A RCA42A Min.	TIP42A RCA42A Max.	TIP42B RCA42B Min.	TIP42B RCA42B Max.	TIP42C RCA42C Min.	TIP42C RCA42C Max.	UNITS
I_{CEO} $I_B = 0$	-30		–	-0.7	–	-0.7	–	–	–	–	mA
	-60		–	–	–	–	–	-0.7	–	-0.7	
I_{CES} $V_{EB} = 0$	-40		–	-0.4	–	–	–	–	–	–	mA
	-60		–	–	–	-0.4	–	–	–	–	
	-80		–	–	–	–	–	-0.4	–	–	
	-100		–	–	–	–	–	–	–	-0.4	
I_{EBO} $V_{BE} = -5$ V		0	–	-1	–	-1	–	-1	–	-1	mA
$V_{CEO}(sus)$ $I_B = 0$		-0.03[a]	-40[b]	–	-60[b]	–	-80[b]	–	-100[b]	–	V
h_{FE}	-4	-0.3[a]	30	–	30	–	30	–	30	–	
	-4	-3[a]	15	150	15	150	15	150	15	150	
V_{BE}	-4	-6[a]	–	-2.2	–	-2.2	–	-2.2	–	-2.2	V
$V_{CE}(sat)$ $I_B = -0.6$ A		-6[a]	–	-2	–	-2	–	-2	–	-2	V
h_{fe} f = 1 kHz	-10	-0.5	20	–	20	–	20	–	20	–	
$\|h_{fe}\|$ f = 1 MHz	-10	-0.5	3	–	3	–	3	–	3	–	
t_{ON} ($t_d + t_r$) $V_{CC} = -30$ V, $R_L = 5\ \Omega$, $I_{B1} = I_{B2} = -0.6$ A		-6	0.3 (typ.)		0.3 (typ.)		0.3 (typ.)		0.3 (typ.)		µs
t_{OFF} ($t_s + t_f$) $V_{CC} = -30$ V, $R_L = 5\ \Omega$, $I_{B1} = I_{B2} = -0.6$ A		-6	0.7 (typ.)		0.7 (typ.)		0.7 (typ.)		0.7 (typ.)		µs
$R_{\theta JC}$			–	1.92	–	1.92	–	1.92	–	1.92	°C/W
$R_{\theta JA}$			–	62.5	–	62.5	–	62.5	–	62.5	°C/W

[a] Pulsed, pulse duration = 300 µs, duty factor ≤ 2%.

[b] *CAUTION:* Sustaining voltage, V_{CEO}(sus), *MUST NOT* be measured on a curve tracer.

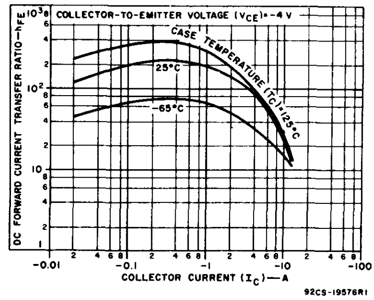


Fig. 4 — Typical dc beta characteristics for TIP42, TIP42A, TIP42B, RCA42, RCA42A and RCA42B.

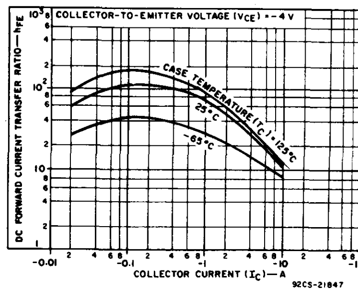


Fig. 5 — Typical dc beta characteristics for TIP42C and RCA42C.

TIP47, TIP48, TIP49, TIP50

High-Voltage Silicon N-P-N VERSAWATT Transistors

For High-Speed Switching and Linear-Amplifier Applications

The RCA-TIP47, TIP48, TIP49, and TIP50 are silicon n-p-n transistors with pi-nu construction. Typical applications for these transistors include high-voltage switches and switching regulators. TV horizontal-deflection circuits, power supplies, and TV audio-output circuits. They are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package, and can be provided in formed-lead configurations upon request.

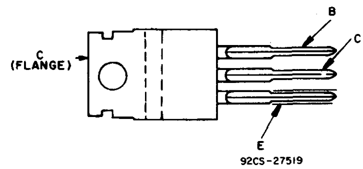
Features:

- **Rugged clip-type pellet attachment**
- **Glass passivated chip**
- **VERSAWATT package (molded silicone plastic)**
- **Thermal-cycling ratings**
- **Maximum safe-area-of-operation curves**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP47	TIP48	TIP49	TIP50	
V_{CBO}	350	400	450	500	V
$V_{CEO}(sus)$	250	300	350	400	V
V_{EBO}	5	5	5	5	V
I_C	1	1	1	1	A
I_{CM}	2	2	2	2	A
I_B	0.6	0.6	0.6	0.6	A
P_T:					
T_C up to 25°C	40	40	40	40	W
T_C above 25°C. Derate linearly	0.32				W/°C
T_A up to 25°C	1.8				W
T_{stg}, T_J	−65 to 150				°C
T_L:					
At distance ≥ 1/8 in. (3.17 mm) from seating plane for 10 s max.	235				°C

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

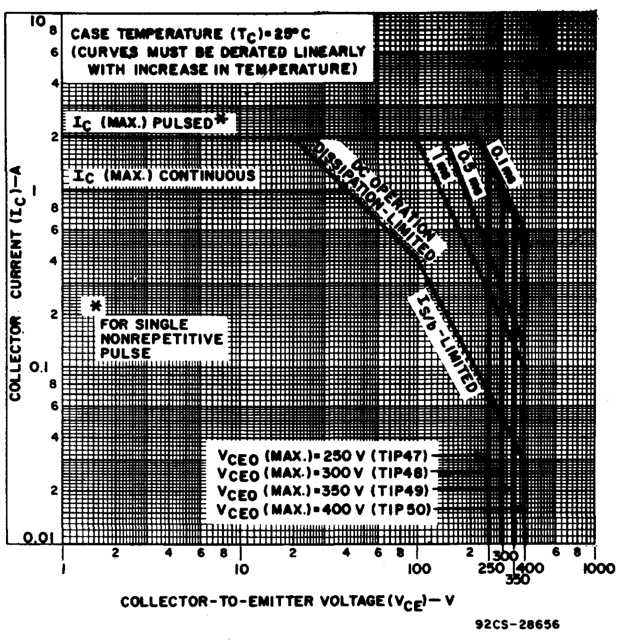


Fig.1 – Maximum operating areas for all types.

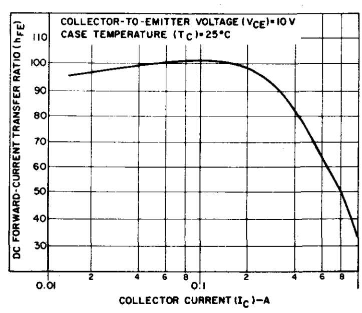


Fig.2 – Typical dc beta characteristics for all types.

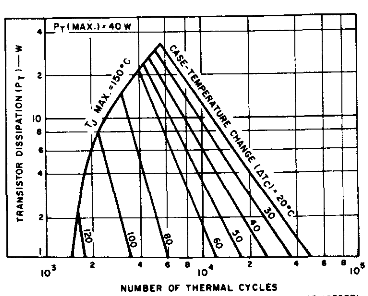


Fig.3 – Thermal-cycling rating chart for all types.

TIP47, TIP48, TIP49, TIP50

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST COND. VOLTAGE V dc V_{CE}	TEST COND. CURRENT A dc I_C	TIP47 Min.	TIP47 Max.	TIP48 Min.	TIP48 Max.	TIP49 Min.	TIP49 Max.	TIP50 Min.	TIP50 Max.	UNITS
I_{CEO}	150		–	1	–	–	–	–	–	–	mA
$I_B = 0$	200		–	–	–	1	–	–	–	–	
$R_{BE} = 1000\ \Omega$	250		–	–	–	–	–	1	–	–	
	300		–	–	–	–	–	–	–	1	
I_{CES}	350		–	1	–	–	–	–	–	–	mA
$V_{EB} = 0$	400		–	–	–	1	–	–	–	–	
	450		–	–	–	–	–	1	–	–	
	500		–	–	–	–	–	–	–	1	
I_{EBO} $V_{BE} = -5$ V		0	–	1	–	1	–	1	–	1	mA
h_{FE}	10	1[a]	10	–	10	–	10	–	10	–	
	10	0.03[a]	30	150	30	150	30	150	30	150	
$V_{CEO}(sus)$ $I_B = 0$		0.3[a]	250[b]	–	300[b]	–	350[b]	–	400[b]	–	V
V_{BE}	10	1[a]	–	1.5	–	1.5	–	1.5	–	1.5	V
$V_{CE}(sat)$ $I_B = 0.2$ A		1[a]	–	1	–	1	–	1	–	1	V
$\|h_{fe}\|$ f = 1 MHz	10	0.2	5	–	5	–	5	–	5	–	
f_T f = 1 MHz	10	0.2	5	–	5	–	5	–	5	–	MHz
h_{fe} f = 1 kHz	10	0.2	25	–	25	–	25	–	25	–	
$I_{S/b}$ t = 0.5 s	100	–	0.4	–	0.4	–	0.4	–	0.4	–	A
t_{ON} $(t_d + t_r)$[c] $V_{CC} = 200$ V		1	0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		0.2 (typ.)		µs
t_s[c] $V_{CC} = 200$ V		1	2 (typ.)		2 (typ.)		2 (typ.)		2 (typ.)		µs
t_f[c] $V_{CC} = 200$ V		1	0.5 (typ.)		0.5 (typ.)		0.5 (typ.)		0.5 (typ.)		µs
$R_{\theta JC}$			–	3.12	–	3.12	–	3.12	–	3.12	°C/W
$R_{\theta JA}$			–	70	–	70	–	70	–	70	°C/W

a Pulsed, pulse duration = 300 µs, duty factor ≤ 2%..

b *CAUTION: Sustaining voltage, $V_{CEO}(sus)$, MUST NOT be measured on a curve tracer.*

c $I_{B1} = I_{B2} = 0.1$ A.

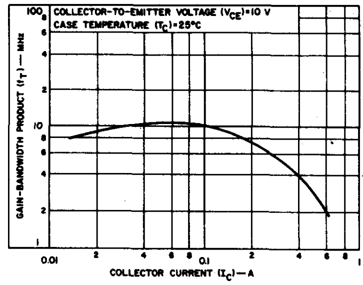


Fig.4 – Typical gain-bandwidth characteristics for all types.

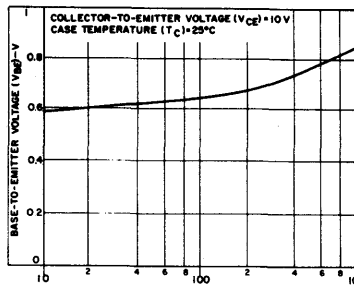


Fig.5 – Typical base-to-emitter voltage vs. collector current.

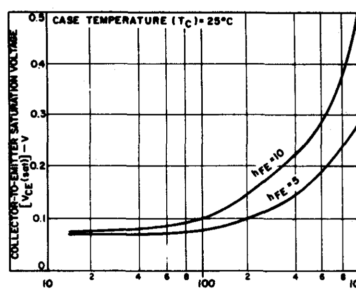


Fig.6 – Typical saturation-voltage characteristics for all types.

TIP120, TIP121, TIP122, RCA120. RCA121, RCA122

8-Ampere N-P-N Darlington Power Transistors

60, 80, and 100 Volts, 65 Watts
Gain of 500 at 0.5 A
Gain of 1000 at 3 A

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

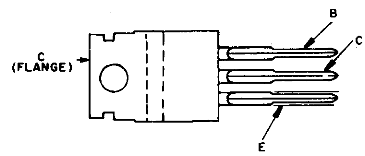
Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

The RCA-TIP120, TIP121, TIP122, RCA 120, RCA121 and RCA122 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

The TIP120, TIP121 and TIP122 are n-p-n complements of the TIP125, TIP126 and TIP127. The RCA120 and RCA121 are n-p-n complements of the RCA125 and RCA126.

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP120 RCA120	TIP121 RCA121	TIP122 RCA122	
V_{CBO}	60	80	100	V
$V_{CER}(sus)$ R_{BE} = 100 Ω	60	80	100	V
$V_{CEO}(sus)$	60	80	100	V
$V_{CEV}(sus)$ V_{BE} = −1.5 V	60	80	100	V
V_{EBO}	5	5	5	V
I_C	8	8	8	A
I_{CM}	10	10	10	A
I_B	0.25	0.25	0.25	A
P_T: T_C up to 25°C	65	65	65	W
T_C above 25°C . . . Derate linearly at		0.52		W/°C
T_{stg}, T_J		−65 to 150		°C
T_L: At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

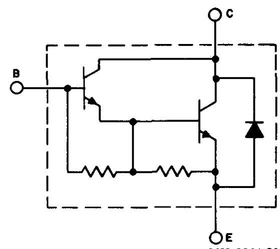


Fig. 1 – Schematic diagram for all types.

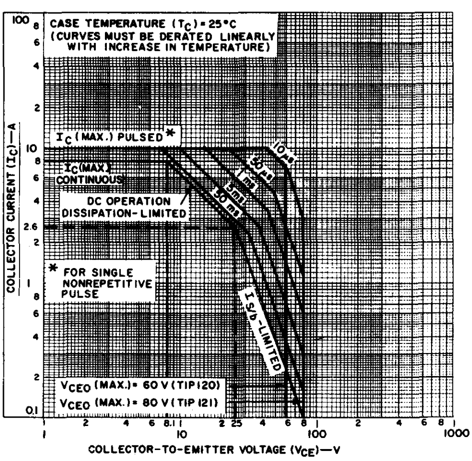


Fig. 2 – Maximum operating areas for TIP120 and TIP121.

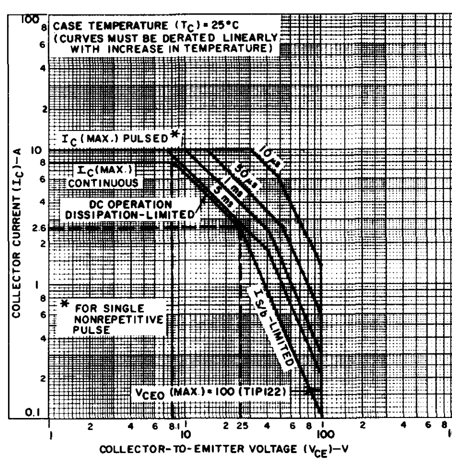


Fig. 3 – Maximum operating areas for TIP122.

TIP120, TIP121, TIP122, RCA120, RCA121, RCA122

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS Voltage V dc		Current A dc		LIMITS TIP120 RCA120		TIP121 RCA121		TIP122 RCA122		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} I_E=0	60 80 100				– – –	0.2 – –	– – –	– 0.2 –	– – –	– – 0.2	mA
I_{CEO}	30 40 50			0 0 0	– – –	0.5 – –	– – –	– 0.5 –	– – –	– – 0.5	
I_{EBO}		–5	0		–	3	–	3	–	3	mA
V_{CEO}(sus)			0.2[a]	0	60	–	80	–	100	–	V
h_{FE}	3 3		3[a] 0.5[a]		1000 500	– –	1000 500	– –	1000 500	– –	
V_{BE}	3		3[a]		–	2.5	–	2.5	–	2.5	V
V_{CE}(sat)			3[a] 5[a]	0.012 0.02	– –	2 3	– –	2 3	– –	2 3	V
h_{fe} f=1 kHz	5		1		1000	–	1000	–	1000	–	
$\|h_{fe}\|$ f=1 MHz	5		1		20	–	20	–	20	–	
C_{obo} V_{CB}=10 V f=1 MHz					–	200	–	200	–	200	pF
$E_{S/b}$ L=12 mH, R_{BE}=100 Ω		–1.5	4.5		120	–	120	–	120	–	mJ
$I_{S/b}$ t=0.5 s non-rep. pulse	25				2.6	–	2.6	–	2.6	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

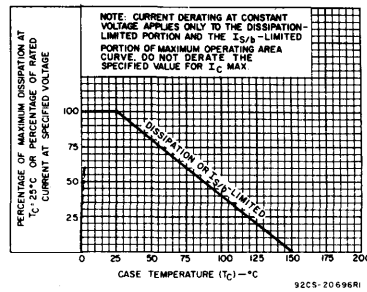


Fig. 4 — Derating curve for all types.

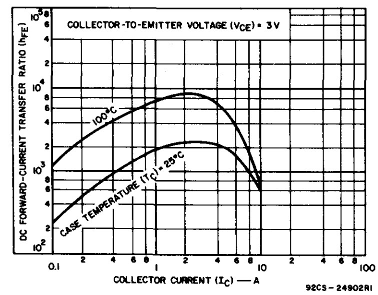


Fig. 5 — Typical dc beta characteristics for all types.

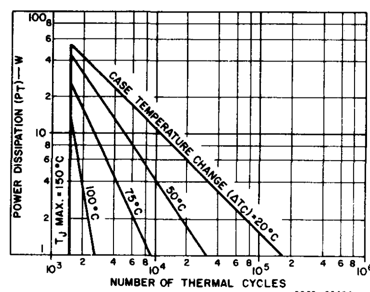


Fig. 6 — Thermal-cycling rating chart for all types.

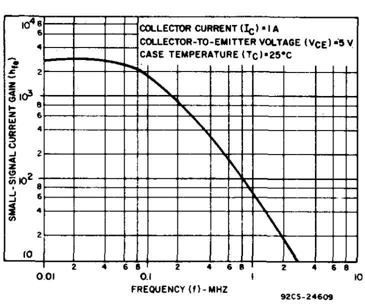


Fig. 7 — Typical small-signal current gain for all types.

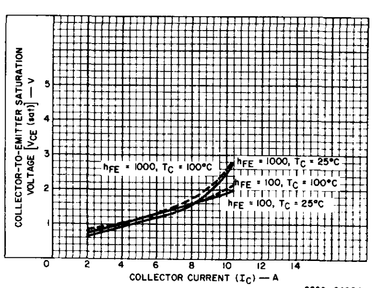


Fig. 8 — Typical saturation characteristics for all types.

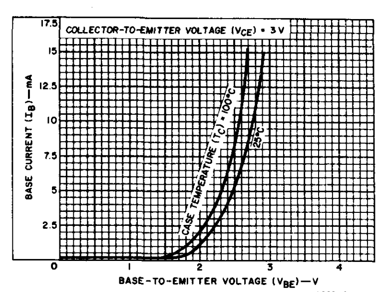


Fig. 9 — Typical input characteristics for all types.

TIP120, TIP121, TIP122, RCA120, RCA121, RCA122

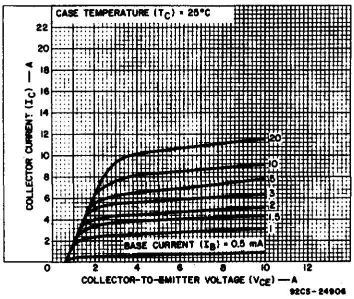


Fig. 10 — Typical output characteristics for all types.

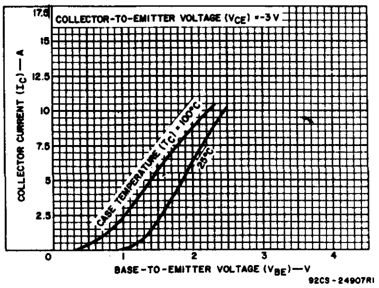


Fig. 11 — Typical transfer characteristics for all types.

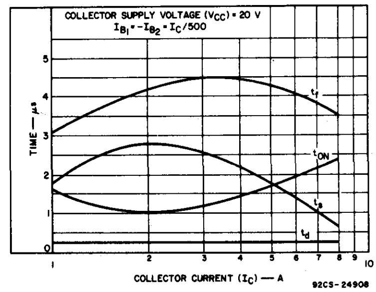


Fig. 12 — Typical saturated switching characteristics for all types.

TIP125, TIP126, TIP127, RCA125, RCA126

8-Ampere P-N-P Darlington Power Transistors

−60, −80, and −100 Volts, 65 Watts
Gain of 1000 at −3 A
Gain of 500 at −0.75 A

The RCA-TIP125, TIP126, TIP127, RCA 125 and RCA126 are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

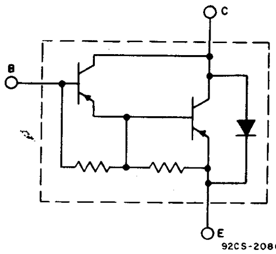


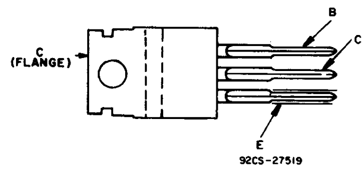
Fig. 1 – Schematic diagram for all types.

The TIP125, TIP126 and TIP127 are p-n-p complements of the TIP120, TIP121 and TIP122. The RCA125 and RCA126 are p-n-p complements of the RCA120 and RCA121.

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



BOTTOM VIEW

JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP125 RCA125	TIP126 RCA126	TIP127 –	
V_{CBO}	−60	−80	−100	V
$V_{CEO}(sus)$	−60	−80	−100	V
V_{EBO}	−5	−5	−5	V
I_C	−8	−8	−8	A
I_{CM}	−15	−15	−15	A
I_B	−0.25	−0.25	−0.25	A
P_T:				
$T_C \leq 25°C$	65	65	65	W
$T_C > 25°C$ . . TIP125, TIP126, TIP127 Derate linearly at		0.52		W/°C
RCA125, RCA126. . Derate linearly to		150°C		
T_{stg}, T_J		−65 to 150		°C
T_L At distance 1/18 in. (3.17 mm) from case for 10s max .		235		°C

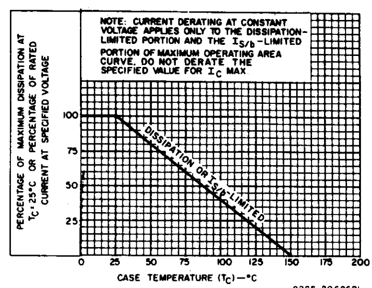


Fig. 3 — Dissipation derating curve for all types.

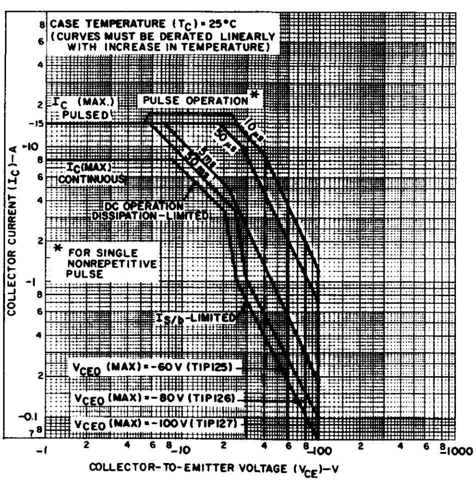


Fig. 2 – Maximum operating areas for all types.

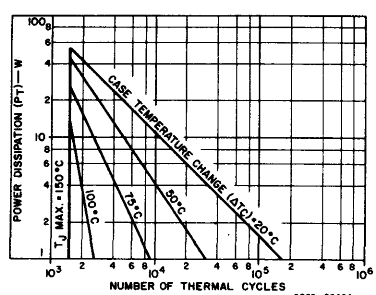


Fig. 4 — Thermal-cycling rating chart for all types.

TIP125, TIP126, TIP127, RCA125, RCA126

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARAC-TERISTIC	TEST CONDITIONS			LIMITS						UNITS
	Voltage V dc	Current A dc		TIP125 RCA125		TIP126 RCA126		TIP127 –		
	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}	–30		0	–	–0.5	–	–	–	–	mA
	–40		0	–	–	–	–0.5	–	–	
	–50		0	–	–	–	–	–	–0.5	
I_{EBO} V_{BE}=5 V		0		–	–10	–	–10	–	–10	mA
V_{CEO}(sus)		–0.03[a]	0	–60	–	–80	–	–100	–	V
h_{FE}	–3	–0.75[a]		500	–	500	–	500	–	
	–3	–3[a]		1000	–	1000	–	1000	–	
V_{BE}	–3	–3[a]		–	–2.5	–	–2.5	–	–2.5	V
V_{CE}(sat)		–3[a]	–0.012	–	–2	–	–2	–	–2	V
		–5[a]	–0.02	–	–4	–	–4	–	–4	
h_{fe} f=1 kHz	–5	–1		1000	–	1000	–	1000	–	
$\|h_{fe}\|$ f=1 MHz	–5	–1		20	–	20	–	20	–	
$I_{S/b}$ t=1-s nonrep. pulse	–20			–3.2	–	–3.2	–	–3.2	–	A
$R_{\theta JC}$				–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor ⩽ 2%.

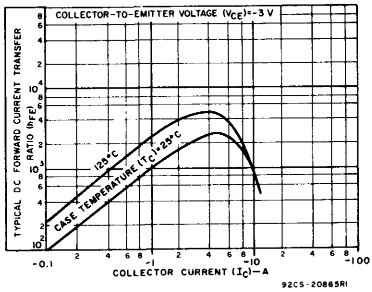


Fig. 5 – Typical dc beta characteristics for all types.

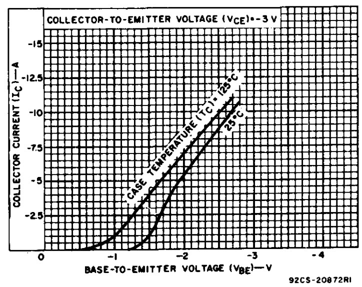


Fig. 6 – Typical transfer characteristics for all types.

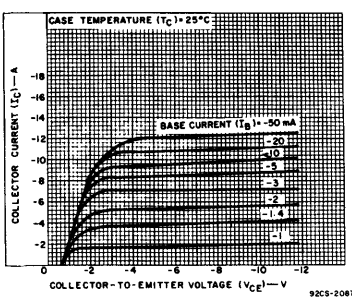


Fig. 7 – Typical output characteristics for all types.

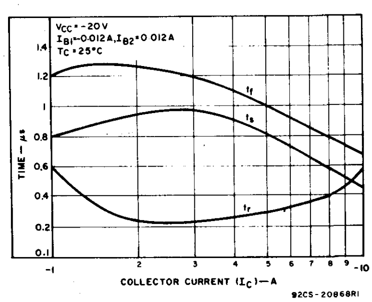


Fig. 8 – Typical saturated switching-time characteristics for all types.

CH2102, CH2270, CH2405, CH3053, CH3439, CH3440, CH4036, CH4037, CH5320-CH5323, CH6479

Unmounted and Unencapsulated N-P-N and P-N-P Silicon Power Transistor Chips

Features:

- **Prepared and tested for use in hybrid circuits**
- **h_{FE} ratings from 30 to 50 (min.)**
- **I_{CBO} leakage ratings in the 10 µA to 1 mA range**
- **V_{CEO} ratings up to 90 V on planar transistor chips; up to 325 V on passivated mesa types**
- **I_C up to 12 A (CH6479)**

The transistor chip families described in this bulletin are selected from the broad line of RCA discrete power transistors. Known also as pellets or dies, these chips represent the essential electronic portion of the transistor. They are especially suited for direct mounting on a heat sink in hybrid circuits. The n-p-n and p-n-p types can be used either singly or in complementary-pair configurations for large-signal medium-power applications.

All of the chip families shown are double-diffused epitaxial types. Six of the families are of planar construction; the other is of a passivated mesa construction. The oxide layer that results from conventional planar processing protects the planar types. The junctions and surfaces of the mesa transistor chips are protected by deposited glass-passivated coverings.

Aluminum has been deposited at the base and emitter electrodes of all the transistor chips for ease of bonding. The base and emitter bonding areas on each chip will accommodate up to a 0.003-inch (0.076-mm)-diameter bond wire except for the CH6479 which will accommodate a 0.010-inch (0.254-mm) wire. Either thermo-compression or ultrasonic bonding can be used to attach gold wires to these electrodes; aluminum wires can also be bonded by conventional ultrasonic techniques.

The collector contact, which is on the underside of the chip, has been metallized with gold for all of the chips except CH6479. For all of the chips, the collector can be attached directly to a heat sink by adhesive or by gold-silicon or gold-germanium eutectic bonding methods.

The CH6479, because of its large size, must be mounted on a heat sink made of material with thermal expansion coefficient close to that of silicon; suitable materials are molybdenum or beryllium oxide. A special cleaning step is required in mounting the CH6479.

All of the chips must be mounted in an inert or reduced atmosphere. The chips must not be subjected to more than 400°C for a maximum of 1 minute. Because of the specially prepared surfaces of the chips (except as noted for the CH6479), etching of the pellets or the use of flux is not recommended.

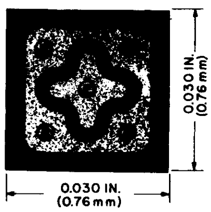
The chips are supplied in plastic containers. Each chip is securely held in a recessed partition of the container by a clear plastic cover that also protects the surface from dust and abrasion. For additional protection, the container is sealed in a clear plastic bag. If the sealed shipping container is opened or broken, ruptured, punctured, or damaged in any way, the chips must be stored at a temperature of not more than 40°C and a relative humidity of not more than 50% in a clean, dust-free environment. If the sealed shipping container is damaged on receipt as described above, the product should be immediately returned to RCA.

These unmounted and unencapsulated chips are tested electrically and visually inspected to meet the specifications shown on the following pages. Written notification of non-conformance to such specifications must be made to RCA within 90 days of the date of the shipment by RCA. RCA assumes no responsibility for chips which have been subjected to further processing, such as, but not limited to, lead-bonding or pellet-mounting operations.

RCA has the right to change the chip design and processing without notification.

Assistance in determining proper mounting and bonding procedures is available from RCA.

2N2102 Family (n-p-n)



Ⓑ 4 Base Bonding Areas 0.008 in. (0.20 mm) diameter

Ⓔ Emitter Bonding Area 0.008 in. (0.20 mm) diameter

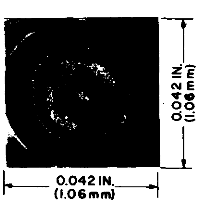
CH2102 CH2270 CH2405 CH3053

RCA-CH2102, CH2270, CH2405, and CH3053 are double-diffused n-p-n epitaxial planar transistor chips similar to RCA-2N2102, 2N2270, 2N2405, and 2N3053 transistors, respectively. They can be used either singly or in complementary-pair configurations with RCA p-n-p chips CH4036 and CH4037 for large-signal medium-power applications.

ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

Characteristic	Symbol	Test Conditions: Voltage V dc		Current mA dc		Limits: CH2102		CH2270		CH2405		CH3053		Units
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector Cutoff Current	I_{CBO}	60					10		10		10		10	µA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.01	5		5		5		5		V
Collector-to-Emitter Sustaining Voltage: Base open[a]	$V_{CEO(sus)}$			20		60		45		90		30		V
DC Forward-Current Transfer Ratio[b]	h_{FE}		10	150		50		50		50		50		

2N3439 Family (n-p-n)



Ⓑ Base Bonding Area 0.005 in. (0.13 mm) diameter

Ⓔ Emitter Bonding Area 0.005 in. (0.13 mm) diameter

CH3439 CH3440

RCA-CH3439 and CH3440 are passivated mesa n-p-n transistor chips similar to those used in RCA-2N3439 and 2N3440 high-voltage transistors. Because of their high breakdown voltages, good high-frequency response, and fast switching speeds, these transistor chips can be used in high-voltage differential and operational amplifiers, high-voltage inverters and high-voltage, low-current switching regulators.

ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

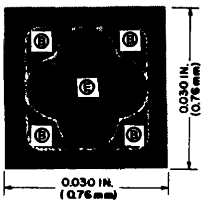
Characteristic	Symbol	Test Conditions: Voltage V dc		Current mA dc		Limits: CH3439		CH3440		Units
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	Min.	Max.	
Collector Cutoff Current	I_{CBO}	200					20		50	µA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.02	5		5		V
Collector-to-Emitter Sustaining Voltage: Base open[a]	$V_{CEO(sus)}$			20		325		250		V
DC Forward-Current Transfer Ratio[b]	h_{FE}		10	20		30		30		

[a] CAUTION: This voltage MUST NOT be measured on a curve tracer. [b] Pulse tested; 2% duty factor, less than or equal to 300 µs duration.

CH2102, CH2270, CH2405, CH3053, CH3439, CH3440, CH4036, CH4037, CH5320-CH5323, CH6479

Unmounted and Unencapsulated N-P-N and P-N-P Silicon Power Transistor Chips (Cont'd)

2N4036 Family (p-n-p)



(B) 4 Base Bonding Areas 0.008 in. (0.20 mm) diameter

(E) Emitter Bonding Area 0.008 in. (0.20 mm) diameter

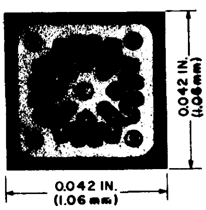
CH4036 CH4037

RCA-CH4036 and CH4037 are double-diffused p-n-p epitaxial planar transistor chips similar to RCA-2N4036 and 2N4037 transistors. Their high-voltage ratings and heat-dissipating ability make them ideal for amplifying large signals at a medium power level. They can be used singly or as complements of RCA n-p-n chips CH2102, CH2270, CH2405, and CH3053.

ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

Characteristic	Symbol	Test Conditions				Limits				Units
		Voltage V dc		Current mA dc		CH4036		CH4037		
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	Min.	Max.	
Collector Cutoff Current	I_{CBO}	-60					-10		-10	μA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				-0.01	-6.5		-6.6		V
Collector-to-Emitter Sustaining Voltage: Base open [a]	$V_{CEO(sus)}$			-20		-65		-40		V
DC Forward-Current Transfer Ratio [b]	h_{FE}		-10	-150		35		35		

2N5320 Family (n-p-n)



(B) 4 Base Bonding Areas 0.008 in. (0.20 mm) diameter

(E) Emitter Bonding Area 0.008 in. (0.20 mm) diameter

CH5320 CH5321

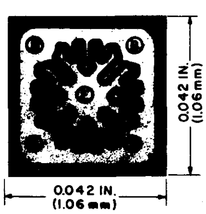
RCA-CH5320 and CH5321 are double-diffused n-p-n epitaxial planar transistor chips similar to RCA-2N5320 and 2N5321 transistors. They can be used singly or as complements of RCA p-n-p chips CH5322 and CH5323.

ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

Characteristic	Symbol	Test Conditions				Limits				Units
		Voltage V dc		Current mA dc		CH5320		CH5321		
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	Min.	Max.	
Collector Cutoff Current:	I_{CBO}	60					10		10	μA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.01	5		5		V
Collector-to-Emitter Sustaining Voltage: Base open [a]	$V_{CEO(sus)}$			20		80		55		V
DC Forward-Current Transfer Ratio [b]	h_{FE}		10	250		30		30		

[a]CAUTION: This voltage MUST NOT be measured on a curve tracer. [b]Pulse tested; 2% duty factor, less than or equal to 300 μs duration.

2N5323 Family (p-n-p)



(B) 4 Base Bonding Areas 0.008 in. (0.20 mm) diameter

(E) Emitter Bonding Area 0.008 in. (0.20 mm) diameter

CH5322 CH5323

RCA-CH5322 and CH5323 are double-diffused p-n-p epitaxial planar transistor chips similar to RCA-2N5322 and 2N5323 transistors. They can be used singly or as complements of RCA n-p-n chips CH5320 and CH5321 for amplifying large signals at a medium power level.

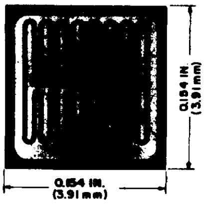
ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

Characteristic	Symbol	Test Conditions				Limits				Units
		Voltage V dc		Current mA dc		CH5322		CH5323		
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	Min.	Max.	
Collector Cutoff Current	I_{CBO}	-60					-10		-10	μA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				-0.01	-5		-5		V
Collector-to-Emitter Sustaining Voltage: Base open [a]	$V_{CEO(sus)}$			-20		-80		-55		V
DC Forward-Current Transfer Ratio [b]	h_{FE}		-10	-250		30		30		

CH2102, CH2270, CH2405, CH3053, CH3439, CH3440, CH4036, CH4037, CH5320-CH5323, CH6479

Unmounted and Unencapsulated N-P-N and P-N-P Silicon Power Transistor Chips (Cont'd)

2N6479 Family (n-p-n)



Ⓑ Base Bonding Area 0.013 in. (0.33 mm) x 0.091 in. (2.31 mm)

Ⓔ Emitter Bonding Area 0.013 in. (0.33 mm) x 0.091 in. (2.31 mm)

CH6479

RCA-CH6479 is a double-diffused n-p-n epitaxial planar transistor chip similar to the RCA-2N6479 transistor. Radiation hardening makes this type suitable for aerospace applications, and high-switching speeds make it ideal for use in high-speed inverters, switching regulators, and military hybrid applications.

ELECTRICAL CHARACTERISTICS, at Chip Temperature = 25°C

Characteristic	Symbol	Test Conditions				Limits		Units
		Voltage V dc		Current mA dc		CH6479		
		V_{CB}	V_{CE}	I_C	I_E	Min.	Max.	
Collector Cutoff Current	I_{CBO}	100					1	mA
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				1	5		V
Collector-to-Emitter Sustaining Voltage: Base open [a]	$V_{CEO(sus)}$			25		60		V
DC Forward-Current Transfer Ratio [b]	h_{FE}		2	500		40		

CH6479 Chip Special Clean-Up Schedule:
Before eutectic mounting, the CH6479 chip must be etched for 30 seconds in a 10% (by volume) electronic-grade hydrofluoric acid solution at 25°C ± 5°C with agitation. Normal precautions for using hydrofluoric acid should be observed. The chip must then be dried and mounted within 8 hours.

CHIP INSPECTION INFORMATION

Each lot is inspected to a 2.5% AQL (cumulative) according to Mil Std. 105 using 20 times magnification. The following defects determine the inspection criteria:

Foreign matter adhering to the base and emitter bond areas.

Improperly cut pellets that include a portion of another pellet.

Bridging by the metallization which causes a short.

Blistering, lifting or absence of the aluminum metallization.

Fractures or edges within 0.0005 in. (0.013) mm of the base collector junction.

Severed base-contact *rings that isolate all the bonding pads* and most of the base area.

Oxide missing from the junction area.

RF Power Transistors
Technical Data

2N2857

Silicon N-P-N Epitaxial Planar Transistor

For UHF Applications in Industrial and Military Equipment

Features:

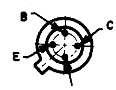
- high gain-bandwidth product— f_T = 1000 MHz min.
- high converter (450-to-30 MHz) gain— G_c = 15 dB typ. for circuit bandwidth of approximately 2 MHz
- high power gain as neutralized amplifier— G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator— P_o = {30 mW min., 40 mW typ. at 500 MHz; 20 mW typ., at 1 GHz}
- low device noise figure— NF = {4.5 dB max. as 450 MHz amplifier; 7.5 dB typ. as 450-to-30 MHz converter}
- low collector-to-base time constant — $r_b'C_c$ = 7 ps typ.
- low collector-to-base feedback capacitance— C_{cb} = 0.6 pF typ.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30	max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15	max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5	max.	V
COLLECTOR CURRENT, I_C	40	max.	mA
TRANSISTOR DISSIPATION, P_T:			
At case temperatures* up to 25° C	300	max.	mW
At case temperatures* above 25° C	Derate at 1.72		mW/°C
At ambient temperatures up to 25°C	200	max.	mW
At ambient temperatures above 25° C	Derate at 1.14		mW/°C
TEMPERATURE RANGE:			
Storage and Operating (Junction)	-65 to +200		°C
LEAD TEMPERATURE (During soldering): At distances ≥ 1/32 inch from seating surface for 10 seconds max	265	max.	°C

* Measured at center of seating surface.

TERMINAL DESIGNATIONS



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JEDEC TO-72

ELECTRICAL CHARACTERISTICS, *At an Ambient Temperature, T_A = 25° C, Unless Otherwise Specified*

Characteristic	Symbol	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Emitter-to-Base Voltage V_{EB} (V)	DC Emitter Current I_E (mA)	DC Base Current I_B (mA)	DC Collector Current I_C (mA)	Limits Type 2N2857 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	T_A = 25°C T_A = 150°C	15 15			0 0			-	-	10 1.0	nA μA
Collector-to-Base Breakdown Voltage	BV_{CBO}					0		0.001	30	-	-	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO}						0	3	15	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}					-0.01		0	2.5	-	-	V
Static Forward-Current Transfer Ratio	h_{FE}			1				3	30	-	150	
Small-Signal Forward-Current Transfer Ratio	h_{fe}	0.001[c] 100[c]		6 6				2 5	50 10	- -	220 19	
Collector-to-Base Feedback Capacitance	C_{cb}	0.1 to 1[b]	10			0			-	0.6	1.0	pF
Input Capacitance	C_{ib}	0.1 to 1[a]			0.5			0	-	1.4	-	pF
Collector-to-Base Time Constant	$r_b'C_c$	31.9[c]	6			-2			4	7	15	ps
Small-Signal, Common-Emitter Power Gain in Neutralized Amplifier Circuit	G_{pe}	450[c]		6				1.5	12.5	-	19	dB
Power Output as Oscillator	P_o	≥ 500[a]	10			-12			30	-	-	mW
UHF Device Noise Figure	NF	450[c,d,f]		6				1.5	-	3.8	4.5	dB
UHF Measured Noise Figure	NF	450[c,d]		6				1.5	-	-	5.0	dB
VHF Device Noise Figure	NF	60[b,d]		6				1	-	2.2	-	dB

[a] Fourth lead (case) not connected

[b] Three-terminal measurement: Lead No. 1 (Emitter) and lead No. 4 (Case) connected to guard terminal.

[c] Fourth lead (case) grounded.

[d] Generator resistance, R_g = 50 ohms.

[e] Generator resistance, R_g = 400 ohms.

[f] Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test circuit (0.25 dB) and the contribution of the following stages in the test set-up (0.25 dB).

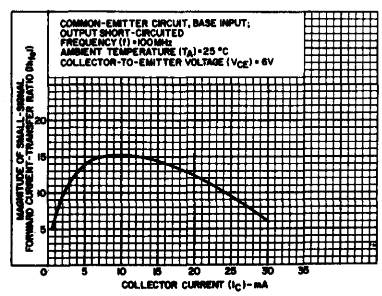


Fig. 1 - Small-signal beta characteristic for type 2N2857.

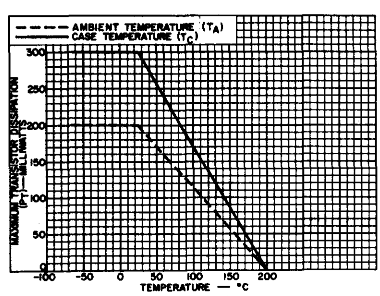


Fig. 2 - Rating chart for type 2N2857.

2N2876

Silicon N-P-N Planar Transistors

For Large-Signal, High-Power, VHF Applications in Military and Industrial Communications Equipment

Features:

- High Power Output, Unneutralized (P_{OUT}): 10 w min. at 50 Mc, 3 w min. at 150 Mc } 2N2876
- High Voltage Ratings: V_{CBO} = 80 volts max. V_{CEO} = 60 volts max.
- 100 per cent tested to assure freedom from second breakdown in class A operation at maximum ratings

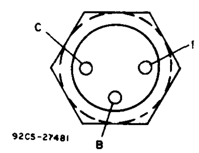
RCA-2N2876 Features:

- Low Thermal Resistance (θ_{J-C})— high-thermal-conductivity ceramic insulation between collector and mounting stud
- *Isolated Stud Package:* all three electrodes electrically isolated from case —for design flexibility; heavy copper mounting stud—for effective contact with heat sink; pin terminals arranged on a .200" pin-circle diameter —fit commercially available sockets

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N2876	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	80	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open, V_{CEO}	60	volts
With V_{BE} = −1.5 volts, V_{CEV}	80	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	volts
COLLECTOR CURRENT, I_C	2.5	amp
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25°C	17.5	watts
At case temperatures above 25°C	Derate linearly	100mw/°C
TEMPERATURE RANGE:		
Storage	−65 to +200	°C
Operating (Junction)	−65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distance ≥ 1/32" from ceramic wafer for 10 sec. max.	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-60

ELECTRICAL CHARACTERISTICS *Case Temperature = 25° C Unless Otherwise Specified*

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	V_{CC}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS 2N2876 Min.	Max.	Units
Collector-Cutoff Current	I_{CBO}	30			0			-	0.1	µA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.5	80	-	V
Collector-to-Emitter Breakdown Voltage (Sustaining)	$BV_{CEO}(sus)$					0	500*	60	-	V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			-1.5			0.1	80	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1		0	4	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					500	2.5 amp	-	1	V
Feedback Capacitance (Measured at 140 KHz)	$C_{b'c}$	30			0			-	20	pF
RF Power Output, Unneutralized Measured at 50 MHz	P_{out}		28				500	10[a]	-	W
50 MHz			28				375	-	-	W
150 MHz			28				275	3[b]	-	W
Gain-Bandwidth Product	f_T		28				250	200 (typ.)		MHz
Base Spreading Resistance (Measured at 400 MHz)	$r_{bb'}$		28				250	6.0 (typ.)		ohms
Collector-to-Case Capacitance	C_c							-	6	pF

* Pulsed. Pulse duration ≤ 5 µsec; duty factor ≤ 1%. [a] For P_{IN} = 2 watts. [b] For P_{IN} = 1 watt.

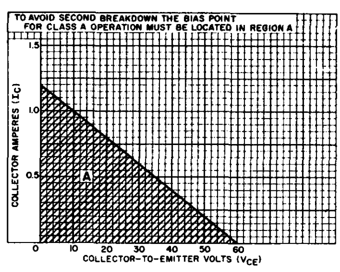


Fig. 1 - Region of safe operation (without second breakdown) in class A service for type 2N2876.

2N3229
Silicon N-P-N Planar Transistors

For Large-Signal, High-Power, VHF Applications in Military and Industrial Communications Equipment

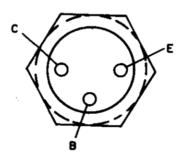
Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	105	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open, V_{CEO}	60	volts
With V_{BE} = -1.5 volts, V_{CEV}	105	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	volts
COLLECTOR CURRENT, I_C	2.5	amperes
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25° C.	17.5	watts
At case temperatures above 25° C.	Derate linearly 100 mw/°C	
TEMPERATURE RANGE:		
Storage	-65 to 200	°C
Operating (Junction)	-65 to 200	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32" from ceramic wafer for 10 sec. max.	230	°C

Features:

- High Power Output, Unneutralized (P_{OUT}):
  15 w min. at 50 MHz
  5 w min. at 150 MHz
- High Voltage Ratings:
  V_{CBO} = 105 volts max.
  V_{CEV} = 105 volts max.
  V_{CEO} = 60 volts max.
- 100 per cent tested to assure freedom from second breakdown in class-A operation at maximum ratings
- Low Thermal Resistance (θ_{J-C})— high thermal-conductivity ceramic insulation between collector and mounting stud
- Isolated Stud Package:
  all three electrodes electrically isolated from case—for design flexibility
  heavy copper mounting stud—for effective contact with heat sink
  pin terminals arranged on a .200" pin-circle diameter—fit commercially available sockets

TERMINAL DESIGNATIONS



JEDEC TO-60

ELECTRICAL CHARACTERISTICS *Case Temperature = 25° C Unless Otherwise Specified*

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS Min.	Max.	Units
Collector-Cutoff Current	I_{CBO}	30			0			-	0.1	μa
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.5	105	-	volts
Collector-to-Emitter Breakdown Voltage (Sustaining)	$BV_{CEO(sus)}$					0	500*	60	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			-1.5			0.1	105	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1		0	4	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$					500	2.5 amp	-	1	volt
Feedback Capacitance (Measured at 140 kHz)	$C_{b'c}$	30			0			-	20	pF
RF Power Output, Unneutralized	P_{out}									
Measured at 50 MHz			50				550	15[a]	-	watts
150 MHz			50				250	5[b]	-	watts
Gain-Bandwidth Product	f_T		28				250	200(typ.)		MHz
Base-Spreading Resistance (Measured at 400 MHz)	$r_{bb'}$		28				250	6.0(typ.)		ohms
Collector-to-Case Capacitance	C_c							-	6	pF

* Pulsed. Pulse duration ≤ 5 μsec; duty factor ≤ 1%.
[a] For P_{IN} = 2 watts
[b] For P_{IN} = 1 watt

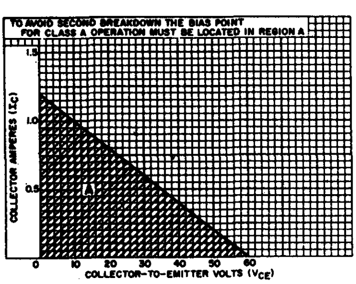


Fig. 1 - Region of safe operation (without second breakdown) in class A service.

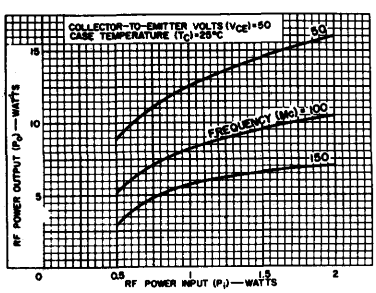


Fig. 2 - Typical operation characteristics.

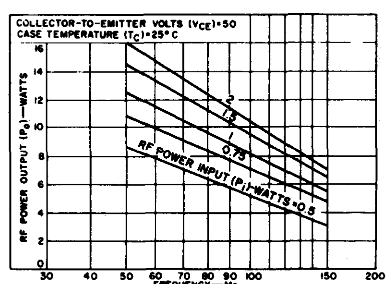


Fig. 3 - Typical operation characteristics.

2N3375, 2N3553, 2N3632

Silicon N-P-N Overlay Transistors

For VHF-UHF Applications

Maximum Ratings, *Absolute-Maximum Values:*

		2N3553	2N3375	2N3632	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	65	65	V
COLLECTOR-TO-EMITTER VOLTAGE:					
With base open	V_{CEO}	40	40	40	V
With V_{BE} = −1.5V	V_{CEV}	65	65	65	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	4	4	V
COLLECTOR CURRENT:					
Peak		1.0	1.5	3.0	A
Continuous	I_C	0.33	0.5	1.0	A
TRANSISTOR DISSIPATION	P_T				
At case temperatures up to 25° C		7.0	11.6	23	W

At case temperature above 25° C. Derate linearly to 0 watts at 200° C

	2N3553 2N3375 2N3632	
TEMPERATURE RANGE:		
Storage & Operating (Junction)	-65 to 200	°C
LEAD TEMPERATURE (During soldering): At distances ≥ 1/32 in. (.793 mm) from insulating wafer (TO-60 package) or from seating plane (TO-39 package) for 10 s max	230	°C

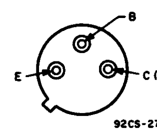
Features:

- **High Power Output, Class-C Amplifier:**

TYPE	400 MHz	260 MHz	175 MHz	100 MHz
2N3632		10 W Typ.	13.5 W Min.	
2N3553		2.5 W Typ.	2.5 W Min.	
2N3375	3 W Min.			7.5 W Min.

- **High Power Output, Oscillator:**
  2.5W (Typ.) at 500 MHz, (2N3375)
  1.5W (Typ.) at 500 MHz, (2N3553)
- **High Voltage Ratings**

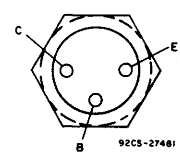
TERMINAL DESIGNATIONS



LEAD 1 - EMITTER
LEAD 2 - BASE
LEAD 3 - COLLECTOR, CASE

2N3553

JEDEC TO-39



PIN 1 - EMITTER
PIN 2 - BASE
PIN 3 - COLLECTOR
STUD - NO CONNECTION

2N3632
2N3375

JEDEC TO-60

All the pins of the 2N3632 and 2N3375 are electrically isolated from the case.

ELECTRICAL CHARACTERISTICS: ***At Case Temperature (T_C) = 25°C***

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS 2N3632 Min.	2N3632 Max.	2N3553 Min.	2N3553 Max.	2N3375 Min.	2N3375 Max.	Units
Collector-Cutoff Current	I_{CEO}		30			0		-	0.25	-	0.1	-	0.1	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$				0 0 0		0.1 0.3 0.5	- - 65	- - -	- 65 -	- - -	65 - -	- - -	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$					0	0 to 200[a]	40[b]	-	40[b]	-	40[b]	-	V
	$V_{(BR)CEV}$			−1.5			0 to 200[a]	65[b]		65[b]		65[b]	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.1 0.25		0 0	- 4	- -	4 -	- -	4 -	- -	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					100 50	500 250	- -	1 -	- -	- 1	- -	1 -	V
Collector-to-Base Capacitance Measured at 1 MHz	C_{obo}	30			0			-	20	-	10	-	10	pF
RF Power Output Amplifier, Unneutralized At 100 MHz 175 MHz 260 MHz 400 MHz	P_{OE}		28 28 28 28					- 13.5[e] 10[f] (typ.) -	- - -	- 2.5[g] - -	- - - -	7.5[c] - - 3[d]	- - - -	W
Gain-Bandwidth Product	f_T		28 28				100 150	- 400 (typ.)	- 	500 (typ.) -		- 500 (typ.)	- 	MHz
Base-Spreading Resistance Measured at 100 MHz 200 MHz 400 MHz	r_{bb}		28 28 28				100 250 250	- 6.5 (typ.) -	- -	12.0 (typ.) - -	 - -	- - 10.0 (typ.)	- - 	ohms

[a] Pulsed through an inductor (25 mH); duty factor = 50%.
[b] Measured at a current where the breakdown voltage is a minimum.
[c] For P_{IE} = 1.0 W; minimum efficiency = 65%.
[d] For P_{IE} = 1.0 W; minimum efficiency = 40%.
[e] For P_{IE} = 3.5 W; minimum efficiency = 70%.
[f] For P_{IE} = 3.0 W; typical efficiency = 60%.
[g] For P_{IE} = 1/4 W; minimum efficiency = 50%.

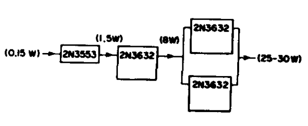


Fig. 1 - Typical 175-MHz amplifier chain for P_{OE} of 25 to 30 years.

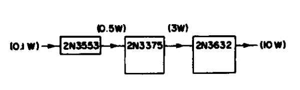


Fig. 2 - Typical 260-MHz amplifier chain for P_{OE} of 10 watts.

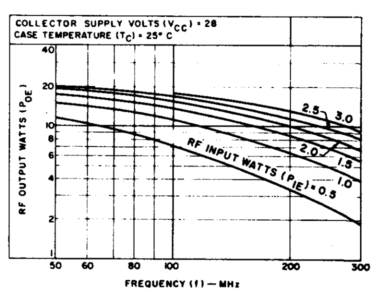


Fig. 3 - Power output as a function of frequency for 2N3632.

2N3375, 2N3553, 2N3632

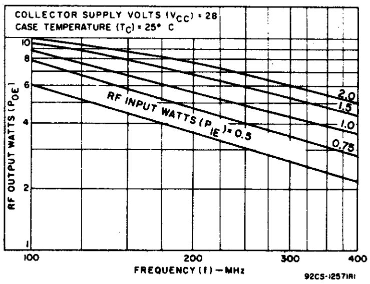


Fig. 4 - Power output as a function of frequency for 2N3375.

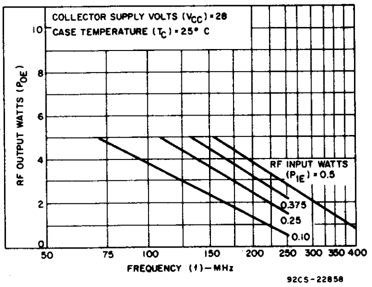


Fig. 5 - Power output as a function of frequency for type 2N3553.

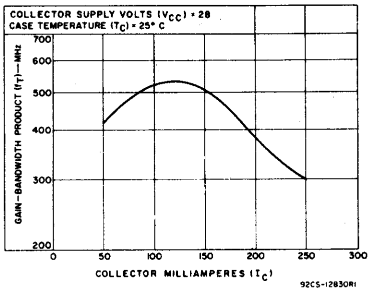


Fig. 6 - Gain-bandwidth product as a function of collector current for types 2N3632.

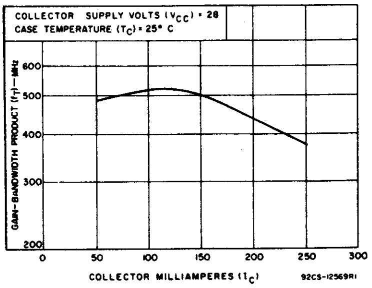


Fig. 7 - Gain-bandwidth product as a function of collector current for types 2N3375.

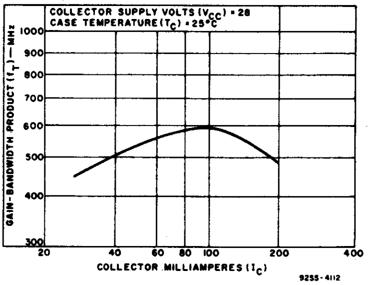


Fig. 8 - Gain-bandwidth product as a function of collector current for 2N3553.

2N3478

Silicon N-P-N Epitaxial Planar Transistor

For VHF/UHF Applications in Industrial and Commercial Equipment

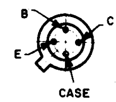
Features:

- high gain-bandwidth product – f_T = 900 MHz typ.
- low noise figure NF = 5 dB typ. at 470 MHz; 4.5 dB max. at 200 MHz; 2.5 dB typ. at 60 MHz
- high unneutralized power gain G_{pe} = 11.5 dB min. at 200 MHz
- hermetically sealed four-lead package
- all active elements insulated from case
- low collector-to-base feedback capacitance, C_{cb} 0.7 pF max.

Maximum Ratings, *Absolute-Maximum Values:*

Collector-to-Base Voltage, V_{CBO}	30	V
Collector-to-Emitter Voltage, V_{CEO}	15	V
Emitter-to-Base Voltage, V_{EBO}	2	V
Collector Current, I_C	limited by dissipation	
Transistor Dissipation, PT:		
at ambient temperatures up to 25° C	200	mW
at ambient temperatures above 25° C	See *Fig. 1*	
Temperature Range:		
Storage and Operating (Junction)	-65 to 200	°C
Lead Temperature (During Soldering):		
At distances not closer than 1/32" to seating surface for 10 seconds max.	265	°C

TERMINAL DESIGNATIONS



92CS-27513

JEDEC TO-72

ELECTRICAL CHARACTERISTICS, *At an Ambient Temperature (T_A) of 25° C*

Characteristics	Symbols	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	Limits Type 2N3478 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}		1		0		–	–	0.02	μA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0	0.001	30	–	–	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO}					0.001	15	–	–	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				-0.001	0	2	–	–	V
Static Forward-Current Transfer Ratio	h_{FE}			8		2	25	–	150	
Magnitude of Small-Signal Forward-Current Transfer Ratio	h_{fe}[a]	100		8		2	7.5	9	16	
Collector-to-Base Feedback Capacitance	C_{cb}[b]	1	10		0		–	–	1	pF
Small-Signal, Common-Emitter Power Gain in Unneutralized Amplifier Circuit	G_{pe}[a]	200		8		2	11.5	–	17	dB
Small-Signal, Common-Emitter Power Gain in Neutralized Amplifier Circuit	G_{pe}[a, c]	470		6		1.5	–	12	–	dB
UHF Noise Figure	NF[a, c]	470		6		1.5	–	5	–	dB
VHF Noise Figure	NF[a] NF[a, d]	200 60		8 8		2 1	– –	 2.5	4.5 –	dB dB

[a] Fourth lead (case) grounded.

[b] C_{cb} is a three terminal measurement of the collector-to-base capacitance with the emitter and case connected to the guard terminal.

[c] Source Resistance, R_s = 50 ohms.

[d] Source Resistance, R_s = 400 ohms.

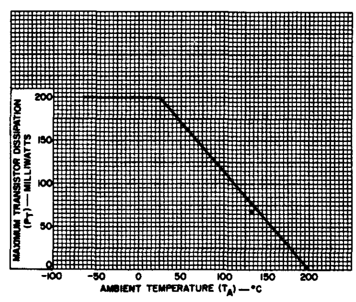


Fig. 1 - Rating chart for type 2N3478

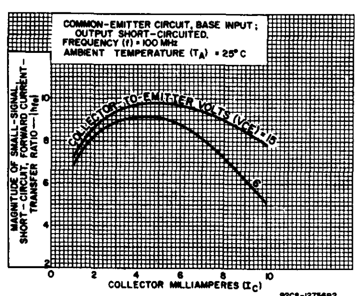


Fig. 2 - Typical small-signal beta characteristics for type 2N3478

2N3600

SILICON N-P-N EPITAXIAL PLANAR TRANSISTORS

For VHF Applications In Military, Communications, and Industrial Equipment

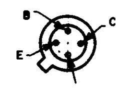
Features:

- high gain-bandwidth product
- hermetically sealed four-lead package
- low leakage current
- high 200-MHz power gain

2N3600

- low noise figure
  NF = 4.5 dB max. at 200 MHz
- low collector-to-base time constant
  $r_b'C_c$ = 15 ps max.
- high power gain as neutralized amplifier
  G_{pe} = 17 dB min. at 200 MHz

TERMINAL DESIGNATIONS



JEDEC TO-72

92CS-27513

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N3600	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3	V
COLLECTOR CURRENT, I_C	*	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures** { up to 25°C	300	mW
At case temperatures** { above 25°C	Derate at 1.71 mW/°C	
For operation at ambient temperatures:		
At ambient temperatures { up to 25°C	200	mW
At ambient temperatures { above 25°C	Derate at 1.14 mW/°C	
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances ⩾ 1/16 inch from seating surface for 60 seconds max.	300	°C

* Limited by transistor dissipation. ** Measured at center of seating surface.

ELECTRICAL CHARACTERISTICS

Characteristics	Symbols	TEST CONDITIONS: Ambient Temperature T_A (°C)	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Emitter-to-Base Voltage V_{EB} (V)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	DC Base Current I_B (mA)	LIMITS Type 2N3600 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	25 150		15 15			0 0			- -	- -	0.01 1	μA μA
Collector-to-Base Breakdown Voltage	BV_{CBO}	25					0	0.001		30	-	-	V
Collector-to-Emitter Sustaining Voltage	$BV_{CEO}(sus)$	25						3	0	15	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25					0.01	0		3	-	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25						10	1	-	-	0.4	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$	25						10	1	-	-	1	V
Static Forward Current-Transfer Ratio	h_{FE}	25			1			3		20	-	150	
Small-Signal Forward Current-Transfer Ratio[a]	h_{fe}	25	100 1 kHz		6 6			5 2		8.5 40	- -	15 200	
Common-Base Output Capacitance[b]	C_{ob}	25	0.1 to 1	0			0			-	-	-	pF
Collector-to-Base Feedback Capacitance[b]	C_{cb}	25	0.1 to 1	10			0			-	-	1	pF
Common-Base Input Capacitance[c]	C_{ib}	25	0.1 to 1			0.5		0		-	1.4	-	pF
Collector-to-Base Time Constant[a]	$r_b'C_c$	25	31.9	6				5		4	-	15	ps
Small-Signal Power Gain in Neutralized Common-Emitter Amplifier Circuit[a]	G_{pe}	25	200		6			5		17	-	24	dB
Power Output in Common-Emitter Oscillator Circuit[c] (See Fig.5)	P_o	25	≥ 500	10			12			20	-	-	mW
Nose Figure[a]	NF	25	200		6			1.5		-	-	4.5	dB
Noise Figure[a,d]	NF	25	60		6			1		-	-	3	dB

[a] Lead No.4 (case) grounded.
[b] Three-terminal measurement of the collector-to-base capacitance with the case and emitter leads connected to the guard terminal.
[c] Lead No.4 (case) floating.
[d] Generator Resistance (R_g) = 400 ohms.

2N3733

10-W, 400-MHz Silicon N-P-N Overlay Transistor

For Large-Signal, High-Power VHF/UHF Applications

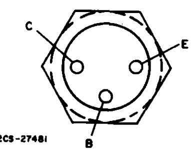
Features:

- High power output, unneutralized Class C amplifier:
  - at 400 MHz: 10 W min.
  - at 280 MHz: 14.5 W typ.
- High voltage ratings:
  - V_{CBO} = 65 V max.
  - V_{CEV} = 65 V max.
  - V_{CEO} = 40 V max.
- 100 per cent tested to assure freedom from second breakdown for operation in Class A applications
- Low thermal resistance

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base-emitter junction reverse-biased (V_{BE} = -1.5 V)	V_{CEV}	65	V
*With base open	V_{CEO}	40	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
*COLLECTOR CURRENT:			
Continuous	I_C	1	A
Peak		3	A
*CONTINUOUS BASE CURRENT	I_B	1	A
*TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		23	W
At case temperatures above 25°C		Derate linearly to 0 watts at 200°C	
*TEMPERATURE RANGE:			
Storage and operating (junction)		-65 to 200	°C
*LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max. . .		230	°C

TERMINAL DESIGNATIONS



JEDEC TO-60

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc I_E	I_B	I_C	LIMITS MIN.	MAX.	UNITS
* Collector Cutoff Current: With base open	I_{CEO}		30			0		-	0.25	mA
With base-emitter junction reverse-biased	I_{CEV}		65	-1.5				-	5	mA
At T_C = 200°C			30	-1.5				-	10	mA
With emitter open	I_{CBO}	65						-	0.5	mA
* Emitter Cutoff Current	I_{EBO}			-4				-	0.25	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$				0		0.5	65	-	V
Collector-to-Emitter Breakdown Voltage: With base-emitter junction reverse-biased	$V_{(BR)CEV}$			-1.5			0 to 200●	65**	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.25		0	4	-	V
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$					0	200	40	-	V
With external base-to-emitter resistance (R_{BE}) = 100 Ω	$V_{CER}(sus)$						200	40	-	V
* DC Forward Current Transfer Ratio	h_{FE}		5 5				1 0.25	5 10	- 150	
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					200	1000	-	1	V
* Base-Emitter Voltage	V_{BE}		5				1000	-	1.5	V
Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 100 MHz)	$\|h_{fe}\|$		28 28				250 250	2.5* 4.0 (typ.)	-	
* Collector-to-Base Capacitance (f = 0.1 to 1 MHz)	C_{ob}	28					250	-	25	pF
* Available Amplifier Signal Input Power P_o = 10 W, Z_G = 50 Ω, f = 400 MHz	P_i							-	4	W
* Collector Circuit Efficiency P_o = 10 W, Z_G = 50 Ω, f = 400 MHz	η_C							45	-	%
Base-Spreading Resistance Measured at 200 MHz	r_{bb}		28				250	6.5 (typ.)		Ω
Collector-to-Case Capacitance	C_s							-	6	pF
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$							-	7.5	°C/W

● Pulsed through an inductor (25 mH); duty factor = 50%

** Measured at a current where the breakdown voltage is a minimum

* In accordance with JEDEC registration data

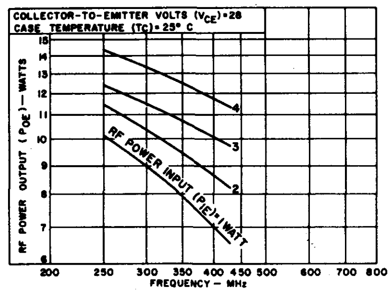


Fig. 1 - Power output as a function of frequency.

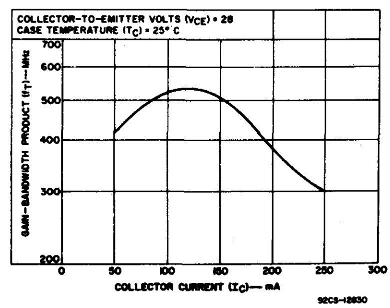


Fig. 2 - Gain-bandwidth product as a function of collector current.

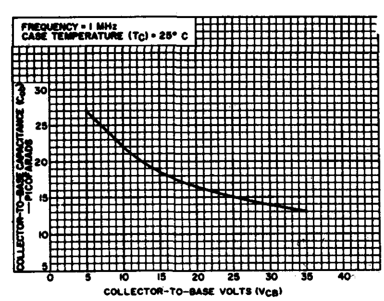


Fig. 3 - Variation of collector-to-base capacitance.

2N3839

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR

For Low-Noise UHF Applications in Industrial and Military Equipment

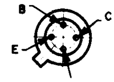
Features:

- very low device noise figure — NF = 3.4 dB max. as 450-MHz amplifier
- high gain-bandwidth product — f_T = 1000 MHz min.
- high converter (450-to-30 MHz) gain — G_c = 15 dB typ. for circuit bandwidth of approximately 2 MHz
- high power gain as neutralized amplifier — G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as UHF oscillator — P_o = 30 mW min., 40 mW typ. at 500 MHz = 20 mW typ. at 1 GHz
- low collector-to-base time constant — $r_b{}'C_c$ = 7 ps typ.
- low collector-to-base feedback capacitance — C_{cb} = 0.6 pF typ.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5	V
COLLECTOR CURRENT, I_C	40	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures** up to 25°C	300	mW
At case temperatures** above 25°C	Derate at 1.72	mW/°C
For operation at ambient temperatures:		
At ambient temperatures up to 25°C	200	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	265	°C

TERMINAL DESIGNATIONS



92CS-27513

JEDEC TO-72

ELECTRICAL CHARACTERISTICS

CHARACTERISTICS	SYMBOL	FREQUENCY f (MHz)	DC COLLECTOR-TO-BASE VOLTAGE V_{CB} (V)	DC COLLECTOR-TO-EMITTER VOLTAGE V_{CE} (V)	DC EMITTER-TO-BASE VOLTAGE V_{EB} (V)	DC EMITTER CURRENT I_E (mA)	DC BASE CURRENT I_B (mA)	DC COLLECTOR CURRENT I_C (mA)	LIMITS TYPE 2N3839 Min.	Typ.	Max.	UNITS
Collector-Cutoff Current T_A = 25°C T_A = 150°C	I_{CBO}		15 15			0 0			- -	- -	10 1.0	nA μA
Collector-to-Base Breakdown Voltage	BV_{CBO}					0		0.001	30	-	-	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO}						0	3	15	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}					0.01		0	2.5	-	-	V
Static Forward Current-Transfer Ratio	h_{FE}			1				3	30	-	150	
Small-Signal Forward Current-Transfer Ratio	h_{fe}	0.001[c] 100[c]		6 6				2 5	50 10	- -	220 20	
Collector-to-Base Feedback Capacitance	C_{cb}	0.1 to 1.0[b]	10			0			-	0.6	1.0	pF
Input Capacitance	C_{ib}	0.1 to 1.0			0.5			0	-	1.4	-	pF
Collector-to-Base Time Constant	$r_b{}'C_c$	31.9[c]	6			-2			1	7	15	ps
Small-Signal, Common-Emitter Power Gain in Neutralized Amplifier Circuit	G_{pe}	450[c]		6				1.5	12.5	-	19	dB
Power Output as Oscillator	P_o	≥500[a]	10			-12			30	-	-	mW
UHF Measured Noise Figure	NF	450[c,d]		6				1.5	-	-	3.9	dB
UHF Device Noise Figure	NF	450[c,d,f]		6				1.5	-	-	3.4	dB
VHF Measured Noise Figure	NF	60[c,e]		6				1	-	2	-	dB

[a] Lead No.4 (case) not connected.
[b] 3-terminal measurement with emitter and case connected to guard terminal.
[c] Lead No.4 (case) grounded.
[d] Generator resistance, R_g = 50 ohms.
[e] Generator resistance, R_g = 400 ohms.
[f] Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test circuit (0.25 dB) and the contribution of the following stages in the test setup (0.25 dB).

2N3866

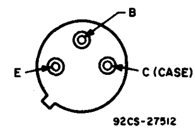
Silicon N-P-N Overlay Transistor

High-Gain Driver for VHF/UHF Applications in Military and Industrial Communications Equipment

Features

- **High Power Gain, Unneutralized Class C Amplifier**
  - 1 W output at 400 MHz (10 dB gain)
  - 1 W output at 250 MHz (15 dB gain)
  - 1 W output at 175 MHz (17 dB gain)
  - 1 W output at 100 MHz (20 dB gain)
- ***Low Output Capacitance***
  C_{obo} = 3 pF max.

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

* COLLECTOR-TO-BASE VOLTAGE . . .	V_{CBO}	55	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 10Ω.	V_{CER}	55	V
* With base open	V_{CEO}	30	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	3.5	V
* CONTINUOUS COLLECTOR CURRENT	I_C	0.4	A
* CONTINUOUS BASE CURRENT	I_B	0.4	A
* *TRANSISTOR DISSIPATION*	P_T		
At case temperature up to 25°C		5	W
At case temperatures above 25°C . . .		See Fig. 2	
* TEMPERATURE RANGE:			
Storage & Operating (Junction).		–65 to +200	°C
* LEAD TEMPERATURE			
At distances ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		230	°C

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

STATIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Voltage (V) V_{CE}	DC Voltage (V) V_{EB}	DC Current (mA) I_E	DC Current (mA) I_B	DC Current (mA) I_C	LIMITS Min.	LIMITS Max.	UNITS
* Collector-Cutoff Current: Base-emitter junction reverse biased	I_{CEX}	55	1.5				–	0.1	mA
T_C = 200°C		30	1.5				–	0.1	
Base open	I_{CEO}	28			0		–	20	μA
* Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.1	55	–	V
* Collector-to-Emitter Breakdown Voltage: With base open	$V_{(BR)CEO}$				0	5	30	–	V
With base connected to emitter through 10-ohm resistor	$V_{(BR)CER}$		0			5	55	–	
* Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.1		0	3.5	–	V
* Emitter-Cutoff Current	I_{EBO}		3.5				–	0.1	mA
* Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				20	100	–	1.0	V
* DC Forward-Current Transfer Ratio	h_{FE}	5 5				360 50	5 10	– 200	
Thermal Resistance: (Junction-to-Case)	$\theta_{J\text{-}C}$						–	35	°C/W

DYNAMIC

TEST & CONDITIONS	SYMBOL	FREQUENCY MHz	LIMITS MINIMUM	LIMITS MAXIMUM	UNITS
Power Output (V_{CC} = 28 V): P_{IE} = 0.1 W	P_{OE}	400	1.0	–	W
Large-Signal Common-Emitter Power Gain (V_{CC} = 28 V): P_{IE} = 0.1 W	G_{PE}	400	10	–	dB
* Collector Efficiency (V_{CC} = 28 V): P_{IE} = 0.1 W, P_{OE} = 1 W, Source Impedance = 50Ω	η_C	400	45	–	%
* Magnitude of Common-Emitter, Small Signal, Short-Circuit Forward-Current Transfer Ratio I_C = 50 mA, V_{CE} = 15 V	$\|h_{fe}\|$	200	2.5	–	
* Available Amplifier Signal Input Power, P_{OE} = 1 W, Source Impedance = 50Ω	P_i	400	–	0.1	W
* Common-Base Output Capacitance (V_{CB} = 28 V)	C_{obo}	1	–	3	pF

* In accordance with JEDEC registration data format JS-6 RDF-3

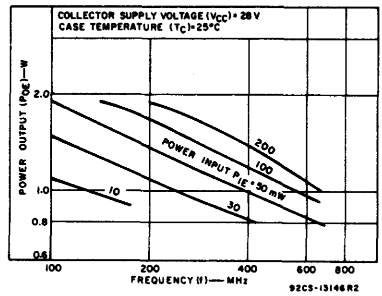


Fig. 1 - Power output as a function of frequency.

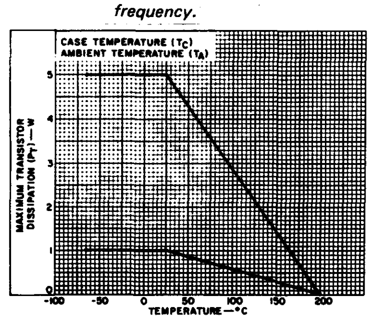


Fig. 2 - Dissipation derating curve.

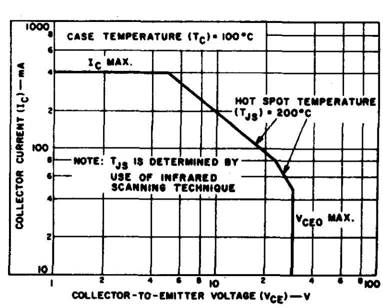


Fig. 3 - Safe area for dc operation.

2N4012

High-Power Silicon N-P-N Overlay Transistor

For Applications as a Frequency Multiplier Into the UHF or L-Band Range

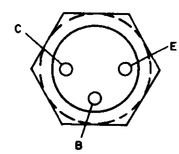
Features

- 2.5 W output with 4 dB conversion gain (min.) as tripler to 1 GHz
- 3 W output with 4.8 dB conversion gain (typ.) as doubler to 800 MHz
- High voltage ratings
- Freedom from second breakdown

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	40	V
With V_{BE} = −1.5 volts	V_{CEV}	65	V
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
COLLECTOR CURRENT	I_C	1.5	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		11.6	W
At case temperatures above 25°C		See Fig. 5	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to +200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max.		230	°C

TERMINAL DESIGNATIONS



92CS-27481

JEDEC TO-60

ELECTRICAL CHARACTERISTICS, Case Temperature = 25°C

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Volts		DC Base Volts	DC Current (Milliamperes)			LIMITS		UNITS
		V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}		30			0		–	0.1	mA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.1	65	–	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEO}					0	0 to 200[a]	40[b]	–	volts
	BV_{CEV}			-1.5			0 to 200[a]	65[b]	–	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1		0	4	–	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					100	500	–	1	volt
Collector-to-Base Capacitance	C_{ob}	30			0			–	10	pF
RF Power Output Tripler At 1002 Mc/s Doubler At 800 Mc/s	P_{OUT}		28 28					2.5[c] 3.0[d] (typ.)		watts
Gain-Bandwidth Product	f_T		28				150	500 (typ.)		Mc/s
Collector-to-Base Cutoff Frequency[e]	f_c		28				0	25 (typ.)		Gc/s

a Pulsed through an inductor (25 mH); duty factor = 50%.
b Measured at a current where the breakdown voltage is a minimum.
c For P_{IN} = 1.0 W; at 334 Mc/s; minimum collector efficiency = 25%.
d For P_{IN} = 1.0 W; at 400 Mc/s; typical collector efficiency = 35%.
e Cutoff frequency is determined from Q measurement at 210 Mc/s. The cutoff frequency of the collector-to-base junction of the transistor, f_c = Q x 210 Mc/s.

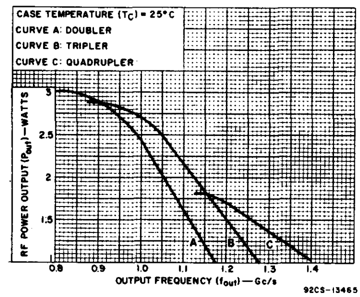


Fig. 1 - Output power as a function of output frequency.

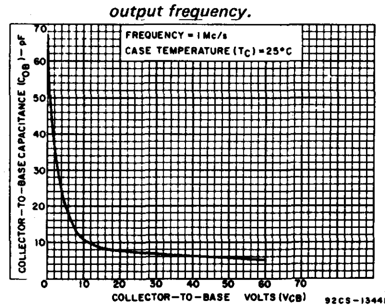


Fig. 2 - Collector-to-base capacitance as a function of collector-to-base voltage.

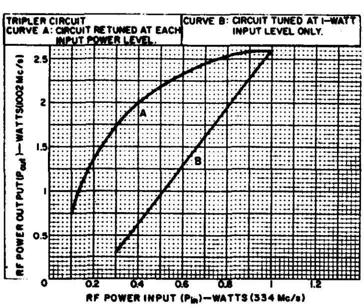


Fig. 3 - Power output as a function of power input.

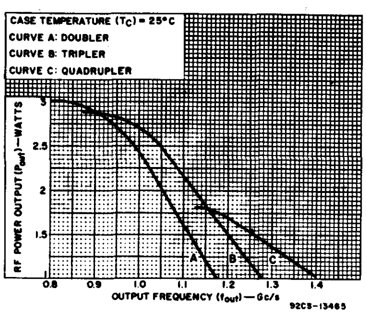


Fig. 4 - Power output as a function of collector supply voltage

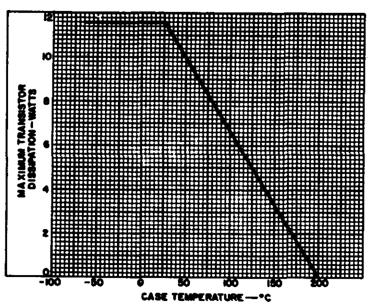


Fig. 5 - Dissipation derating curve.

2N4427

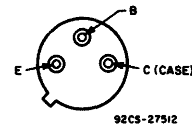
Silicon N-P-N Overlay Transistor

High-Gain Driver for VHF-UHF

Features:

- **1 W output with 10 dB gain (min.) at 175 MHz V_{CC} = 12 V**
- **0.4 W output with 5 dB gain (typ.) at 470 MHz V_{CC} = 12 V**

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	40	V
* COLLECTOR-TO-EMITTER VOLTAGE: With base open	V_{CEO}	20	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	2	V
* CONTINUOUS COLLECTOR CURRENT	I_C	0.4	A
* CONTINUOUS BASE CURRENT	I_B	0.4	A
* TRANSISTOR DISSIPATION: At case temperatures up to 100°C	P_T	2	W
* TEMPERATURE RANGE: Storage & Operating (Junction)		−65 to 200	°C
* LEAD TEMPERATURE (During soldering): At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max.		230	°C

* In accordance with JEDEC registration data format JS-6 RDF-3.

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C.

Characteristic	Symbol	TEST CONDITIONS: DC Voltage (V) V_{BE}	V_{EB}	V_{CB}	V_{CE}	DC Current (mA) I_E	I_B	I_C	Limits Min.	Max.	Units
* Collector-Cutoff Current: With base open	I_{CEO}				12		0		–	0.02	mA
With base-emitter junction reverse-biased	I_{CEV}	−1.5			40				–	0.1	mA
T_C = 150°C	I_{CEV}	−1.5			12				–	5	mA
* Emitter-Cutoff Current	I_{EBO}		2						–	0.1	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$					0		0.1	40	–	V
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$						0	5	20	–	V
With external base-to-emitter resistance (R_{BE}) = 10Ω	$V_{CER(sus)}$							5	40	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$					0.1		0	2	–	V
* Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$						20	100	–	0.5	V
* DC Forward Current Transfer Ratio	h_{FE}				5 5			360 100	5 10	– 200	
* Magnitude of Common-Emitter Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 200 MHz)	$\|h_{fe}\|$				15			50	2.5	–	
* Collector-to-Base Capacitance (f = 1 MHz)	C_{ob}			12		0			–	4	pF
RF Power Output Class C Amplifier, Unneutralized (f = 175 MHz, P_{IE} = 0.1 W, $\eta_C \geq$ 50%)	P_{OE}			12 (V_{CC})					1	–	W
* Available Amplifier Signal Input Power (f = 175 MHz, P_{OE} = 1 W, Z_{IN} = 50 Ω)	P_i			12 (V_{CC})					–	0.1	W
* Collector Efficiency (f = 175 MHz, P_{OE} = 1 W, Z_{IN} = 50 Ω)	η_C			12 (V_{CC})					50	–	%
Thermal Resistance Junction-to-Case	$R_{\theta JC}$								–	50	°C/W

* In accordance with JEDEC registration data format JS–6 RDF–3.

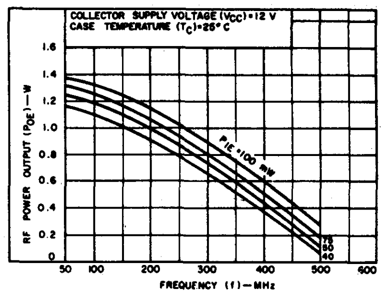


Fig. 1 - Power output as a function of frequency.

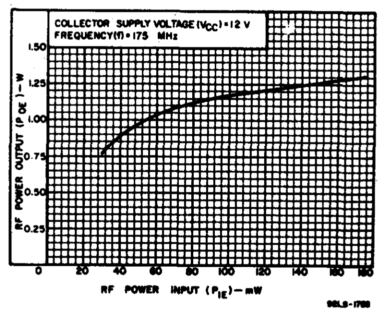


Fig. 2 - Power output as a function of power input at 175 MHz.

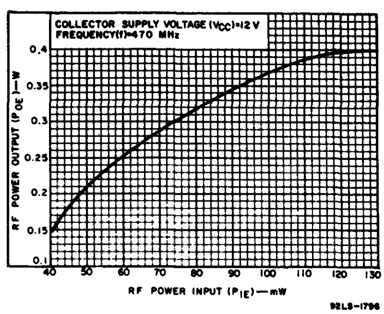


Fig. 3 - Power output as a function of power input at 470 MHz.

2N4440

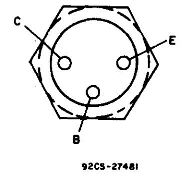
Silicon N-P-N Overlay Transistor

For Class A, B, or C VHF/UHF
Military and Industrial Communications Equipment

Features:

- **5 W output min. at 400 MHz**
- **6.5 W output typ. at 225 MHz**

TERMINAL DESIGNATIONS



JEDEC TO-60

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	V
*COLLECTOR-TO-EMITTER VOLTAGE:			
With base-emitter junction reverse-biased (V_{BE}) = -1.5 V	V_{CEV}	65	V
* With base open	V_{CEO}	40	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
*CONTINUOUS COLLECTOR CURRENT	I_C	1.5	A
*CONTINUOUS BASE CURRENT	I_B	0.2	A
*TRANSISTOR DISSIPATION▲:	P_T		
At case temperatures up to 25°C		11.6	W
At case temperatures above 25°C		See Fig. 2	
*TEMPERATURE RANGE:			
Storage and operating (junction)		-65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max		230	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc: V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc: I_E	I_B	I_C	LIMITS: MIN.	MAX.	UNITS
*	Collector Cutoff Current: With base open	I_{CEO}		30			0		-	0.1	mA
	With base-emitter junction reverse-biased	I_{CEV}		65	-1.5				-	1	mA
	At T_C = 200°C	I_{CEV}		30	-1.5				-	5	mA
*	Emitter Cutoff Current	I_{EBO}			-4				-	0.1	mA
	Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$				0		0.1	65	-	V
	Collector-to-Emitter Breakdown Voltage: With base-emitter junction reverse-biased	$V_{(BR)CEV}$			-1.5			0 to 200●	65**	-	V
	Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0.1		0	4	-	V
*	Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$					0	200●	40	-	V
	With external base-to-emitter resistance (R_{BE}) = 100Ω	$V_{CER}(sus)$						200●	40	-	V
*	DC Forward Current Transfer Ratio	h_{FE}		5 5				1350 125	3 10	- 200	
*	Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					50	250	-	1	V
	Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 100 MHz)	$\|h_{fe}\|$		28				125	4* 5 (typ.)	-	
*	Collector-to-Base Capacitance (f = 1 MHz)	C_{ob}	28					125	-	12	pF
*	Available Amplifier Signal Input Power (P_o = 5 W, Z_G = 50Ω, f = 400 MHz)	P_i							-	1.7	W
*	Collector Circuit Efficiency (P_o = 5 W, Z_G = 50Ω, f = 400 MHz)	η_C							45	-	%
	Base-Spreading Resistance Measured at 200 MHz	$r_{bb'}$		28				250	10 (typ.)		Ω
	Collector-to-Case Capacitance	C_s							-	6	pF
	Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$							-	15	°C/W

●Pulsed through an inductor (25 mH); duty factor=50%
**Measured at a current where the breakdown voltage is a minimum
*In accordance with JEDEC registration data.

▲Secondary breakdown considerations limit maximum dc operating conditions. . .contact your RCA Representative for specific data.

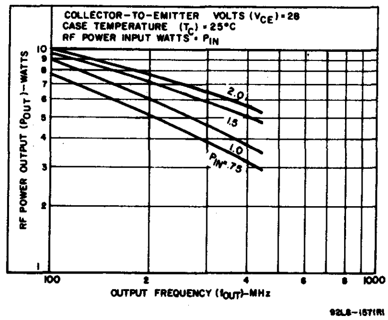


Fig. 1 - Typical power output as a function of frequency.

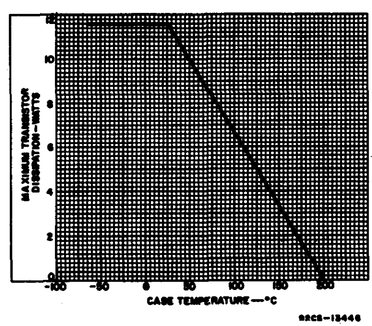


Fig. 2 - Dissipation derating chart.

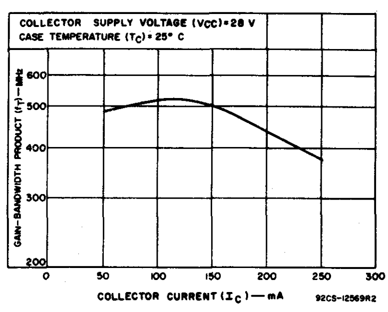


Fig. 3 - Typical gain-bandwidth product as a function of collector current.

2N4932, 2N4933

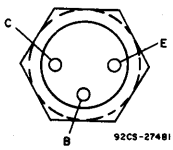
Silicon N-P-N Overlay Transistors

For International VHF Mobile and Portable Communication, 66 to 88 MHz

Features:

- **Operation From a Power Supply of – 13.5 volts (2N4932) 24 volts (2N4933)**
- **Power Output (Min.) at 88 MHz 12 watts (2N4932) 20 watts (2N4933)**
- **Load Protection**
- **High Voltage Ratings**

TERMINAL DESIGNATIONS



JEDEC TO-60

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

		2N4932	2N4933	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	50	70	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	25	35	V
With V_{BE} = −1.5V	V_{CEV}	50	70	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4.0		V
COLLECTOR CURRENT:				
Peak		10		A
Continuous	I_C	3.3		A

		2N4932	2N4933	
RF INPUT POWER	P_{in}			
At 88 MHz		3.5		W
TRANSISTOR DISSIPATION	P_T			
At case temperatures up to 25° C		70		W
TEMPERATURE RANGE:				
Storage & Operating (Junction)		−65 to 200		°C
LEAD TEMPERATURE (During soldering):				
At distances ≥ 1/32 in. from insulating wafer for 10 s max.		230		°C

ELECTRICAL CHARACTERISTICS FOR 2N4932
Case Temperature = 25° C

Characteristic	Symbol	TEST CONDITIONS						Limits		Units
		DC Collector Volts		DC Base Volts	DC Current (Milliamperes)					
		V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}		15			0			1.0	mA
	I_{CBO}	40			0				10	mA
Collector-to-Emitter Breakdown Voltage	$V_{CEV}(sus)$			−1.5			200[a]	50		V
	$V_{CEO}(sus)$					0	200[a]	25		V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				10		0	4		V
Collector-to-Base Capacitance	C_{ob}	15			0				120	pF
RF Power Output	P_{out}							12[c]		W

ELECTRICAL CHARACTERISTICS FOR 2N4933
Case Temperature = 25° C

Characteristic	Symbol	TEST CONDITIONS						Limits		Units
		DC Collector Volts		DC Base Volts	DC Current (Milliamperes)					
		V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}		30			0			1.0	mA
	I_{CBO}	50			0				10	mA
Collector-to-Emitter Breakdown Voltage	$V_{CEV}(sus)$			−1.5			200[a]	70		V
	$V_{CEO}(sus)$					0	200[a]	35		V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				10		0	4		V
Collector-to-Base Capacitance	C_{ob}	30			0				85	pF
RF Power Output	P_{out}							20[b]		W

[a] Pulsed through an inductor (25mH), duty factor = 50%

[b] For P_{in} = 3.5 W, at 88 MHz; V_{cc} = 24V, minimum efficiency = 70%

[c] For P_{in} = 3.5 W, at 88 MHz; V_{cc} = 13.5V, minimum efficiency = 70%

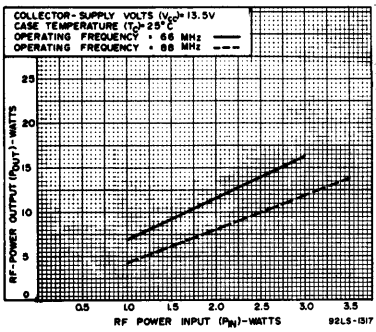


Fig. 1 - Typical power output as a function of power input for the 2N4932.

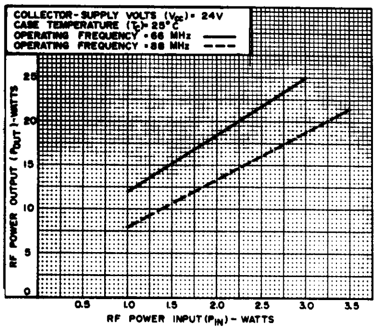


Fig. 2 - Typical power output as a function of power input for the 2N4933.

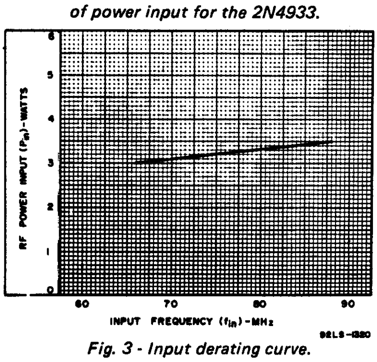


Fig. 3 - Input derating curve.

2N5070
Silicon N-P-N Overlay Transistor

For High-Frequency Single-Sideband Communications Equipment

Features:

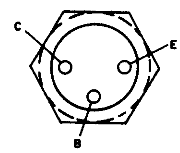
- Suitable for class A or class B amplifiers
- 25 W PEP output min. at 30 MHz with
  gain: 13 dB
  η: 40% min.,
  IMD: 30 dB max.
- Low thermal resistance

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base-emitter junction reverse-biased (V_{BE}) = -1.5 V	V_{CEV}	65	V
With external base-to-emitter resistance (R_{BE}) = 5Ω	V_{CER}	40	V
* With base open	V_{CEO}	30	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
*COLLECTOR CURRENT:	I_C		
Continuous		3.3	A
Peak		10	A
*CONTINUOUS BASE CURRENT	I_B	1	A
*TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		70	W
At case temperatures above 25°C		See Fig. 2	
*TEMPERATURE RANGE:			
Storage and operating (junction)		-65 to 200	°C
*LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max.		230	°C

*In accordance with JEDEC registration data

TERMINAL DESIGNATIONS



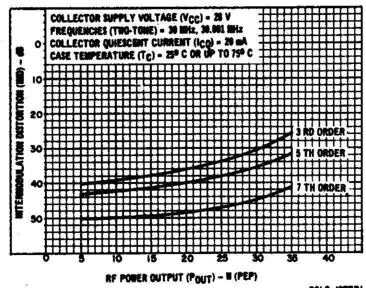
92CS-27481

JEDEC TO-60

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25° C unless otherwise specified*

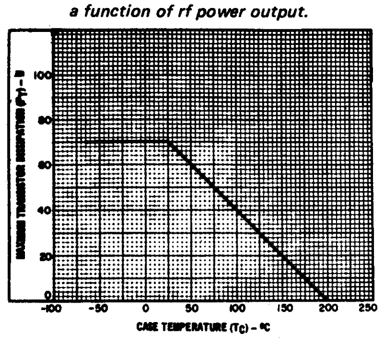
	CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc			TEST CONDITIONS: CURRENT mA dc			LIMITS		UNITS
			V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	MIN.	MAX.	
*	Collector Cutoff Current: With base-emitter junction reverse-biased	I_{CEV}		60	-1.5				–	10	mA
	At T_C = 150° C	I_{CEV}		60	-1.5				–	10	mA
	With emitter open	I_{CBO}		60		0			–	10	mA
	With base open	I_{CEO}		30			0		–	5	mA
*	Emitter Cutoff Current	I_{EBO}			4				–	10	mA
	Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse-biased	$V_{CEV}(sus)$			-1.5			200[a]	65	–	V
*	With base open	$V_{CEO}(sus)$					0	200[a]	30	–	V
*	With external base-to-emitter resistance (R_{BE}) = 5Ω	$V_{CER}(sus)$						200[a]	40	–	V
	Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				10			4	–	V
*	DC Forward Current Transfer Ratio	h_{FE}		5 5				3000 1000	10 20	100 –	
*	Magnitude of Common-Emitter Small-Signal Short-Circuit Forward Current Transfer Ratio (f = 50 MHz)	$\|h_{fe}\|$		15				1000	2	–	
*	Output Capacitance (f = 1 MHz)	C_{ob}	30			0			–	85	pF
*	Available Amplifier Signal Input Power Z_G = 50Ω, P_o = 25 W(PEP) f_1 = 30 MHz, f_2 = 30.001 MHz	P_i							–	1.25 PEP	W
*	Intermodulation Distortion Z_G = 50Ω, P_o = 25 W(PEP) f_1 = 30 MHz, f_2 = 30.001 MHz	IMD							–	30	dB
*	Collector Efficiency Z_G = 50Ω, P_o = 25 W(PEP) f_1 = 30 MHz, f_2 = 30.001 MHz	η_C							40	–	%
	Thermal Resistance Junction-to-Case	$R_{\theta JC}$							–	2.5	°C/W

*In accordance with JEDEC registration data format
[a]Pulsed through a 25-mH inductor; duty factor = 50%



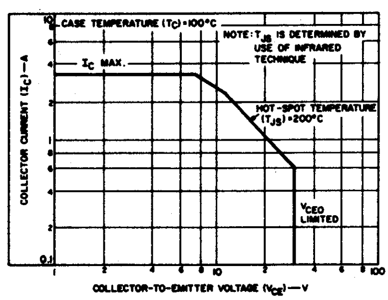
92LS-1877R1

Fig. 1 - Typical intermodulation distortion as a function of rf power output.



92LS-1682R2

Fig. 2 - Dissipation derating chart.



92CS-19139

Fig. 3 - Safe operation with dc forward bias.

2N5071

24-W(CW), 76-MHz Emitter-Ballasted Overlay Transistor

Silicon N-P-N Device for 24-Volt Applications in VHF Communications Equipment

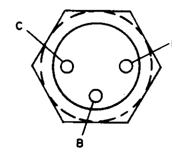
Features:

- **For class B or class C amplifiers**
- **For 24-V FM (30 to 76 MHz) communications**
- **24 W output at 76 MHz with 9 dB gain (Min.)**
- **Low thermal resistance**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	65	V
*COLLECTOR-TO-EMITTER VOLTAGE	V_{CEO}	30	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
*COLLECTOR CURRENT:			
Continuous	I_C	3.3	A
Peak		10	A
*CONTINUOUS BASE CURRENT	I_B	1	A
*TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		70	W
*TEMPERATURE RANGE:			
Storage and operating (junction)		−65 to 200	°C
*LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max.		230	°C

TERMINAL DESIGNATIONS



92CS-27481

JEDEC TO-60

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

STATIC

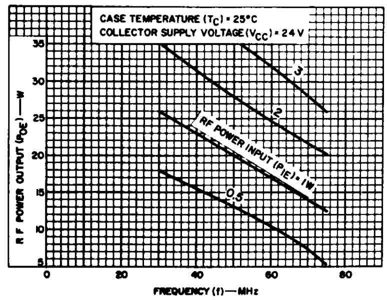
CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Voltage-V V_{CB}	V_{CE}	DC Base Voltage-V V_{BE}	DC Current mA I_E	I_B	I_C	LIMITS MIN.	MAX.	UNITS
* Collector-Cutoff Current:	I_{CEV}		60	−1.5				–	10	mA
At T_C = 150°C			60	−1.5				–	10	mA
With base open	I_{CEO}		30			0		–	5	mA
With emitter open	I_{CBO}	60						–	10	mA
* Emitter-Cutoff Current	I_{EBO}			4				–	10	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$				0		200[a]	65	–	V
* Collector-to-Emitter Breakdown Voltage: With base open	$V_{(BR)CEO}$				0		200[a]	30	–	V
* Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$					0	200[a]	30	–	V
With external base-to-emitter resistance (R_{BE}) = 5 Ω	$V_{CER}(sus)$						200[a]	40	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$					10	0	4	–	V
* DC Forward Current Transfer Ratio	h_{FE}		5				3 A	10	100	
			5				1 A	20	–	
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$							–	2.5	°C/W

[a]Pulsed through a 25-mH inductor; duty factor = 50%; repetition rate ≥ 60 Hz.

DYNAMIC

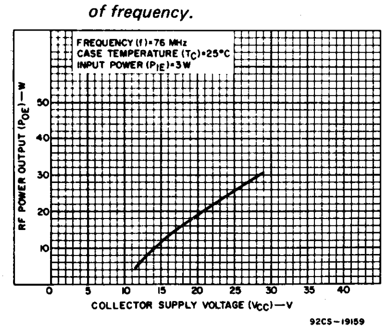
CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Supply (V_{CC})—V	Input Power (P_{IE})—W	Frequency (f) - MHz	LIMITS MIN.	MAX.	UNITS
Power Output	P_{OE}	24	3	76	24	–	W
Power Gain	G_{PE}	24	3	76	9	–	dB
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio	$\|h_{fe}\|$	V_{CE} = 15 V, I_C = 1A		50	2	–	
* Available Amplifier Signal Input Power	P_i	Source impedance (Zg) = 50	P_{OE} = 24 W	76	–	3	W
* Collector Efficiency	η_C	24	3	76	60	–	%
Load Mismatch	LM	24	1.2	30	GO/NO GO VSWR = 3:1		
* Collector-to-Base Capacitance	C_{obo}	V_{CB} = 30 V	–	1	–	85	pF

* In accordance with JEDEC registration data



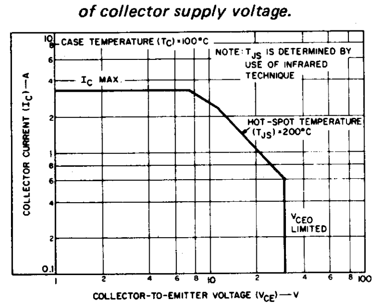
92LS-1838R2

Fig. 1 - Typical output power as a function of frequency.



92CS-19159

Fig. 2 - Typical output power as a function of collector supply voltage.



92CS-19139

Fig. 3 - Safe area for dc operation.

2N5090

High-Power Silicon N-P-N Overlay Transistor

High-Gain Type for Class A, B, or C Operation in VHF/UHF Circuits

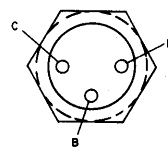
Features:

- **Maximum safe-area-of-operation curve**
- **1.2 W (min.) output at 400 MHz (7.8 dB gain)**
- **1.6 W (typ.) output at 175 MHz (12 dB gain)**
- **Hermetic stud-type package**
- **All electrodes isolated from stud**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	V
COLLECTOR-TO-EMITTER VOLTAGE: With external base-to-emitter resistance, R_{BE} = 10Ω	V_{CER}	55	V
* With base open	V_{CEO}	30	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	3.5	V
*CONTINUOUS COLLECTOR CURRENT	I_C	0.4	A
*CONTINUOUS BASE CURRENT	I_B	0.4	A
*TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 100°C		4	W
At case temperatures above 100°C		Derate linearly at 0.04 W/°C	
*TEMPERATURE RANGE: Storage & Operating (Junction)		−65 to +200	°C
*LEAD TEMPERATURE (During soldering): At distances ≥ 1/16 in. (1.58 mm) from insulating wafer for 10 s max.		230	°C

TERMINAL DESIGNATIONS



92CS-27481

JEDEC TO-60

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

STATIC

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Voltage-V V_{CE}	DC Base Voltage-V V_{BE}	DC Current mA I_E	I_B	I_C	LIMITS MIN.	LIMITS MAX.	UNITS
*	Collector-Cutoff Current: With base open	I_{CEO}	28			0		–	0.02	mA
	With base-emitter junction reverse-biased	I_{CEV}	55	−1.5				–	0.1	mA
	With base-emitter junction reverse-biased & T_C = 200°C	I_{CEV}	30	−1.5				–	5	mA
*	Emitter-Cutoff Current	I_{EBO}		3.5				–	0.1	mA
	Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.1	55	–	V
*	Collector-to-Emitter Sustaining Voltage: With base-open	$V_{CEO}(sus)$				0	5	30	–	V
	With external base-to-emitter resistance (R_{BE}) = 10Ω	$V_{CER}(sus)$					5	55[a]	–	V
	Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.1		0	3.5	–	V
*	Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				20	100	–	1.0	V
*	DC Forward-Current Transfer Ratio	h_{FE}	5 5				360 50	5 10	– 200	
	Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$						–	25	°C/W

[a]Pulsed through a 25-mH inductor; duty factor = 0.05%.

DYNAMIC

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Voltage V	Output Power (P_{OE}) W	Input Power (P_{IE}) W	Collector Current (I_C) mA	Frequency (f) MHz	LIMITS MIN.	LIMITS MAX.	UNITS
	Power Output (Class C amplifier, unneutralized)	P_{OE}	V_{CC} = 28		0.2		400	1.2	–	W
	Gain-Bandwidth Product	f_T	V_{CE} = 15			50		500	–	MHz
*	Magnitude of Common Emitter, Small-Signal, Short-Circuit Forward-Current Transfer Ratio	$\|h_{fe}\|$	V_{CE} = 15			50		2.5	–	
*	Available Amplifier Signal Input Power	P_i		1.2			400	–	0.2	W
*	Collector Efficiency	η_C		1.2				45	–	%
*	Collector-to-Base Capacitance	C_{obo}	V_{CB} = 30				1	–	3.5	pF

*In accordance with JEDEC registration data format JS-6 RDF-3.

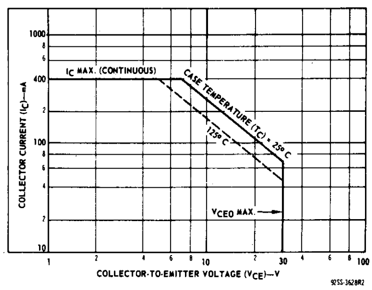


Fig. 1 - Safe area for dc operation.

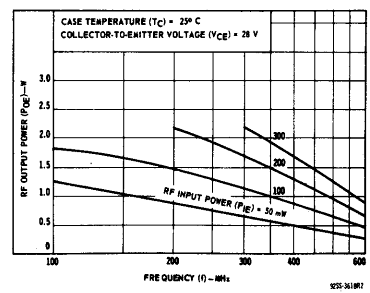


Fig. 2 - Typical output power as a function of frequency.

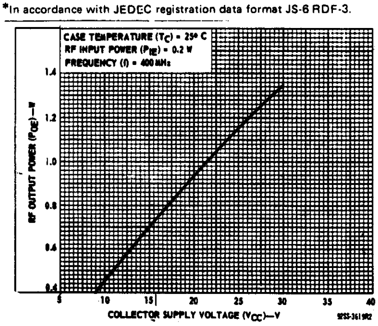


Fig. 3 - Typical output power as a function of collector supply voltage.

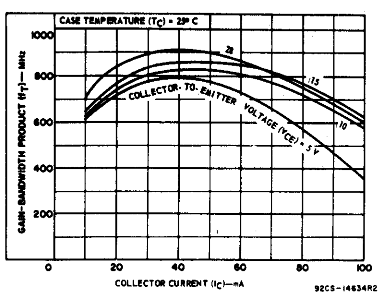


Fig. 4 - Typical gain-bandwidth product as a function of collector current.

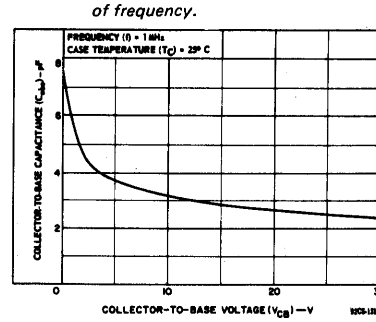


Fig. 5 - Typical variation of collector-to-base capacitance with collector-to-base voltage.

2N5102

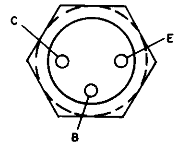
Silicon N-P-N Overlay Transistor

High-Power Device for Class-C, AM Operation in VHF Circuits

Features:

- 15 Watts Output Min. at 136 MHz
- For 24-Volt Aircraft Communication
- Complete Load Mismatch Protection
- High Voltage Ratings
- Case Connected to Emitter

TERMINAL DESIGNATIONS



92CS-27481

JEDEC TO-60

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE:			
With V_{BE} = −1.5 volts	V_{CEV}	100	V
With external base-to-emitter resistance R_{BE} = 5 Ω	V_{CER}	50	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
COLLECTOR CURRENT:			
Peak		10	A
Continuous	I_C	3.3	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 25° C		70	W
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. from insulating wafer for 10 s max		230	°C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc			CURRENT mA dc			LIMITS		UNITS
		V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	MIN.	MAX.	
• Collector Cutoff Current: With base-emitter junction reverse biased	I_{CEV}		83	-1.5				–	20	mA
• At T_C = 150°C	I_{CEV}		30	-1.5				–	10	mA
With external base-to-emitter resistance (R_{BE}) = 5 Ω	I_{CER}		50					–	10	mA
• Emitter Cutoff Current	I_{EBO}			-4				–	10	mA
• Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse biased	$V_{CEV}(sus)$			-1.5			600[a]	100	–	V
With external base-to-emitter resistance (R_{BE}) = 5 Ω	$V_{CER}(sus)$						200[a]	50	–	V
With base open	$V_{CEO}(sus)$					0	200[a]	35	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				10		0	4	–	V
• DC Forward Current Transfer Ratio	h_{FE}		4 4				3 A 0.5 A	10 10	– 100	
• Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 150 MHz)	$\|h_{fe}\|$		24				500	1	–	
• Output Capacitance (f = 1 MHz)	C_{ob}	30			0			–	85	pF
• Available Amplifier Signal Input Power[b] (P_O = 15 W, Z_G = 50 Ω, f = 136 MHz)	P_i							–	6	W
• Collector Circuit Efficiency (P_{IE} = 6 W, Z_G = 50 Ω, f = 136 MHz)	η_C							70	–	%
Modulation (f = 118 MHz)	M		24 (V_{CC})					80	–	%
Load Mismatch (f = 118 MHz)	LM		24 (V_{CC})				1100	Will not be damaged		
Dynamic Input Impedance (P_{IE} = 6 W, f = 150 MHz)	Z_{IN}		24 (V_{CC})					1.7 + j 2.6 (typ)		Ω
Thermal Resistance (Junction to Case)	$R_{\theta JC}$							–	2.5	°C/W

• In accordance with JEDEC registration data.

[a] Pulsed through a 9-mH inductor; duty factor = 50%.

[b] Unmodulated carrier.

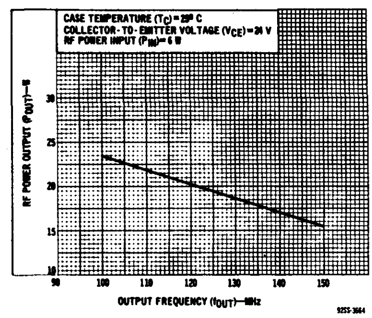


Fig. 1 - Typical power output as a function of frequency.

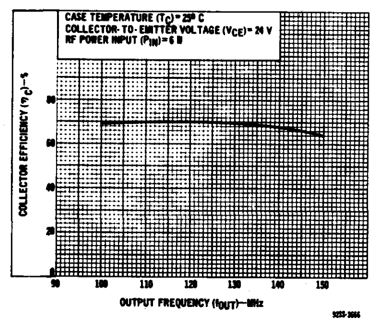


Fig. 2 - Typical collector efficiency as a function of output frequency.

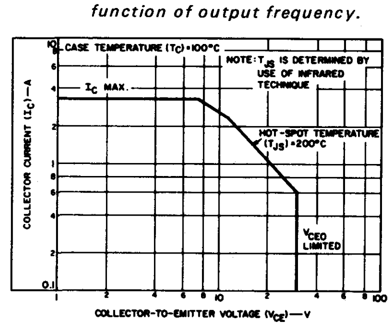


Fig. 3 - Safe operation area with dc forward bias.

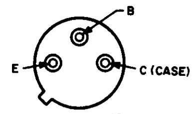
2N5109

Silicon N-P-N Overlay Transistor

High Gain for Line Amplifiers in CATV and MATV Equipment

Features:
- High gain-bandwidth product
- Large dynamic range
- Low distortion
- Low noise

TERMINAL DESIGNATION



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

* COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	40	V
COLLECTOR-TO-EMITTER VOLTAGE:			
* With base open	V_{CEO}	20	V
With external base-to-emitter resistance (R_{BE}) = 10 Ω	V_{CER}	40	V
* EMITTER-TO-BASE VOLTAGE	V_{EBO}	3	V
* CONTINUOUS COLLECTOR CURRENT	I_C	0.4	A
* CONTINUOUS BASE CURRENT	I_B	0.4	A
* TRANSISTOR DISSIPATION:	P_T		
At case temperature up to 75°C		2.5	W
* TEMPERATURE RANGE:			
Storage and operating (Junction)		-65 to +200	°C
* LEAD TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from the seating plane for 10 s max		230	°C

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC COLLECTOR OR BASE VOLTAGE – V: V_{CB}	V_{BE}	V_{CE}	V_{EB}	DC CURRENT (mA): I_E	I_B	I_C	LIMITS: MIN.	MAX.	UNITS
Collector-Cutoff Current: With base open	I_{CEO}			15			0		–	20	µA
* With base-emitter junction reverse-biased	I_{CEV}		-1.5	35					–	5	mA
* T_C = 150°C			-1.5	15					–	5	mA
* Emitter-Cutoff Current	I_{EBO}				3				–	0.1	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$					0		0.1	40	–	V
* Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER}(sus)$[a]							5	40	–	V
With base open	$V_{CEO}(sus)$						0	5	20	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$					0.1		0	3	–	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$						10	100	–	0.5	V
* Collector-to-Base Capacitance (f = 1 MHz)	C_{cb}	15				0			–	3.5	pF
* DC Forward-Current Transfer Ratio	h_{FE}			15 5				50 360	40 5	120 –	
Small-Signal Common-Emitter Forward Current Transfer Ratio (f = 200 MHz)	h_{fe}			15 15 15				25 50 100	4.8 6 4.8	– – –	
* Magnitude of Common-Emitter Small-Signal Forward Current Transfer Ratio (f = 200 MHz)	$\|h_{fe}\|$			15				50	6	–	
* Available Amplifier Signal Input Power (P_{out} = 1.26 mW, Source Impedance = 50 Ω, f = 200MHz)	P_i	15 (V_{CC})						50	–	0.1	mW
* Voltage Gain, Wideband, 50 to 216 MHz	G_{VE}			15				50	11		dB
Cross Modulation @ 54 dBmV[b] Output	CM			15				50	–57 (typ.)		dB
Power Gain, Narrowband (f = 200 MHz, P_{IN} = –10 dBm)	G_{PE}			15				10	11		dB
Noise Figure (f = 200 MHz)	NF			15				10	3 (typ.)		dB

[a]Pulsed through a 25 mH inductor; duty factor = 50%

[b] 0 dBmV = 1 millivolt

* In accordance with JEDEC registration data

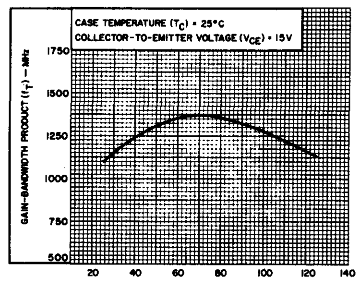


Fig. 1 - Gain-bandwidth product as a function of collector current.

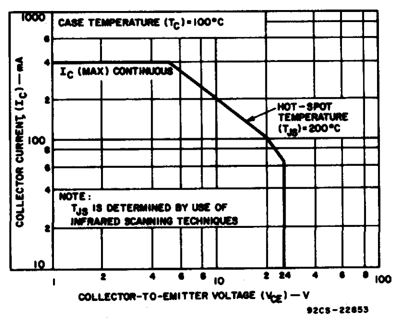


Fig. 2 - Maximum operating area.

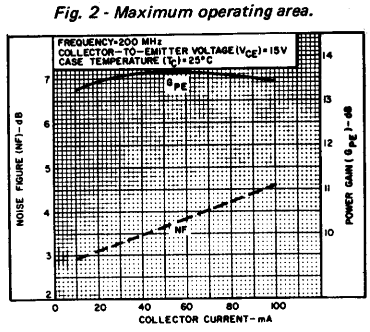


Fig. 3 - Power gain and noise figure as a function of collector current.

2N5179

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR

For UHF Applications in Military, Communications, and Industrial Equipment

Maximum Ratings, Absolute-Maximum Values:

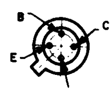
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	20	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	12	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5	V
COLLECTOR CURRENT, I_C	50	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures** up to 25°C	300	mW
At case temperatures** above 25°C	Derate at 1.71mW/°C	
For operation at ambient temperatures:		
At ambient temperatures up to 25°C	200	mW
At ambient temperatures above 25°C	Derate at 1.14mW/°C	
TEMPERATURE RANGE:		
Storage and Operating (Junction)	−65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32" from seating surface for 10 seconds max.	265	°C

** Measured at center of seating surface.

Features:

- **high gain-bandwidth product — 1000MHz min.**
- **hermetically sealed TO-72 four-lead metal package**
- **low leakage current**
- **high power gain as neutralized amplifier — G_{pe} = 15dB min. at 200MHz**
- **high power output as UHF oscillator — 20mW typ. at 500MHz**
- **low noise figure — NF = 4.5dB max. at 200MHz**
- **low collector-to-base time constant — $r_b'C_c$ = 14ps max.**
- **high reliability — production lots of RCA-2N5179 are subjected to and meet the minimum mechanical, environmental, and life-test requirements of the basic MILITARY specification MIL-S-19500. See Fig.2 for a description of the Group A and Group B Tests.**

TERMINAL DESIGNATIONS



92CS-27513

JEDEC TO-72

ELECTRICAL CHARACTERISTICS

Characteristics	Symbols	Ambient Temp. T_A (°C)	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Emitter-to-Base Voltage V_{EB} (V)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	DC Base Current I_B (mA)	Limits Type 2N5179 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	25 150		15 15			0 0			- -	- -	0.02 1	μA μA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	25					0	0.001		20	-	-	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$	25						3	0	12	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	25					−0.01	0		2.5	-	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25						10	1	-	-	0.4	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$	25						10	1	-	-	1	V
Static Forward Current-Transfer Ratio	h_{FE}	25			1			3		25	70	250	
Magnitude of Small-Signal Forward Current-Transfer Ratio[a]	$\|h_{fe}\|$	25	100 1 kHz		6 6			5 2		9 25	14 90	20 300	
Collector-to-Base Feedback Capacitance[b]	C_{cb}	25	0.1 to 1	10			0			-	0.7	1	pF
Common-Base Input Capacitance[c]	C_{ib}	25	0.1 to 1			0.5		0		-	-	2	pF
Collector-to-Base Time Constant[a]	$r_b'C_c$	25	31.9	6				2		3	7	14	ps
Small-Signal Power Gain in Neutralized Common-Emitter Amplifier Circuit[a]	G_{pe}	25	200		12			5		15	21	-	dB
Power Output in Common-Emitter Oscilator Circuit[c]	P_o	25	>500	10			−12			20	-	-	mW
Noise Figure[a]	NF	25	200		6			1.5		-	3	4.5	dB

[a] Lead No.4(case) grounded; R_g = 125Ω

[b] Three-terminal measurement of the collector-to-base capacitance with the case and emitter leads connected to the guard terminal.

[c] Lead No. 4 (case) floating.

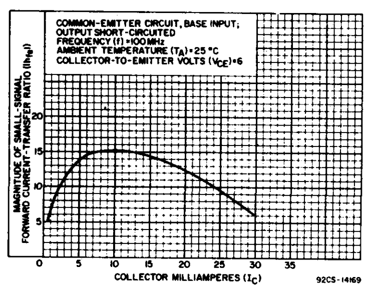
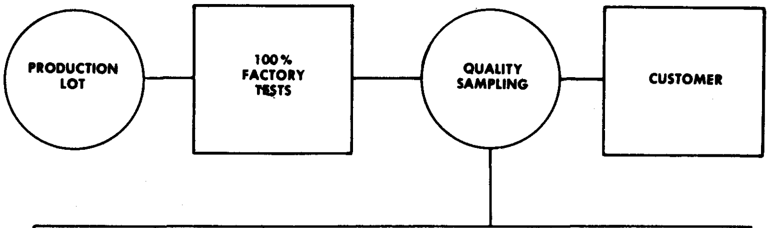


Fig. 1-Small-signal beta characteristics for type 2N5179.

2N5179



ITEM	TEST DESCRIPTION	LTPD
GROUP A TESTS		
Subgroup 1.	Visual and Mechanical Examination	5%
Subgroup 2.	Electrical	10%
GROUP B TESTS		
Subgroup 1.	Physical Dimensions	20%
Subgroup 2.	Solderability, Temperature Cycling, Thermal Shock, Moisture Resistance	20%
Subgroup 3.	Shock, Vibration Fatigue, Vibration Variable Frequency, Constant Acceleration	20%
Subgroup 4.	Terminal Strength	20%
Subgroup 5.	Salt Atmosphere	20%
Subgroup 6.	High-Temperature Life, Non-Operating (T_A = 200°C)	λ = 10%
Subgroup 7.	Steady-State-Operation Life (P_D = 300mW, T_A = 25°C)	λ = 10%

Fig. 2 - Group A and Group B Quality Sampling Tests.

2N5180

Silicon N-P-N Epitaxial Planar Transistor

For VHF Applications in Industrial and Commercial Equipment

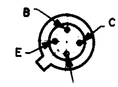
Features:
- High gain-bandwidth product
- Low noise figure
- High unneutralized power gain
- Hermetically sealed four-lead metal package
- All active elements insulated from case
- Low collector-to-base feedback

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	30	V
*COLLECTOR-TO-EMITTER VOLTAGE	V_{CEO}	15	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	2	V
*CONTINUOUS COLLECTOR CURRENT	I_C	limited by dissipation	
*TRANSISTOR DISSIPATION:	P_T		
At ambient temperatures up to 25°C		180	mW
At ambient temperatures above 25°C		See Fig.2	
*TEMPERATURE RANGE:			
Storage & Operating (Junction)		–65 to 175	°C
*LEAD TEMPERATURE (During Soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		265	°C

* Measured at center of seating surface.

TERMINAL DESIGNATIONS



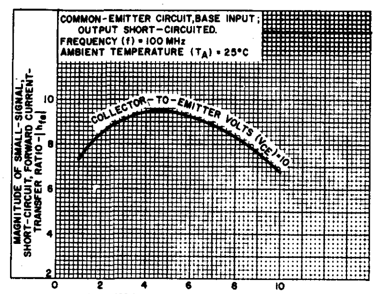
92CS-27513

JEDEC TO-72

ELECTRICAL CHARACTERISTICS, at T_A = 25°C

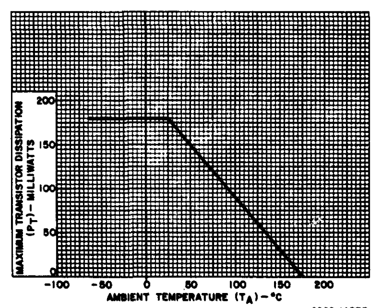
	Characteristics	Symbols	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter Current I_E	DC Collector Current I_C	Limits Type 2N5180 Min.	Typ.	Max.	Units
			MHz	V	V	mA	mA				
*	Collector-Cutoff Current	I_{CBO}		8		0		-	-	0.5	μA
*	Collector-to-Base Breakdown Voltage	BV_{CBO}				0	0.001	30	-	-	V
*	Collector-to-Emitter Breakdown Voltage	BV_{CEO}					0.001	15	-	-	V
*	Emitter-to-Base Breakdown Voltage	BV_{EBO}				-0.001	0	2	-	-	V
*	Static Forward-Current Transfer Ratio	h_{FE}			8		2	20	-	200	
*	Magnitude of Small-Signal Forward-Current Transfer Ratio	$\|h_{fe}\|^a$	100		8		2	6.5	9	17	
*	Collector-to-Base Feedback Capacitance	$C_{cb}{}^b$	0.1 to 1	8		0		-	-	1	pF
*	Small-Signal, Common-Emitter Power Gain in Unneutralized Amplifier Circuit	$G_{PE}{}^a$	200		10		2	12	-	19	dB
	VHF Noise Figure	NF^a $NF^{a,c}$	200 60		8 8		2 1	- -	- 2.5	4.5	dB dB
*	Collector-Base Time Constant	$r_b'C_c$	31.9	8		-2		2	–	16	ps
*	Real Part of Common-Emitter Small-Signal Short-Circuit Input Impedance	$R_e(h_{ie})$	200		10		2	60	–	240	Ω
*	Bandwidth	BW	200		10		2	650	–	1700	MHz

ᵃFourth lead (case) grounded.
ᵇC_{cb} is a three terminal measurement of the collector-to-base capacitance with the emitter and case connected to the guard terminal.
ᶜSource Resistance, R_s=400 ohms.
* In accordance with JEDEC registration data format JS-9 RDF-1.



92CS-14785

Fig. 1 - Typical small-signal beta characteristics for 2N5180.



92CS-14777

Fig. 2 - Rating chart for 2N5180.

2N5913

Silicon N-P-N Overlay Transistor

12.5-Volt, High-Gain Type for Class-C Amplifiers in VHF/UHF Communications Equipment

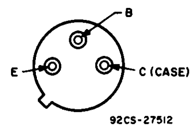
Features:

- High Power Gain, High Power Output . . .
  - At 12.5 V:
    - 2-W (typ.) output at 470 MHz (7-dB gain)
    - 2-W (typ.) output at 250 MHz (9-dB gain)
    - 2-W (typ.) output at 175 MHz (13-dB gain)
  - At 8 V:
    - 1.5-W (typ.) output at 470 MHz (4.8-dB gain)
    - 1.5-W (typ.) output at 250 MHz (7.0-dB gain)
    - 1.5-W (typ.) output at 175 MHz (10-dB gain)

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

* COLLECTOR-TO-BASE VOLTAGE. V_{CBO}	36	V
COLLECTOR-TO-EMITTER BREAKDOWN VOLTAGE:		
With base shorted to emitter . . . . $V_{(BR)CES}$	36	V
* With base open . . . . $V_{(BR)CEO}$	14	V
* EMITTER-TO-BASE VOLTAGE . . . V_{EBO}	3.5	V
* CONTINUOUS COLLECTOR CURRENT . . . . I_C	0.33	A
* TRANSISTOR DISSIPATION: . . . . . P_T		
At case temperatures up to 75°C. .	3.5	W
At case temperatures above 75°C .	Derate at 0.0028 W/°C	
* TEMPERATURE RANGE:		
Storage & Operating (Junction) . .	-65 to +200	°C
* LEAD TEMPERATURE:		
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max. .	230	°C

TERMINAL DESIGNATIONS



JEDEC TO-39

ELECTRICAL CHARACTERISTICS ***Case Temperature (T_C) = 25°C Unless Otherwise Specified***

STATIC

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS DC Voltage (V) V_{CE}	V_{EB}	DC Current (mA) I_E	I_B	I_C	LIMITS Min.	Max.	UNITS
*	Collector-Cutoff Current: Base Connected to Emitter	I_{CES}	12.5			0			1.0[b]	mA
	Base Open	I_{CEO}	10			0			0.3	mA
*	Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.5	36	-	V
*	Collector-to-Emitter Breakdown Voltage: With base open	$V_{(BR)CEO}$				0	25[a]	14	-	V
	With base connected to emitter	$V_{(BR)CES}$		0			25[a]	36	-	V
*	Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.5		0	3.5	-	V
	Thermal Resistance: (Junction-to-Case)	$\theta_{J\text{-}C}$						-	35.7	°C/W

[a] Pulsed through a 25-mH inductor; duty factor = 50%.

[b] T_C = 100°C.

DYNAMIC

	TEST & CONDITIONS	SYMBOL	FREQUENCY MHz	LIMITS MINIMUM	TYPICAL	UNITS
	Power Output (V_{CC} = 12.5 V): P_{IE} = 0.1 W	P_{OE}	175	1.75		W
*	Large-Signal Common-Emitter Power Gain (V_{CC} = 12.5 V): P_{IE} = 0.1 W	G_{PE}	175	12.4		dB
*	Collector Efficiency (V_{CC} = 12.5 V): P_{IE} = 0.1 W	η_C	175	50		%
*	Common-Base Output Capicatance V_{CB} = 12 V	C_{obo}	1	15 (max.)		pF

* In accordance with JEDEC registration data format JS-6 RDF-3/JS-9 RDF-7.

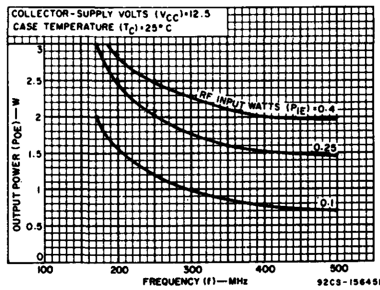


Fig. 1 - Typical power output as a function of frequency.

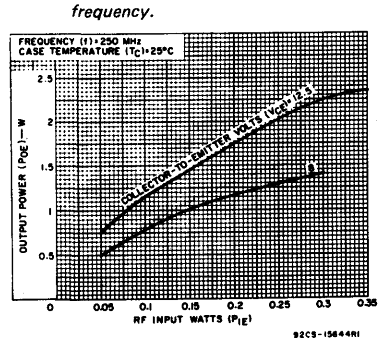


Fig. 2 - Typical power output as a function of power input at 250 MHz.

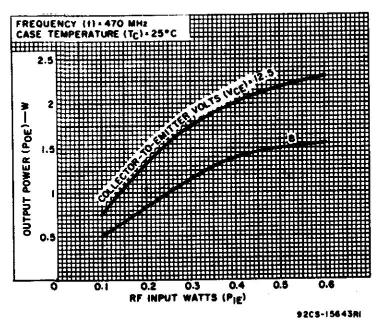


Fig. 3 - Typical power output as a function of power input at 470 MHz.

2N6670

Silicon N-P-N Epitaxial Planar Transistor

Output Device for Class C AM Operation in 27 MHz "CB" and VHF Communications Equipments

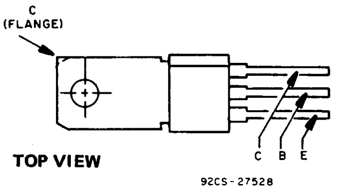
Features:

- **Designed for vhf "CB" transmitters**
- **4-W output at 27 MHz (12.5 V_{CC})**
- **Infinite vswr capability (12.5 V_{CC}, 27 MHz)**
- **Can retrofit TO-220 sockets**

The RCA-2N6670● is a silicon n-p-n epitaxial planar transistor intended for use in mobile citizen-band (CB) transmitters operating from a 12.5 V supply as a class C AM rf output device. It is useful for class C output, driver, or predriver stages in FM and CW service up to 80 MHz. This type is supplied in the JEDEC TO-202AB molded-plastic (VERSA-TAB) package.

● Formerly RCA Dev. No. TA9124.

TERMINAL DESIGNATIONS



JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*	V_{CES}		100	V
*	V_{CBO}		80	V
*	$V_{CEO}(sus)$		50	V
*	V_{EBO}		3	V
*	I_C (Continuous)		1.5	A
*	P_T			
	$T_C \leq 25°C$		10	W
	$T_C > 25°C$	Derate linearly	0.08	W/°C
*	T_J, T_{stg}		−65 to 150	°C
*	T_L During soldering [At distance ≥ 1/8 in. (3.17 mm) from molded plastic package measured either along terminals or mounting flange for 10 s max.]		230	°C

* In accordance with JEDEC registration data format JS-6 RDF-3/JS-9 RDF-7

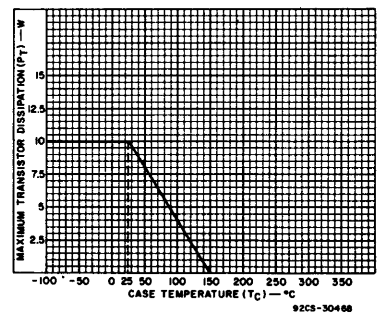


Fig. 1 — Derating curve.

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

STATIC

	CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Voltage-V V_{CB}	TEST CONDITIONS: DC Collector Voltage-V V_{CE}	TEST CONDITIONS: DC Current mA I_C	LIMITS MIN.	LIMITS MAX.	UNITS
*	Collector-Cutoff Current: At T_C = 100°C	I_{CES}		60		–	10	µA
	With base open	I_{CEO}		30		–	10	µA
	With emitter open	I_{CBO}	15			–	10	µA
*	Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0.5	80	–	V
*	Collector-to-Emitter Breakdown Voltage: With base shorted	$V_{(BR)CES}$			50	100	–	V
*	Collector-to-Emitter Breakdown Voltage: With R_{BE} = 10 Ω	$V_{(BR)CER}$			0.1	90	–	V
*	Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO}(sus)$			200■	50	–	V
*	Emitter-to-Base Breakdown Voltage I_E = 1 mA	$V_{(BR)EBO}$			0	3	–	V
*	DC Forward Current Transfer Ratio	h_{FE}		2	400	30	–	
	Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$				–	12.5	°C/W

■ Pulsed; pulse duration ≤ 300 µs, duty factor ≤ 2%.

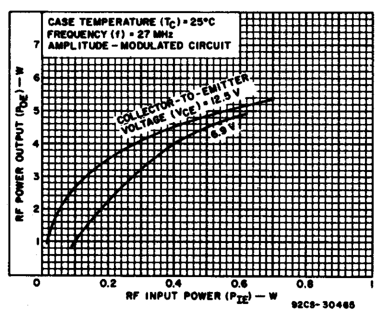


Fig. 2 — Typical output power as a function of input power at 27 MHz.

2N6670

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C (cont'd)

DYNAMIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Supply (V_{CC})–V	TEST CONDITIONS: Input Power (P_{IE})–W	TEST CONDITIONS: Frequency (f) - MHz	LIMITS: MIN.	LIMITS: MAX.	UNITS
Power Output	P_{OE}	12.5	0.4	27	4[b]	–	W
[a] Power Gain	G_{PE}	12.5	0.4	27	10	–	dB
[a] Collector Efficiency	η_C	12.5	0.4	27	65[c]	–	%
Modulation Index	m	25	0.4 (mod.)	27	85[d]	95 (typ.)	
Load Mismatch ∞:1	VSWR	25	1.6[d,e]	27	1	–	cycle
[a] Collector-to-Base Capacitance	C_{obo}	V_{CB} = 12.5V	–	1	–	50	pF

[a] In accordance with JEDEC registration data.
[b] Circuit in Fig. 8 tuned for optimum AM performance.
[c] Circuit in Fig. 8 tuned for optimum AM performance, output power adjusted for maximum legal limit (4 W carrier).
[d] Pulsed input; 1 kHz square wave, 50% duty cycle.
[e] Peak envelope power (PEP).

TYPICAL APPLICATION INFORMATION

APPLICATION	DC Collector Supply Voltage (V_{CC})–V	Input Power (P_{IE})–W	Output Power (P_{OE})–W	Collector Efficiency (η_C)–%
27-MHz CB Driver/Amplifier	12.5	0.04	4	
40-MHz Class C Amplifier	12.5	0.5	5	70
I_C = 0.8 A	12.5	1	7	–

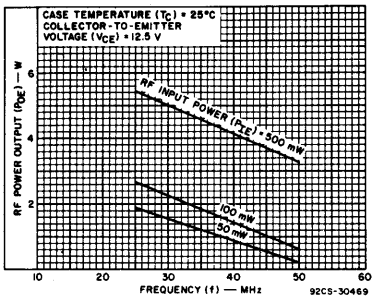


Fig. 3 – Typical rf output power as a function of frequency at V_{CC} = 12.5 V.

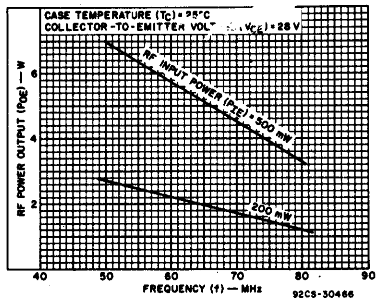


Fig. 4 – Typical rf output power as a function of frequency at V_{CC} = 28 V.

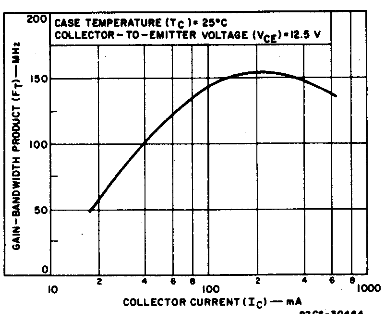


Fig. 5 – Typical gain-bandwidth product as a function of collector current.

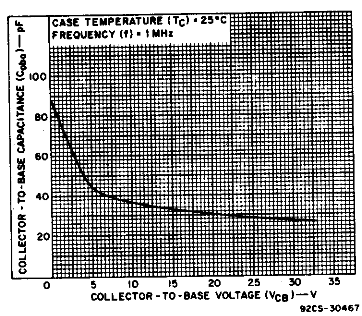


Fig. 6 – Typical collector-to-base capacitance as a function of collector-to-base voltage.

40280

1W, 175-MHz Overlay Transistor

Silicon N-P-N Devices for High-Power VHF Amplifier Service

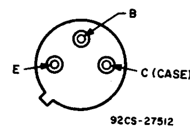
Features:

- Suitable for low-voltage supplies (13.5 V)
- High output power at 175 MHz, unneutralized class C amplifier
- High efficiency at 175 MHz
- Low input impedance

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		40280	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	36	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	18	V
With $V_{BE} = -1.5V$	V_{CEV}	36	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
COLLECTOR CURRENT	I_C	0.5	A
TRANSISTOR DISSIPATION P_T:			
At case temperatures up to 25°C		7.0	W
At case temperatures above 25°C		Derate linearly to 0 watts at 200°C	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230	°C

TERMINAL DESIGNATIONS



40280
JEDEC TO-39

ELECTRICAL CHARACTERISTICS ***At Case Temperature (T_C) = 25 °C***

Characteristics	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS Type 40280 Min.	Max.	Units
Collector Cutoff Current	I_{CEO}		15			0		–	100	µA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.25	36	–	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.10		0	4	–	V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			−1.5			200[a]	36	–	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$					0	200[a]	18	–	V
Real Part of Common-Emitter High Frequency Input Impedance (At f = 175 MHz)	hie (real)		13.5				100	10 (typ.)		Ω
RF Power Output: As Class-C Amplifier, Unneutralized (At f = 175 MHz)	P_{OUT}		13.5					1[b]	–	W
Gain-Bandwidth Product	f_T		13.5				100	550 (typ.)		MHz
Collector-to-Base Capacitance (At f = 1 MHz)	C_{ob}	13.5			0			–	15	pF
Collector-to-Case Capacitance	C_s							–	–	pF
Thermal Resistance Junction-to-Case	θ_{J-C}							–	25	°C/W

[a]Pulsed through an inductor (25 mH); duty factor = 50%. [b]For P_{IN} = 0.125 w; minimum efficiency = 60%.

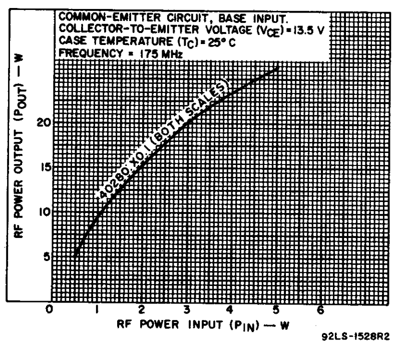


Fig. 1 – Typical RF power output vs. RF power input at 175-MHz.

40290-40292

SILICON N-P-N "overlay" TRANSISTORS

For Low Supply Voltage, High Power Output, Amplitude Modulated, VHF Class-C Amplifier Service in Aircraft, Military, and Industrial Communications Equipment

Features:

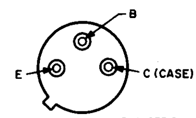
- High carrier output power as 135 MHz Class-C amplifier with 12.5 volt collector supply voltage
  40290 — 2 watts (min.) at P_{IN} = 0.5 watt
  40291 — 2 watts (min.) at P_{IN} = 0.5 watt
  40292 — 6 watts (min.) at P_{IN} = 2.0 watts
- 100% testing of all transistors performed to assure excellent upward modulation characteristics
- High collector efficiency at 135 MHz
- All electrodes isolated from case (40291 and 40292)

Maximum Ratings, *Absolute-Maximum Values:*

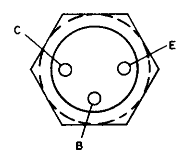
	40290	40291	40292	
COLLECTOR-TO-EMITTER VOLTAGE:				
With V_{BE} = -1.5 volts, V_{CEX}	50	50	50	volts
At f = 100 Mc, V_{CEV}(RF)	90	90	90	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	4	4	volts
COLLECTOR CURRENT, I_C	0.5	0.5	1.25	amperes
TRANSISTOR DISSIPATION, P_T:				
At case temperatures up to 25° C.	7.0	11.6	23.2	watts
At case temperatures above 25° C.	Derate linearly to 0 watts at 200° C			

	40290 40291 40292	
TEMPERATURE RANGE:		
Storage	-65 to 200°C	
Operating (Junction)	-65 to 200°C	
PIN OR LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32 from insulating wafer (TO-60 package) or from seating plane (TO-39 package) for 10 seconds maximum	230	°C

TERMINAL DESIGNATIONS



40290
JEDEC TO-39



40291, 40292
JEDEC TO-60

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Volts V_{CB}	V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS: Type 40290 Min.	Max.	Type 40291 Min.	Max.	Type 40292 Min.	Max.	UNITS
Collector Cutoff Current	I_{CEO}		15			0		–	100	–	100	–	250	μa
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1 0.25		0 0	4.0 –	– –	4.0 –	– –	– 4.0	– –	Volts Volts
Collector-to-Emitter Breakdown Voltage	BV_{CEX}			–1.5			200[a]	50	–	50	–	50	–	Volts
Real Part of Common-Emitter Input Impedance (At f = 135 MHz)	$h_{ie(real)}$		12.5 12.5				100 400	12(Typ.) –	 –	12(Typ.) –	 –	– 6.5(Typ.)	– 	ohms ohms
RF Carrier Power Output: As Class-C Amplifier, (At f = 136 MHz)	P_{OUT}		12.5					2.0[c]	–	2.0[c]	–	6.0[d]	–	watts
Gain-Bandwidth Product	f_T		12.5 12.5				100 400	500(Typ.) –	 –	500(Typ.) –	 –	– 300(Typ.)	– 	MHz MHz
Collector-to-Base Capacitance (At f = 1 MHz)	C_{ob}	12.5			0			–	17	–	17	–	30	pF
Collector-to-Case Capacitance	C_s							–	–	–	6.0	–	6.0	pF
Thermal Resistance (Junction-to-Case)	$\theta_{J\text{-}C}$							–	25	–	15	–	7.5	°C/W

[a] Pulsed through an inductor (25 mh); R_{BE} = 39 ohms; duty factor = 50%.
[b] At frequencies of 100 Mc or higher.
[c] For P_{IN} = 0.5 w; minimum efficiency = 70%.
[d] For P_{IN} = 2.0 w; minimum efficiency = 70%.

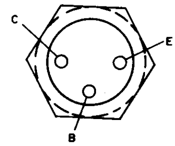
40340, 40341

High-Power 50-MHz Emitter-Ballasted Silicon N-P-N Overlay Transistors

For 13.5-V and 24-V Applications in Mobile Communications Equipment

Features:
- Emitter ballasting resistors
- 13.5 V–25 W min. power output, 7 dB min. gain (40340)
- 24 V–30 W min. power output, 10 dB min. gain (40341)
- Emitter connected to case
- Infinite load mismatch tested at 50 MHz

TERMINAL DESIGNATIONS



JEDEC TO-60

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		40340	40341	
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	25	35	V
With base-emitter junction reverse-biased (V_{BE}) = −1.5 volts	V_{CEV}	60	70	V
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	70	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4.0	4.0	V
PEAK COLLECTOR CURRENT		10	10	A
CONTINUOUS COLLECTOR CURRENT	I_C	3.3	3.3	A
TRANSISTOR DISSIPATION	P_T			
At case temperatures up to 25°C		70	70	W
TEMPERATURE (Operating junction)	T_J	200	200	°C

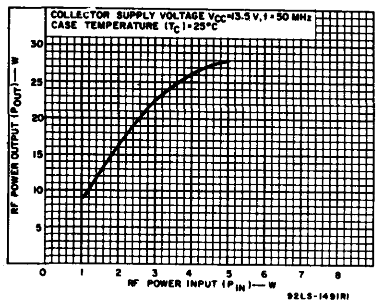


Fig. 1 - Typical performance of type 40340 in a common-emitter amplifier.

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

STATIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Voltage (V) V_{CB}	V_{CE}	DC Base Voltage (V) V_{BE}	DC Current (mA) I_E	I_C	LIMITS 40340 Min.	40340 Max.	40341 Min.	40341 Max.	UNITS
Collector-Cutoff Current: With base open	I_{CEO}		30 15				– –	– 1.0	– –	1.0 –	mA
With emitter open	I_{CBO}	50 40					– –	– 10	– –	10 –	mA
Collector-to-Emitter Breakdown Voltage: With base open	$V_{(BR)CEO}$					200*	25	–	35	–	V
With base-emitter junction reverse biased, and external base-to-emitter resistance (R_{BE}) = 20 Ω	$V_{(BR)CEV}$			−1.5		200*	60	–	70	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				10		4	–	4	–	V
Thermal Resistance: (Junction-to-Case)	$R_{\theta JC}$						2.5		2.5		°C/W

*Pulsed through a 25-mH inductor; duty factor = 50%.

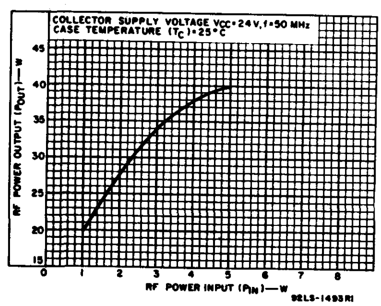


Fig. 2 - Typical performance of type 40341 in a common-emitter amplifier.

DYNAMIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC Collector Supply (V_{CC})—V	Input Power (P_{IE})—W	Frequency (f) - MHz	LIMITS 40340 Min.	40340 Max.	40341 Min.	40341 Max.	UNITS
Power Output	P_{OE}	13.5 24	5 3	50 50	25 –	– –	– 30	– –	W
Power Gain	G_{PE}	13.5 24	5 3	50 50	7 –	– –	– 10	– –	dB
Collector Efficiency	η_C	13.5 24	5 3	50 50	60 –	– –	– 60	– –	%
Load Mismatch	LM	13.5 24	5 3	50 50	GO/NO GO				
Collector-to-Base Capacitance	C_{obo}	V_{CB} = 30 V_{CB} = 15		1 1	– –	– 120	– –	85 –	pF

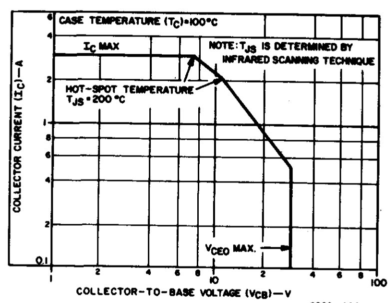


Fig. 3 - Safe area for dc operation.

40608

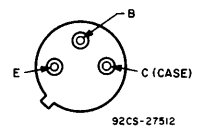
Silicon N-P-N Overlay Transistor

For Class A Wide-Band CATV and MATV Applications

Features:

- High Gain-Bandwidth Product
- Low Cross-Modulation

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE . . V_{CBO} 40 V

COLLECTOR-TO-EMITTER VOLTAGE:
With external base-to-emitter resistance, $(R_{BE}) = 100\Omega$ . . . . . . V_{CER} 40 V

EMITTER-TO-BASE VOLTAGE . . . . . V_{EBO} 2 V

COLLECTOR CURRENT . . . . I_C 0.4 A

TRANSISTOR DISSIPATION . . . . P_T
At case temperatures up to 25°C . . . . . . 3.5 W
At case temperatures above 25°C. . . . . . See *Fig. 1.*

TEMPERATURE RANGE:
Storage & Operating (Junction). . . . . −65 to +200 °C

LEAD TEMPERATURE (During soldering):
At distances ≥ 1/32 in. (0.79 mm) from seating plane for 10 s max. . . . . 230 °C

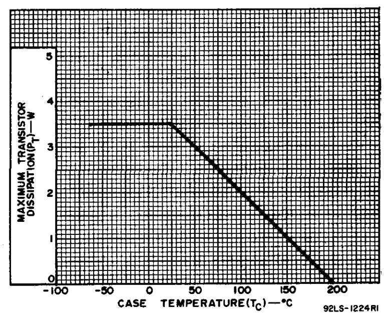


Fig. 1 - Dissipation derating curve.

ELECTRICAL CHARACTERISTICS, *Case Temperature* = 25° C

Characteristic	Symbol	Test Conditions: DC Collector Volts V_{CB}	V_{CE}	DC Current (mA) I_E	I_B	I_C	Limits Min.	Max.	Units
Collector-Cutoff Current	I_{CEO}		20		0			100	μA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.1	40		V
Collector-to-Emitter Voltage (Sustaining)	$V_{CER}(sus)$					50[a]	40		V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.1		0	2		V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				10	50		1.0	V
Collector-to-Base Capacitance (Measured at 1 MHz)	C_{ob}	30		0				3.0	pF
Gain-Bandwidth Product	f_T		15			50	700		MHz
DC Forward-Current Transfer Ratio	h_{FE}		15			50	35	120	
Voltage Gain	VG		15			50	11		dB
Cross Modulation @46 dBmV	CM		15			50	−57 (Typ.)		dB

[a] Pulsed through an inductor (20 mH); duty factor = 50%; $R_{BE} \doteq 100\ \Omega$.

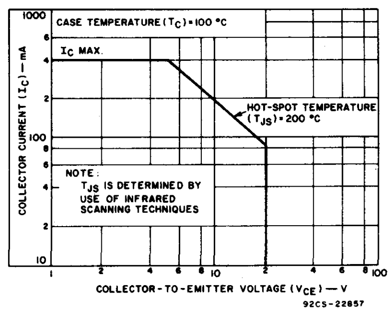


Fig. 2 - Safe area for dc operation.

40894-40897

High-Frequency Silicon N-P-N Transistors

For TV-Tuner, FM and AM/FM "Front-End", and IF Amplifier, Oscillator, and Converter Service

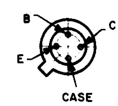
Features:

- **High gain-bandwidth products:**
  f_T = 1200 MHz typ. for tuner types
  = 800 MHz typ. for if-amplifier types
- **Very low collector-to-base feedback capacitance:**
  C_{cb} = 0.7 pF typ. for 40894, 40895
- **Low noise figure:**
  3 dB typ. at 200 MHz for rf amplifier type
- **High power gain as neutralized amplifier:**
  G_{PE} = 15 dB min. at 200 MHz (40894)
- **High power output as uhf oscillator:**
  P_{OE} = 20 mW typ. at 500 MHz (40896)
- **Low noise figure:**
  NF = 4.5 dB max. at 200 MHz (40894)
- **Low collector-to-base time constant:**
  $r_b'C_c$ = 14 ps max.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE	V_{CEO}	12	V
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	20	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	2.5	V
CONTINUOUS COLLECTOR CURRENT	I_C	50	mA
TRANSISTOR DISSIPATION	P_T		
With heat sink, at case temperatures up to 25°C		300	mW
With heat sink, at case temperatures above 25°C		Derate linearly 1.71	mW/°C
At ambient temperatures up to 25°C		200	mW
At ambient temperatures above 25°C		Derate linearly 1.14	mW/°C
TEMPERATURE RANGE:			
Storage & Operating (Junction)		-65 to +200	°C
CASE TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating surface for 10 seconds max.		265	°C

TERMINAL DESIGNATIONS



92CS-27513

JEDEC TO-72

ELECTRICAL CHARACTERISTICS at Ambient Temperature (T_A) = 25°C unless otherwise specified

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS: FREQUENCY MHz	DC COLLECTOR OR EMITTER VOLTAGE V			DC CURRENT mA			LIMITS: TYPE 40894 RF AMPLIFIER			TYPE 40895 MIXER			TYPE 40896 OSCILLATOR			TYPE 40897 IF AMPLIFIER			UNITS
			V_{CB}	V_{CE}	V_{EB}	I_E	I_C	I_B	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}		15			0			-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	µA
T_A = 150°C	I_{CBO}		15			0			-	-	1	-	-	1	-	-	1	-	-	1	µA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$					0	0.001		20	-	-	20	-	-	20	-	-	20	-	-	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$						3	0	15	-	-	15	-	-	15	-	-	15	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$					0.01	0		2.5	-	-	2.5	-	-	2.5	-	-	2.5	-	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$						10	1	-	-	0.4	-	-	0.4	-	-	0.4	-	-	0.4	V
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$						10	1	-	-	1	-	-	1	-	-	1	-	-	1	V
Static Forward Current-Transfer Ratio	h_{FE}			6			1		50	80	250	40	70	250	27	50	250	70	120	250	
Magnitude of Common-Emitter, Small-Signal Short-Circuit, Forward Current Transfer Ratio[a]	$\|h_{fe}\|$	100 1 kHz		6 6			5 2		9 25	14 90	20 300	9 25	14 90	20 300	9 25	14 90	20 300	9 25	14 90	20 300	
Collector-to-Base Feedback Capacitance[b]	C_{cb}	0.1 to 1	10			0			-	0.7	1	-	0.7	1	-	0.7	1	-	0.7	1	pF
Common-Base Input Capacitance[c]	C_{ib}	0.1 to 1			0.5		0		-	-	2	-	-	2	-	-	2	-	-	2	pF
Collector-to-Base Time Constant[a]	$r_b'C_c$	31.9	6				2		3	7	14	3	7	14	3	7	14	3	7	14	ps
Small-Signal Power Gain in Neutralized Common-Emitter Amplifier Circuit[a]	G_{PE}	10.7 200		12 12			5 5		– 15	– 21	– –	– 15	– 21	– –	– 15	– 21	– –	18 –	25 –	– –	dB
Noise Figure[a]	NF	200		6			1.5		-	3	4.5	-	-	-	-	-	-	-	-	-	dB

[a] Lead No. 4 (case) grounded; R_g = 125Ω

[b] Three-terminal measurement of the collector-to-base capacitance with the case and emitter leads connected to the guard terminal.

[c] Lead No. 4 (case) floating.

40936

20-W (PEP) Emitter-Ballasted Overlay Transistor

For 2- to-30-MHz Single-Sideband Linear Amplifier Applications

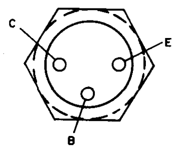
Features:

- For class A or class B amplifier service
- Integral emitter-ballasting resistors
- 20 W(PEP) output (min.) at 30 MHz with: gain = 13 dB (min.); collector efficiency = 40% (min.); intermodulation distortion = -30 dB (max.)
- Low-Thermal-Resistance Package

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE:			
With V_{BE} = -1.5 V	V_{CEV}	65	V
With external base-to-emitter resistance R_{BE} = 5 Ω	V_{CER}	40	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
COLLECTOR CURRENT:			
Peak		10	A
Continuous	I_C	3.3	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 75°C		50	W
At case temperatures above 75°C		Derate linearly at 0.4 W/°C.	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		-65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.787 mm) from insulating wafer for 10 s max		230	°C

TERMINAL DESIGNATIONS



92CS-27481

JEDEC TO-60

ELECTRICAL CHARACTERISTICS, at Case Temperature (T_C) = 25°C

STATIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC COLLECTOR VOLTAGE (V) V_{CB}	V_{CE}	DC BASE VOLTAGE (V) V_{BE}	DC CURRENT (mA) I_E	I_C	LIMITS MIN.	MAX.	UNITS
Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse biased	V_{CEV}(sus)			-1.5		200[a]	65	–	V
With external base-to-emitter resistance (R_{BE})=5Ω	V_{CER}(sus)					200[a]	40	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				20		4	–	V
Collector-to-Emitter Cutoff Current	I_{CEO}		30				–	5.0	mA
Collector-to-Base Cutoff Current	I_{CBO}	60					–	10	mA
Collector-to-Base Capacitance (f = 1 MHz)	C_{obo}	30					–	85	pF
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$						–	2.5	°C/W

[a]Pulsed through an inductor (25 mH); duty factor = 50%.

DYNAMIC (30-MHz Single-Sideband Amplifier)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC COLLECTOR SUPPLY VOLTAGE (V) V_{CC}	OUTPUT POWER W(PEP) P_{OE}	FREQUENCY (MHz) f	DC CURRENT (mA) I_C	LIMITS MIN.	MAX.	UNITS
RF Input Power: Average	P_{IE}	28	10	30	20	–	0.5	W
Peak envelope (PEP)	P_{IE}	28	20	30	20	–	1.0	W
Power Gain	G_{PE}	28	20	30	20	13	–	dB
Collector Efficiency	η_C	28	20	30	20	40	–	%
Intermodulation Distortion*	IMD	28	20	30	20	–	-30	dB

*Referenced to either of the two tones, and without the use of feedback to enhance linearity.

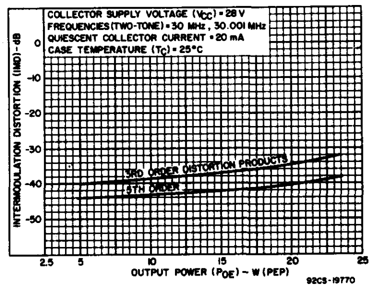


Fig. 1 - Typical intermodulation distortion as a function of output power.

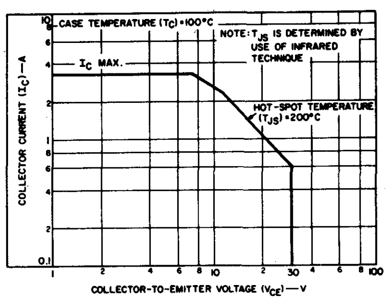


Fig. 2 - Maximum operating area for forward-bias operation.

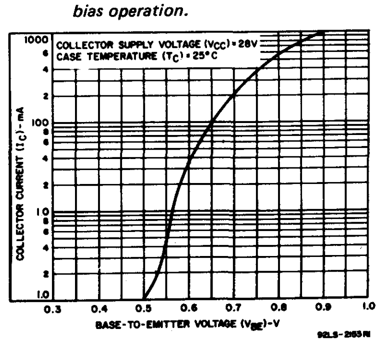


Fig. 3 - Typical transfer characteristic.

40964, 40965

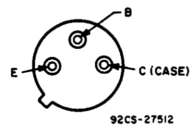
Silicon N-P-N Overlay Transistors

High-Gain Devices for Class C VHF/UHF Multiplier and Amplifier Service

Features:

- **High power gain:**
  6 dB (min.) up to f = 470 MHz (40964 tripler)
  7 dB (min.) at f = 470 MHz (40965 amplifier)

TERMINAL DESIGNATIONS



JEDEC TO-39

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	36	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 33Ω	$V_{CER(sus)}$	36	V
With base open	$V_{CEO(sus)}$	14	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	2	V
CONTINUOUS COLLECTOR CURRENT	I_C	0.2	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		3.5	W
TEMPERATURE RANGE:			
Storage & Operating (Junction)		-65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max		230	°C

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C

STATIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS Voltage V dc	Current mA dc			LIMITS 40964 40965		UNITS
		V_{CE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}	10		0		–	0.1	mA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$		0			36	–	V
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$			0	5[a]	14	–	V
With external base-to-emitter resistance (R_{BE}) = 33Ω	$V_{CER(sus)}$				5[a]	36	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$		0.1		0	2	–	V
Thermal Resistance: (Junction-to-Case)	$R_{\theta JC}$					–	50	°C/W

[a]Pulsed through a 25-mH inductor; duty factor = 50%.

DYNAMIC

CHARACTERISTIC	SYMBOL	TEST CONDITIONS Collector Supply (V_{CC}) - V dc	Input Power (P_{IE}) - W	Frequency (f) - MHz	LIMITS 40964 Min.	40964 Typ.	40965 Min.	40965 Typ.	UNITS
Power Output	P_{OE}	12	0.1	156.7-470	0.4	0.44	–	–	W
				470	–	–	0.5	0.55	
		8	0.1	156.7-470	–	0.33	–	–	
				470	–	–	–	0.33	
Power Gain	G_{PE}	12	0.1	156.7-470	6	6.4	–	–	dB
				470	–	–	7	7.4	
		8	0.1	156.7-470	–	5.2	–	–	
				470	–	–	–	5.2	
Collector Efficiency	η_C	12	0.1	156.7-470	25	–	–	–	%
				470	–	–	40	–	
		8	0.1	156.7-470	–	25	–	–	
				470	–	–	–	40	
Collector-to-Base Capacitance	C_{obo}	V_{CB} = 12 V, I_C = 0	–	1	–	5 (max.)	–	5 (max.)	pF
Gain-Bandwidth Product	f_T	V_{CE} = 12 V, I_C = 50 mA	–	–	–	700	–	700	MHz

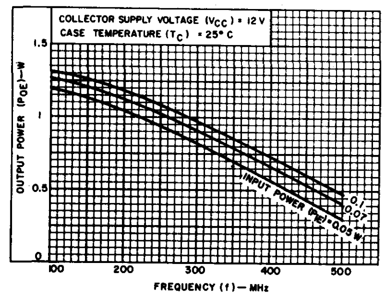


Fig. 1 - Typical power output as a function of frequency for 40965.

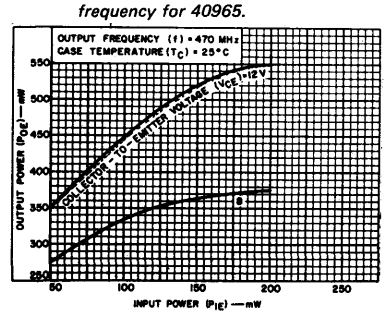


Fig. 2 - Typical power output as a function of power input for 40964.

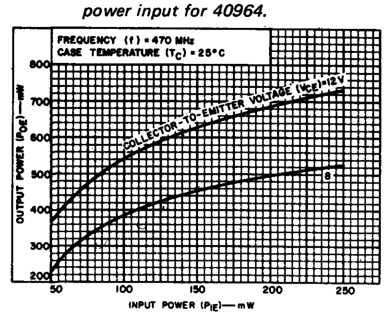


Fig. 3 - Typical power output as a function of power input for 40965.

41024
1-W, 1-GHz Silicon N-P-N Overlay Transistor

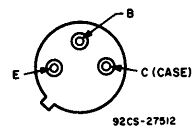
High-Gain Device for Class B- or C- Operation in UHF Circuits

MAXIMUM RATINGS, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	V
COLLECTOR-TO-EMITTER SUSTAINING VOLTAGE:			
With external base-to-emitter resistance (R_{BE}) = 10 Ω	V_{CER}	55	V
With base open	V_{CEO}	24	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	3	V
CONTINUOUS COLLECTOR CURRENT	I_C	0.4	A
TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		3.5	W
At case temperatures above 25°C		See Fig. 1	
TEMPERATURE RANGE:			
Storage and Operating (Junction)		−65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.		230	°C

Features:
- **1-watt output min. at 1 GHz (5 dB gain)**
- **For sonde applications**
  0.3-watt output typ. at 1.68 GHz (V_{CC} = 20 V)

TERMINAL DESIGNATIONS



JEDEC TO-39

ELECTRICAL CHARACTERISTICS, Case Temperature (T_C) = 25°C

CHARACTERISTIC	SYMBOL	TEST CONDITIONS Voltage V dc V_{CB}	V_{CE}	Current mA dc I_E	I_B	I_C	LIMITS Min.	Max.	UNITS
Collector Cutoff Current: With base open	I_{CEO}		15		0		–	20	µA
With base connected to emitter	I_{CES}		50				–	1	µA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$			0		0.1	55	–	V
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER}(sus)$					5	55	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$			0.1		0	3	–	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				10	100	–	0.5	V
Collector-to-Base Capacitance (Measured at 1 MHz)	C_{ob}	30		0			–	3.0	pF
Magnitude of Common-Emitter Small-Signal Short-Circuit Forward-Current Transfer Ratio (Measured at 200 MHz)	$\|h_{fe}\|$		15			50	6.0	–	
RF Power Output Common Emitter Amplifier at 1 GHz	P_{OUT}		28				1[a]	–	W

[a]For P_{IN} = 0.316 W, minimum efficiency = 35%.

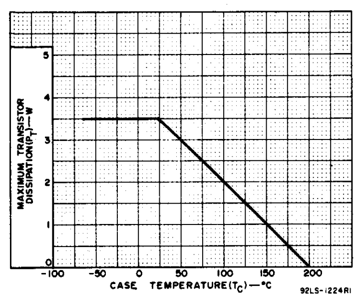


Fig. 1 - Derating curve.

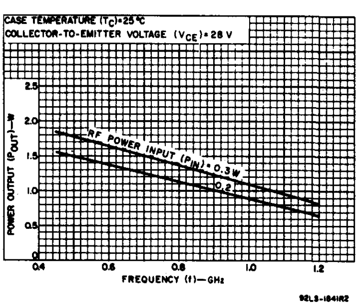


Fig. 2 - Typical power output vs. frequency.

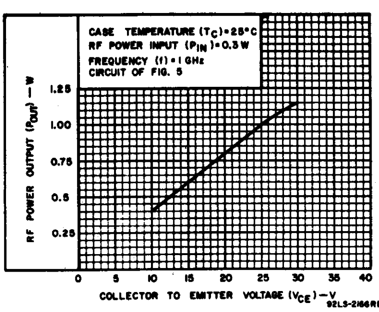


Fig. 3 - Typical rf power output as a function of collector-to-emitter voltage.

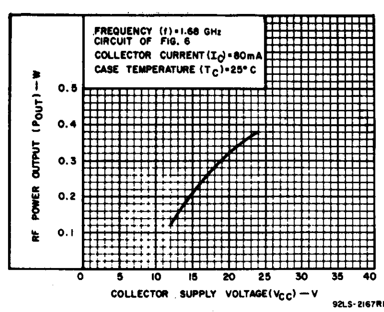


Fig. 4 - Typical oscillator power output as a function of collector supply voltage.

Power Hybrid Circuits
Technical Data

HC2000H, HC2500
Multi-Purpose 7-Ampere Operational Amplifiers

Linear Amplifiers for Applications in Industrial and Commercial Equipment

The RCA-HC2000H and HC2500 hybrid-circuit operational amplifiers are designed for operation from either single or split power supplies at output currents up to 7 amperes and power outputs up to 100 watts. These versatile amplifiers are recommended for servoamplifiers, audio power amplifiers, driven inverters, power operational amplifiers, deflection amplifiers, solenoid drivers, voltage regulators, and similar linear-amplifier power applications. They are supplied in a metal hermetic package.

The HC2000H and HC2500 employ a quasi-complementary-symmetry output stage with hometaxial-base output transistors. They feature low distortion, with a maximum total harmonic distortion of 0.5 per cent over a bandwidth of 30 kHz at a power output of 60 watts and a typical intermodulation distortion of less than 1 per cent at rms power outputs from 0.2 to 70 watts. At an rms output of 50 milliwatts, the HC2500 has an exceptionally low typical intermodulation distortion of only 0.06 per cent.

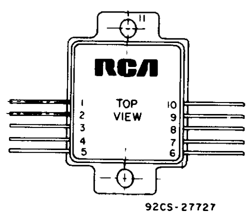
The HC2000H includes a load-line limiting network that provides protection against short-circuit loads and against high-energy transients when the amplifier is used to drive inductive loads. Both circuits also feature adjustable idling current and direct coupling to the load.

High-reliability versions of the HC2000H are also available for use in aerospace, military, and critical industrial applications. These types are screened to four reliability levels (/1, /2, /3, and /4) that approximate the reliability classes of MIL-STD-750. These slash-series types are the electronic industry's first series of high-reliability high-power hybrid-circuit op-amps.

Features:

- Bandwidth: 30 kHz at 60 W
- High power output: up to 100 W(rms)
- High output current: 7A (peak)
- Low IMD and THD
- Adjustable idling current
- *Stability with resistive or reactive loads*
- Single or split power supply (30 to 75 V, single, ± 15 to ±37.5, split)
- Class AB output stage (HC2500) Class B output state (HC2000H)
- Direct coupling to load
- Built-in load-line-limiting circuit to protect amplifiers from accidentally short-circuited output terminals (HC2000H)
- Reactive-load fault protection (HC2000H)
- Socket available
- Rugged package with heavy leads
- Light weight: 100 grams

TERMINAL DESIGNATION



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HC2000H, HC2500

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

	HC2000H HC2500
V_S: Between leads 1 & 10	75 V
I_{OM}	7 A
P_T: Per Output Device	See Figs. 3 & 4
T_{stg}	−55 to +125°C
T_J	−55 to +150°C
T_L (During Soldering): At distance ≥1/8 in. (3.17 mm) from case for 10 s max.	235°C
ϕL (Min): At distance ≥0.075 (1.91 mm) from case	0.04 in. (1.02 mm)

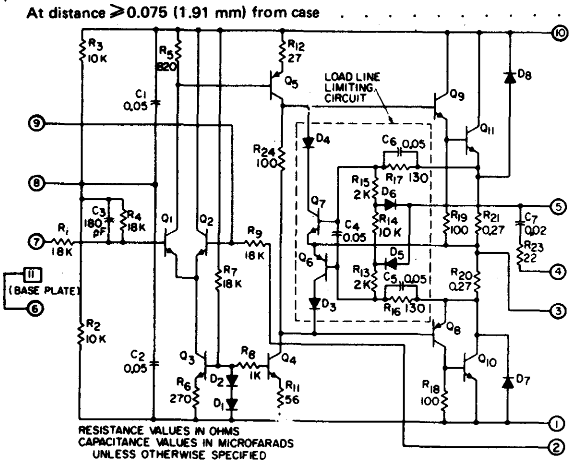


Fig. 1 – Schematic diagram of type HC2000H operational amplifier.

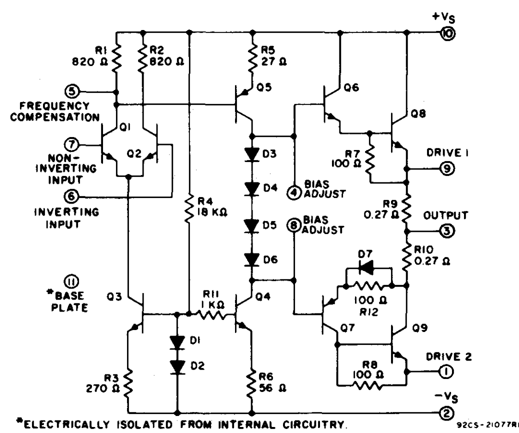


Fig. 2 – Schematic diagram of type HC2500 operational amplifier.

HC2000H, HC2500

COMPARISON CHART

TYPE	IM DIST.	OUTPUT PROTECTION NETWORK	OPERATING MODE	FREQUENCY COMPENSATION	COMMUTATING DIODES
HC2500	0.06% @ 50 mW	NO	CLASS AB	CAPACITOR ON SIGNAL TERMINALS	NO
HC2000H	0.6% @ 200 mW	YES	CLASS B	LC FILTER ON OUTPUT	YES

HC2000H

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS			UNITS
	V_S –V	f –kHz	P_O –W	R_L –Ω	MIN.	TYP.	MAX.	
V_{OUT}/V_{IN} Open-Loop	±37.5	4	25	4	–	2000	–	
Closed-Loop	±37.5	1	1	4	26	30	–	
Z_{IN} Measured between leads 7 & 8	–	–	–	–	16	18	–	kΩ
I_o	±37.5	–	–	–	15	–	30	mA
V_{IO} Measured between leads 4 & 5	±37.5	–	–	4	0	±30	±250	mV
V_{OUT}	±37.5	1	100	4	28	32	–	V
f_H (See Fig.9)	±37.5	–	1	4	43	–	–	kHz
THD (See Fig. 10)	±37.5	1	60	4	–	0.4	0.5	%
I_S (See Fig. 12)	±37.5	1	–	0	±2	–	±3.85	A
S/N Z_G = 600 Ω	±37.5	–	–	–	–	78	–	dB
SR (Unity gain, I_{OM} = 4A)	±37.5	1	100	4	5	–	–	V/μs
$R_{\theta JC}$ Per Output Device (See Figs. 3 & 4)	–	–	–	–	–	–	2	°C/W

HC2500

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C and Supply Voltage (V_S) = ±37.5 V*

CHARACTERISTIC	REFERENCE FIG. NO.	TEST CONDITIONS				LIMITS			UNITS
		SPECIAL NOTES	FREQ. (f)–kHz	OUTPUT POWER (P_O)–W	LOAD RESIST. (R_L)–Ω	MIN.	TYP.	MAX.	
V_{offset}		Measured Pin 3 to Gnd	–	–	4	–	–	±250	mV
I_o		Idling Current < 1 mA	–	–	Open	–	–	±30	mA
V_{OUT}		Peak dc voltage	0	200	4	28	–	–	V
f_H			–	1	4	43	–	–	kHz
THD	21		1	60	4	–	0.3	0.5	%
A_{CL}			1	1	4	31	32	–	
$R_{\theta JC}$	3, 4		–	–	–	–	–	2	°C/W

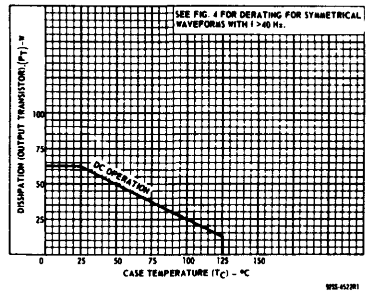


Fig. 3 – Dissipation (dc) derating curve for each output transistor for both types.

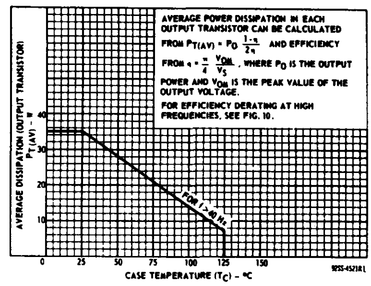


Fig. 4 – Dissipation (average) derating curve for each output transistor (for symmetrical wave-forms with f >40 Hz) for both types.

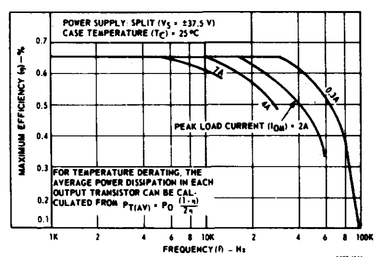


Fig. 5 – Maximum efficiency vs. frequency for several values of peak load current for both types.

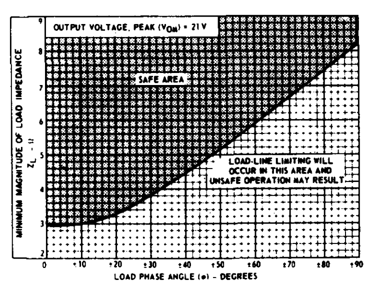


Fig. 6 – Minimum load impedance vs. load phase angle and safe area of operation for both types.

HC2000H, HC2500

HC2500

ELECTRICAL CHARACTERISTICS (Cont'd)
Typical Values (for Design Guidance), *At Case Temperature (T_C) = 25°C and Supply Voltage (V_S) = ±37.5*

CHARACTERISTIC	REFERENCE FIG. NO.	TEST CONDITIONS: SPECIAL NOTES	FREQ. (f)–kHz	OUTPUT POWER (P_O)–W	LOAD RESIST. (R_L)–Ω	LIMITS: MIN.	TYP.	MAX.	UNITS
A_{OL}	16	Idling current = 50 mA	1	25	4	–	70	–	dB
V_{IO}			–	0	Open	–	±10	–	mV
I_{IO}			–	0	Open	–	7	–	μA
I_{IB}			–	0	Open	–	20	–	μA
R_{CM}			0.005	0	Open	–	1	–	MΩ
V_{ICR}			0.5	100	4	–	32	–	V
CMRR			0.005	0	Open	–	50	–	dB
V_{RR}			0.06	0	4	–	30	–	dB
IMD	20	Idling current = 50 mA	–	0.05	4	–	0.06	–	%
SR	24	A_{CL} = 2, C_c = 100 pF	0.5 Square Wave	–	4	–	4.3	–	V/μs
ΔI_i	23	25°C to 100°C	–	–	4	–	1	–	mA/°C

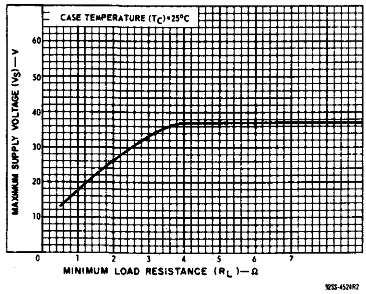


Fig. 7 – Maximum allowable supply voltage vs. load resistance for HC2000H.

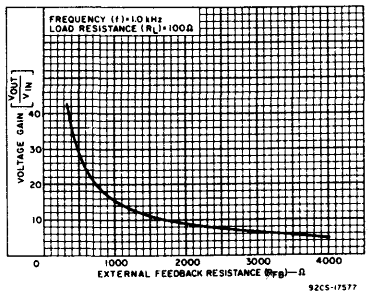


Fig. 8 – Closed-loop voltage gain vs. external feedback resistance for HC2000H.

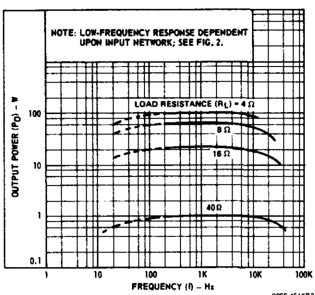


Fig. 9 – Output power vs. frequency for HC2000H.

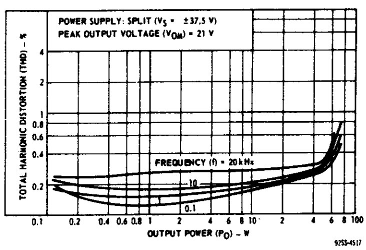


Fig. 10 – Total harmonic distortion with split power supply for HC2000H.

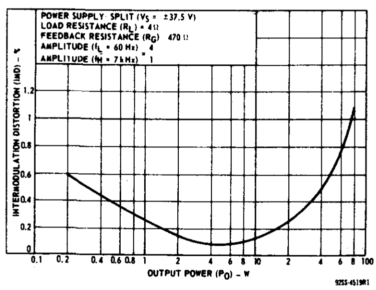


Fig. 11 – Intermodulation distortion with split supply and 4-ohm load for HC2000H.

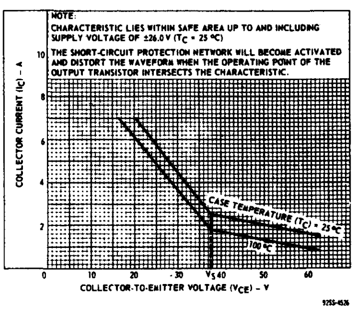


Fig. 12 – Characteristics of built-in load-line-limiting circuit for HC2000H.

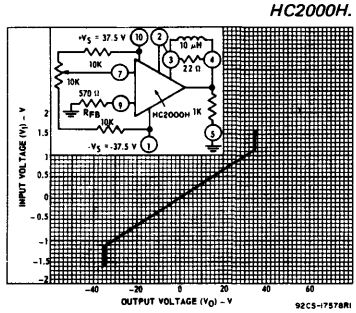


Fig. 13 – Gain linearity characteristics for HC2000H.

HC2000H, HC2500

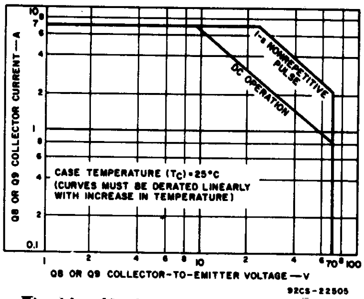


Fig. 14 – Maximum operating area for HC2500.

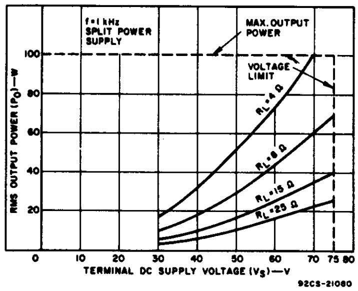


Fig. 15 – Output power as a function of supply voltage, with various values of load resistance, for symmetrical sine-wave operation for HC2500.

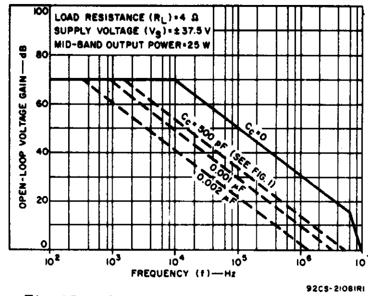


Fig. 16 – Typical open-loop voltage gain vs. frequency for HC2500.

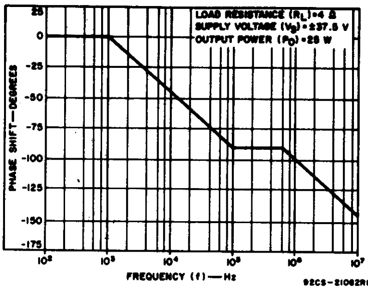


Fig. 17 – Typical open-loop phase shift vs. frequency for HC2500.

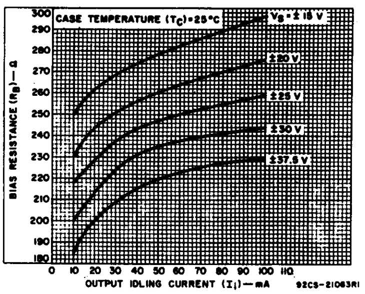


Fig. 18 – Bias resistor value vs. output idling current (I_I) for HC2500.

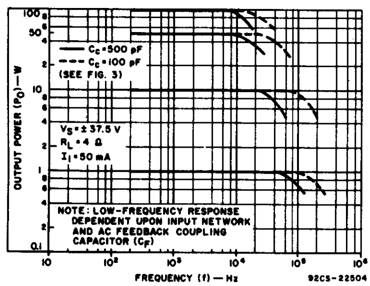


Fig. 19 – Output power vs. frequency for HC2500.

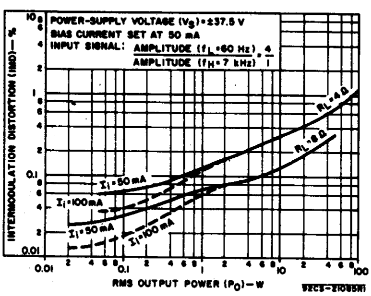


Fig. 20 – Typical intermodulation distortion vs. rms output power for HC2500.

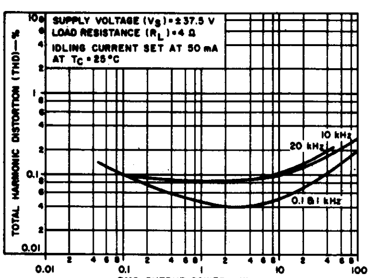


Fig. 21 – Typical harmonic distortion vs. rms output power for HC2500.

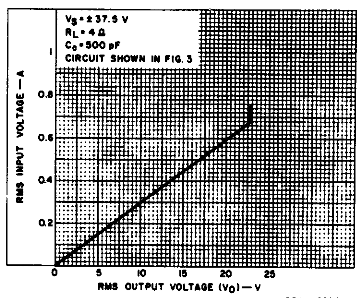


Fig. 22 – Input sensitivity for HC2500.

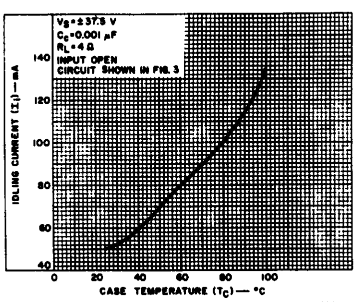


Fig. 23 – Typical idling-current drift for HC2500.

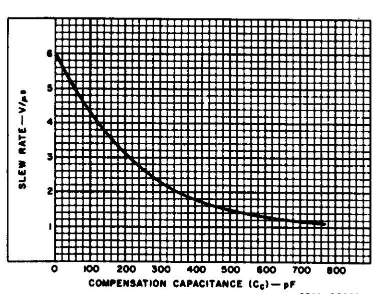


Fig. 24 – Typical slew rate vs. value of compensation capacitor C_C for HC2500.

Triacs
Technical Data

T2300, T2301, T2302, T2310, T2311, T2312 Series

2.5-A Sensitive-Gate Silicon Triacs

Mod. TO-5 and Mod. TO-5 with Heat Radiator Packages For AC Power Switching

The RCA-T2300, T2301, T2302, T2310, T2311, T2312 series triacs are gate-controlled full-wave silicon ac switches that are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

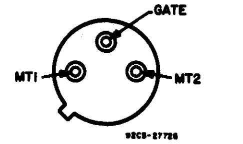
The T2310, T2311, and T2312 series are the same as the T2300, T2301, and T2302 series, respectively, but have factory-attached heat radiators and are intended for printed-circuit-board applications.

The gate sensitivity of these triacs permits the use of economical transistorized control circuits and enhances their use in low-power phase-control and load-switching applications.

Features:

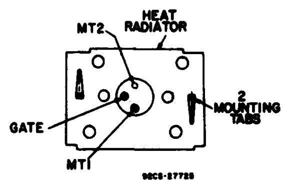
- **Very high gate sensitivity—3, 4, and 10 mA**
- **di/dt capability—100 A/μs**
- **Shorted-emitter, center-gate design**
- **Low switching losses**
- **Low on-state voltage at high current levels**

TERMINAL CONNECTIONS



T2300
T2301
T2302
Series

Modified TO-5



T2310
T2311
T2312
Series

Mod. TO-5 with Heat Radiator

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies Up to 50/60 Hz and with Resistive or Inductive Load

3 mA Gate	T2300F	T2300A	T2300B	T2300D	
4 mA Gate	T2301F	T2301A	T2301B	T2301D	
10 mA Gate	T2302F	T2302A	T2302B	T2302D	
3 mA Gate	T2310F	T2310A	T2310B	T2310D	
4 mA Gate	T2311F	T2311A	T2311B	T2311D	
10 mA Gate	T2312F	T2312A	T2312B	T2312D	
V_{DROM}▲					
Gate open, T_J=−40 to 100°C	50	100	200	400	V
$I_{T(RMS)}$ (θ = 360°):					
T_C = 70°C	2.5				A
T_A = 25°C	1.9				A
For other conditions	See Figs. 2,3,4,5				
I_{TSM}: For one cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$:					
60 Hz (sinusoidal)	25				A
50 Hz (sinusoidal)	21				A
For more than one cycle of applied principal voltage	See Figs. 6,7				
di/dt: V_D = V_{DROM}, I_{GT} = 50 mA, t_r = 0.1 μs	100				A/μs
I^2t [At T_C shown for $I_{T(RMS)}$]:					
t = 20 ms	4.3				A^2s
= 2.5 ms	2				A^2s
= 0.5 ms	1				A^2s
For other time values	See Fig. 7				
I_{GTM}●: For 1 μs max.	1				A
P_{GM}: Peak (For 1 μs max., I_{GTM} ≤ 1 A(peak)	10				W
$P_{G(AV)}$:					
T_C = 60°C	0.15				W
T_A = 25°C	0.05				W
T_{stg}■	−40 to 150				°C
T_C■	−40 to 100				°C
T_T■: During soldering for 10 s maximum at distance ≥ 1/16 in. (1.58 mm) from seating plane	225				°C

▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

● For either polarity of gate voltage (V_G) with reference to main terminal 1.

■ For temperature measurement reference point, see Dimensional Outlines.

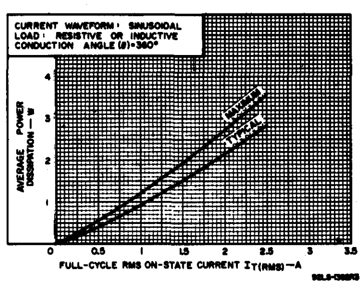


Fig. 1—Power dissipation vs. on-state current.

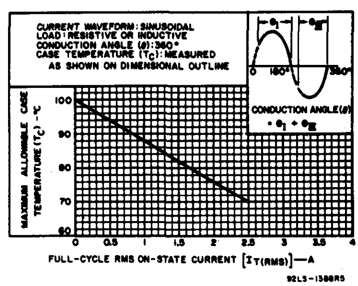


Fig. 2—Maximum allowable case temperature vs. on-state current.

T2300, T2301, T2302, T2310, T2311, T2312 Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Except as Specified			UNITS
	Min.	Typ.	Max.	
I_{DROM}▲: Gate open, T_J=100°C, V_{DROM}=Max.rated value	–	0.2	0.75	mA
V_{TM}▲: i_T=10 A(peak), T_C=25°C	–	1.7	2.2	V
I_{HO}▲: *(See Figs. 9 & 10)* Gate open, Initial principal current=150 mA (dc), v_D=12 V, T_C=25°C				
(T2300, T2301, T2310, T2311 series)	–	2	5	mA
(T2302, T2312 series)	–	7	15	mA
dv/dt (Commutating)▲: v_D=V_{DROM}, $I_{T(RMS)}$=2.5 A, commutating di/dt=0.95 A/ms, gate unenergized, T_C=100°C	0.5	–	–	V/μs
dv/dt (Off-state)▲: v_D=V_{DROM}, exponential voltage rise, gate open,				
T_C= 90°C (T2300, T2301, T2310, T2311 series)	3	5	–	V/μs
T_C=100°C (T2302, T2312 series)	6	10	–	V/μs
I_{GT}▲●: *(See Figs. 13 & 14)* v_D=12 V dc, R_L=30 Ω, T_C=25°C				mA
Mode I+ (V_{MT2} positive, V_G positive)				
T2300, T2310 series	–	1	3	
T2301, T2311 series	–	1	4	
T2302, T2312 series	–	3.5	10	
Mode III− (V_{MT2} negative, V_G negative)				
T2300, T2310 series	–	1	3	
T2301, T2311 series	–	1	4	
T2302, T2312 series	–	3.5	10	
Mode I− (V_{MT2} positive, V_G negative)				
T2300, T2310 series	–	2	3	
T2301, T2311 series	–	2	4	
T2302, T2312 series	–	7	10	
Mode III+ (V_{MT2} negative, V_G positive)				
T2300, T2310 series	–	2	3	
T2301, T2311 series	–	2	4	
T2302, T2312 series	–	7	10	
V_{GT}▲●: *(See Fig. 15)*				V
v_D=12 V dc, R_L=30 Ω, T_C=25°C	–	1	2.2	V
v_D=V_{DROM}, R_L= 3 kΩ, T_C=100°C	0.15	–	–	V
t_{gt}: v_D=V_{DROM}, I_{GT}=60 mA, t_r=0.1 μs, i_T=10 A(peak), T_C=25°C	–	1.8	2.5	μs
$R_{\theta JC}$: Steady-state	–	–	8.5	°C/W
$R_{\theta JA}$	–	–	150	°C/W

▲For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
●For either polarity of gate voltage (V_G) with reference to main terminal 1.

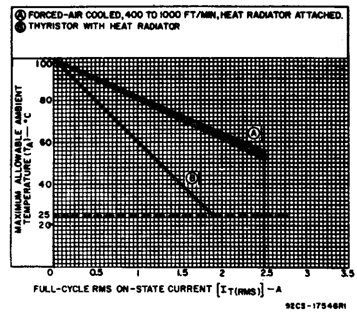


Fig. 3—Maximum allowable ambient temperature vs. on-state current for T2310, T2311, T2312 series.

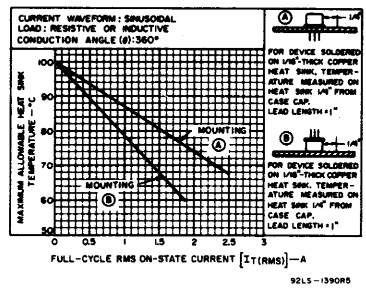


Fig. 4—Maximum allowable heat-sink temperature vs. on-state current for T2300, T2301, T2302 series.

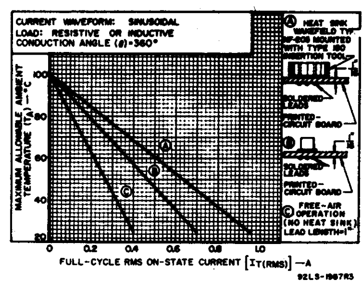


Fig. 5—Maximum allowable ambient temperature vs. on-state current for T2302 series.

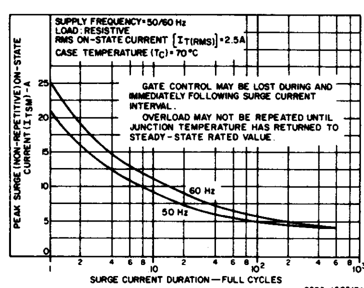


Fig. 6—Peak surge on-state current vs. surge-current duration.

T2300, T2301, T2302, T2310, T2311, T2312 Series

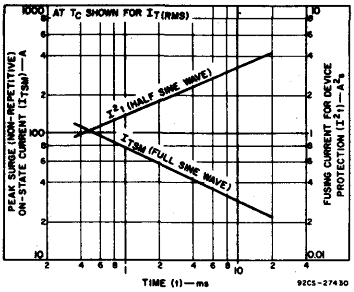


Fig. 7—Peak surge on-state current and fusing current vs. time.

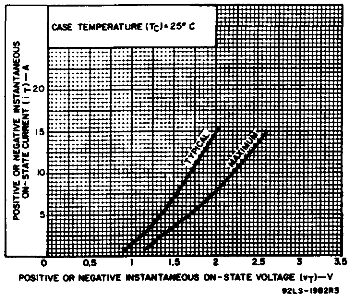


Fig. 8—On-state current vs. on-state voltage for all standard series.

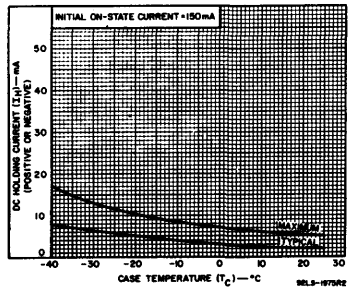


Fig. 9—DC holding current (positive or negative) vs. case temperature for T2300, T2301, T2310, T2311 series.

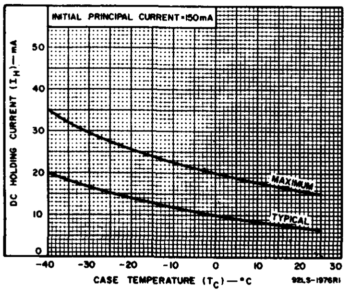


Fig. 10—DC holding current (positive or negative) vs. case temperature for T2302, T2312 series.

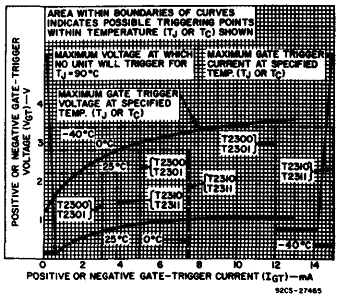


Fig. 11—Gate-trigger voltage vs. gate-trigger current for T2300, T2301, T2310, T2311 series.

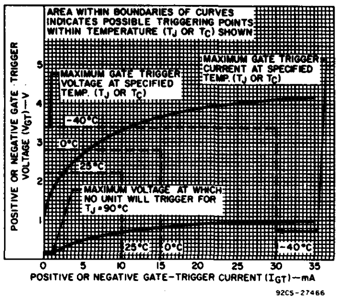


Fig. 12—Gate-trigger voltage vs. gate-trigger current for T2302, T2312 series.

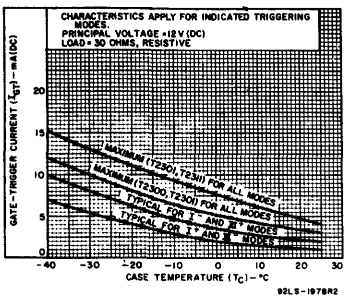


Fig. 13—Gate-trigger current vs. case temperature for T2300, T2301.

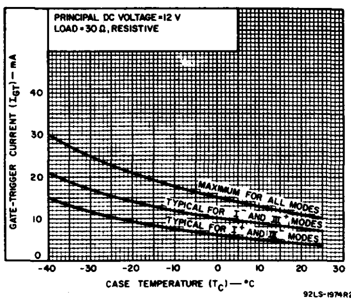


Fig. 14—Gate-trigger current vs. case temperature for T2302, T2312 series.

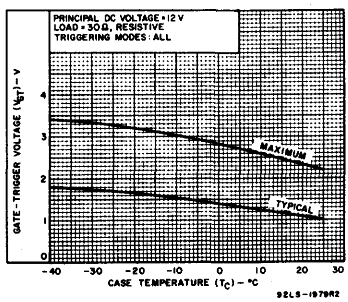


Fig. 15—Gate-trigger voltage vs. case temperature.

T2303 (2N5754-2N5757), T2313 Series

2.5-A Silicon Triacs

Modified TO-5 and Modified TO-5 with Heat Radiator Packages
For AC power Switching Applications

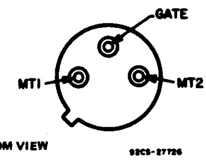
The RCA-T2303 and T2313 series triacs are gate-controlled full-wave silicon ac switches that are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate-triggering voltages.

The T2303 (2N5754-57) series types employ a hermetic modified TO-5 package. The T2313 series types employ a hermetic modified TO-5 with a factory-attached heat radiator package.

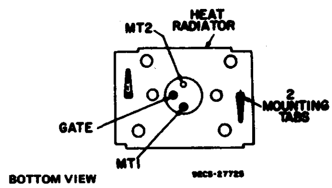
Features:

- Gate sensitivity –25 mA
- di/dt capability –100 A/µs
- Shorted-emitter, center-gate design
- Low switching losses
- Low-on-state voltage at high current levels

TERMINAL CONNECTIONS



T2303 (2N5754–57) Series



T2313 Series

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

For operation with sinusoidal supply voltage at frequencies up to 50/60 Hz and with resistive or inductive load

	T2303F T2313F	2N5754 T2313A	2N5755 T2313B	2N5756 T2313D	2N5757 T2313M	
* V_{DROM}▲:						
Gate open, T_J = –65 to 100°C	50	100	200	400	600	V
$I_{T(RMS)}$ (θ = 360°C):						
* T_C = 70°C (T2303 series)			2.5			A
T_A = 25°C (T2313 series)			1.9			A
For other conditions			See Figs. 2,3,4			
I_{TSM}:						
For one cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$:						
* 60 Hz (sinusoidal)			25			A
50 Hz (sinusoidal)			21			A
For more than one cycle of applied principal voltage			See Figs. 5,6			
di/dt:						
V_D = V_{DROM}, I_{GT} = 50 mA, t_r = 0.1 µs			100			A/µs
I^2t [At T_C shown for $I_{T(RMS)}$]:						
t = 20 ms			4.3			A^2s
t = 2.5 ms			2			A^2s
t = 0.5 ms			1			A^2s
For other time values			See Fig. 6			
* I_{GTM}●:						
For 1 µs max. (See Fig. 9)			1			A
P_{GM}:						
Peak (For 1 µs max., I_{GTM} ≤ 1 A (peak), (See Fig. 9)			10			W
* $P_{G(AV)}$ – T_C = 70°C			0.15			W
T_A = 25°C			0.05			W
* T_{stg}■			–65 to 150			°C
* T_C■			–65 to 100			°C
T_T■:						
During soldering for 10 s maximum at distance ≥ 1/16 in. (1.58 mm) from seating plane			225			°C

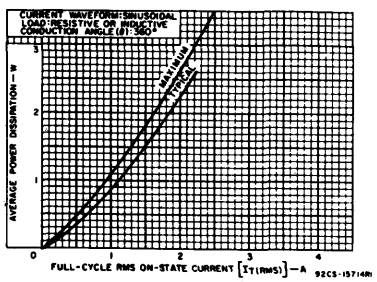


Fig. 1 – Power dissipation vs. on-state current.

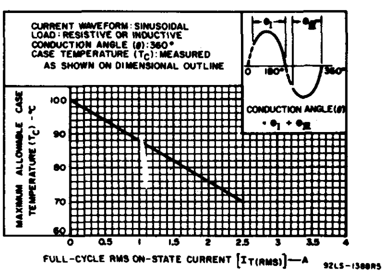


Fig. 2 – Maximum allowable case temperature vs. on-state current.

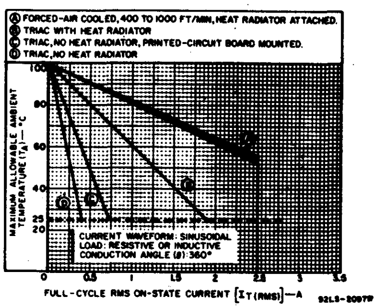


Fig. 3 – Maximum allowable ambient temperature vs. on-state current.

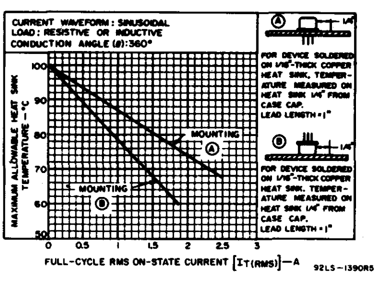


Fig. 4 – Maximum allowable heat-sink temperature vs. on-state current.

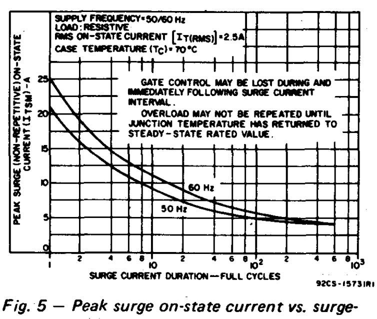


Fig. 5 – Peak surge on-state current vs. surge-current duration.

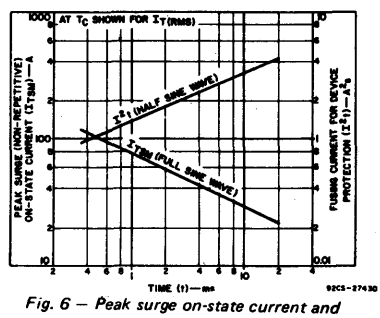


Fig. 6 – Peak surge on-state current and fusing current vs. time.

T2303 (2N5754-2N5757), T2313 Series

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTICS	LIMITS For All Types Except as Specified MIN.	TYP.	MAX.	UNITS
• I_{DROM}▲: Gate open, T_J = 100°C, V_{DROM} = Max. rated value	–	0.2	0.75	mA
V_{TM}▲: i_T = 10 A (peak), T_C = 25°C	–	2.2	2.6	V
• i_T = 3.5 A (peak), T_C = 25°C	–	–	1.8	V
I_{HO}▲: (See Fig. 7) Gate open, Initial principal current = 150 mA (dc), v_D = 12 V, T_C = 25°C	–	6	35	mA
= −65°C	–	20	82•	mA
dv/dt (Commutating)▲: v_D = V_{DROM}, $I_{T(RMS)}$ = 2.5 A commutating di/dt = 0.95 A/ms, gate unenergized, T_C = 70°C	0.5	–	–	V/μs
• dv/dt (Off-State)▲: v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100°C:	10	100	–	V/μs
I_{GT}▲●: (See Fig. 10) v_D = 12 V dc, R_L = 30Ω, T_C = 25°C; Mode / V_{MT2} / V_G				
I+ positive positive	–	5	25	mA
III− negative negative	–	5	25	mA
I− positive negative	–	10	40	mA
III+ negative positive	–	10	40	mA
v_D = 12 V dc, R_L = 30Ω, T_C = −65°C; Mode / V_{MT2} / V_G				
I+ positive positive	–	30	60•	mA
III− negative negative	–	30	60•	mA
I− positive negative	–	40	100•	mA
III+ negative positive	–	40	100•	mA
V_{GT}▲●: (See Fig. 11) v_D = 12 V dc, R_L = 30Ω, T_C = 25°C	–	0.9	2.2	V
= −65°C	–	1.5	3•	V
v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C	0.2	–	–	V
t_{gt}: v_D = V_{DROM}, I_{GT} = 60 mA, t_r = 0.1 μs, i_T = 10 A (peak) T_C = 25°C	–	1.8	2.5	μs
• $R_{\theta JC}$: Steady-State	–	–	8.5	°C/W
$R_{\theta JA}$: Steady-State	–	–	150	°C/W

• In accordance with JEDEC registration data format (JS-14, RDF-2– filed for the JEDEC (2N-Series) types.
▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.

T2303 (2N5754-2N5757), T2313 Series

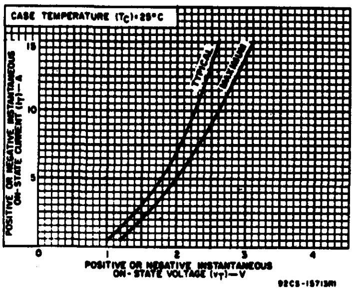


Fig. 7 — On-state current vs. on-state voltage.

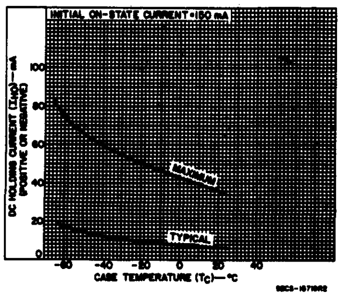


Fig. 8 — DC holding current (positive or negative) vs. case temperature.

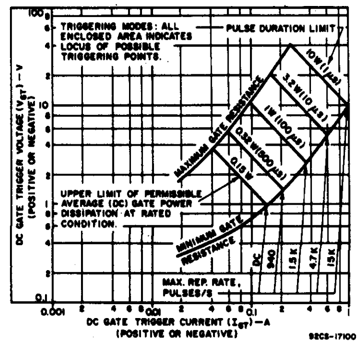


Fig. 9 — Gate-trigger characteristics and limiting conditions for determination of permissible gate-trigger pulses.

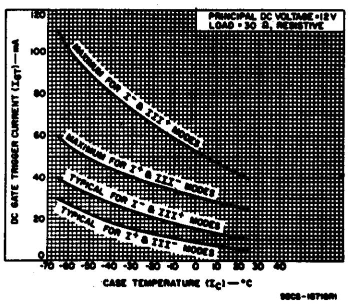


Fig. 10 — DC gate-trigger current vs. case temperature.

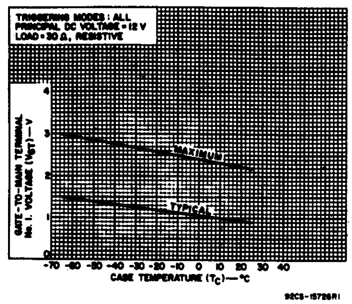


Fig. 11 — DC gate-trigger voltage vs. case temperature.

T2304, T2305 Series

400-Hz, 0.5A Sensitive-Gate Silicon Triacs

For Control-Systems Application in Airborne and Ground-Support Type Equipment

RCA T2304- and T2305-series triacs are gate-controlled full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

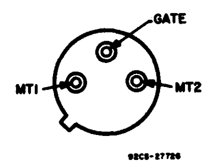
These triacs are intended for operation up to 400 Hz with resistive or inductive loads and nominal line voltages of 115 and 208 V RMS sine wave and repetitive peak off-stage voltages of 200 V and 400 V.

The high gate sensitivity of these triacs permits the use of economical transistorized or integrated control circuits and enhances their use in low-power phase control and load-switching applications.

Features:

- **High gate sensitivity, I_{GT} = 10/40 mA max.**
- **di/dt capability = 100 A/μs**
- **Commutating dv/dt capability characterized at 400 Hz**
- **Shorted-Emitter Design**

TERMINAL CONNECTIONS



Modified JEDEC TO-5

MAXIMUM RATINGS, *Absolute-Maximum Values:*

For Operation with Sinusoidal Supply Voltage at Frequencies up to 400 Hz and with Resistive or Inductive Load.

		T2304B T2305B	T2304D T2305D	
REPETITIVE PEAK OFF-STATE VOLTAGE:*				
Gate open, T_J = -50 to 100°C	V_{DROM}	200	400	V
RMS ON-STATE CURRENT (Conduction angle = 360°):	$I_{T(RMS)}$			
Case temperature (T_C) = 90°C		0.5		A
Ambient temperature (T_A) = 25°C, without heat sink		0.4		A
For other conditions		See Figs. 2 & 3		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}			
For one cycle of applied principal voltage, T_C = 90°C				
400 Hz (sinusoidal)		50		A
60 Hz (sinusoidal)		25		A
50 Hz (sinusoidal)		21		A
For more than one cycle of applied principal voltage		See Fig. 4		
RATE-OF-CHANGE OF ON-STATE CURRENT:	di/dt			
V_{DM} = V_{DROM}, I_{GT} = 60 mA, t_r = 0.1 μs		100		A/μs
FUSING CURRENT (for triac protection):				
T_J = -50 to 100°C, t = 1.25 to 10 ms	I^2t	2		A^2s
PEAK GATE-TRIGGER CURRENT:■	I_{GTM}			
For 1 μs (max.) (*See Fig. 10*)		1		A
GATE POWER DISSIPATION:				
PEAK (For 1 μs max., (*See Fig. 10*)	P_{GM}	10		W
AVERAGE (At T_C = 60°C)	$P_{G(AV)}$	0.15		W
(At T_A = 25°C, without heat sink)	$P_{G(AV)}$	0.05		W
TEMPERATURE RANGE:▲				
Storage	T_{stg}	-50 to 150		°C
Operating (Case)	T_C	-50 to 100		°C
LEAD TEMPERATURE (During soldering):				
At distances ≥ 1/16 in. (1.58 mm) from the case for 10 s max.	T_L	225		°C

* For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see Dimensional Outline.

ELECTRICAL CHARACTERISTICS

At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS T2304 Series Min.	Typ.	Max.	T2305 Series Min.	Typ.	Max.	UNITS
Peak Off-State Current:♦ Gate open, T_J = 100°C, V_{DROM} = Max. rated value	I_{DROM}	-	0.2	0.75	-	0.2	0.75	mA
Maximum On-State Voltage:♦ For i_T = 10 A (peak), T_C = 25°C	V_{TM}	-	1.7	2.2	-	1.7	2.2	V
DC Holding Current:♦ Gate open, Initial principal current = 150 mA (DC), v_D = 12 V, T_C = 25°C	I_{HO}	-	7	15	-	15	30	mA
For other case temperatures		See Figs. 8 & 9						
Critical Rate-of-Rise of Commutation Voltage:♦ For v_D = V_{DROM}, $I_{T(RMS)}$ = 0.5 A, commutating di/dt = 1.8 A/ms, gate unenergized, T_C = 90°C	dv/dt	1	4	-	1	4	-	V/μs
Critical Rate-of-Rise of Off-State Voltage:♦ For v_D = V_{DROM}, exponentail voltage rise, gate open, T_C = 100°C	dv/dt	10	100	-	10	100	-	V/μs
DC Gate-Trigger Current:♦ For v_D = 12 V (DC), R_L = 30 Ω, T_C = 25°C — Mode I⁺, V_{MT2} positive, V_G positive	I_{GT}	-	3.5	10	-	5	25	mA
Mode III⁻, V_{MT2} negative, V_G negative		-	3.5	10	-	5	25	mA
Mode I⁻, V_{MT2} positive, V_G negative		-	7	10	-	10	40	mA
Mode III⁺, V_{MT2} negative, V_G positive		-	7	10	-	10	40	mA
For other case temperatures		See Figs. 11 & 12						
DC Gate-Trigger Voltage:♦† For v_D = 12 V (DC), R_L = 30Ω, T_C = 25°C	V_{GT}	-	1	2.2	-	1	2.2	V
For other case temperatures		See Fig. 13						
For v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C		0.15	-	-	0.15	-	-	V
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 60 mA, t_r = 0.1 μs, i_T = 10 A (peak), T_C = 25°C (See Fig. 16)	t_{gt}	-	1.8	-	2.5	1.8	2.5	μs
Thermal Resistance, Junction-to-Case:	$\theta_{J\text{-}C}$	-	-	8.5	-	-	8.5	°C/W

♦ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
† For either polarity of gate voltage (V_G) with reference to main terminal 1.

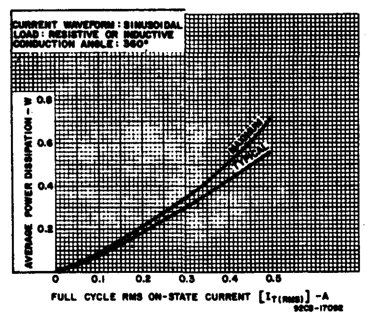


Fig. 1—Power dissipation vs. on-state current.

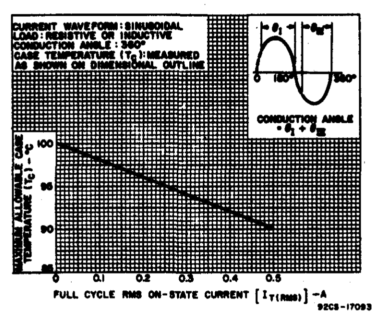


Fig. 2—Maximum allowable case temperature vs. on-state current.

T2304, T2305 Series

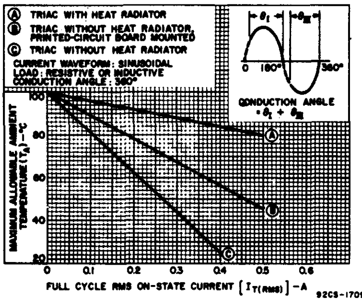


Fig. 3—Maximum allowable ambient temperature vs. on-state current for the package/mounting options of these triacs.

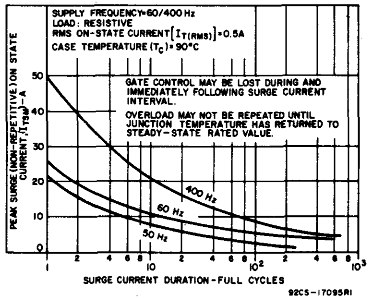


Fig. 4—Peak surge on-state current vs. surge-current duration.

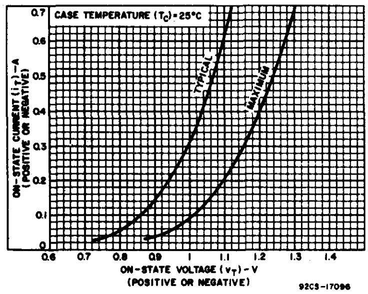


Fig. 5—On-state current vs. on-state voltage (steady-state condition).

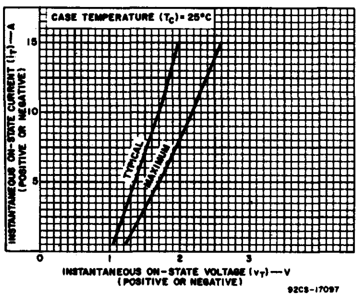


Fig. 6—On-state current vs. on-state voltage (surge condition).

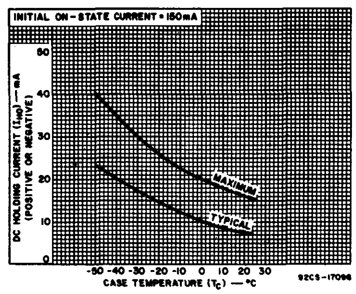


Fig. 7—DC holding current vs. case temperature for T2304 series.

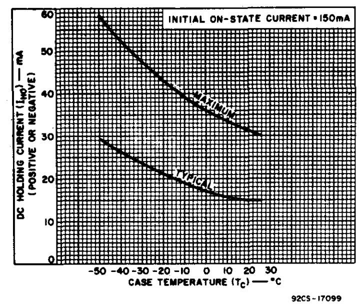


Fig. 8—DC holding current vs. case temperature for T2305 series.

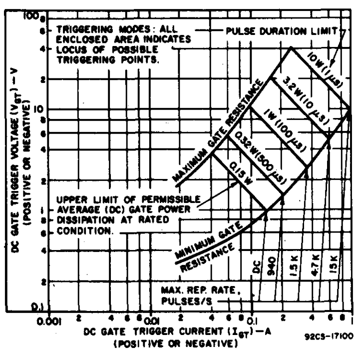


Fig. 9—Gate-trigger characteristics and limiting conditions for determination of permissible gate-trigger pulses.

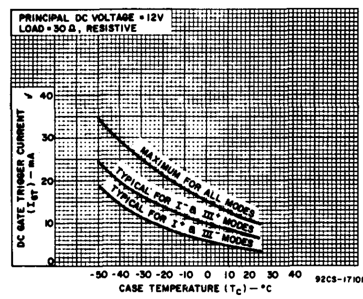


Fig. 10—DC gate-trigger current vs. case temperature for T2304 series.

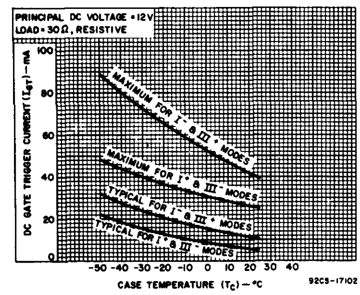


Fig. 11—DC gate-trigger current vs. case temperature for T2305 series.

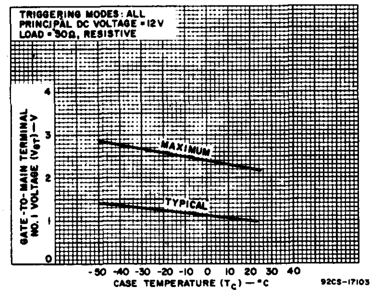


Fig. 12—DC gate-trigger voltage vs. case temperature.

T2320, T2322, T2323, T2327 Series

2.5-A Sensitive-Gate Silicon Triacs

For AC Power Switching

The RCA-T2320, T2322, T2323 and T2327, series triacs are gate-controlled full-wave silicon ac switches that are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

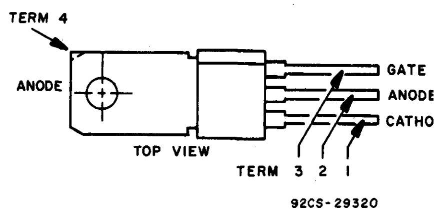
The gate sensitivity of these triacs permits the use of economical transistorized or integrated circuit control circuits and enhances their use in low-power phase-control and load-switching applications.

All types in each series utilize the JEDEC-TO-202AB (RCA VERSATAB) plastic package.

Features:

- **Very high gate sensitivity—3,5 and 10 mA**
- **di/dt capability—100 A/μs**
- **Shorted-emitter, center-gate design**
- **Low switching losses**
- **Low on-state voltage at high current levels**
- **Glass-passivated chip for stability**
- **Package and formed-lead options available**

TERMINAL CONNECTIONS



JEDEC TO-202AB
(Type 1 Package)

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies Up to 50/60 Hz and with Resistive or Inductive Load

3 mA Gate	T2320F	T2320A	T2320B	T2320C	T2320D	T2320E	
10 mA Gate	T2322F	T2322A	T2322B	T2322C	T2322D	T2322E	
25 mA Gate	T2323F	T2323A	T2323B	T2323C	T2323D	T2323E	
5 mA Gate	T2327F	T2327A	T2327B	T2327C	T2327D	T2327E	
V_{DROM}▲: Gate open, T_J=−40 to 100°C	50	100	200	300	400	500	V

Rating	All types	Unit
$I_{T(RMS)}$ (θ= 360°): T_C = 70°C	2.5	A
T_A = 25°C	0.8	A
For other conditions	See Figs. 3 and 4	
I_{TSM}: For one full cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$: 60 Hz (sinusoidal)	25	A
50 Hz (sinusoidal)	23.5	A
For more than one cycle of applied principal voltage	See Fig.5	
di/dt: V_D = V_{DROM}, I_{GT} = 50 mA, t_r = 0.1 μs (See Fig. 10)	100	A/μs
I^2t [At T_C shown for $I_{T(RMS)}$] (Half-sine wave): t = 20 ms	3.4	A^2s
= 2.5 ms	1.7	A^2s
0.5 ms	1	A^2s
For other time values	See Fig.6	
I_{GTM}●: For 1 μs max.	1	A
P_{GM}: Peak (For 1 μs max., I_{GTM} ≤ 1 A(peak)	10	W
$P_{G(AV)}$: T_C = 60°C	0.1	W
T_A = 25°C	0.05	W
T_{stg}■	−40 to 150	°C
T_C■	−40 to 100	°C
T_T■: During soldering for 10 s maximum at distance ≥ 1/16 in. (1.58 mm) from seating plane	225	°C

▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.
■ For termperature measurement reference point, *see Dimensional Outlines*.

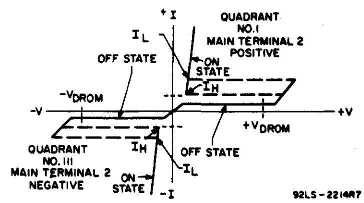


Fig. 1 — Principal voltage-current characteristic.

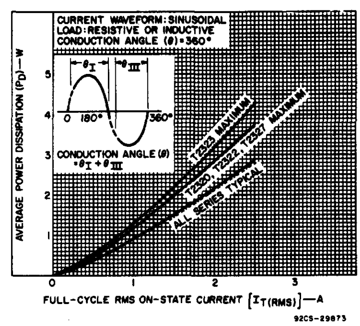


Fig. 2 — Power dissipation as a function of on-state current.

T2320, T2322, T2323, T2327 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Except as Specified Min.	Typ.	Max.	UNITS
I_{DROM}▲: Gate open, T_J = 100°C, V_{DROM} = Max. rated value	–	0.2	0.75	mA
V_{TM}▲:				
i_T = 10 A(peak), T_C = 25°C T2320, T2322, T2327 series	–	1.7	2.2	V
i_T = 10 A(peak), T_C = 25°C T2323 series	–	1.7	2.6	
I_{HO}▲: Gate open, Initial principal current = 150 mA (dc), v_D = 12 V, T_C = 25°C	–	15	30	mA
dv/dt (Commutating)▲: v_D = V_{DROM}, $I_{T(RMS)}$ = 2.5 A, commutating di/dt = 1.8 A/ms, gate unenergized, T_C = 90°C	1	4	–	V/μs
dv/dt (Off-state)▲: v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100°C	10	100	–	
I_{GT}▲●: (*See Fig. 8*) v_D = 12 V dc, R_L = 30 Ω, T_C = 25°C				
Mode / V_{MT2} / V_G				
I+ positive positive				
T2320 series	–	–	3	
T2322 series	–	–	10	
T2323 series	–	–	25	
T2327 series	–	–	5	
III− negative negative				
T2320 series	–	–	3	
T2322 series	–	–	10	
T2323 series	–	–	25	
T2327 series	–	–	5	mA
I− positive negative				
T2320 series	–	–	3	
T2322 series	–	–	10	
T2323 series	–	–	40	
T2327 series	–	–	5	
III+ negative positive				
T2320 series	–	–	3	
T2322 series	–	–	10	
T2323 series	–	–	40	
T2327 series	–	–	5	
V_{GT}▲●: (*See Fig. 9*)				
v_D = 12 V dc, R_L = 30 Ω, T_C = 25°C	–	1	2.2	V
v_D = V_{DROM}, R_L = 125 Ω, T_C = 100°C	0.15	–	–	
t_{gt}: v_D = V_{DROM}, I_{GT} = 60 mA, t_r = 0.1 μs, i_T = 10 A(peak), T_C = 25°C	–	1.8	2.5	μs
$R_{\theta JC}$ (Package Types 1, 11, 12, 3, 32)	–	–	8	
$R_{\theta JA}$ (Package Types 1, 11, 12, 3, 32)	–	–	80	°C/W
$R_{\theta JL}$ (Package Types 2, 21)	–	–	50	
$R_{\theta JA}$ (Package Types 2, 21)	–	–	100	

▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.

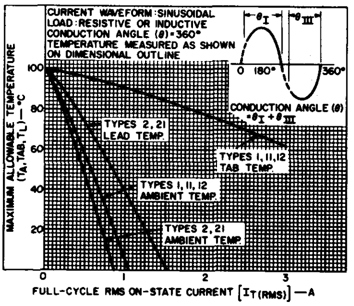


Fig. 3 – Maximum allowable temperature as a function of on-state current for T2320, T2322, and T2327.

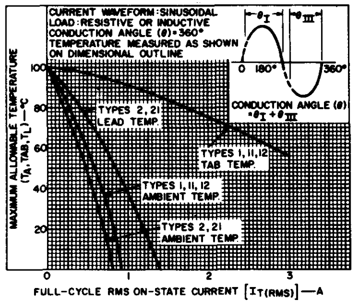


Fig. 4 – Maximum allowable temperature as a function of on-state current for T2323.

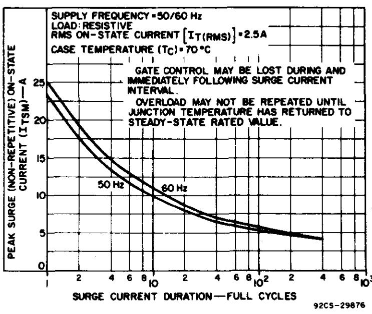


Fig. 5 – Peak surge on-state current as a function of surge-current duration.

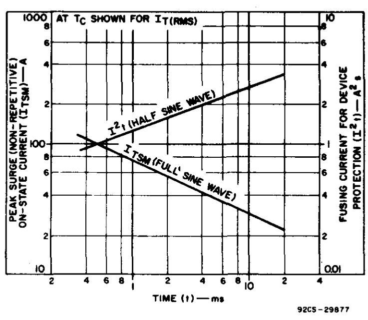


Fig. 6 – Peak surge on-state current and fusing current as a function of time.

T2320, T2322, T2323, T2327 Series

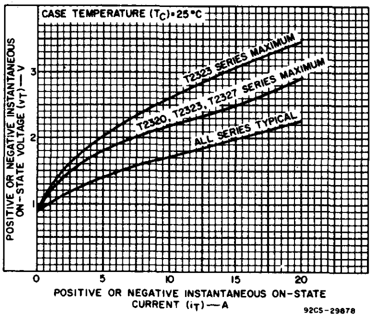


Fig. 7 – On-state current as a function of on-state voltage.

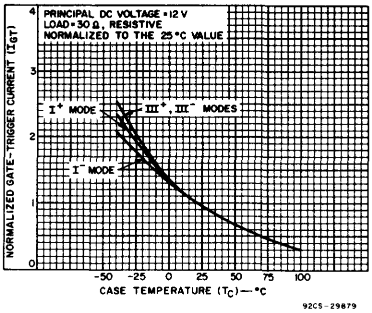


Fig. 8 – Gate-trigger current as a function of case temperature.

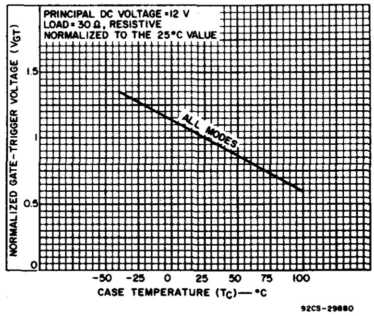


Fig. 9 – Gate trigger voltage as a function of case temperature.

T2500 Series

6-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

Types T2500B and T2500D* are gate-controlled full-wave silicon triacs utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, heating controls, relay replacement, solenoid drivers, static switching, and power-switching systems.

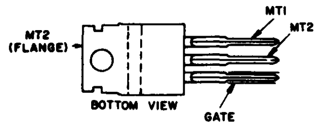
These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 6 amperes at a T_C of 80°C and repetitive off-state voltage ratings of 200 volts and 400 volts, respectively.

These triacs employ the plastic JEDEC TO-220-AB package.

*Formerly RCA Dev. Nos. TA8504 and TA8505.

Features:
- 60-A Peak Surge Full-Cycle Current Ratings
- Shorted-Emitter, Center-Gate Design
- Package Design Facilitates Mounting on a Printed-Circuit Board
- Low Switching Losses
- Low Thermal Resistance

TERMINAL CONNECTIONS



BOTTOM VIEW
JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

Rating	Symbol	T2500B	T2500D	Units
REPETITIVE PEAK OFF-STATE VOLTAGE:• Gate open, T_J = −65 to 100°C	V_{DROM}	200	400	V
RMS ON-STATE CURRENT (Conduction angle = 360°): Case temperature T_C = 80°C	$I_{T(RMS)}$	6		A
For other conditions		See Fig. 2		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT: For one cycle of applied principal voltage, T_C = 80°C: 60 Hz (sinusoidal)	I_{TSM}	60		A
50 Hz (sinusoidal)		50		A
For more than one cycle of applied principal voltage		See Fig. 3		
RATE OF CHANGE OF ON-STATE CURRENT: $V_{DM} = V_{DROM}$, I_{GT} = 200 mA, tr = 0.1 μs	di/dt	70		A/μs
FUSING CURRENT (for Triac Protection): T_C = −65 to 100°C, t = 1.25 to 10 ms	I^2t	18		A^2s
PEAK GATE-TRIGGER CURRENT:• For 10 μs max; see Fig. 10	I_{GTM}	4		A
GATE POWER DISSIPATION: Peak (For 1 μs max., $I_{GTM} \leq 4$ A; see Fig. 6)	P_{GM}	16		W
AVERAGE	$P_{G(AV)}$	0.2		W
TEMPERATURE RANGE:▲ Storage	T_{stg}	−65 to 150		°C
Operating (Case)	T_C	−65 to 100		°C
TERMINAL TEMPERATURE (During soldering): For 10 s max. (terminals and case)	T_T	225		°C

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see *Dimensional Outline.*

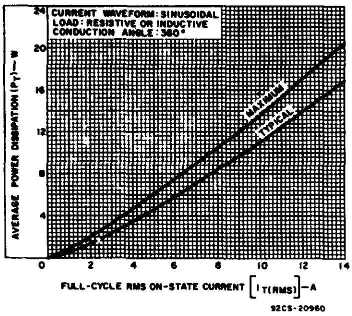


Fig. 1—Power dissipation vs. on-state current.

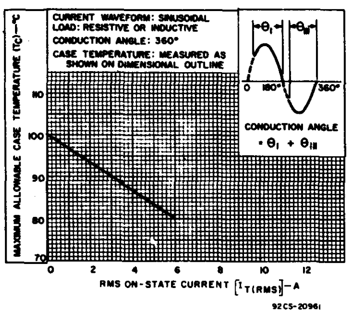


Fig. 2—Allowable case temperature vs. on-state current.

ELECTRICAL CHARACTERISTICS at Maximum Ratings unless otherwise specified, and at indicated Case Temperature (T_C)

CHARACTERISTIC	SYMBOL	T2500B MIN.	T2500B TYP.	T2500B MAX.	T2500D MIN.	T2500D TYP.	T2500D MAX.	UNITS
Peak Off-State Current:• Gate Open, V_{DROM} = Max. rated value At T_J = 100°C	I_{DROM}	–	0.1	2	–	0.1	2	mA
Maximum On-State Voltage:• For i_T = 30 A (peak) and T_C = 25°C	V_{TM}	–	1.7	2	–	1.7	2	V
DC Holding Current:• Gate Open, Initial principal current = 150 mA (dc) At T_C = 25°C	I_{HO}	–	15	30	–	15	30	mA
For other case temperatures		See Fig. 5						
Critical Rate of Rise of Commutation Voltage:•♦ For $v_D = V_{DROM}$, $I_{T(RMS)}$ = 6 A, Commutating di/dt = 3.2 A/ms, and gate unenergized At T_C = 80°C	dv/dt	4	10	–	4	10	–	V/μs
Critical Rate of Rise of Off-State Voltage:• For $v_D = V_{DROM}$, exponential voltage rise, and gate open At T_C = 100°C	dv/dt	100	300	–	75	250	–	V/μs
For other case temperatures		See Fig. 9						
DC Gate-Trigger Current:•† For v_D = 12 V (dc), R_L = 12 Ω, T_C = 25°C, and specified triggering mode: I+ Mode (V_{MT2} positive, V_G positive)	I_{GT}	–	10	25	–	10	25	mA
III− Mode (V_{MT2} negative, V_G negative)		–	15	25	–	15	25	
I− Mode (V_{MT2} positive, V_G negative)		–	20	60	–	20	60	
III+ Mode (V_{MT2} negative, V_G positive)		–	30	60	–	30	60	
For other case temperatures		See Figs. 7 and 8						

T2500 Series

ELECTRICAL CHARACTERISTICS at Maximum Ratings unless otherwise specified, and at indicated Case Temperature (T_C)

CHARACTERISTIC	SYMBOL	LIMITS T2500B MIN.	T2500B TYP.	T2500B MAX.	T2500D MIN.	T2500D TYP.	T2500D MAX.	UNITS
DC Gate-Trigger Voltage:*† For v_D = 12 V (dc) and R_L = 12 Ω At T_C = 25°C	V_{GT}	–	1.25	2.5	–	1.25	2.5	V
For other case temperatures		See Fig.9						
For v_D = V_{DROM} and R_L = 125 Ω At T_C = 100°C		0.2	–	–	0.2	–	–	
Gate-Controlled Turn-On Time (Delay Time + Rise Time): For v_D = V_{DROM}, I_{GT} = 160 mA, rise time = 0.1 μs, and i_T = 10 A (peak) At T_C = 25°C (See Fig. 11)	t_{gt}	–	1.6	2.5	–	1.6	2.5	μs
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	–	–	2.7	–	–	2.7	°C/W
Junction-to-Ambient	$R_{\theta JA}$	–	–	60	–	–	60	°C/W

*For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

†For either polarity of gate voltage (V_G) with reference to main terminal 1.

♦Variants of these devices having dv/dt characteristics selected specifically for inductive loads are available on special order; for additional information, contact your RCA Representative or your RCA Distributor.

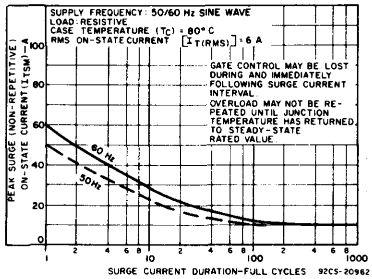


Fig. 3—Peak surge on-state current vs. surge-current duration.

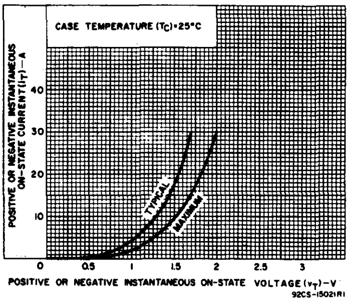


Fig. 4—On-state current vs. on-state voltage.

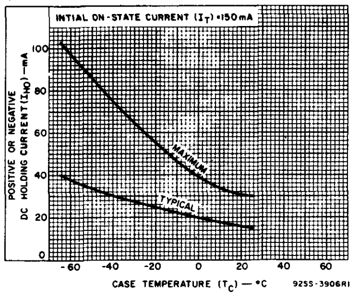


Fig. 5—DC holding current for either direction of on-state current vs. case temperature.

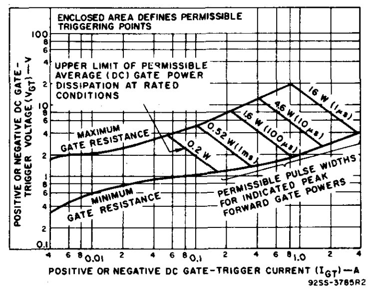


Fig. 6—Gate-pulse characteristics for all triggering modes.

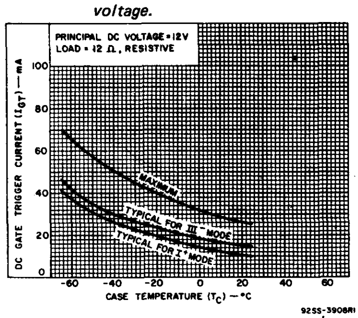


Fig. 7—DC gate-trigger current (for I^+ and III^- triggering modes) vs. case temperature.

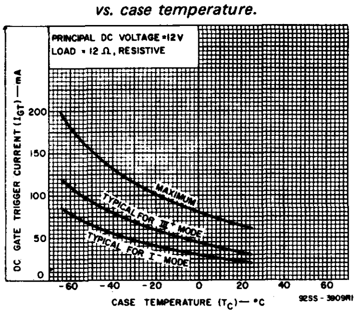


Fig. 8—DC gate-trigger current (for I^- and III^+ triggering modes) vs. temperature.

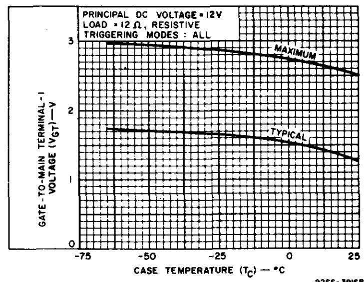


Fig. 9—DC gate-trigger voltage vs. case temperature.

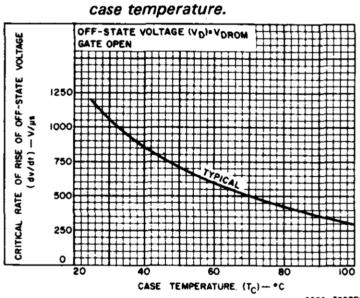


Fig. 10—Critical rate of rise of off-state voltage vs. case temperature.

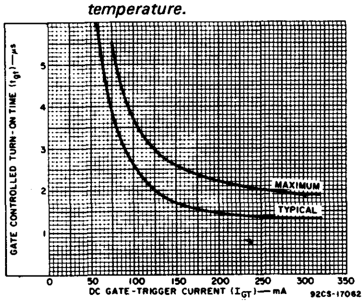


Fig. 11—Typical turn-on time vs. gate-trigger current.

T2700, T2710 Series

6-A Silicon Triacs

For Power-Control and Power-Switching Applications

RCA T2700- and T2710-series devices are gate-controlled full-wave silicon triacs. They are intended for the control of ac loads in applications such as heating controls, motor controls, light dimmers, and power switching systems.

These triacs are designed to switch from an off-state to an on-state condition for either polarity of applied voltage with positive or negative triggering voltages to the gate.

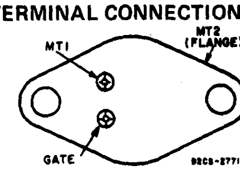
Features:

- **Shorted-emitter construction ... contains an internally diffused resistor between gate and Main Terminal 1**
- **Center gate construction ... provides rapid uniform gate-current spreading for faster turn-on with substantially reduced heating effects**

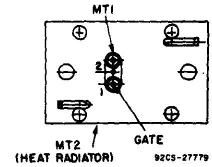
T2700B and T2700D are hermetically sealed types having an on-state current rating of 6 amperes at a case temperature of +75°C and repetitive off-state voltage ratings of 200 volts and 400 volts, respectively.

The T2700 series types employ the hermetic JEDEC TO-66 package. The T2710 series employ the hermetic TO-66 with a factory attached heat-radiator package.

TERMINAL CONNECTIONS



JEDEC TO-66



JEDEC TO-66 With Heat Radiator

Maximum Ratings, *Absolute-Maximum Values:*

For Operation with Sinusoidal Supply Voltage at Frequencies of 50/60 Hz, and with Resistive or Inductive Load

	T2700B T2710B	T2700D T2710D	
REPETITIVE PEAK OFF-STATE VOLTAGE♦, V_{DROM}:			
Gate Open, For T_J = -65 to +100 °C	200	400	V
RMS ON-STATE CURRENT, $I_{t(rms)}$:			
For case temperature (T_C) of +75 °C and a conduction angle of 360°	6	6	A
For ambient temperatures (T_A) up to +100 °C and a conduction angle of 360°	See Fig. 3.		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT, I_{TSM}:			
For one cycle of applied principal voltage, T_C = 75°C			
60 Hz (sinusoidal)	100	100	A
50 Hz (sinusoidal)	85	85	A
For more than one full cycle of applied voltage	See Fig. 4.		
RATE OF CHANGE OF ON-STATE CURRENT:			
V_{DM} = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs di/dt	100		A/μs
FUSING CURRENT (for triac protection, I^2t: T_J = -65 to 100°C, t = 1.25 to 10 ms	50	50	A^2s
PEAK GATE-TRIGGER CURRENT■, I_{GTM}:			
For 1 μs max.	4	4	A
GATE POWER DISSIPATION:■			
PEAK, P_{GM} For 1 μs max. and I_{GTM} ≦ 4 A (peak)	16	16	W
AVERAGE, $P_{G(AV)}$	0.2	0.2	W
TEMPERATURE RANGE♦:			
Storage	-65 to +150		°C
Operating (case)	-65 to +100		°C

♦For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_{GT}) with reference to main terminal 1.

♦For information on the reference point of temperature measurement, see *Dimensional Outline.*

ELECTRICAL CHARACTERISTICS

At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified
(For Definitions of Terms and Symbols, See Page 6)

CHARACTERISTIC	SYMBOL	T2700B Min.	T2700B Typ.	T2700B Max.	T2710B Min.	T2710B Typ.	T2710B Max.	T2700D Min.	T2700D Typ.	T2700D Max.	T2710D Min.	T2710D Typ.	T2710D Max.	UNITS
Peak Off-State Current:* Gate Open At T_J = +100 °C and V_{DROM} = Max. rated value	I_{DROM}	–	0.1	4	–	0.1	1.2	–	0.2	4	–	0.2	1.2	mA
Maximum On-State Voltage:* For i_T = 30A (peak) and T_C = +25 °C	V_{TM}	–	1.8	2.25	–	1.8	2.25	–	1.8	2.25	–	1.8	2.25	V
DC Holding Current:* Gate Open Initial principal current = 150 mA (DC) At T_C = +25 °C	I_{HO}	–	15	30	–	15	30	–	15	30	–	15	30	mA
For other case temperatures		See Fig. 6.												
Critical Rate of Rise of Commutation Voltage:*♦ For V_D = V_{DROM}, $I_{t(rms)}$ = 6 A, commutating di/dt = 3.2 A/ms, and gate unenergized At T_C = +75 °C	dv/dt	3	10	–	–	–	–	3	10	–	–	–	–	V/μs
$I_{t(rms)}$ and T_A specified by curve A of Fig. 3		–	–	–	3	10	–	–	–	–	3	10	–	
$I_{t(rms)}$ and T_A specified by curve B of Fig. 3		–	–	–	4	12	–	–	–	–	4	12	–	
Critical Rate of Rise of Off-State Voltage:* For V_D = V_{DROM}, exponential voltage rise, and gate open At T_C = +100 °C	dv/dt	30	150	–	30	150	–	20	100	–	20	100	–	V/μs
DC Gate-Trigger Current:*† For V_D = 12 volts (DC), R_L = 12 Ω T_C = +25 °C, and specified triggering mode: I+ Mode: positive V_{MT2}, positive V_{GT}	I_{GT}	–	15	25	–	15	25	–	15	25	–	15	25	mA
III– Mode: negative V_{MT2}, negative V_{GT}		–	15	25	–	15	25	–	15	25	–	15	25	
I– Mode: positive V_{MT2}, negative V_{GT}		–	25	40	–	25	40	–	25	40	–	25	40	
III+ Mode: negative V_{MT2}, positive V_{GT}		–	25	40	–	25	40	–	25	40	–	25	40	
For other case temperatures		See Fig. 8 & 9.												
DC Gate-Trigger Voltage:*† For V_D = 12 volts (DC) and R_L = 12 Ω At T_C = +25 °C	V_{GT}	–	1	2.2	–	1	2.2	–	1	2.2	–	1	2.2	V
For other case temperatures		See Fig. 10.												
For V_D = V_{DROM} and R_L = 125 Ω At T_C = +100 °C		0.2	–	–	0.2	–	–	0.2	–	–	0.2	–	–	

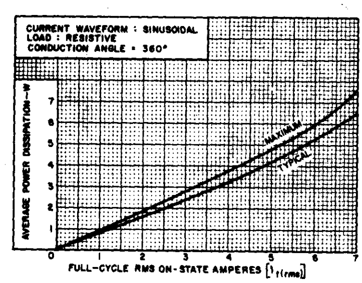


Fig. 1—Power dissipation vs. on-state current.

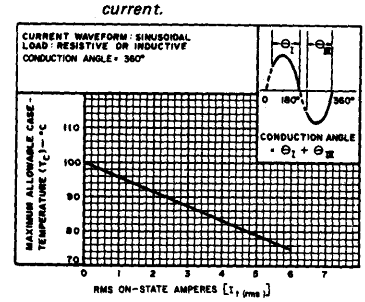


Fig. 2—Allowable case temperature vs. on-state current.

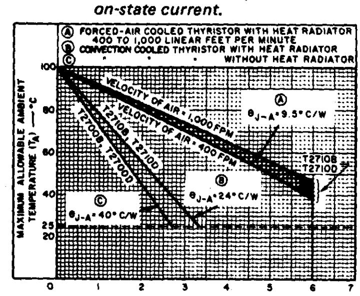


Fig. 3—Maximum allowable ambient temperature vs. on-state current.

T2700, T2710 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified
(For Definitions of Terms and Symbols, See Page 6)

CHARACTERISTIC	SYMBOL	LIMITS												UNITS
		T2700B			T2710B			T2700D			T2710D			
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For $V_D = V_{DROM}$ and $I_{GT} = 80$ mA, 0.1 µs rise time, and $i_T = 10$ A (peak) At $T_C = +25°C$	t_{gt}	–	2.2	–	–	2.2	–	–	2.2	–	–	2.2	–	µs
Thermal Resistance: Junction-to-Case (Steady-State)	$\theta_{J\text{-}C}$	–	–	4	–	–	–	–	–	4	–	–	–	°C/W
Junction-to-Case (Transient)		See Fig. 11.												
Junction-to-Ambient	$\theta_{J\text{-}A}$	–	–	–	See Fig. 3.			–	–	–	See Fig. 3.			

•For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
†For either polarity of gate voltage (V_{GT}) with reference to main terminal 1.
▲Variants of these devices having dv/dt characteristics selected specifically for inductive loads are available on special order; for additional information, contact your RCA Representative or your RCA Distributor.

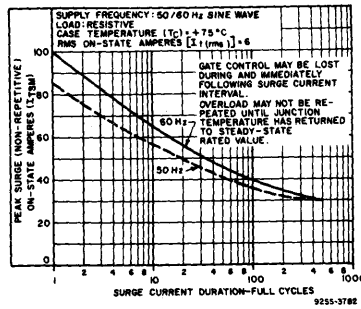


Fig. 4–Peak surge on-state current vs. surge-current duration.

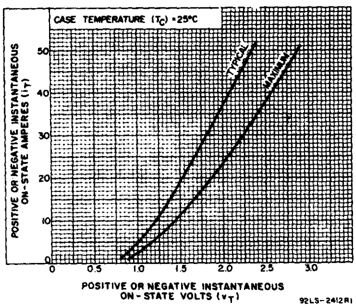


Fig. 5–On-state current vs. on-state voltage.

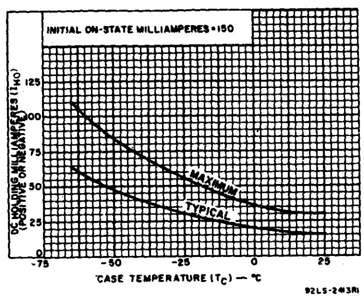


Fig. 6–DC holding current for either direction of on-state current vs. case temperature.

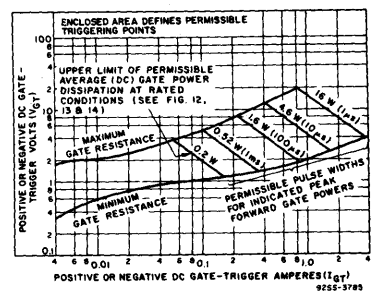


Fig. 7–Gate-pulse characteristics for all triggering modes.

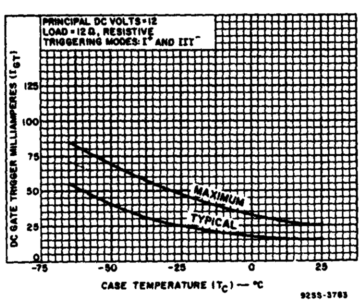


Fig. 8–DC gate-trigger current (for I+ and III− triggering modes) vs. case temperature.

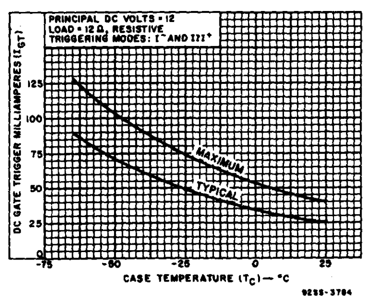


Fig. 9–DC gate-trigger current (for I− and III+ triggering modes) vs. case temperature.

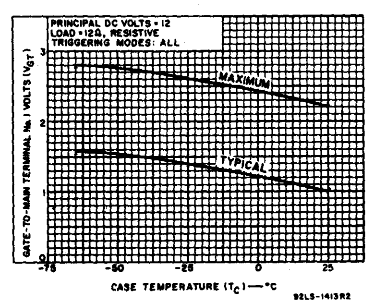


Fig. 10–DC gate-trigger voltage vs. case temperature.

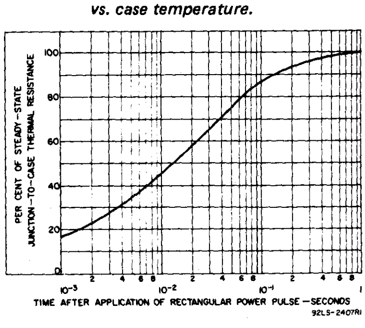


Fig. 11–Transient thermal resistance (junction-to-case vs. time).

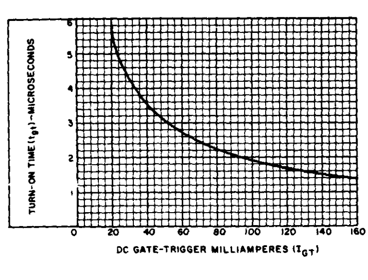


Fig. 12–Typical turn-on time vs. gate-trigger current.

T2800, T2801, T2802 , T2850 Series

6-A and 8-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

These RCA triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

The T2801 and T2802 series triacs are characterized for I^+, III^- gate triggering modes only and should suit a wide range of applications that employ diac or anode on/off triggering.

All series employ the plastic JEDEC TO-220AB package. The T2850-series package has three leads that are electrically isolated from the mounting flange. Because of this internal isolation, the triac can be mounted directly on a heat sink, without any insulating hardware; therefore heat transfer is improved and heat-sink size can be reduced.

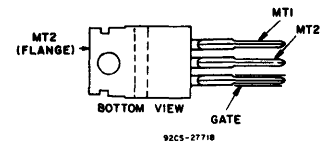
Features:

- **80-A and 100-A Peak Surge Full-Cycle Current Ratings**
- **Glass Passivated Junctions**
- **Short-Emitter Center-Gate Design**
- **Low Switching Losses**
- **Low Thermal Resistance**
- **Package Design Facilitates Mounting on a Printed-Circuit Board**

Additional Features for T2850 Series:

- **Internal Isolation**
- **Package Suitable for Direct Mounting on Heat Sink**

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal-Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

		T2800F	T2800A	T2800B	T2800C	T2800D	T2800E	T2800M	–	
		T2801F	T2801A	T2801A	T2801B	T2801C	T2801D	T2801E	–	
		T2802F	T2802A	T2802B	T2802C	T2802D	T2802E	T2802M	T2802S	
		T2850F	T2850A	T2850B	–	T2850D	T2850E	–	–	
REPETITIVE PEAK OFF-STATE VOLTAGE:●										
Gate open, T_J = −65 to 100°C	V_{DROM}	50	100	200	300	400	500	600	700	V
RMS ON-STATE CURRENT (Conduction angle = 360°):	$I_{T(RMS)}$									
Case Temperature										
T_C = 80°C (T2800, T2802, T2850 series)		8								A
= 80°C (T2801 series only)		6								A
For other conditions		See Fig. 3								
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}									
For one cycle of applied principal voltage										
60 Hz (sinusoidal), T_C=80°C (T2800, T2802, T2850 series)		100								A
50 Hz (sinusoidal) T_C=80°C (T2800, T2802, T2850 series)		85								A
60 Hz (sinusoidal), T_C=80°C (T2801 series only)		80								A
50 Hz (sinusoidal), T_C=80°C (T2801 series only)		65								A
For more than one cycle of applied principal voltage		See Fig. 4, 5								
RATE OF CHANGE OF ON-STATE CURRENT:										
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs	di/dt	70								A/μs
FUSING CURRENT (for triac protection):										
At T_C shown for $I_{T(RMS)}$:										
t = 20 ms										
T2800, T2802, T2850		55								A^2s
T2801		35								A^2s
= 2.5 ms										
T2800, T2802, T2850		28								A^2s
T2801		18								A^2s
= 0.5 ms										
T2800, T2802, T2850		16								A^2s
T2801		10								A^2s
PEAK GATE-TRIGGER CURRENT:■										
For 1 μs max. See Fig. 11	I_{GTM}	4								A
GATE POWER DISSIPATION:										
Peak (for 1 μs max., $I_{GTM} \leq$ 4 A, See Fig. 11	P_{GM}	16								W
AVERAGE (T2800, T2802, T2802 series)	$P_{G(AV)}$	0.35								W
AVERAGE (T2850 series)	$P_{G(AV)}$	0.2								W
TEMPERATURE RANGE:▲										
Storage	T_{stg}	−65 to 150								°C
Operating (Case)	T_C	−65 to 100								°C
TERMINAL TEMPERATURE (During soldering):										
For 10 s max. (terminals and case)	T_T	225								°C

●For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲For temperature measurement reference point, see Dimensional Outline.

T2800, T2801, T2802, T2850 Series

ELECTRICAL CHARACTERISTICS, ***At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperature***

CHARACTERISTICS	SYMBOL	LIMITS For All Types Except as Specified MIN.	TYP.	MAX.	UNITS
Peak Off-State Current:● Gate open, T_J = 100°C, V_{DROM} = Max. rated value	I_{DROM}	–	0.1	2	mA
Maximum On-State Voltage:● (See Fig. 6, 7) For i_T = 30 A (peak), T_C = 25°C (T2800, T2802, T2850 series	v_{TM}	–	1.7	2	V
(T2801 series)		–	2	3	
DC Holding Current:● Gate open, Initial principal current = 150 mA (dc) v_D = 12 V, T_C = 25°C, T2800, T2850 series	I_{HO}	–	15	30	mA
T2801 series		–	100	–	
T2802 series		–	20	60	
For other case temperatures		See Fig. 8, 9, 10			
Critical Rate-of-Rise of Commutation Voltage:●▲ For v_D = V_{DROM}, $I_{T(RMS)}$ = 8 A, commutating di/dt = 4.3 A/ms, gate unenergized, T_C = 80°C (T2800, T2802, T2850 series)	dv/dt	4	10	–	V/μs
For v_D = V_{DROM}, $I_{T(RMS)}$ = 6 A, commutating di/dt = 4.3 A/ms, gate unenergized, T_C = 80°C (T2801 series)		2	10	–	
Critical Rate-of-Rise of Off-State Voltage:● For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100°C: T2850A	dv/dt	125	350	–	V/μs
T2800B, T2802B, T2850B		100	300	–	
T2800C, T2802C		85	275	–	
T2800D, T2802D, T2850D		75	250	–	
T2800E, T2802E		65	225	–	
T2800M, T2802M		60	200	–	
T2801B		50	300	–	
T2801C		40	275	–	
T2801D		30	250	–	
T2801E		20	225	–	
DC Gate-Trigger Current:●■ For v_D = 12 V (dc) R_L = 12Ω T_C = 25°C; Mode / V_{MT2} / V_G: I⁺ positive positive T2800, T2850 series	I_{GT}	–	10	25	mA
T2801 series		–	25	80	
T2802 series		–	25	50	
III⁻ negative negative T2800, T2850 series		–	15	25	
T2801 series		–	25	80	
T2802 series		–	25	50	
I⁻ positive negative T2800, T2850 series only		–	20	60	
III⁺ negative positive T2800, T2850 series only		–	30	60	
For other case temperatures		See Fig. 12, 13, 14			
DC Gate-Trigger Voltage:●■ For v_D = 12 V (dc), R_L = 12Ω, T_C = 25°C T2800, T2802, T2850 series	V_{GT}	–	1.25	2.5	V
T2801 series		–	1.5	4	
For other case temperatures		See Fig. 15, 16			
For v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C		0.2	–	–	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 80 mA, t_r = 0.1 μs, i_T = 10 A (peak), T_C = 25°C (T2800, T2802, T2850 series)	t_{gt}	–	1.6	2.5	μs
(T2801 series)		–	2.2	–	
Thermal Resistance: Junction-to-Case (T2800, T2801, T2802 series)	$R_{\theta JC}$	–	–	2.2	°C/W
(T2850 series)		–	–	3.1	
Junction-to-Ambient	$R_{\theta JA}$	–	–	60	

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ Variants of these devices having dv/dt characteristics selected specifically for inductive loads are available on special order; for additional information, contact your RCA Representative or your RCA Distributor.

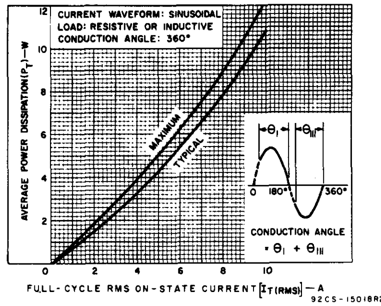


Fig. 1 – Power dissipation vs. on-state current for T2800, T2802, T2850 series.

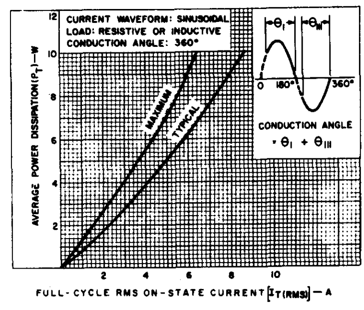


Fig. 2 – Power dissipation vs. on-state current for T2801 series.

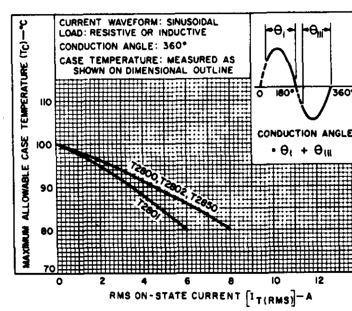


Fig. 3 – Maximum allowable case temperature vs. on-state current.

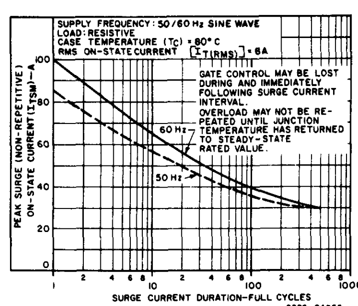


Fig. 4 – Peak surge on-state current vs. surge current duration for T2800, T2802, T2850 series.

T2800, T2801, T2802 , T2850 Series

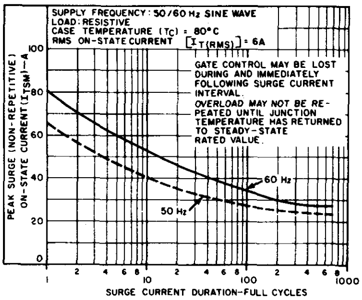


Fig. 5 – Peak surge on-state current vs. surge current duration for T2801 series.

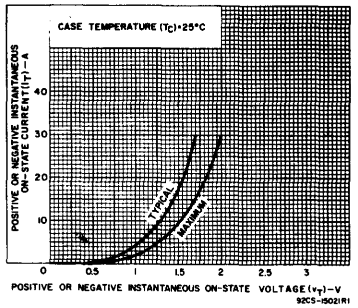


Fig. 6 – On-state current vs. on-state voltage for T2800, T2802, T2850 series.

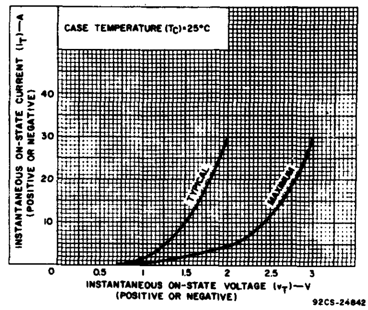


Fig. 7 – On-state current vs. on-state voltage for T2801 series.

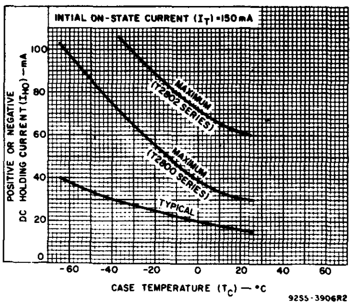


Fig. 8 – DC holding current vs. case temperature for T2800, T2802.

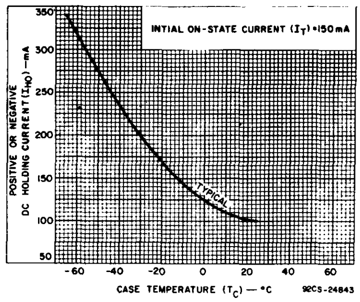


Fig. 9 – DC holding current vs. case temperature for T2801 series.

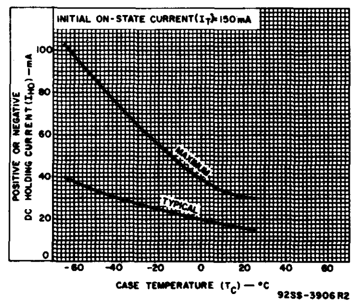


Fig. 10 – DC holding current vs. case temperature for T2850 series.

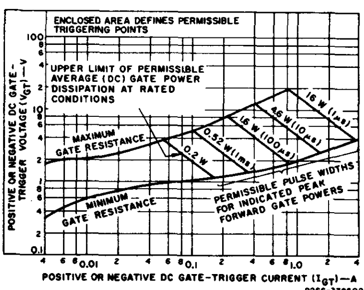


Fig. 11 – Gate pulse characteristics for all triggering modes for all series.

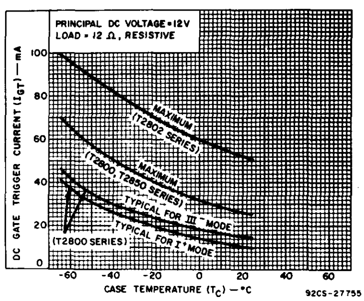


Fig. 12 – DC gate-trigger current (for I^+ and III^- triggering modes) vs. case temperature for T2800, T2802,T2850 series.

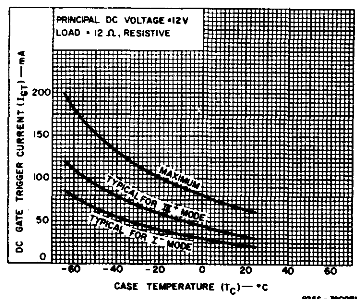


Fig. 13 – DC gate-trigger current (for I^- and III^+ triggering modes) vs. case temperature for T2800, T2802, T2850 series.

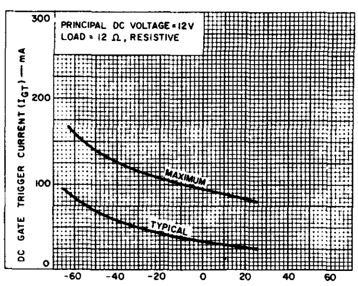


Fig. 14 – DC gate-trigger current (for I^+ and III^- triggering modes) vs. case tempperature for T2801 series.

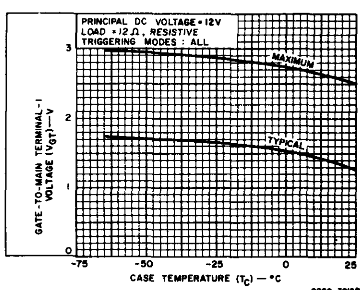


Fig. 15 – DC gate-trigger voltage vs. case temperature for T2800, T2802, T2850 series.

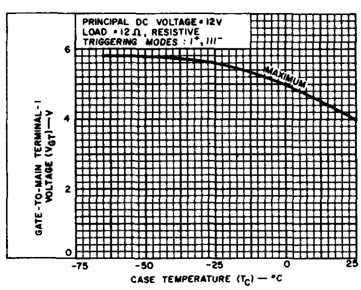


Fig. 16 – DC gate-trigger voltage vs. case temperature for T2801 series.

T2800, T2801, T2802, T2850 Series

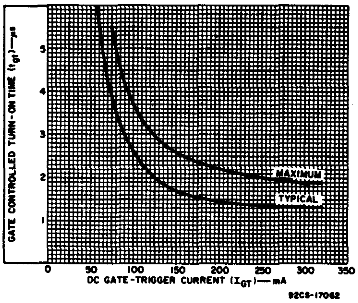


Fig. 17 — Turn-on time vs. gate-trigger current for T2800, T2802, T2850 series.

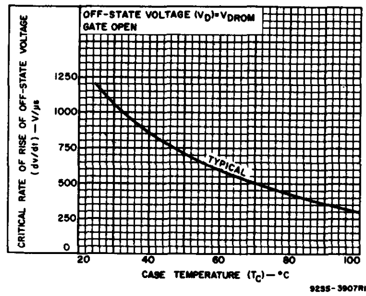


Fig. 18 — Typical critical rate-of-rise of off-state voltage vs. case temperature for all series.

T2851 Series

8-A Isolated-Tab Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

The RCA-T2851 series triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate-triggering voltages. They have an on-state current rating of 8 amperes at a T_C of 75°C and repetitive off-state voltage ratings of 200, 300, 400, and 500 volts.

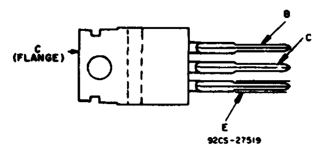
These triacs are characterized for I^+, III^- gate-triggering modes only and should suit a wide range of applications that employ diac or anode on/off triggering.

The T2851 series types employ an ISOWATT package, a plastic case with three leads that are electrically isolated from the mounting flange. Because of this internal isolation, the triac can be mounted directly on a heat sink, without any insulating hardware; therefore heat transfer is improved and heat-sink size can be reduced.

Features:

- **Internal isolation**
- **100-A peak surge full-cycle current ratings**
- **Shorted-emitter, center-gate design**
- **Low switching losses**
- **Low thermal resistance**
- **Package suitable for direct mounting on heat sink**
- **Glass-passivated junctions**

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

	T2851B	T2851C	T2851D	T2851E	
V_{DROM}• T_J = −65 to 100°C	200	300	400	500	V
$I_{T(RMS)}$ T_C = 75°C, θ = 360°	8				A
For other conditions	See Fig. 3				
I_{TSM}					
For one cycle of applied principal voltage					
60 Hz (sinusoidal), T_C = 75°C	100				A
50 Hz (sinusoidal), T_C = 75°C	85				A
For more than one cycle of applied principal voltage	See Fig. 4				
di/dt					
v_D = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs	70				A/μs
I^2t [At T_C shown for $I_{T(RMS)}$, half-sine wave]: See Fig. 5					
t = 20 ms	55				A^2s
= 2.5 ms	28				A^2s
= 0.5 ms	16				A^2s
I_{GTM}■					
For 1 μs max., See Fig. 6	4				A
P_{GM} (For 1 μs max., I_{GTM} ≤ 4 A), See Fig. 6	16				W
$P_{G(AV)}$	0.2				W
T_{stg}	−65 to 150				°C
T_C	−65 to 100				°C
T_T (During soldering for 10 s max.)	225				°C

•For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.

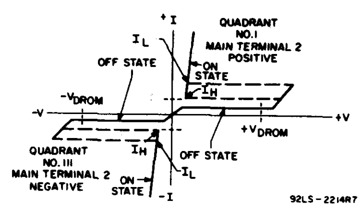


Fig. 1 – Principal voltage-current characteristic.

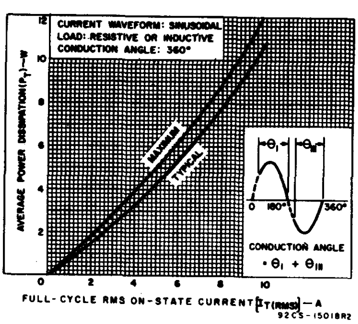


Fig. 2 – Power dissipation as a function of on-state current.

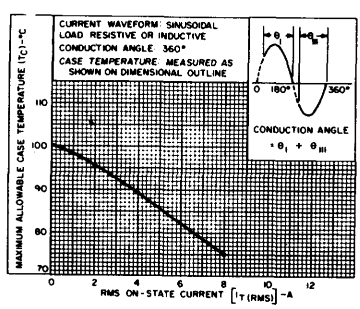


Fig. 3 – Allowable case temperature as a function of on-state current.

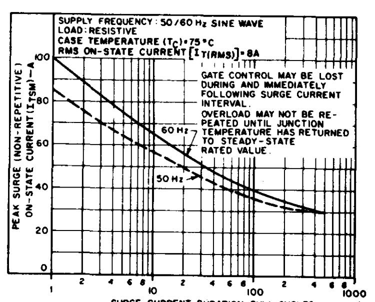


Fig. 4 – Peak surge on-state current as a function of surge current duration.

T2851 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified			UNITS
	Min.	Typ.	Max.	
I_{DROM}● $T_J = 100^oC$, V_{DROM} = Max. rated value	–	0.1	2	mA
V_{TM}● i_T = 30 A (peak), $T_C = 25^oC$, See Fig. 7	–	1.7	2	V
I_{HO}● v_D = 12 V, $T_C = 25^oC$ For other case temperatures	– See Fig. 8	100	–	mA
dv/dt (Commutating)● $v_D = V_{DROM}$, $I_{T(RMS)}$ = 6 A, di/dt = 4.3 A/ms, gate unenergized, $T_C = 75^oC$, See Fig. 12	2	10	–	V/μs
dv/dt (Off-State)● $v_D = V_{DROM}$, exponential voltage rise, gate open, $T_C = 100^oC$				V/μs
T2851B	50	300	–	
T2851C	40	275	–	
T2851D	30	250	–	
T2851E	20	225	–	
I_{GT}● Mode V_{MT2} V_G v_D = 12 V dc I$^+$ + + R_L = 12 Ω $T_C = 25^oC$ III$^-$ – – For other case temperatures	– – See Fig. 10	25 25	80 80	mA
V_{GT}●■ v_D = 12 V dc, R_L = 12 Ω, $T_C = 25^oC$ $v_D = V_{DROM}$, R_L = 125 Ω, $T_C = 100^oC$ For other case temperatures	– 0.2 See Fig. 11	1.5 –	3 –	V
t_{gt} $v_D = V_{DROM}$, I_{GT} = 80 mA, t_r = 0.1 μs, i_T = 10 A (peak), $T_C = 25^oC$, See Fig. 13	–	2.2	–	μs
$R_{\theta JC}$	–	–	3.1	$^oC/W$
$R_{\theta JA}$	–	–	60	$^oC/W$

●For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

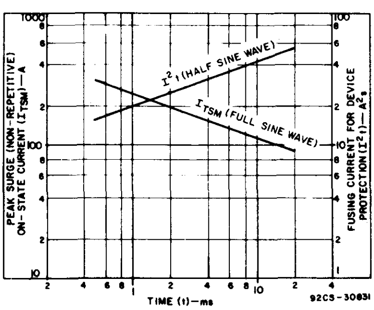


Fig. 5 – Peak surge on-state current and fusing current as a function of time.

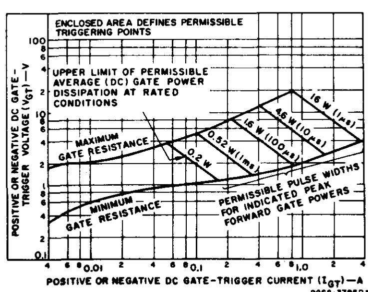


Fig. 6 – Gate-pulse characteristics for all triggering modes.

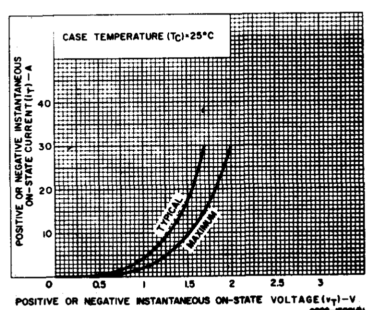


Fig. 7 – On state current as a function of on-state voltage.

T2851 Series

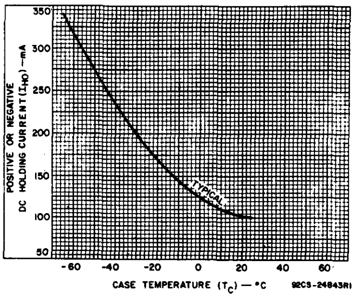


Fig. 8 – DC holding current as a function of case temperature.

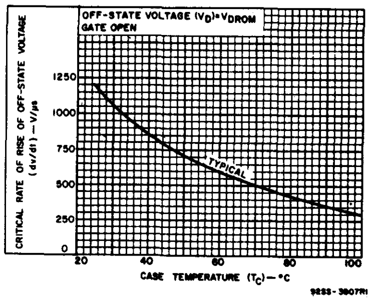


Fig. 9 – Typical critical rate-of-rise of off-state voltage as a function of case temperature for T2851B.

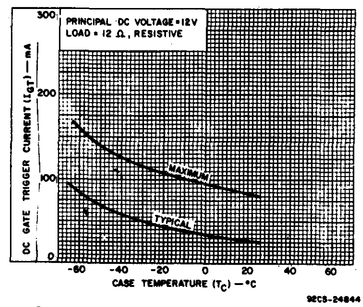


Fig. 10 – DC gate-trigger current (for I^+ and III^- triggering modes) as a function of case temperature.

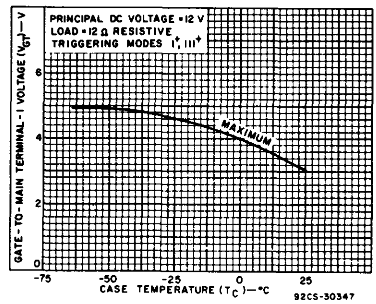


Fig. 11 – DC gate-trigger voltage as a function of case temperature.

T4100, T4101, T4110, T4111, T4120, T4121 Series (Includes 2N5567-2N5574)

10-A and 15-A Silicon Triacs

For General Purpose AC Power Switching

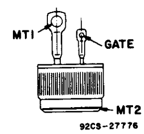
These RCA triacs are gate-controlled, full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

These triacs are intended for control of ac loads in applications such as heating controls, motor controls, arc-welding equipment, light dimmers, and power switching systems.

Features:

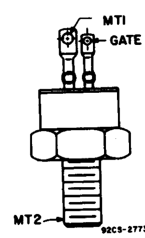
- **di/dt Capability = 150 A/μs**
- **Shorted-Emitter, Center-Gate Design**
- **Low Switching Losses**
- **Low On-State Voltage at High Current Levels**
- **Low Thermal Resistance**

TERMINAL CONNECTIONS



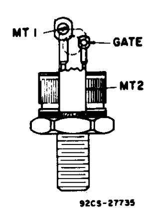
2N5667 T4100F T4101E
2N5568 T4100E T4101F
2N5571 T4100M T4101M
2N5572

Press-Fit Types



2N5569 T4110E
2N5570 T4110M
2N5573 T4111F
2N5574 T4111E
T4110F T4111M

Stud Types



T4120B T4121B
T4120D T4121D
T4120E T4121E
T4120F T4121F
T4120M T4121M

Isolated-Stud Types

MAXIMUM RATINGS, ***Absolute-Maximum Values:***
For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

		T4100F T4101F T4110F T4111F T4120F T4121F	2N5567 2N5569 2N5571 2N5573 T4120B T4121B	2N5568 2N5570 2N5572 2N5574 T4120D T4121D	T4100E T4101E T4110E T4111E T4120E T4121E	T4100M T4101M T4110M T4111M T4120M T4121M	
*REPETITIVE PEAK OFF-STATE VOLTAGE:●							
Gate open, T_J = −65 to 100°C	V_{DROM}	50	200	400	500	600	V
*RMS ON-STATE CURRENT (Conduction angle = 360°):							
Case temperature	$I_{T(RMS)}$						
T_C = 85°C (2N5567, 68, 69, 70, T4101M, T4111M, T4121B, D, M)				10			A
= 80°C (2N5571, 72, 73, 74, T4100M, T4110M Press-fit & stud types)				15			A
= 75°C (T4120B, D, M − Isolated-stud types)				15			A
For other conditions				See Fig. 3, 4			
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}						
For one cycle of applied principal voltage, T_C as above							
60 Hz (sinusoidal)				100			A
50 Hz (sinusoidal)				85			A
For more than one cycle of applied principal voltage				See Fig. 5, 6			
RATE-OF-CHANGE OF ON-STATE CURRENT:							
V_{DM} = V_{DROM}, I_{GT} = 160 mA, t_r = 0.1 μs	di/dt			150			A/μs
FUSING CURRENT (for Triac Protection):							
At T_C shown for $I_{T(RMS)}$	I^2t						
t = 20 ms				55			A^2s
= 2.5 ms				28			A^2s
= 0.5 ms				16			A^2s
PEAK GATE-TRIGGER CURRENT:■							
For 1 μs max., See Fig. 11	I_{GTM}			4			A
*GATE POWER DISSIPATION:							
PEAK (For 1 μs max., I_{GTM} ≤ 4 A, See Fig. 11	P_{GM}			16			W
AVERAGE	$P_{G(AV)}$			0.5			W
*TEMPERATURE RANGE:▲							
Storage	T_{stg}			−65 to 150			°C
Operating (Case)	T_C			−65 to 100			°C
*TERMINAL TEMPERATURE (During soldering):							
For 10 s max. (terminals and case)	T_T			225			°C
STUD TORQUE:	τ_s						
Recommended				35			in-lb
Maximum (DO NOT EXCEED)				50			in-lb

* In accordance with JEDEC registration data format (JS-14, RDF 2) filed for the JEDEC (2N-Series) types.
● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see Dimensional Outline.

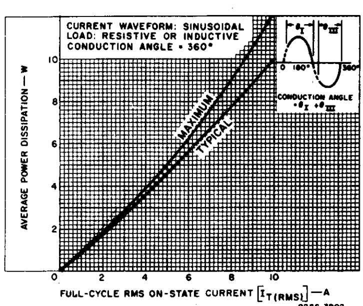


Fig. 1 — Power dissipation vs. on-state current for all 10-A triacs.

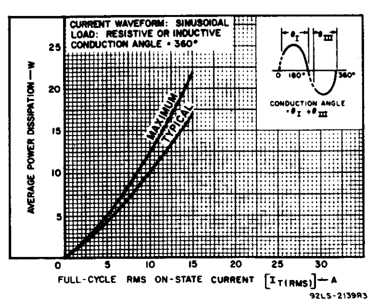


Fig. 2 — Power dissipation vs. on-state current for all 15-A triacs.

T4100, T4101, T4110, T4111, T4120, T4121 Series (Includes 2N5567-2N5574)

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Indicated*

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Peak Off-State Current:♠ Gate open, T_J = 100°C, V_{DROM} = Max. rated value	I_{DROM}	–	0.1	2*	mA
Maximum On-State Voltage:♠ For i_T = 14 A (peak), T_C = 25°C (2N5567, 68, 69, 70, T4101M, T4111M, T4121 series)	V_{TM}	–	1.35	1.65*	mA
= 21 A (peak), T_C = 25°C (2N5571, 72, 73, 74, T4100M, T4110M, T4120 series)		–	1.4	1.8*	
DC Holding Current:♠ Gate open, Initial principal current = 500 mA (DC), v_D = 12 V: 2N5567, 68, 69, 70, T4101M, T4111M, T4121 series: T_C = 25°C	I_{HO}	–	15	30	V
T_C = −65°C		–	75	200*	
2N5571, 72, 73, 74, T4100M, T4110M, T4120 series: T_C = 25°C		–	20	75	
T_C = −65°C		–	75	300*	
For other case temperature			See Fig. 9 & 10		
Critical Rate-of-Rise of Commutation Voltage:♠ For v_D = V_{DROM}, $I_{T(RMS)}$ = 10 A, commutating di/dt = 5.4 A/ms, gate unenergized, T_C = 85°C 2N5567, 68, 69, 70, T4101M, T4111M, T4121 series	dv/dt	2*	5	–	V/μs
For v_D = V_{DROM}, $I_{T(RMS)}$ = 15 A, commutating di/dt = 8 A/ms, gate unenergized, T_C = 80°C (2N5571, 72, 73, 74, T4100M, T4110M – Press-fit & stud types)		2*	10	–	
= 75°C (T4120B, D, M – Isolated-stud)		2	10	–	
Critical Rate-of-Rise of Off-State Voltage:♠ For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100°C: 2N5567, 2N5569, T4121, 2N5571, 2N5573, T4120B	dv/dt	30*	150	–	V/μs
2N5568, 2N5570, T4121D, 2N5572, 2N5574, T4120D		20*	100	–	
T4101M, T4111M, T4121M, T4100M, T4110M, T4120M		10	75	–	
DC Gate-Trigger Current:♠♦ For v_D = 12 V (DC), R_L = 30 Ω, T_C = 25°C; Mode V_{MT2} V_G; I+ positive positive: All 10-A triacs	I_{GT}	–	10	25	mA
All 15-A triacs		–	20	50	
III− negative negative: All 10-A triacs		–	10	25	
All 15-A triacs		–	20	50	
I− positive negative: All 10-A triacs		–	20	40	
All 15-A triacs		–	35	80	
III+ negative positive: All 10-A triacs		–	20	40	
All 15-A triacs		–	35	80	
For v_D = 12 V (DC), R_L = 30Ω, T_C = −65°C; Mode V_{MT2} V_G; I+ positive positive: All 10-A triacs		–	45	100*	
All 15-A triacs		–	75	150*	
III− negative negative: All 10-A triacs		–	45	100*	
All 15-A triacs		–	75	150*	
I− positive negative: All 10-A triacs		–	80	150*	
All 15-A triacs		–	100	200*	
III+ negative positive: All 10-A triacs		–	80	150*	
All 15-A triacs		–	100	200*	
For other case temperatures			See Fig. 12, 13, 14, & 15		
DC Gate-Trigger Voltage:♠♦ For v_D = 12 V(DC), R_L = 30Ω: T_C = 25°C	V_{GT}	–	1	2.5	V
T_C = −65°C		–	2	4*	
For other case temperatures			See Fig. 16 & 17		
For v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C		0.2	–	–	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 160 mA, t_r = 0.1 μs, i_T = 15 A (peak) All 10-A triacs, i_T = 25 A (peak) All 15-A triacs, T_C = 25°C	t_{gt}	–	1.6	2.5	μs
Thermal Resistance: Junction-to-Case: Steady-State	$\theta_{J\text{-}C}$	–	–	1*	°C/W
Transient			See Fig. 20		
Junction-to-Isolated Hex (Stud, see Dim. Outline): Steady-State	$\theta_{J\text{-}IH}$	–	–	1.1	

* In accordance with JEDEC registration data format (JS-14, RDF 2) filed for the JEDEC (2N-Series) types.
♠ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
♦ For either polarity of gate voltage (V_G) with reference to main terminal 1.

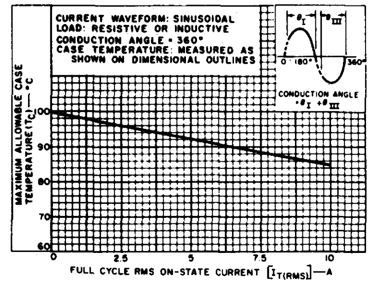


Fig. 3 — Maximum allowable case temperature vs. on-state current for all 10-A triacs.

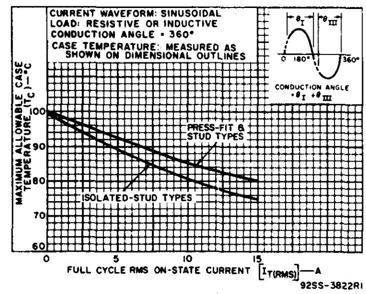


Fig. 4 — Maximum allowable case temperature vs. on-state current for all 15-A triacs.

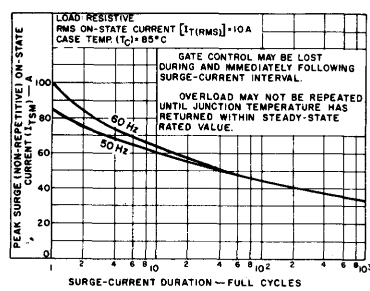


Fig. 5 — Peak surge on-state current vs. surge current duration for all 10-A triacs.

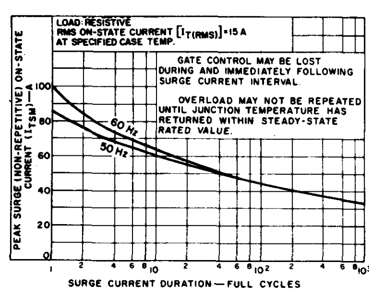


Fig. 6 — Peak surge on-state current vs. surge current duration for all 15-A triacs.

T4100, T4101, T4110, T4111, T4120, T4121 Series (Includes 2N5567-2N5574)

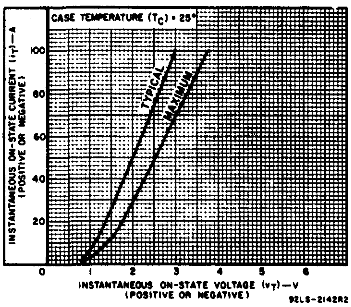


Fig. 7 – On-state current vs. on-state voltage for all 10-A triacs.

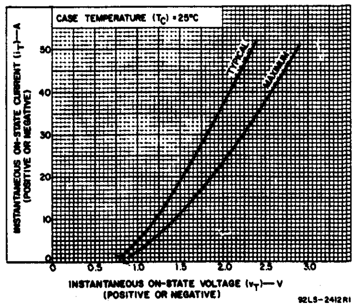


Fig. 8 – On-state current vs. on-state voltage for all 15-A triacs.

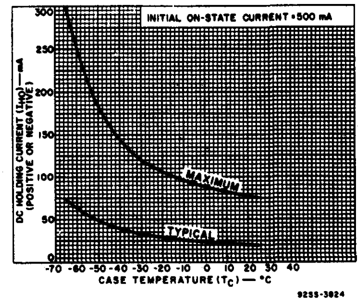


Fig. 9 – DC holding current vs. case temperature for all 10-A triacs.

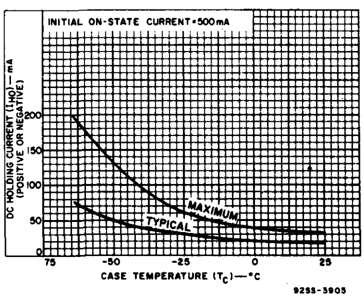


Fig. 10 – DC holding current vs. case temperature for all 15-A triacs.

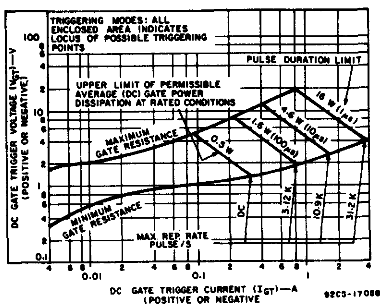


Fig. 11 – Gate trigger characteristics and limiting conditions for determination of permissible gate trigger pulses for all triacs.

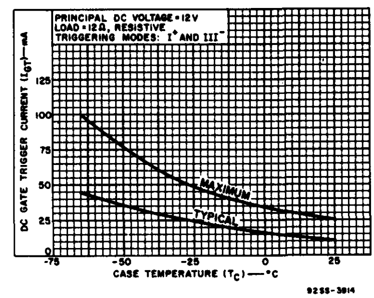


Fig. 12 – DC gate-trigger current vs. case temperature (I^+ & III^- modes) for all 10-A triacs.

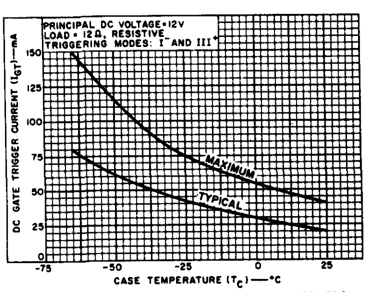


Fig. 13 – DC gate-trigger current vs. case temperature (I^- & III^+ modes) for all 10-A triacs.

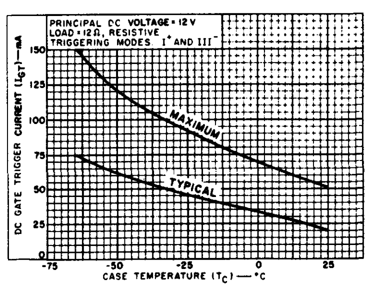


Fig. 14 – DC gate-trigger current vs. case temperature (I^+ & III^- modes) for all 15-A triacs.

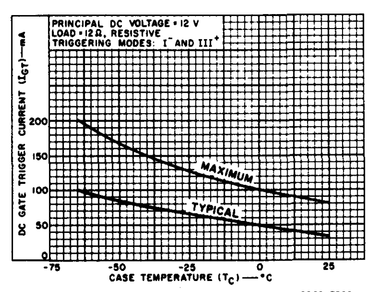


Fig. 15 – DC gate-trigger current vs. case temperature (I^- & III^+ modes) for all 15-A triacs.

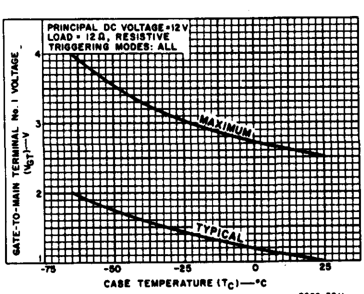


Fig. 16 – DC gate-trigger voltage vs. case temperature for all 10-A triacs.

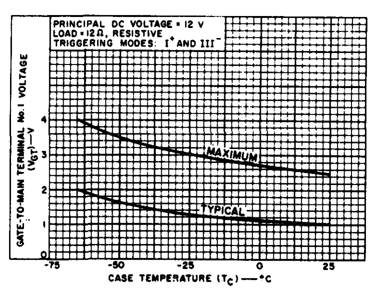


Fig. 17 – DC gate-trigger voltage vs. case temperature for all 15-A triacs.

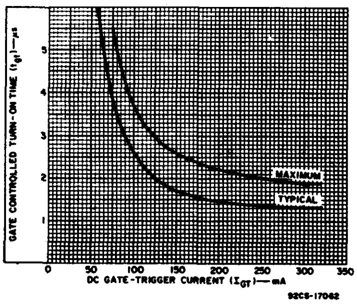


Fig. 18 – Turn-on time vs. gate trigger current for all types.

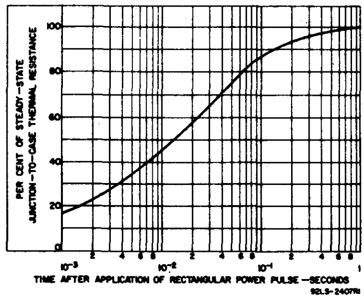


Fig. 19 – Transient junction-to-case thermal resistance vs. time for all triacs.

WARNING:
The RCA isolated-stud package thyristors should be handled with care. The ceramic portion of these thyristors contains BERYLLIUM OXIDE as a major ingredient. Do not crush, grind, or abrade these portions of the thyristors because the dust resulting from such action may be hazardous if inhaled.

T4103-T4105, T4113-T4115 Series

400-Hz, 6, 10, & 15-A Silicon Triacs

For Control-Systems Application in Airborne and Ground-Support Type Equipment

These RCA triacs are gate-controlled full-wave silicon ac switches.

The devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

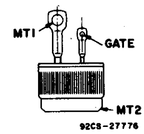
They are intended for operation up to 400 Hz with resistive or inductive loads and nominal line voltages of 115 and 208 V RMS sine wave and repetitive peak off-state voltages of 200 V and 400 V.

These triacs exhibit commutating voltage (dv/dt) capability at high commutating current (di/dt). They can also be used in 60-Hz applications where high commutating capability is required.

Features:

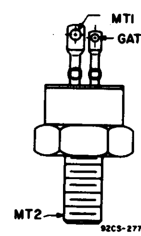
- di/dt capability = 150 A/μs
- Shorted-emitter center-gate design
- Commutating dv/dt capability characterized at 400 Hz

TERMINAL CONNECTIONS



T4103 Series
T4104 Series
T4105 Series

Press-fit



T4113 Series
T4114 Series
T4115 Series

Stud

MAXIMUM RATINGS, *Absolute-Maximum Values: For Operartion with Sinusoidal Supply Voltage at Frequencies up to 400 Hz and with Resistive or Inductive Load*

Rating	Symbol	T4103B T4104B T4105B / T4113B T4114B T4115B	T4103D T4104D T4105D / T4113D T4114D T4115D	T4103E T4104E T4105E / T4113E T4114E T4115E	T4103M T4104M T4105M / T4113M T4114M T4115M	All types	Units
REPETITIVE PEAK OFF-STATE VOLTAGE:• Gate open, T_J = 50 to 100°C	V_{DROM}	200	400	500	600		V
RMS ON-STATE CURRENT (Conduction angle = 360°): Case temperature	$I_{T(RMS)}$						
T_C = 90°C (T4105B, T4105D, T4115B, T4115D)						6	A
= 85°C (T4104B, T4104D, T4114B, T4114D)						10	A
= 80°C (T4103B, T4103D, T4113B, T4113D)						15	A
For other conditions						See Fig. 2	
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT For one cycle of applied principal voltage	I_{TSM}						
400 Hz (sinusoidal)						200	A
60 Hz (sinusoidal)						100	A
50 Hz (sinusoidal)						85	A
For more than one cycle of applied principal voltage						See Fig. 3	
RATE-OF-CHANGE OF ON-STATE CURRENT: $V_{DM} = V_{DROM}$, I_{GT} = 160 mA, t_r = 0.1 μs	di/dt					150	A/μs
FUSING CURRENT (for triac protection): T_J = –50 to 100°C, t = 1.25 to 10 ms	I^2t					30	A^2s
PEAK GATE-TRIGGER CURRENT:■ For 1 μs max.	I_{GTM}					4	A
GATE POWER DISSIPATION: PEAK (For 1 μs max., $I_{GTM} \leq 4$ A, See Fig. 6)	P_{GM}					16	W
AVERAGE	$P_{G(AV)}$					0.2	W
TEMPERATURE RANGE: Storage	T_{stg}					-50 to 150	°C
Operating (Case)	T_C					-50 to 100	°C
TERMINAL TEMPERATURE (During soldering): For 10 s max. (terminals and case)	T_T					225	°C
STUD TORQUE: τ_s Recommended						35	in-lb
Maximum (DO NOT EXCEED)						50	in-lb

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see Dimensional Outline.

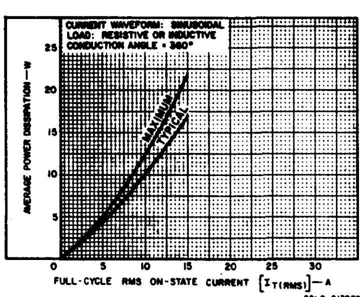


Fig. 1—Power dissipation vs. on-state current.

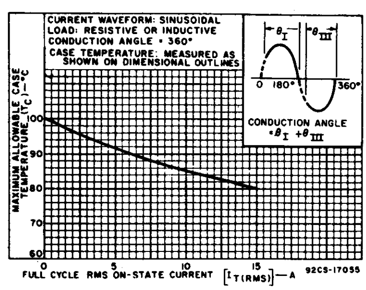


Fig. 2—Maximum allowable case temperature vs. on-state current.

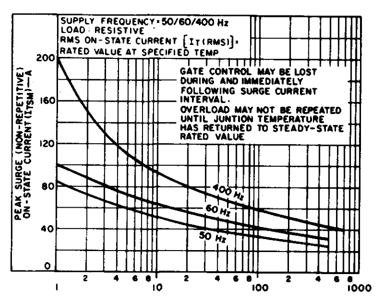


Fig. 3—Peak surge on-state current vs. surge-current duration.

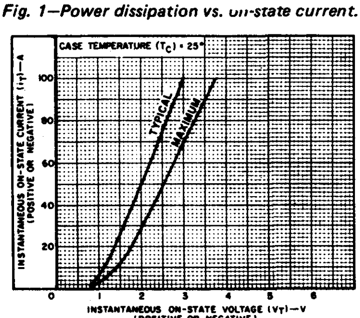


Fig. 4—On-state current vs. on-state voltage.

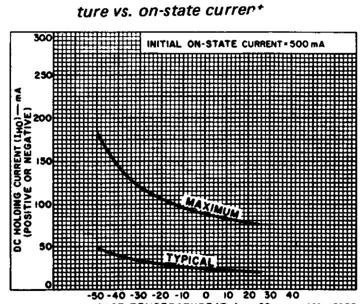


Fig. 5—DC holding current vs. case temperature.

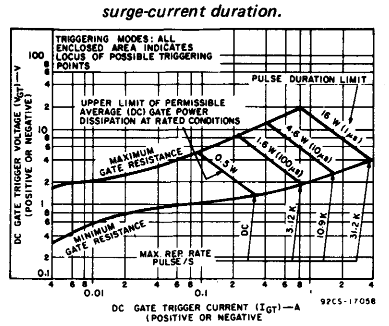


Fig. 6—Gate-trigger characteristics and limiting conditions for determination of permissible gate–trigger pulses.

T4103-T4105, T4113-T4115 Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS ALL TYPES Min.	Typ.	Max.	UNITS
Peak Off-State Current:♠ Gate open, T_J = 100°C, V_{DROM} = Max. rated value	I_{DROM}	-	0.1	2	mA
Maximum On-State Voltage:♠ For i_T = 21 A (peak), T_C = 25 °C	V_{TM}	-	1.4	1.8	V
DC Holding Current:♠ Gate open, Initial principal current = 500 mA (DC), v_D = 12 V, T_C = 25° C	I_{HO}	-	20	75	mA
For other case temperatures			See Fig. 5		
Critical Rate-of-Rise of Commutation Voltage:♠ For v_D = V_{DROM}, $I_{T(RMS)}$ = rated value, gate unenergized; Commutating di/dt = 21.4 A/ms, T_C = 90° C: T4105B, T4105D, T4115B, T4115D	dv/dt	5	10	-	V/µs
Commutating di/dt = 36 A/ms, T_C = 85° C: T4104B, T4104D, T4114B, T4114D		5	10	-	
Commutating di/dt = 53.3 A/ms, T_C = 80° C: T4103B, T4103D, T4113B, T4113D		5	10	-	
Critical Rate-of-Rise of Off-State Voltage:♠ For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 100° C	dv/dt	30	150	-	V/µs
DC Gate-Trigger Current:♠† For v_D = 12 V (DC), R_L = 30 Ω, and T_C = 25 °C — Mode I+, V_{MT2} positive, V_G positive	I_{GT}	-	20	50	mA
Mode III−, V_{MT2} negative, V_G negative		-	20	50	
Mode I−, V_{MT2} positive, V_G negative		-	35	80	
Mode III+, V_{MT2} negative, V_G positive		-	35	80	
For other case temperatures			See Figs. 7 & 8		
DC Gate-Trigger Voltage:♠† For v_D = 12 V(DC), R_L = 30Ω, T_C = 25°C	V_{GT}	-	1	2.5	V
For other case temperatures			See Fig. 9		
For v_D = V_{DROM}, R_L = 125Ω, T_C = 100°C		0.2	-	-	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 160mA, t_r = 0.1 µs, i_T = 25A (peak), T_C = 25°C	t_{gt}	-	1.6	2.5	µs
Thermal Resistance Steady-State (Junction-to-Case)	$\theta_{J\text{-}C}$	-	-	1	°C/W
Transient (Junction-to-Case)			See Fig. 11		
Steady-State (Junction-to-Ambient)	$\theta_{J\text{-}A}$	-	-	33	°C/W

♠ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

† For either polarity of gate voltage (V_G) with reference to main terminal 1.

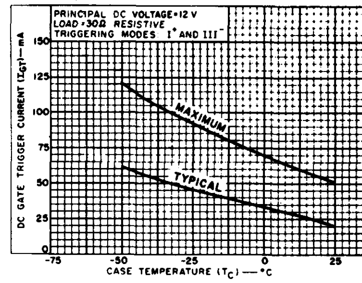


Fig. 7—DC gate-trigger current vs. case temperature. (I^+ and III^- modes).

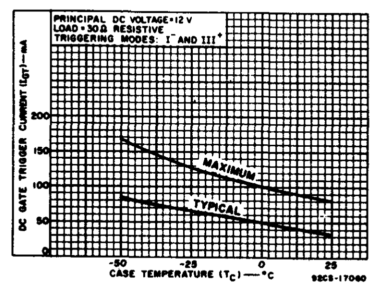


Fig. 8—DC gate-trigger current vs. case temperature. (I^- and III^+ modes).

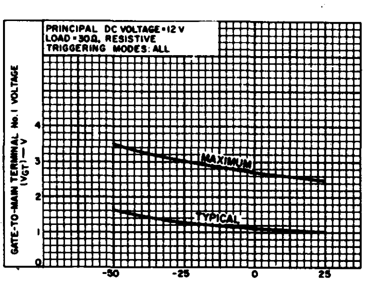


Fig. 9—DC gate-trigger voltage vs. case temperature.

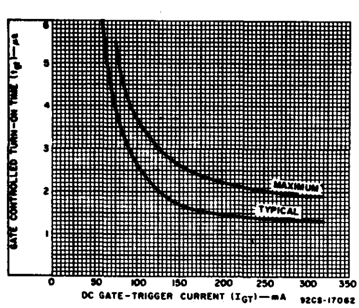


Fig. 10—Turn-on time vs. gate-trigger current.

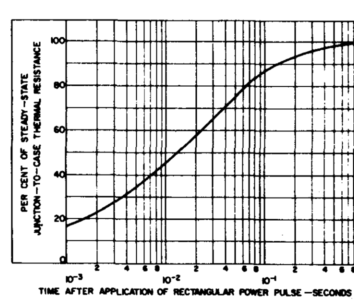


Fig. 11—Transient thermal resistance vs. time (junction-to-case).

T4130, T4131, T4140, T4141, T4150, T4151, T6430, T6431, T6440, T6441, T6450, T6451 Series

10-, 15-, 30-, and 40-A Silicon Triacs

For Phase-Control and Load-Switching Applications

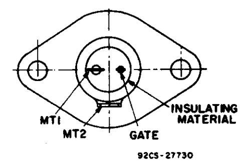
These RCA triacs are gate-controlled, full wave ac switches. They are designed to switch from an off-state to an on state for either polarity of applied voltage with positive or negative gate triggering voltages.

The T4130, T4140, and T4150 series have current ratings of 15 amperes. The T4131, T4141, and T4151 series have current ratings of 10 amperes. The T6430, T6440, and T6450 series have current ratings of 40 amperes. The T6431, T6441, and T6451 series have current ratings of 30 amperes. Triacs in each series have voltage ratings of 50 to 600 volts.

The T4130, T4131, T6430, and T6431 series employ a press-fit package with flexible leads, encapsulated on an isolated stud.

Features:
- **3-kV rms encapsulant (HYPOT) breakdown voltage**
- **Flame-resistant encapsulant (self-extinguishing)**
- **Rugged packages**
- **Standard RCA triac features**

TERMINAL CONNECTIONS



Press-Fit, Isolated on TO-3 Flange

T4140 T6440
T4141 T6441

FLEXIBLE-LEAD (TERMINAL) CONNECTIONS

Flexible-Lead (Insulation) Color		Terminal
Yellow	–	Gate
Red	–	Main Terminal No. 1
Black	–	Main Terminal No. 2

Note: Terminals are identified by color code only. Position of the flexible leads (relative to terminals of the device) leaving the encapsulant is random.

Press-Fit, Encapsulated on Isolated-Stud with Flexible Leads

T4130 T6430
T4131 T6431

Press-Fit, Encapsulated, Isolated on TO-3 Flange with Flexible Leads

T4150 T6450
T4151 T6451

Type No.	Rep. Peak Off-State Voltage V_{DROM} (V)	On-State Current I_T (RMS) (A)	T_C (°C)	Package (Press-fit)	Wire Size MT 1&2 Gage No.	Wire Size Gate Gage No.	Wire Insulation Thickness MT 1&2 in. (mm)	Wire Insulation Thickness Gate in. (mm)	Refer to Bulletin File No.*
10-A Triacs – T4131, T4141, and T4151 Series				**Electrical and Mechanical Data**					
T4131F	50	10	85	With flex.leads, encap.on isolated-stud	14	22	0.031 (0.787)	0.016 (0.406)	457
T43131B	200								
T4131D	400								
T4131E	500								
T4131M	600								
T4141F	50	10	85	Isolated on TO-3 flange	–	–	–	–	457
T4141B	200								
T4141D	400								
T4141E	500								
T4141M	600								
T4151F	50			With flex.leads, encap.,isolated on TO-3 flange	14	22	0.031 (0.787)	0.016 (0.406)	457
T4151B	200								
T4151D	400								
T4151E	500								
T4151M	600								
15-A Triacs – T4130, T4140, and T4150 Series				**Electrical and Mechanical Data**					
T4130F	50	15	75	With flex.leads, encap.on isolated-stud	14	22	0.031 (0.787)	0.016 (0.406)	458
T4130B	200								
T4130D	400								
T4130E	500								
T4130M	600								
T4140F	50			Isolated on TO-3 flange	–	–	–	–	458
T4140B	200								
T4140D	400								
T4140E	500								
T4140M	600								
T4150F	50	15	75	With flex.leads, encap.,isolated on TO-3 flange	14	22	0.031 (0.787)	0.016 (0.406)	458
T4150B	200								
T4150F	400								
T4 150E	500								
T4150M	600								
30-A Triacs – T6431, T6441, and T6451 Series				**Electrical and Mechanical Data**					
T6431F	50	30	55	With flex.leads, encap.on isolated-stud	12	22	0.034 (0.863)	0.016 (0.406)	459
T6431B	200								
T6341D	400								
T6431E	500								
T6431M	600								
T6441F	50	30	55	Isolated on TO-3 flange	–	–	–	–	459
T6441B	200								
T6441D	400								
T6441E	500								
T6441M	600								

WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

The T4140, T4141, T6440, and T6441 series employ a press-fit package, isolated on a TO-3 flange. The T4150, T4151, T6450, and T6451 series employ a press-fit package with flexible leads encapsulated on an isolated TO-3 flange.

T4130, T4131, T4140, T4150, T4151, T6430, T6431, T6440, T6441, T6450, T6451 Series

Type No.	Rep. Peak Off-State Voltage V_{DROM} (V)	On-State Current I_T (RMS) (A)	T_C (°C)	Package (Press-fit)	Wire Size MT 1&2 Gage No.	Wire Size Gate Gage No.	Wire Insulation Thickness MT 1&2 in. (mm)	Wire Insulation Thickness Gate in. (mm)	Refer to Bulletin File No.*
30-A Triacs – T6431, T6441, and T6451 Series Electrical and Mechanical Data (cont'd)									
T6451F T6451B T6451D T6451E T6451M	50 200 400 500 600	30	55	With flex.leads, encap.,isolated on TO-3 flange	12	22	0.034 (0.863)	0.016 (0.406)	459
40-A Triacs – T6430, T6440, and T6450 Series Electrical and Mechanical Data									
T6430F T6430B T6430 T6430E T6430M	50 200 400 500 600	40	60	With flex.leads, encap. on isolated-stud	12	22	0.034 (0.863)	0.016 (0.406)	593
T6440F T6440B T6440D T6440E T6440M	50 200 400 500 600	40	60	Isolated on TO-3 flange	–	–	–	–	593
T6450F T6450B T6450D T6450E T6450M	50 200 400 500 600	40	60	With flex.leads, encap.,isolated on TO-3 flange	12	22	0.034 (0.863)	0.016 (0.406)	593

* Electrical characteristics and ratings given in these bulletins also apply to the types listed in this chart.

T4700 Series

15-A Silicon Triacs

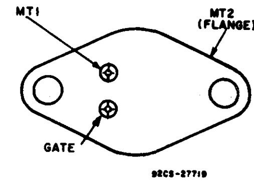
For Low-Power Phase-Control and Load-Switching Applications

Features:
- di/dt Capability = 150 A/μs
- Shorted-Emitter, Center-Gate Design
- Low Switching Losses
- Low On-State Voltage at High Current Levels
- Low Thermal Resistance

RCA T4700 series are gate-controlled full-wave ac silicon switches. They are designed to switch from an off-state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

These devices are intended for the control of ac loads in applications such as space heater, oven and furnace controls, motor controls, and lamp loads.

TERMINAL CONNECTIONS



BOTTOM VIEW

JEDEC TO-66

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

For Operation with 50/60-Hz, Sinusoidal Supply Voltage and Resistive or Inductive Load

		T4700F	T4700B	T4700D	T4700E	
REPETITIVE PEAK OFF-STATE VOLTAGE:■						
Gate Open	V_{DROM}	50	200	400	500	V
RMS ON-STATE CURRENT:						
T_C = 70°C, conduction angle = 360°	$I_{T(RMS)}$	15				A
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}					
For one full cycle of applied principal voltage 60 Hz (sinusoidal), T_C = 70°C		100				A
For one full cycle of applied principal voltage (50-Hz, sinusoidal), T_C = 70°C		85				A
For more than one full cycle of applied voltage		See Fig. 3				
PEAK GATE-TRIGGER CURRENT:						
For 1 μs max.	I_{GTM}	4				A
RATE OF CHANGE OF ON-STATE CURRENT:						
$V_D = V_{DROM}$, I_{GT} = 200 mA, tr = 0.1 μs	di/dt	150				A/μs
FUSING CURRENT (for triac protection):						
T_J = −40 to 100°C, t = 1.25 to 10 ms	I^2t	50				A^2s
GATE POWER DISSIPATION:						
Peak● (for 1 μs max. and I_{GTM} = ≤ 4 A)	P_{GM}	16				W
Average (averaging time = 10 ms max.)	$P_{G(AV)}$	0.45				W
TEMPERATURE RANGE:▲						
Storage	T_{stg}	−40 to 150				°C
Operating (Case)	T_C	−40 to 100				°C
PIN TEMPERATURE (During soldering):						
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	T_P	225				°C

■ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, *see Dimensional Outline.*

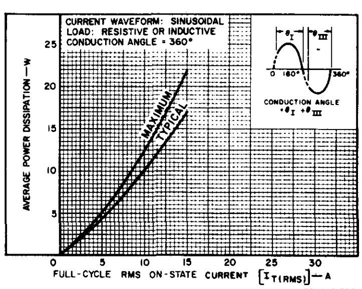


Fig. 1—Power dissipation curve.

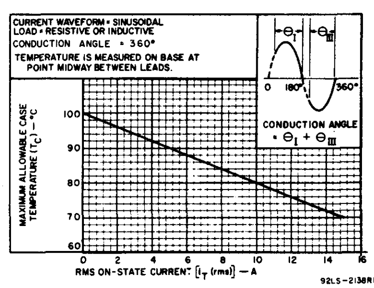


Fig. 2—Conduction rating chart (case temperature).

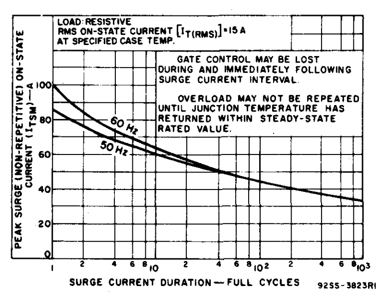


Fig. 3—Surge current rating chart.

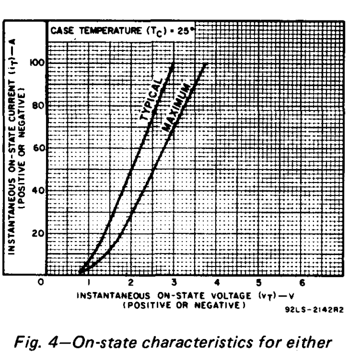


Fig. 4—On-state characteristics for either direction of principal current.

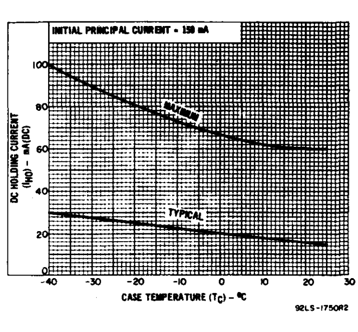


Fig. 5—DC holding current characteristics for either direction of principal current.

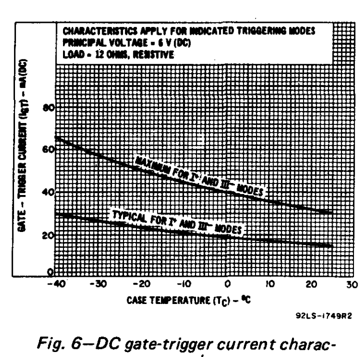


Fig. 6—DC gate-trigger current characteristics for I^+ and III^- modes.

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTICS	TRIAC TYPES						UNITS
	T4700B			T4700D			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current♦**, I_{DROM}** Gate open At T_j = +100° C and V_{DROM} = Max. rated value	–	0.2	4	–	0.2	4	mA
Instantaneous On-State Voltage♦**, v_T** For i_T = 30 A (peak) and T_C = +25° C.	–	1.6	2.0	–	1.6	2.0	V(peak)
DC Holding Current♦**, I_{HO}:** Gate Open Initial principal current = 150 mA (dc) At T_C = +25° C.	–	15	60	–	15	60	mA(dc)
For other case temperatures.		See Fig. 5			See Fig.5		
Critical Rate of Applied Commutating Voltage♦**,** Commutating dv/dt: For v_D = V_{DROM}, $I_{T(RMS)}$ = 15 A, commutating di/dt = 8 A/ms, and gate unenergized At T_C = +70° C.	2	10	–	2	10	–	V/µs
Critical Rate of Rise of Off-State Voltage♦**,** Critical dv/dt: For v_D = V_{DROM}, exponential voltage rise, gate open At T_C = +100° C.	30	150	–	20	100	–	V/µs
DC Gate-Trigger Current♦ ■**, I_{GT}** For v_D = 6 volts (dc), R_L = 12 ohms, T_C = +25° C, and Specified Triggering Mode:							
I^+ Mode: V_{T2} is positive, V_G is positive. . .	–	15	30	–	15	30	mA(dc)
I^- Mode: V_{T2} is positive, V_G is negative. . .	–	35	80	–	35	80	mA(dc)
III^+ Mode: V_{T2} is negative, V_G is positive. . .	–	35	80	–	35	80	mA(dc)
III^- Mode: V_{T2} is negative, V_G is negative. . .	–	15	30	–	15	30	mA(dc)
For other case temperatures.		See Figs. 6 & 7			See Figs. 6 & 7		
DC Gate-Trigger Voltage♦ ■**, V_{GT}:** For v_D = 6 volts (dc) and R_L = 12 ohms At T_C = +25° C.	–	1	2.5	–	1	2.5	V(dc)
For other case temperatures.		See Fig. 8			See Fig. 8		
For v_D = V_{DROM} and R_L = 125 ohms At T_C = +100° C.	0.2	–	–	0.2	–	–	V(dc)
Gate-Controlled Turn-On Time, t_{gt} (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 160 mA, 0.1 µs rise time, and i_T = 25 A (peak) At T_C = +25° C.	–	1.6	2.5	–	1.6	2.5	µs
Thermal Resistance, Junction to case, $R_{\theta JC}$	–	–	1.3	–	–	1.3	°C/W

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.

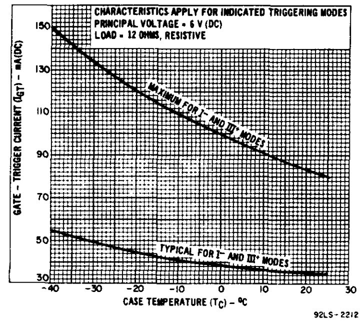


Fig. 7—DC gate-trigger current characteristics for I^- and III^+ modes.

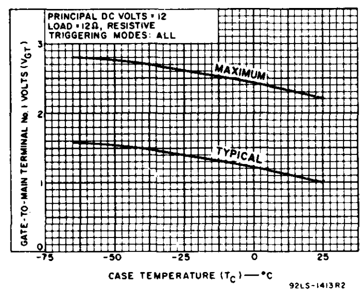


Fig. 8—DC gate-trigger voltage characteristics.

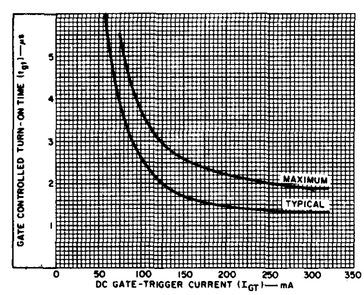


Fig. 9—Turn-on time vs. gate-trigger current.

T6000, T6001, T6006 Series
16-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

The RCA-T6000, T6001 and T6006 series triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 16 amperes at a T_C of 80°C and repetitive off-state voltage ratings of 50 to 600 volts.

The T6001-series triacs are characterized for I^+, III^- gate triggering modes only and should suit a wide range of applications that employ diac or anode on/off triggering.

The T6006-series triacs are characterized for I^+ and III^+ gate-triggering modes only. They are intended for power-control applications in which integrated-circuit zero-crossing switches, such as the RCA-CA3059 series, are used as the triac-triggering circuits. The T6006-series triacs have gate characteristics which assure that a CA3059-series integrated circuit can supply sufficient gate current to trigger them over their full operating temperature range.

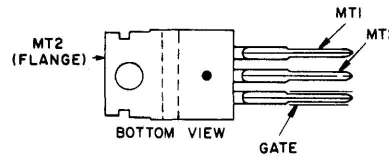
The plastic package design provides not only ease of mounting but also low thermal impedance, which allows operation at high case temperatures and permits reduced heat-sink size.

Lead-form options of the TO-220 package are available. See page on "Lead-Form for RCA Plastic Power Packages".

Features:

- **150-A peak surge full-cycle current ratings**
- **Shorted-emitter center-gate design**
- **Low switching losses**
- **Low thermal resistance**
- **Package design facilitates mounting on a printed-circuit board**

TERMINAL DESIGNATIONS



JEDEC TO-220AB

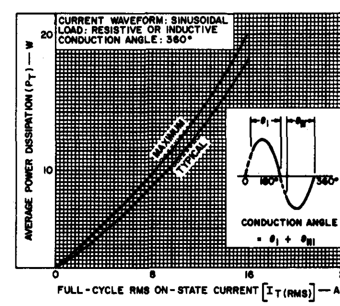


Fig. 1 — Power dissipation vs on-state current.

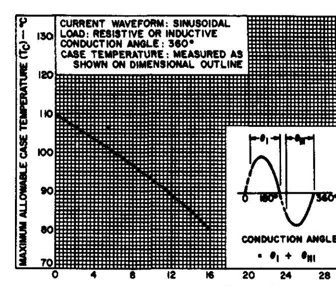


Fig. 2 — Maximum allowable case-temperature vs on-state current.

Maximum Ratings, *Absolute-Maximum Values:*

	T6000F T6001F –	T6000B T6001B T6006B	T6000C T6001C T6006C	T6000D T6001D T6006D	T6000E T6001E T6006E	T6000M T6001M T6606M	
V_{DROM}● T_J = −65 to 110°C	50	200	300	400	500	600	V
$I_{T(RMS)}$ T_C = 80°C, θ = 360°)	16						A
For other conditions	See Fig. 2						
I_{TSM}							
For one cycle of applied principal voltage							
60 Hz (sinusoidal), T_C = 80°C	150						A
50 Hz (sinusoidal), T_C = 80°C	140						A
For more than one cycle of applied principal voltage	See Fig. 3						
di/dt							
$v_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs	100						A/μs
I^2t [At T_C shown for $I_{T(RMS)}$]:							
t = 10 ms	100						A^2s
= 4.25 ms	49						A^2s
I_{GTM}■							
For 1 μs max.	4						A
P_{GM} (For 1 μs max., $I_{GTM} \leq$ 4 A)	16						W
$P_{G(AV)}$	0.5						W
T_{stg}	−65 to 150						°C
T_C	−65 to 110						°C
T_T (During soldering for 10 s max.)	225						°C

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

T6000, T6001, T6006 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified			UNITS
	Min.	Typ.	Max.	
I_{DROM}●				
$T_J = 110^oC$, V_{DROM} = Max. rated value	–	0.1	1.2	mA
v_{TM}● i_T = 30 A (peak), $T_C = 25^oC$ — T6000, T6006 Series	–	1.4	1.75	V
T6001 Series	–	1.8	2.0	V
I_{HO}●				
v_D = 12 V, $T_C = 25^oC$ — T6000 Series	–	15	35	mA
T6001 Series	–	20	50	mA
For other case temperatures	See Fig. 7			
dv/dt●▲				
$v_D = V_{DROM}$, $I_{T(RMS)}$ = 16 A, di/dt = 8.5A/ms, $T_C = 80^oC$	4	10	–	V/μs
dv/dt●				
$v_D = V_{DROM}$, $T_C = 100^oC$				
T6000B, T6001B, T6006B	100	300	–	V/μs
T6000C, T6001C, T6006C	85	275	–	V/μs
T6000D, T6001D, T6006D	75	250	–	V/μs
T6000E, T6001E, T6006E	65	225		V/μs
T6000M, T6001M, T6006M	60	200	–	V/μs
I_{GT}●■ Mode V_{MT2} V_G				
v_D = 12 V (dc), $R_L = 30\ \Omega$, $T_C = 25^oC$ — I+ positive positive T6000 series	–	25	50	mA
T6001 series	–	–	80	mA
T6006 series	–	–	45	mA
III− negative negative T6000 series	–	25	50	mA
T6001 series	–	–	80	mA
I− positive negative T6000 series only	–	45	80	mA
III+ negative positive T6000 series only	–	45	80	mA
T6006	–	–	45	mA
For other case temperatures	See Figs. 9 and 10			
V_{GT}●▲				
v_D = 12 V (dc), $R_L = 30\ \Omega$, $T_C = 25^oC$ — T6001 I+ III−	–	1.25	3.0	V
T6006 I+ III+	–	1.25	1.5	V
T6000 all modes	–	1.25	2.5	V
$v_D = V_{DROM}$, $R_L = 125\ \Omega$, $T_C = 100^oC$	0.2	–	–	V
For other case temperatures	See Fig. 11			
t_{gt}				
$v_D = V_{DROM}$, I_{GT} = 80 mA, t_r = 0.1 μs, i_T = 25 A (peak), $T_C = 25^oC$	–	1.6	2.5	μs
$R_{\theta JC}$	–	–	1.5	°C/W
$R_{\theta JA}$	–	–	50	°C/W

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

▲ Variants of these devices having dv/dt characteristics selected specifically for inductive loads are available on special order; for additional information, contact your RCA Representative or your RCA Distributor.

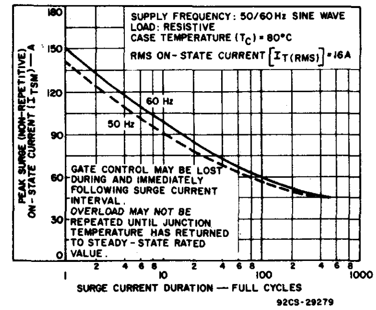


Fig. 3 – Peak surge on-state current vs surge current duration.

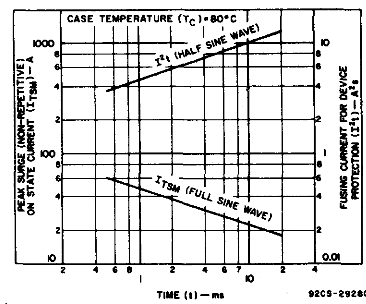


Fig. 4 – Peak surge on-state current and fusing-current vs time.

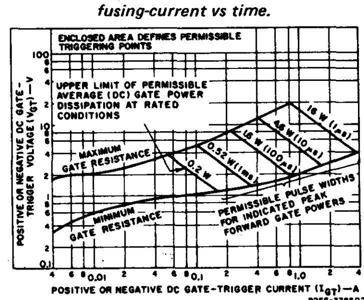


Fig. 5 – Gate pulse characteristics for all triggering modes.

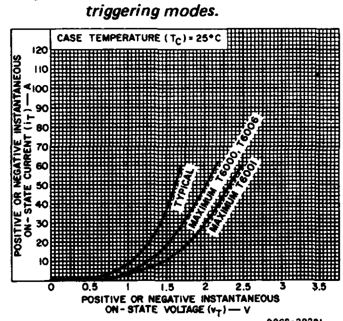


Fig. 6 – On-state current vs on-state voltage.

T6000, T6001, T6006 Series

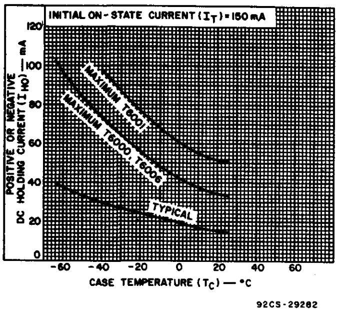


Fig. 7 – DC holding current vs case temperature.

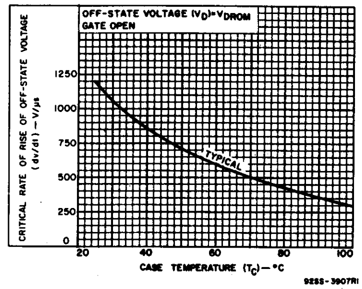


Fig. 8 – Typical critical rate-of-rise of off-state voltage vs case temperature.

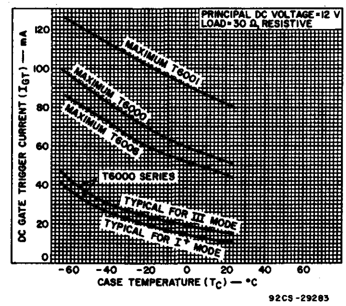


Fig. 9 – DC gate-trigger current (for I^+ and III^- triggering modes) vs case temperature.

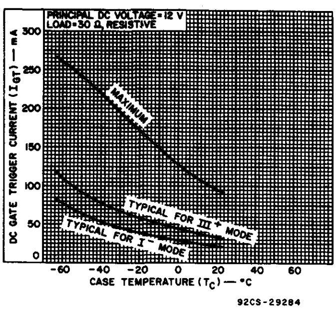


Fig. 10 – DC gate-trigger current (for I^- and III^+ triggering modes) vs case temperature for T6000-series only.

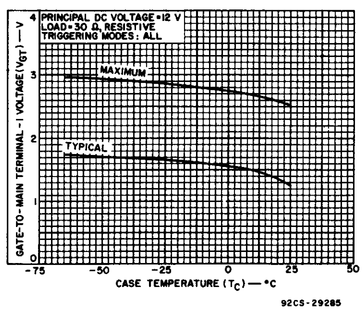


Fig. 11 – DC gate-trigger voltage vs case temperature for T6000 series only.

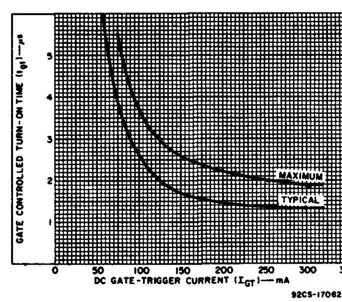


Fig. 12 – Turn-on time vs gate-trigger current.

2N6342A-2N6344A, 2N6346A-2N6348A, (T6000) Series

12-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

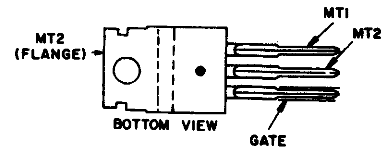
The 2N6342A–44A, and 2N6346A–48A series triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 12 amperes at a T_C of 80°C and repetitive off-state voltage ratings of 200, 400, and 600 volts. The plastic package design provides not only ease of mounting but also low thermal impedance, which allows operation at high case temperatures and permits reduced heat-sink size.

Features:

- **120-A peak surge full-cycle current ratings**
- **Shorted-emitter center-gate design**
- **Low switching losses**
- **Low thermal resistance**
- **Glass-passivated chip for stability**
- **Package design facilitates mounting on a printed-circuit board**

TERMINAL CONNECTIONS



JEDEC TO-220AB

Maximum Ratings, *Absolute-Maximum Values:*

	2N6342A 2N6346A	2N6343A 2N63474	2N6344A 2N6348A	
* V_{DROM}• T_J = −40 to 110°C	200	400	600	V
* $I_{T(RMS)}$ T_C = 80°C, θ = 360°		12		A
For other conditions		See Fig. 5		
I_{TSM}				
For one full cycle of applied principal voltage				
* 60 Hz (sinusoidal), T_C = 80°C		120		A
50 Hz (sinusoidal), T_C = 80°C		113		A
For more than one cycle of applied principal voltage		See Fig. 6		
di/dt				
$v_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 µs		100		A/µs
I^2t [At T_C shown for $I_{T(RMS)}$, half-sine wave]:				
t = 10 ms		64		A^2s
= 2.5 ms		40		A^2s
= 0.5 ms		23		A^2s
* = 1 to 8.3 ms		40		A^2s
* I_{GTM}▪				
For 1 µs max.		4		A
* P_{GM} (For 1 µs max., I_{GTM} ≤ 4 A)		20		W
* $P_{G(AV)}$		0.5		W
* T_{stg}		−40 to 150		°C
* T_C		−40 to 110		°C
* T_T (During soldering for 10 s max.)		230		°C

* In accordance with JEDEC registration data format JC-22 RDF-2.
• For either polarity to main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
▪ For either polarity to gate voltage (V_G) with reference to main terminal 1.

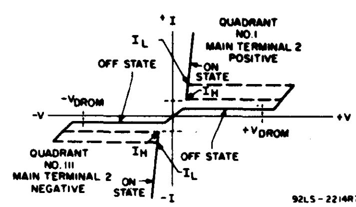


Fig. 1 – Principal voltage-current characteristic.

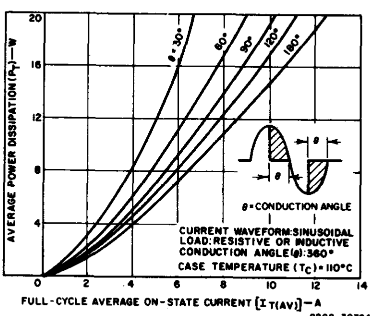


Fig. 2 – Power dissipation as a function of average on-state current.

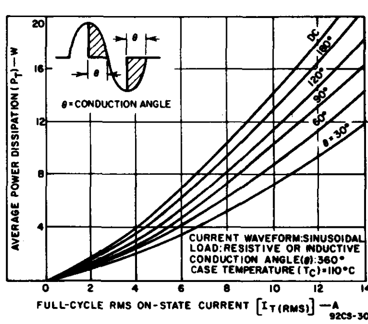


Fig. 3 – Power dissipation as a function of rms on-state current.

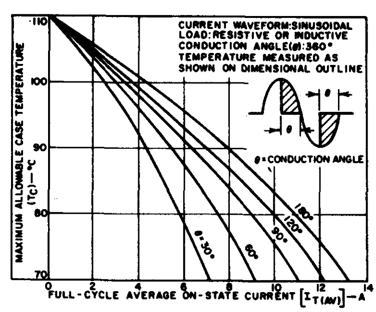


Fig. 4 – Maximum allowable case-temperature as a function of average on-state current.

2N6342A-2N6344A, 2N6346A-2N6348A, (T6000) Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings Uness Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified Min.	Typ.	Max.	UNITS
* I_{DROM}•				
T_J = 110°C, V_{DROM} = Max. rated value	–	–	2	mA
* v_{TM}•				
i_T = 17A (peak), T_C = 25°C	–	1.3	1.75	V
I_{HO}•				
Gate open, Initial principal current = 200 mA				
v_D = 12V, T_C = 25°C	–	6	40	mA
* = –40°C	–	–	75	
dv/dt• (Commutating)				
v_D = V_{DROM}, I_{TM} = 17A, di/dt = 6.5A/ms, T_C = 80°C	–	5	–	V/µs
dv/dt• (Off-State)				
v_D = V_{DROM}, T_C = 100°C				
2N6342A, 2N6346A	100	300	–	
2N6343A, 2N6347A	75	250	–	
2N6344A, 2N6348A	60	200	–	
I_{GT}•■ v_D = 12V (dc), R_L = 100Ω — Mode V_{MT2} V_G				mA
T_C = 25°C 1+ + +	–	6	50	
111– – –	–	10	50	
1– + – (2N6346A-48A only)	–	6	75	
111+ – + (2N6346A-48A only)	–	25	75	
* T_C = –40°C 1+ + +	–	–	100	
* 111– – –	–	–	100	
* 1– + – (2N6346A-48A only)	–	–	125	
* 111+ – + (2N6346A-48A only)	–	–	125	
V_{GT}•■ v_D = 12V (dc), R_L = 100Ω — Mode V_{MT2} V_G				V
T_C = 25°C 1+ + +	–	0.9	2	
111– – –	–	1.1	2	
1– + – (2N6346A-48A only)	–	0.9	2.5	
111+ – + (2N6346A-48A only)	–	1.4	2.5	
* T_C = –40°C 1+ + +	–	–	2.5	
* 111– – –	–	–	2.5	
* 1– + – (2N6346A-48A only)	–	–	3	
* 111+ – + (2N6346A-48A only)	–	–	3	
v_D = V_{DROM}, R_L = 10 kΩ				
T_J = 110°C 1+ + +	0.2	–	–	
111– – –	0.2	–	–	
1– + – (2N6346A-48A only)	0.2	–	–	
111+ – + (2N6346A-48A only)	0.2	–	–	
* t_{gt}				
v_D = V_{DROM}, I_{GT} = 120 mA, t_r = 0.1 µs, i_T = 17A (peak), T_C = 25°C	–	1.5	2	µs
* $R_{\theta JC}$	–	–	2	°C/W

* In accordance with JEDEC registration data format JC-22 RDF2.
• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

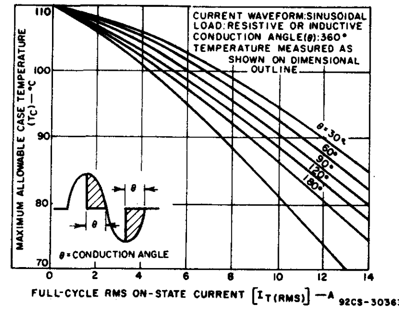


Fig. 5 – Maximum allowable case-temperature as a function of rms on-state current.

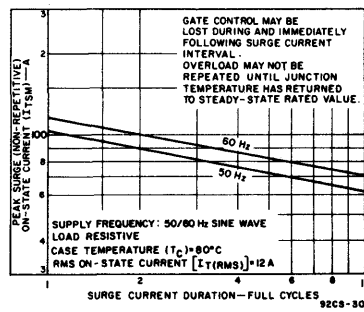


Fig. 6 – Peak surge on-state current as a function of surge current duration.

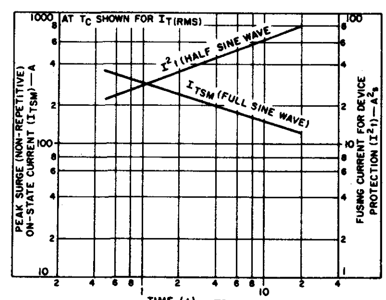


Fig. 7 – Peak surge on-state current and fusing current as a function of time.

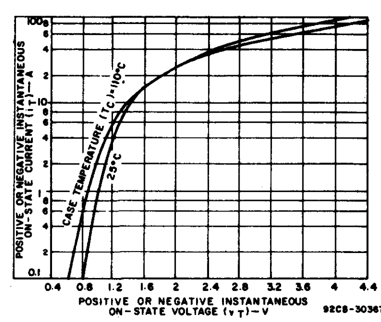


Fig. 8 – On-state current as a function of on-state voltage.

2N6342A-2N6344A, 2N6346A-2N6348A, (T6000) Series

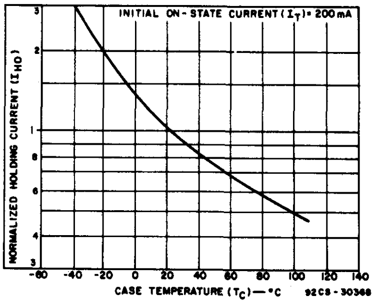


Fig. 9 – Normalized holding current as a function of case temperature.

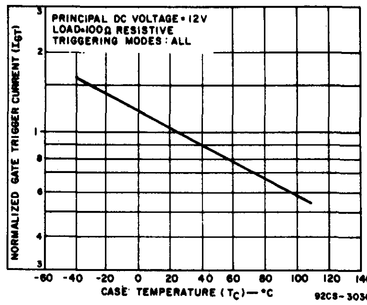


Fig. 10 – Normalized gate trigger current as a function of case temperature.

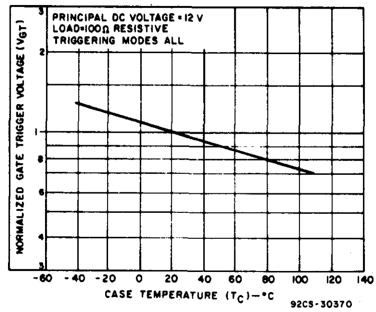


Fig. 11 – Normalized gate trigger voltage as a function of case temperature.

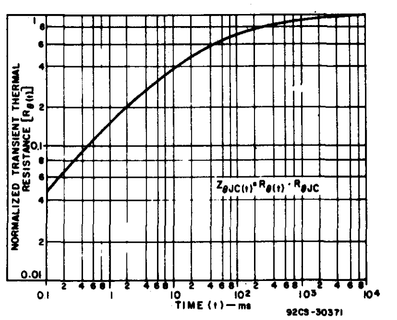


Fig. 12 – Normalized transient thermal resistance as a function of time.

MAC15, MAC15A (T6000) Series

15-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

The RCA-MAC15 and MAC15A series triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

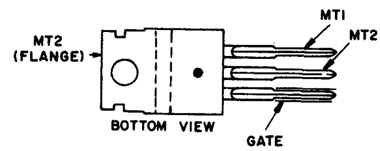
These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 12-A at T_C = 95°C and 15-A at T_C = 80°C and repetitive off-state voltage ratings, of 200, 400, and 600 volts.

The plastic package design provides not only ease of mounting but also low thermal impedance, which allows operation at high case temperatures and permits reduced heat-sink size.

Features:

- **150-A peak surge full-cycle current ratings**
- **Shorted-emitter center-gate design**
- **Low switching losses**
- **Low thermal resistance**
- **Glass-passivated chip for stability**
- **Package design facilitates mounting on a printed-circuit board**

TERMINAL CONNECTIONS



JEDEC TO-220AB

Maximum Ratings, *Absolute-Maximum Values:*

	MAC15-4 MAC15A-4	MAC15-6 MAC15A-6	MAC15-8 MAC15A-8	
V_{DROM}• T_J = −40 to 125°C	200	400	600	V
$I_{T(RMS)}$ θ = 360°:				
T_C = 95°C		12		A
= 80°C		15		A
For other conditions		See Fig. 3		
I_{TSM}:				
For one full cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$				
60 Hz (sinusoidal)		150		A
50 Hz (sinusoidal)		140		A
For more than one cycle of applied principal voltage		See Fig. 4		
di/dt				
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 µs		100		A/µs
I_{GTM}▪				
For 1 µs max.		2		A
P_{GM} (For 1 µs max., $I_{GTM} \leq 4$ A)		20		W
$P_{G(AV)}$		0.5		W
T_{stg}		−40 to 150		°C
T_C		−40 to 125		°C
T_T (During soldering for 10 s max.)		230		°C

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
▪ For either polarity of gate voltage (V_G) with reference to main terminal 1.

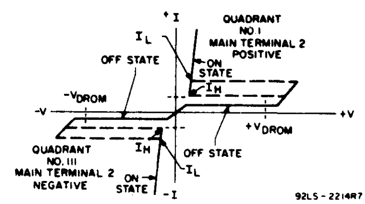


Fig. 1 – Principal voltage-current characteristic.

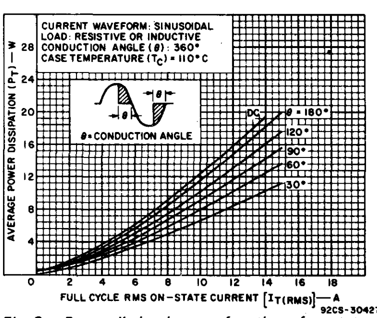


Fig. 2 – Power dissipation as a function of on-state current.

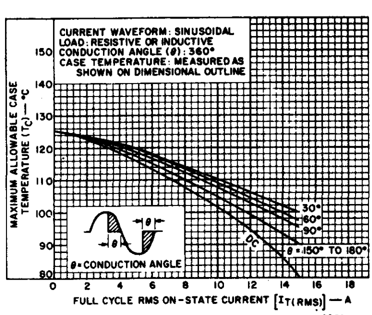


Fig. 3 – Maximum allowable case-temperature as a function of on-state current.

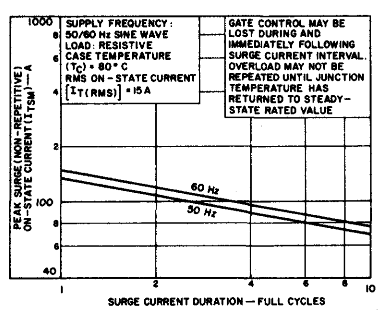


Fig. 4 – Peak surge on-state current as a function of surge current duration.

MAC15, MAC15A (T6000) Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified			UNITS
	Min.	Typ.	Max.	
I_{DROM}● V_{DROM} = Max. rated value, T_C = 125°C	–	–	2	mA
v_{TM}● T_C = 25°C, i_T = 21A (peak)	–	1.3	1.6	V
I_{HO}● Gate open, Initial principal current = 200 mA (dc) v_D = 12 V, T_C = 25°C	–	6	40	mA
dv/dt● (Commutating) v_D = V_{DROM}, i_T = 21A (peak) di/dt = 8 A/ms, T_C = 80°C	–	5	–	V/μs
I_{GT}●■ v_D = 12 V (dc), R_L = 100 Ω, T_C = 25°C, Mode / V_{MT2} / V_G				mA
I+ + +	–	–	50	
III– – –	–	–	50	
I– + – MAC15A series only	–	–	75	
III+ – + MAC15A series only	–	–	75	
V_{GT}●■ v_D = 12 V (dc), R_L = 100 Ω, T_C = 25°C, Mode / V_{MT2} / VG				V
I+ + +	–	0.9	2	
III– – –	–	1.1	2	
I– + – MAC15A series only	–	0.9	2.5	
III+ – + MAC15A series only	–	1.4	2.5	
T_C = 110°C v_D = V_{DROM}, R_L = 10 kΩ				
I+ + +	0.2	–	–	
III– – –	0.2	–	–	
I– + – MAC15A series only	0.2	–	–	
III+ – + MAC15A series only	0.2	–	–	
t_{gt} v_D = V_{DROM}, I_{GT} = 120 mA, t_r = 0.1 μs, i_T = 17A (peak), T_C = 25°C	–	1.5	2	μs
$R_{\theta JC}$	–	–	2	°C/W

● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

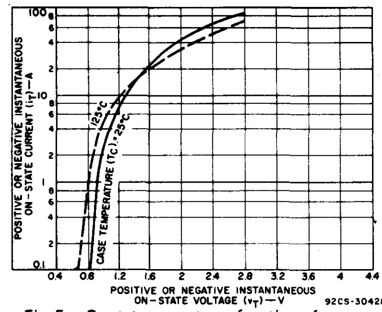


Fig. 5 – On-state current as a function of on-state voltage.

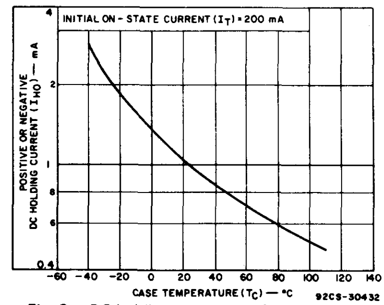


Fig. 6 – DC holding current as a function of case temperature.

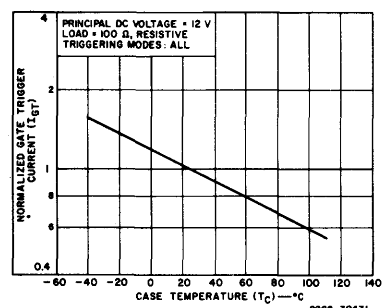


Fig. 7 – Normalized gate trigger current as a function of case temperature.

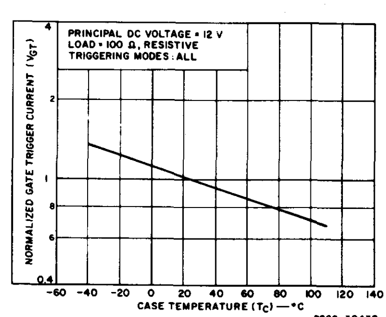


Fig. 8 – Normalized gate trigger voltage as a function of case temperature.

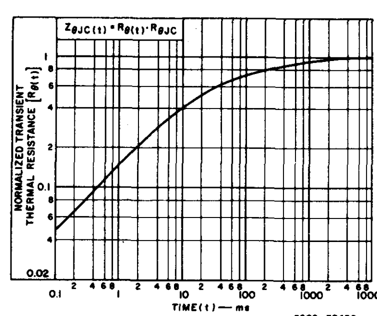


Fig. 9 – Normalized transient thermal resistance as a function of time.

SC149, SC151 (T6000) Series

12-A and 15-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

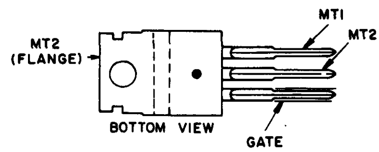
The RCA-SC149 and SC151 series triacs are gate-controlled full-wave silicon switches utilizing the RCA VERSAWATT plastic package (JEDEC TO-220AB) with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 12-A at T_C = 75°C (SC149 series) and 15-A at T_C = 80°C (SC151 series) and repetitive off-state voltage ratings, of 200, 400, 500, and 600 volts. The plastic package design provides not only ease of mounting but also low thermal impedance, which allows operation at high case temperatures and permits reduced heat-sink size.

Features:

- **120-A peak surge full-cycle current ratings**
- **Shorted-emitter center-gate design**
- **Low switching losses**
- **Low thermal resistance**
- **Glass-passivated chip for stability**
- **Package design facilitates mounting on a printed-circuit board**

TERMINAL CONNECTIONS



JEDEC TO-220AB

Maximum Ratings, *Absolute-Maximum Values:*

	SC149B SC151B	SC149D SC151D	SC149E SC151E	SC149M SC151M	
V_{DROM}• T_J = −40 to 100°C	200	400	500	600	V
$I_{T(RMS)}$ θ = 360°:					
For SC149 series, T_C = 75°C	12				A
For SC151 series, T_C = 80°C	15				A
For other conditions	See Fig. 4				
I_{TSM}:					
For one full cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$:					
60 Hz (sinusoidal)	120				A
50 Hz (sinusoidal)	113				A
For more than one cycle of applied principal voltage	See Fig. 5				
di/dt					
$v_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs	100				A/μs
I^2t [At T_C shown for $I_{T(RMS)}$, half-sine wave]:					
t = 10 ms	64				A^2s
2.5 ms	40				A^2s
0.5 ms	23				A^2s
I_{GTM}■					
For 1 μs max.	1				A
P_{GM} (For 1 μs max., I_{GTM} ≤ 4 A)	10				W
$P_{G(AV)}$	0.5				W
T_{stg}	−40 to 125				°C
T_C	−40 to 100				°C
T_T (During soldering for 10 s max.)	230				°C

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.

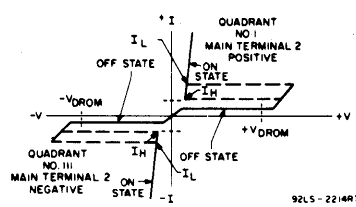


Fig. 1 – Principal voltage-current characteristic.

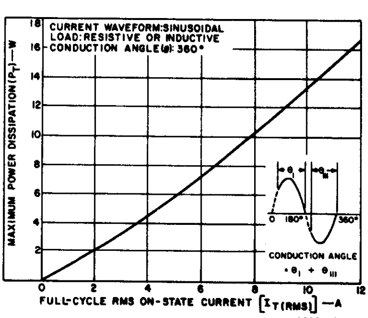


Fig. 2 – Power dissipation as a function of on-state current for SC149 series.

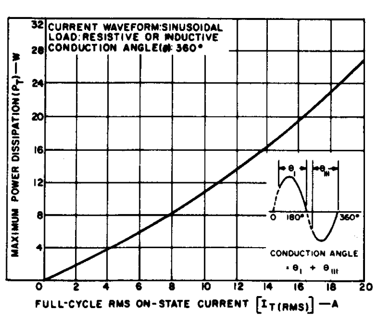


Fig. 3 – Power dissipation as a function of on-state current for SC151 series.

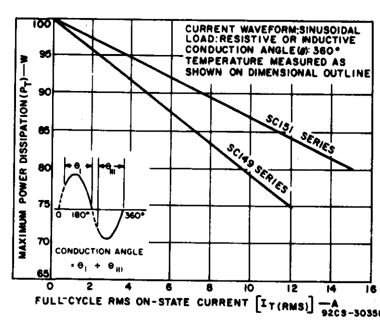


Fig. 4 – Maximum allowable case-temperature as a function of on-state current for both series.

SC149, SC151 (T6000) Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified Min.	Typ.	Max.	UNITS
I_{DROM}●				
V_{DROM} = Max. rated value, T_C = 25°C	–	–	0.1	mA
= 100°C	–	–	0.5	
v_{TM}●				
T_C = 25°C, i_T = 17A (peak) SC149 series	–	–	1.65	V
= 21A (peak) SC151 series	–	–	1.62	
I_{HO}●				
Gate open, initial principal current = 500 mA (dc)				
v_D = 12 V, T_C = 25°C	–	–	50	
= −40°C	–	–	100	
I_L●				mA
R_{GK} = 100 Ω, t_W = 50 μs, t_r = t_f = 5 μs, f = 1 kHz,				
T_C = 25°C Mode V_{MT2} V_G				
I+ + +	–	–	100	
III− − −	–	–	100	
I− + −	–	–	200	
T_C = −40°C I+ + +	–	–	200	
III− − −	–	–	200	
I− + −	–	–	400	
dv/dt● (Commutating)				
v_D = V_{DROM}, $I_{T(RMS)}$ = Max. rated value,				
di/dt = 6.4 A/ms, T_C = 75°C SC149 series	4	–	–	V/μs
di/dt = 8.1 A/ms, T_C = 80°C SC151 series	4	–	–	
dv/dt● (Off-State)				
v_D = V_{DROM}, T_C = 100°C, Exponential voltage rise				
SC149 series	100	200	–	
SC151 series	100	250	–	
I_{GT}●■ v_D = 12 V (dc)				
T_C = 25°C R_L–Ω Mode V_{MT2} V_G				
100 I+ + +	–	–	50	mA
100 III− − −	–	–	50	
50 I− + −	–	–	50	
T_C = −40°C 50 I+ + +	–	–	80	
50 III− − −	–	–	80	
25 I− + −	–	–	80	
V_{GT}●■ v_D = 12 V (dc)				
T_C = 25°C R_L–Ω Mode V_{MT2} V_G				
100 I+ + +	–	–	2.5	V
100 III− − −	–	–	2.5	
50 I− + −	–	–	2.5	
T_C = −40°C 50 I+ + +	–	–	3.5	
50 III− − −	–	–	3.5	
25 I− + −	–	–	3.5	

See footnotes on top of next page.

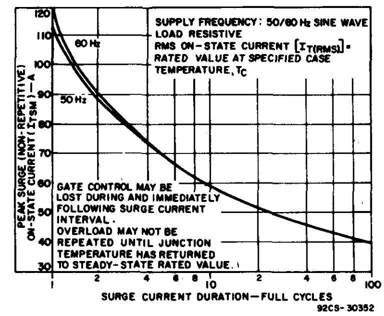


Fig. 5 – Peak surge on-state current as a function of surge current duration.

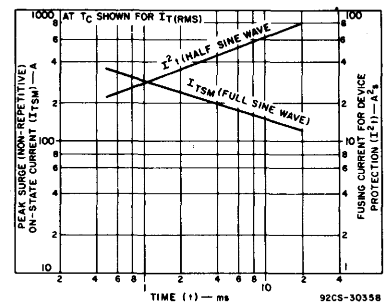


Fig. 6 – Peak surge on-state current and fusing current as a function of time.

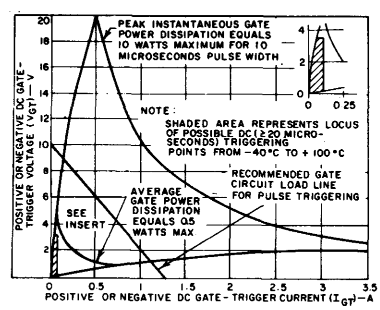


Fig. 7 – Gate pulse characteristics for all triggering modes.

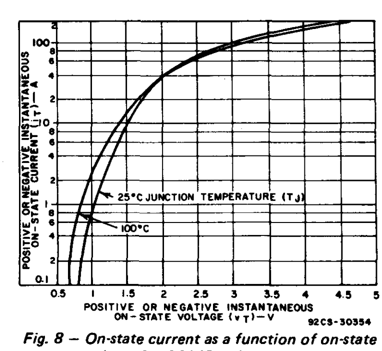


Fig. 8 – On-state current as a function of on-state voltage for SC149 series.

SC149, SC151 (T6000) Series

ELECTRICAL CHARACTERISTICS (Cont'd)

At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified			UNITS
	Min.	Typ.	Max.	
V_{GD}● $v_D = V_{DROM}$, $R_L = 1k\Omega$, $T_C = 100°C$ (For all triggering modes)	0.2	–	–	V
t_{gt} $v_D = V_{DROM}$, $I_{GT} = 80$ mA, $t_r = 0.1\ \mu s$, $i_T = 25$ A (peak), $T_C = 25°C$	–	1.6	2.5	μs
Thermal Characteristics				
$R_{\theta JC}$	–	–	2	°C/W
$R_{\theta JA}$	–	–	75	°C/W
$R_{\theta JC(ac)}$* During ac current conduction SC149 series	–	–	1.52	°C/W
SC151 series	–	–	1.1	°C/W

- ● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
- ■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
- * This characteristic is useful in the calculation of junction-temperature rise above T_C for ac current conduction and applies for a 50 or 60 Hz full sine wave of current. It can be calculated with the following formula:

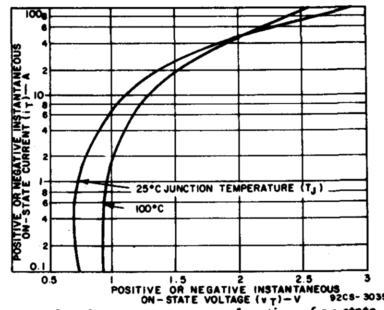


Fig. 9 – On-state current as a function of on-state voltage for SC151 series.

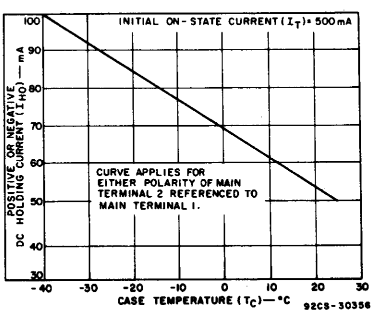


Fig. 10 – DC holding current as a function of case temperature.

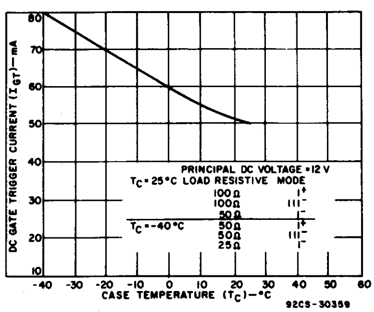


Fig. 11 – DC gate trigger current as a function of case temperature.

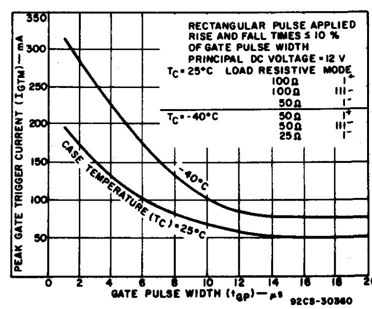


Fig. 12 – Peak gate trigger current as a function of gate pulse width.

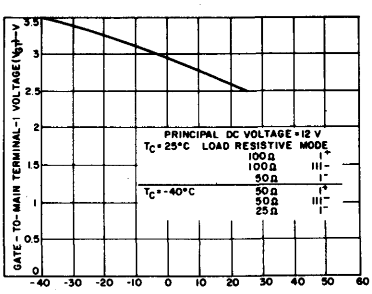


Fig. 13 – DC gate-trigger voltage as a function of case temperature.

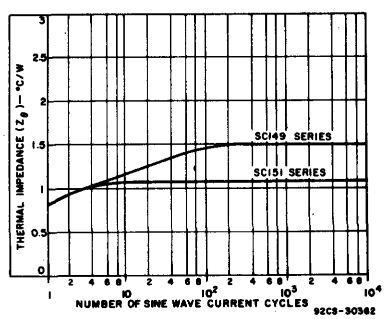


Fig. 14 – Thermal impedance as a function of sine-wave current cycles.

TIC236, TIC246 (T6000) Series

12-A and 16-A Silicon Triacs

Three-Lead Plastic Types for Power-Control and Power-Switching Applications

Features:

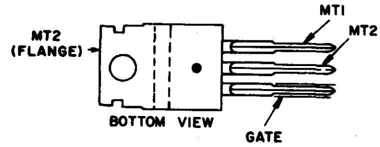
- 100-A and 125-A peak surge full-cycle currrent ratings
- Shorted-emitter center-gate design
- Low switching losses
- Low thermal resistance
- Glass-passivated chip for stability
- Package design facilitates mounting on a printed-circuit board

The RCA-TIC236 and TIC246 series triacs are gate-controlled full-wave silicon switches utilizing a plastic case with three leads to facilitate mounting on printed-circuit boards. They are intended for the control of ac loads in such applications as motor controls, light dimmers, heating controls, and power-switching systems.

These devices are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages. They have an on-state current rating of 12-A and 16-A at T_C of 70°C and repetitive off-state voltage ratings of 200 and 400 volts.

The plastic package design provides not only ease of mounting but also low thermal impedance, which allows operation at high case temperatures and permits reduced heat-sink size.

TERMINAL CONNECTIONS



JEDEC TO-220AB

Maximum Ratings, *Absolute-Maximum Values:*

	TIC236B TIC246B	TIC236D TIC246D	
V_{DROM}• T_J = −40 to 110°C	200	400	V
$I_{T(RMS)}$ T_C = 70°C, θ = 360°			
For TIC236 series	12		A
For TIC246 series	16		A
For other conditions	See Fig. 2		
I_{TSM}:			
For one full cycle of applied principal voltage, at current and temperature shown above for $I_{T(RMS)}$:			
60 Hz (sinusoidal) TIC236 series	100		A
TIC246 series	125		A
50 Hz (sinusoidal) TIC236 series	90		A
TIC246 series	115		A
For more than one cycle of applied principal voltage	See Fig. 3 and 4		
di/dt			
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs	100		A/μs
I^2t [At T_C shown for $I_{T(RMS)}$]:	TIC236 Series	TIC246 Series	
t = 20 ms	55	85	A^2s
2.5 ms	28	42	A^2s
0.5 ms	16	25	A^2s
I_{GTM}■			
For 1 μs max.	1		A
P_{GM} (For 1 μs max., I_{GTM} ≤ 4 A)	16		W
$P_{G(AV)}$	0.5		W
T_{stg}	−40 to 125		°C
T_C	−40 to 110		°C
T_T	130		°C

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to amin terminal 1.

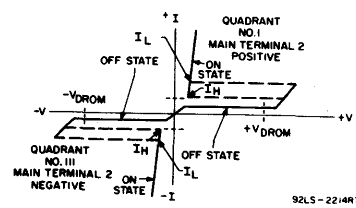


Fig. 1 – Principal voltage-current characteristic.

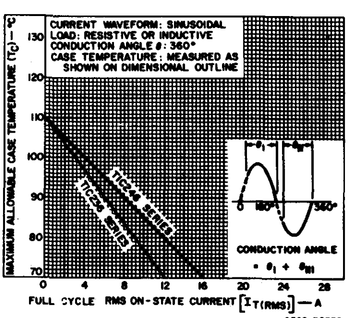


Fig. 2 – Maximum allowable case temperature as a function of on-state current.

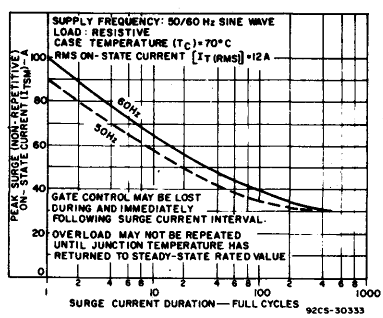


Fig. 3 – Peak surge on-state current as a function of surge current duration for TIC236 series.

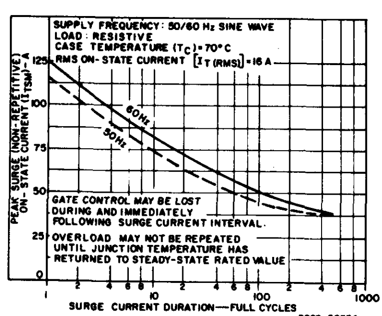


Fig. 4 – Peak surge on-state current as a function of surge current duration for TIC246 series.

TIC236, TIC246 (T6000) Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified, and at Indicated Temperatures

CHARACTERISTIC	LIMITS For All Types Except as Specified Min.	Typ.	Max.	UNITS
I_{DROM}• $T_C = 110°C$, V_{DROM} = Max. rated value	–	–	5	mA
v_{TM}• $T_C = 25°C$, i_T = 17A (peak) TIC236 series	–	–	2.1	V
= 22.5A (peak) TIC246 series	–	–	1.7	V
I_{HO}• Gate open, Initial principal current = 150 mA (dc), v_D = 12 V, $T_C = 25°C$	–	–	50	mA
I_L• $I_{GT} = I_{GT}$ Max., t_w = 20 µs, $t_r = t_f \leq$ 15 ns, f = 1 kHz, $T_C = 25°C$	–	20	–	mA
dv/dt• (Commutating) $v_D = V_{DROM}$, $I_{T(RMS)}$ = Max. rated value, $T_C = 70°C$ di/dt = 6.4 A/ms TIC236 series	4	10	–	V/µs
= 8.5 A/ms TIC246 series	4	10	–	V/µs
dv/dt• (Off-State) $v_D = V_{DROM}$, $T_C = 100°C$, Exponential voltage rise TIC236 series	100	300	–	V/µs
TIC246 series	75	250	–	V/µs
I_{GT}•■ Mode V_{MT2} V_G; v_D = 12 V (dc), R_L = 30 Ω, $T_C = 25°C$: I+ + +	–	15	50	mA
III− − −	–	25	50	mA
I− + −	–	30	50	mA
III+ − +	–	75	–	mA
V_{GT}•■ v_D = 12 V (dc), R_L = 30 Ω, $T_C = 25°C$	–	1.2	2.5	V
t_{gt} $v_D = V_{DROM}$, I_{GT} = 80 mA, t_r = 0.1 µs, i_T = 25 A (peak), $T_C = 25°C$	–	1.6	2.5	µs

Thermal Characteristics

$R_{\theta JC}$ TIC236 series	–	–	2	°C/W
TIC246 series	–	–	1.9	°C/W
$R_{\theta JA}$	–	–	62.5	°C/W

• For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.

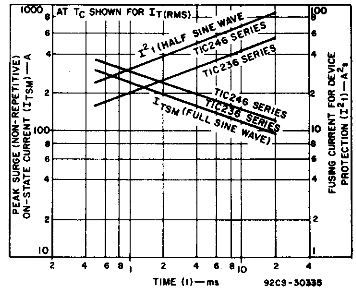


Fig. 5 – Peak surge on-state current and fusing-current as a function of time.

T6400, T6401, T6410, T6411, T6420, T6421 Series (Includes 2N5441-2N5446, 2N5806-2N5809)

25-A, 30-A and40-A Silicon Triacs

For General Purpose AC Power Switching Application
All 30-A and 40-A Triacs

For Control-Systems Application in Airborne and Ground Support Type Equipment
25-A, 400-Hz Triacs (2N5806-2N5809)

Features:

- di/dt Capability = 100 A/μs
- Shorted-Emitter, Center-Gate Design
- Low Switching Losses
- Low On-State Voltage at High Current Levels
- Low Thermal Resistance

Additional Features for the 2N5806-2N5809:

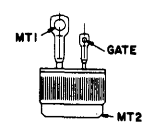
- Available in JAN or JANTX Screening
- Commutating dv/dt capability Characterized at 400 Hz

These RCA triacs are gate-controlled full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

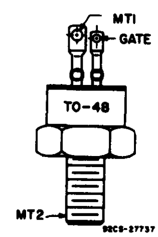
These triacs are intended for control of ac loads in applications such as heating controls, motor controls, arc-welding equipment, light dimmers, and power switching systems. They can also be used in air-conditioning and photocopying equipment.

Types 2N5441-43 and T6401 series employ a press-fit package. Types 2N5444-46, 2N5806-09, and T6411 series employ a stud package. T6421 series and T6421 series employ an isolated-stud package.

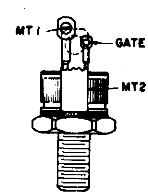
TERMINAL CONNECTIONS



2N5441-43 T6401 series
Press-Fit Types



2N5444-46,
2N5806-09, T6411 series
Stud Types



T6420 series,
T6421 series
Isolated-Stud Types

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/400 Hz and with Resistive or Inductive Load.

Current rating					
40-A	–	2N5441	2N5442	–	2N5443
40-A	–	2N5444	2N5445	–	2N5446
40-A	T6420F	T6420B	T6420D	T6420E	T6420M
30-A	T6401F	T6401B	T6401D	T6401E	T6401M
30-A	T6411F	T6411B	T6411D	T6411E	T6411M
30-A	T6421F	T6421B	T6421D	T6421E	T6421E
25-A	–	2N5806	2N5807	2N5808	2N5809

Rating	Symbol						Units
*REPETITIVE PEAK OFF-STATE VOLTAGE:●	V_{DROM}						
Gate open, T_J = −65 to 110°C		50	200	400	500	600	V
RMS ON-STATE CURRENT (Conduction angle = 360°):	$I_{T(RMS)}$						
Case temperature							
* T_C = 70°C (2N5441;43, –Press-fit types)				40			A
= 65°C (2N5444-46, –Stud types)				40			A
= 60°C (T6420 series – Isolated-stud types)				40			A
= 65°C (T6401 series – Press-fit types)				30			A
= 60°C (T6411 series – Stud types)				30			A
= 55°C (T6421 series – Isolated-stud types)				30			A
= 80°C (2N5806-2N5809 – Stud types)				25			A
For other conditions				See Figs. 4, 5, 6			
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}						
For one cycle of applied principal voltage, T_C as above							
* 60 Hz (sinusoidal - 30-A & 40-A types)				300			A
50 Hz (sinusoidal - 30-A & 40-A types)				265			A
400 Hz (sinusoidal - 25-A types)				370			A
* 60 Hz (sinusoidal - 25-A types)				200			A
50 Hz (sinusoidal - 25-A types)				170			A
For more than once cycle of applied principal voltage				See Figs. 7, 8, 9			
RATE OF CHANGE OF ON-STATE CURRENT:	di/dt						
$V_{DM} = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs				100			A/μs
FUSING CURRENT (For Triac Protection):	I^2t						
[At T_C shown for $I_{T(RMS)}$]:							
t = 20 ms (30-A & 40-A types)				500			A^2s
= 2.5 ms (30-A & 40-A types)				250			A^2s
= 0.5 ms (30-A & 40-A types)				145			A^2s
= 20 ms (25-A types)				240			A^2s
= 2.5 ms (25-A types)				110			A^2s
=0.5 ms (25-A types)				65			A^2s
*PEAK GATE-TRIGGER CURRENT:■	I_{GTM}						
For 1 μs max., See Fig. 15 (30-A and 40-A types only)				12			A
*GATE POWER DISSIPATION:							
PEAK (For 10 μs max., $I_{GTM} \leqslant$ 4 A, −30-A & 40-A types)	P_{GM}			40			W
−25-A types)	P_{GM}			10			W
AVERAGE (30-A & 40-A types)	$P_{G(AV)}$			0.75			W
(25-A types, t = 16.6 ms)	$P_{G(AV)}$			0.5			W
*TEMPERATURE RANGE:▲							
Storage (20-A & 40-A types)	T_{stg}			−65 to 150			°C
(25-A types)	T_{stg}			−55 to 125			°C
Operating (Case) – 40-A types	T_C			−65 to 110			°C
– 30-A types	T_C			−65 to 100			°C
– 25-A types	T_C			−40 to 115			°C
*TERMINAL TEMPERATURE:	T_T						
During soldering for 10 s max. (terminals and case)							
30-A & 40-A types				225			°C
25-A types				260			°C
STUD TORQUE:	τ_s						
Recommended				35			in-lb
				0.4			kgf-m
Maximum (DO NOT EXCEED)				50			in-lb
				0.57			kgf-m

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

* In accordance with JEDEC registration data format (JS-14, RDF 2) filed for the JEDEC (2N-Series) types.
● For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see *Dimensional Outline.*

T6400, T6401, T6410, T6411, T6420, T6421 Series (Includes 2N5441-2N5446, 2N5806-2N5809)

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
Peak Off-State Current:♦ Gate open, V_{DROM} = Max. rated value					
T_J = 110°C, (40-A types)	I_{DROM}	–	0.2	4*	mA
= 100°C, (30-A types)		–	0.2	4	
= 115°C, (25-A types)		–	0.2	2*	
Maximum On-State Voltage:♦					
For i_T = 100 A (peak), T_C = 25°C, (40-A types)	V_{TM}	–	1.7	2	V
For i_T = 56 A (peak), T_C = 25°C, (40-A types)		–	1.5	1.85*	
For i_T = 100 A (peak), T_C = 25°C, (30-A types)		–	2.1	2.5	
= 35 A (peak), pulse width ≤ 1 ms, duty cycle ≤ 2%, I_G = 150 mA, T_C = 25°C (25-A types)		–	1.3	1.6*	
DC Holding Current:♦ Gate open, Initial principal current = 500 mA (dc), v_D = 12V:					
T_C = 25°C (30-A & 40-A types)	I_{HO}	–	25	60	mA
= 25°C (25-A types)		–	30	75	
= −65°C (40-A types)		–	–	100*	
= −40°C (25-A types)		–	45	100*	
For other case temperatures		See Figs. 13 & 14			
Critical Rate of Rise of Commutation Voltage:♦					
v_D = V_{DROM}, $I_{T(RMS)}$ = 40 A, commutating di/dt = 22 A/ms, gate unenergized,	dv/dt				V/μs
T_C = 70°C (40-A, Press-fit types)		5*	30	–	
= 65°C (40-A, Stud-types)		5*	30	–	
= 60°C (40-A, Isolated-stud types)		5*	30	–	
v_D = V_{DROM}, $I_{T(RMS)}$ = 30 A, commutating di/dt = 16 A/ms, gate unenergized,					
T_C = 65°C (30-A, Press-fit types)		3	20	–	
= 60°C (30-A, Stud types)		3	20	–	
= 55°C, (30-A, Isolated-stud types)		3	20	–	
v_D = V_{DROM}, $I_{T(RMS)}$ = 25 A, commutating di/dt = 88 A/ms, gate unenergized					
T_C = 80°C (25-A, Stud types)		5	–	–	
Critical Rate-of-Rise of Off-State Voltage:♦ For v_D = V_{DROM}, exponential voltage rise, gate open					
T_C = 110°C (40-A types):	dv/dt				V/μs
2N5441, 2N5444, T6420B		50*	200	–	
2N5442, 2N5445, T6420D		30*	150	–	
2N5443, 2N5446, T6420M		20*	100	–	
T_C = 100°C (30-A types):					
T6401B, T6411B, T6421B		40	200	–	
T6401D, T6411D, T6421D		25	150	–	
T6401M, T6411M, T6421M		20	100	–	
T_C = 115°C (25-A types)		20	100	–	
DC Gate-Trigger Current:♦♦					
v_D = 12 V (dc) R_L = 30Ω T_C = 25°C; Mode, V_{MT2}, V_G	I_{GT}				mA
I+ positive positive (40-A & 30-A types)		–	15	50	
(25-A types)		–	20	80	
III− negative negative (40-A & 30-A types)		–	20	50	
(25-A types)		–	50	80	
I− positive negative (40-A & 30-A types)		–	30	80	
(25-A types)		–	80	80	
III+ negative positive (40-A & 30-A types)		–	40	80	
(25-A types)		–	100	150	
v_D = 12 V (dc) R_L = 30Ω T_C = −65°C; Mode, V_{MT2}, V_G (40-A types only)					
I+ positive positive		–	–	125*	
III− negative negative		–	–	125*	
I− positive negative		–	–	240*	
III+ negative positive		–	–	240*	
v_D = 12 V (dc) R_L = 25Ω T_C = 40°C; Mode, V_{MT2}, V_G (25-A types only)					
I+ positive positive		–	32	120	
III− negative negative		–	98	120	
I− positive negative		–	–	170	
III+ negative positive		–	–	–	
DC Gate-Trigger Voltage:♦♦ v_D = 12 V (dc), R_L = 30Ω,					
T_C = 25°C (30-A & 40-A types)	V_{GT}	–	1.35	2.5	V
= −65°C (40-A types only)		–	1.8	3.4*	
For other case temperatures			See Fig. 20		
v_D = V_{DROM}, R_L = 125Ω, T_C = 110°C (40-A types)		0.2	–	–	
= 100°C (30-A types)		0.2	–	–	

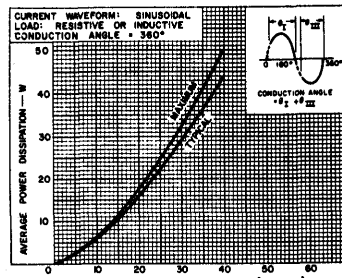


Fig. 1 — Power dissipation vs. on-state current for 2N5441-46, and T6420 series.

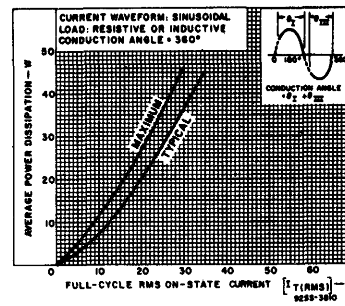


Fig. 2 — Power dissipation vs. on-state current for T6401, T6411, T6421 series.

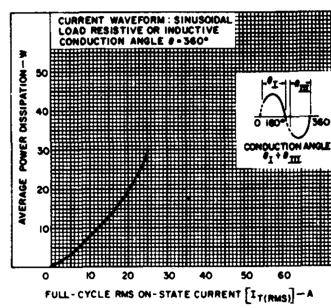


Fig. 3 — Power dissipation vs. on-state current for 2N5806-2N5809.

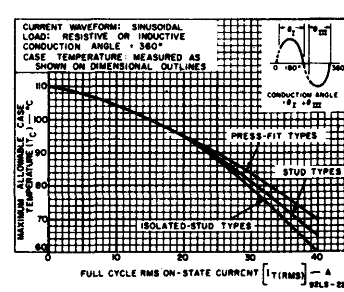


Fig. 4 — Maximum allowable case temperature vs. on-state current for 2N5441-46, and 6420 series.

T6400, T6401, T6410, T6411, T6420, T6421 Series (Includes 2N5441-2N5446, 2N5806-2N5809)

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTICS	SYMBOL	LIMITS MIN.	TYP.	MAX.	UNITS
DC Gate-Trigger Voltage: ♠♦					
v_D = 12 V (dc), R_L = 25Ω					
Triggering Modes I+, III−, I− (25-A types), T_C = 25°C	V_{GT}	–	2	2.5	V
= −40°C		–	2.6	4*	
Triggering Modes III+ (25-A types), T_C = 25°C		–	3	4	
v_D = 12 V (dc), R_L = 1 kΩ, Triggering Modes I+, III−, I− (25-A types): T_C = 115°C		0.15	–	–	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time)					
v_D = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs, i_T = 60 A (peak), T_C = 25°C (40-A types)	t_{gt}	–	1.7	3	μs
v_D = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs, i_T = 45 A (peak), T_C = 25°C (30-A types)		–	1.7	3	
v_D = V_{DROM}, I_{GT} = 150 mA, t_r = 0.1 μs, i_T = 60 A (peak), T_C = 25°C (25-A types)		–	1.6	–	
Thermal Resistance, Junction-to-Case: Steady-State					
Press-fit types	$R_{\theta JC}$	–	–	0.8*	°C/W
Stud types		–	–	0.9*	
Stud types (25-A types only)		–	1	1.23*	
Isolated-stud types		–	–	1	
Transient (Press-fit & stud types)			See Fig. 24		
Thermal Resistance, Junction-to-Ambient Steady-State (25-A types only)	$R_{\theta JA}$	–	–	50*	

* In accordance with JEDEC registration data format (JS-14, RDF 2) field for the JEDEC (2N-Series) types.
♠ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
♦ For either polarity of gate voltage (V_G) with reference to main terminal 1.

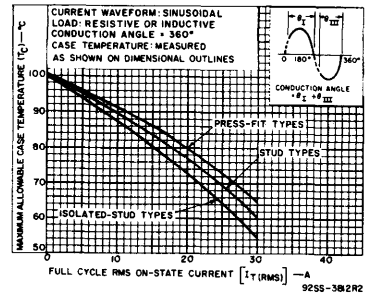


Fig. 5 — Maximum allowable case temperature vs. on-state current for T6401, T6411, T6421 series.

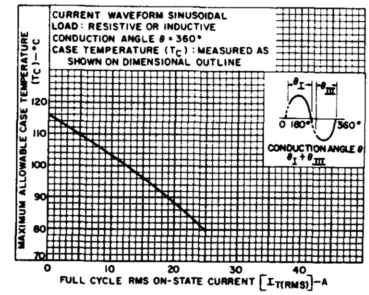


Fig. 6 — Maximum allowable case temperature vs. on-state current for 2N5806-2N5809.

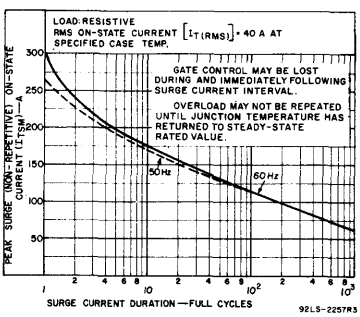


Fig. 7 — Peak surge on-state current vs. surge current duration for 2N5441-46, and T6420 series.

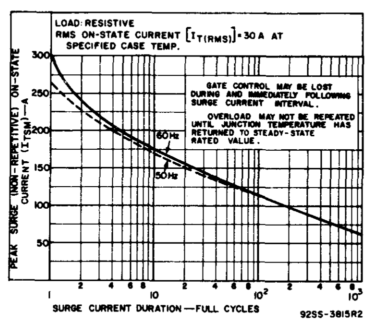


Fig. 8 — Peak surge on-state current vs. surge current duration for T6401, T6411, T6421 series.

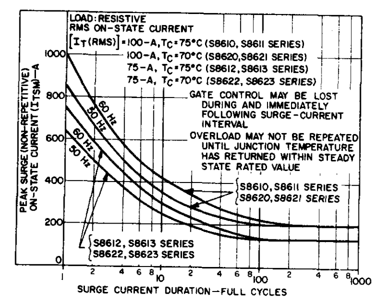


Fig. 9 — Peak surge on-state current vs. surge current duration for 2N5806-2N5809.

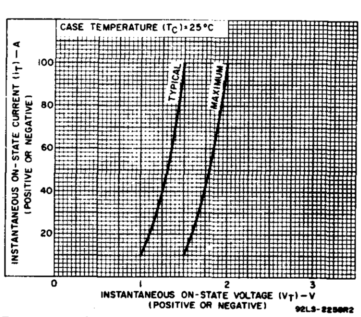


Fig. 10 — On-state current vs. on-state voltage for 2N5441-46, and T6420 series.

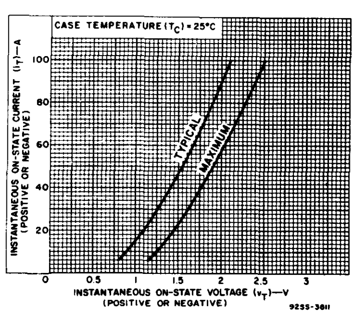


Fig. 11 — On-state current vs. on-state voltage for T6401, T6411, T6421 series.

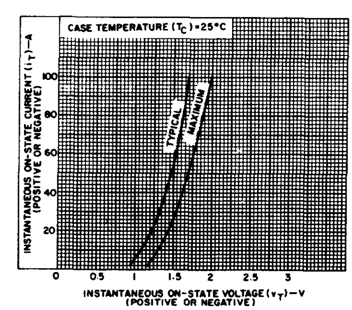


Fig. 12 — On-state current vs. on-state voltage for 2N5806-2N5809.

T6400, T6401, T6410, T6411, T6420, T6421 Series (Includes 2N5441-2N5446, 2N5806-2N5809)

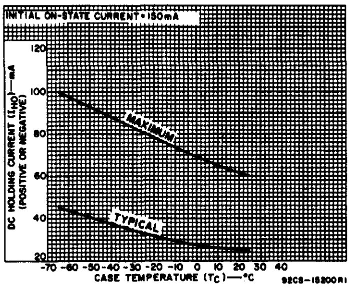


Fig. 13 – DC holding current vs. case temperature for 2N5441-46, T6420, T6401, T6411, T6421 series.

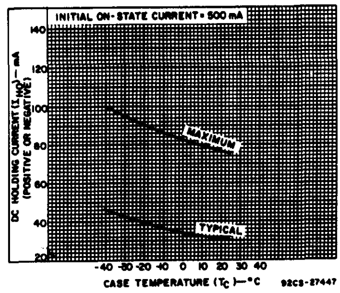


Fig. 14 – DC holding current vs. case temperature for 2N5806-2N5809 series.

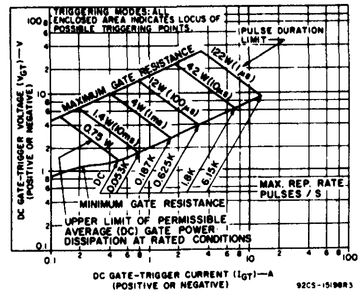


Fig. 15 – Gate-trigger characteristics and limiting conditions for determination of permissable gate-trigger pulses for 2N5441-46, T6420, T6401, T6411, T6421 series.

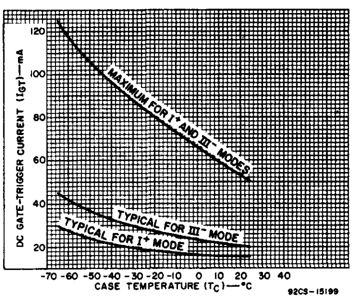


Fig. 16 – DC gate-trigger current vs. case temperature (1+ & III− modes) for 2N5441-46, T6420, T6401, T6411, T6421 series.

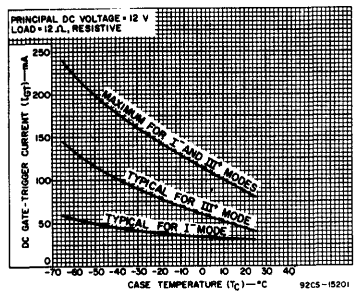


Fig. 17 – DC gate-trigger current vs. case temperature (I− & III+ modes) for 2N5441-46, T6420, T6401, T6411, T6421 series.

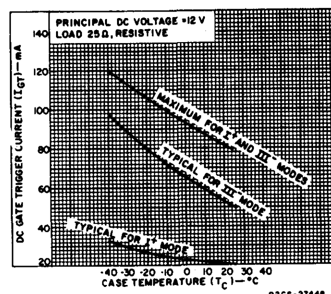


Fig. 18 – DC gate-trigger current vs. case temperature (1+ & III− modes) for 2N5806-2N5809.

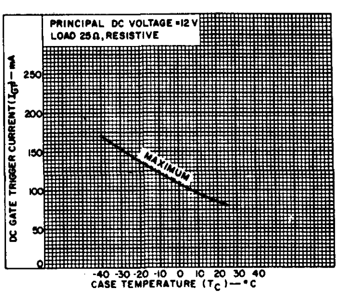


Fig. 19 – DC gate-trigger current vs. case temperature (1− mode) for 2N5806-2N5809.

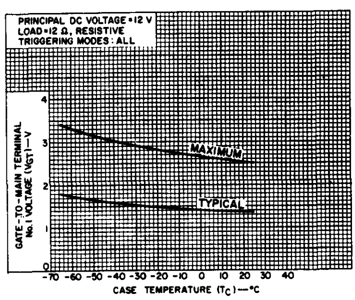


Fig. 20 – DC gate-trigger voltage vs. case temperature for 2N5441-46, T6420, T6401, T6411, T6421 series.

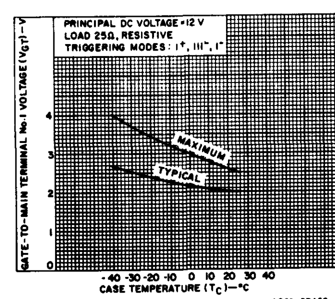


Fig. 21 – DC gate-trigger voltage vs. case temperature for 2N5806-2N5809.

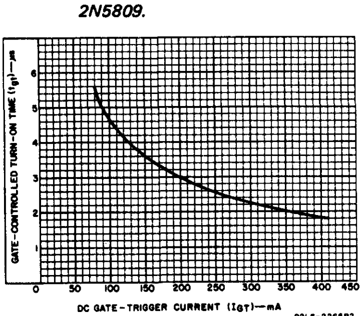


Fig. 22 – Turn-on time vs. gate-trigger current for 2N5441-46, T6420, T6401, T6411, T6421 series.

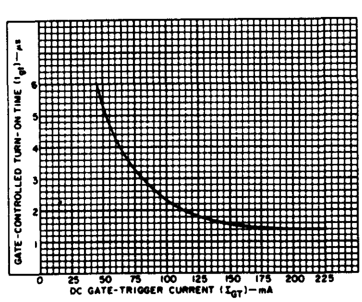


Fig. 23 – Typical turn-on time vs. gate-trigger current for 2N5806-2N5809.

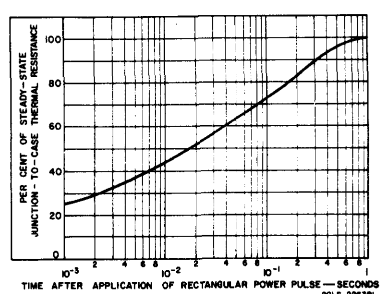


Fig. 24 – Transient junction-to-case thermal resistance vs. time for press-fit and stud types.

T6404, T6405, T6414, T6415 Series

400-Hz, 25 & 40-A Silicon Triacs

For Control-Systems Application in Airborne and Ground-Support Type Equipment

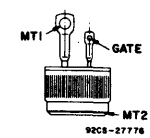
These RCA triacs are gate-controlled full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative gate triggering voltages.

They are intended for operation at 400 Hz with resistive or inductive loads and nominal line voltages of 115 and 208 V RMS sine wave and repetitive peak off-state voltages of 200 V and 400 V.

These triacs exhibit commutating voltage (dv/dt) capability at high commutating current (di/dt). They can also be used in 60-Hz applications where high commutating capability is required.

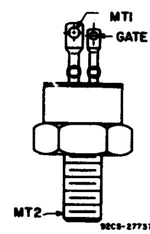
Features:
- RMS On-State Current – $I_{T(RMS)}$ = 25A: T6405 and T6415 Series = 40A: T6404 and T6414 Series
- Commutating dv/dt Capability Characterized at 400 Hz
- Shorted-Emitter Center-Gate Design
- di/dt Capability = 100 A/μs

TERMINAL CONNECTIONS



T6404 Series
T6405 Series

Press-fit



T6414 Series
T6415 Series

Stud

MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at 400 Hz and with Resistive or Inductive Load.

		T6404B T6405B T6414B T6415B	T6404D T6405D T6414D T6415D	T6404E T6405E – –	
REPETITIVE PEAK OFF-STATE VOLTAGE:* Gate open, T_J = −50 to 110° C	V_{DROM}	200	400	500	V
RMS ON-STATE CURRENT (Conduction Angle = 360°):	$I_{T(RMS)}$				
Case temperature					
T_C = 85° C (T6405 Series)			25		A
80° C (T6415 Series)			25		A
70° C (T6404 Series)			40		A
65° C (T6414 Series)			40		A
For other conditions			See Fig. 2		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}				
For one cycle of applied principal voltage, T_C as above					
400 Hz (sinusoidal)			600		A
60 Hz (sinusoidal)			300		A
50 Hz (sinusoidal)			265		A
For more than one cycle of applied principal voltage			See Fig. 3		
RATE-OF-CHANGE OF ON-STATE CURRENT: $V_{DM} = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs	di/dt		100		A/μs
FUSING CURRENT (for Triac Protection): T_J = −50 to 110° C, t = 1.25 to 10 ms	I^2t		270		A^2s
PEAK GATE-TRIGGER CURRENT:■ For 1 μs max. (See Fig. 7)	I_{GTM}		12		A
GATE POWER DISSIPATION:					
Peak (For 10 μs max., $I_{GTM} \leq$ 4 A (peak), (See Fig. 7)	P_{GM}		42		W
Average	$P_{G(AV)}$		0.75		W
TEMPERATURE RANGE:▲					
Storage	T_{stg}		−50 to 150		°C
Operating (Case)	T_C		−50 to 110		°C
TERMINAL TEMPERATURE (During soldering): For 10 s max. (terminals and case)	T_T		225		°C
STUD TORQUE:					
Recommended	τ_s		35		in.-lb
Maximum (DO NOT EXCEED)			50		in.-lb

* For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■ For either polarity of gate voltage (V_G) with reference to main terminal 1.
▲ For temperature measurement reference point, see Dimensional Outline.

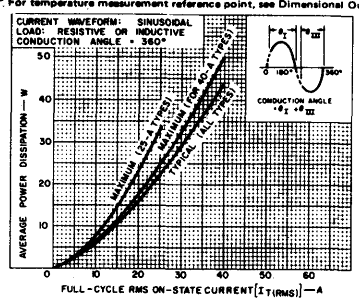


Fig. 1—Power dissipation vs. on-state current.

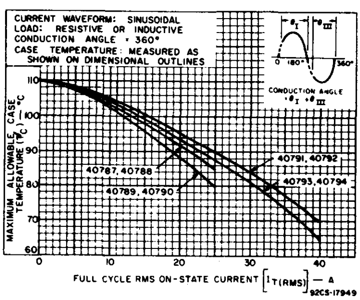


Fig. 2—Maximum allowable case temperature vs. on-state current.

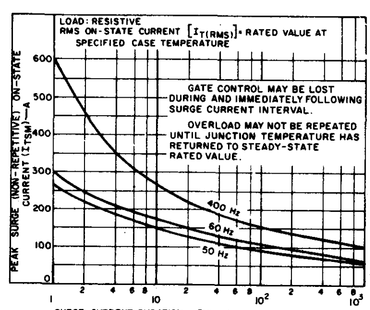


Fig. 3—Peak surge on-state current vs. surge current duration.

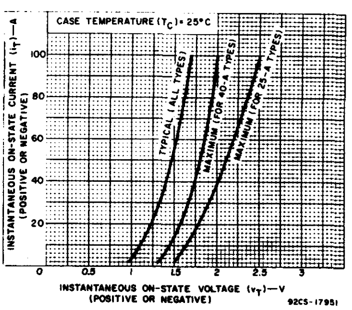


Fig. 4—On-state current vs. on-state voltage.

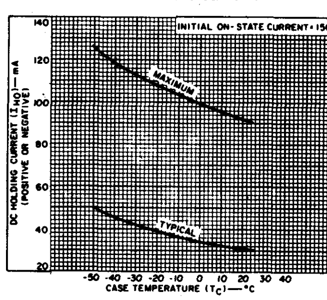


Fig. 5—DC holding current vs. case temperature.

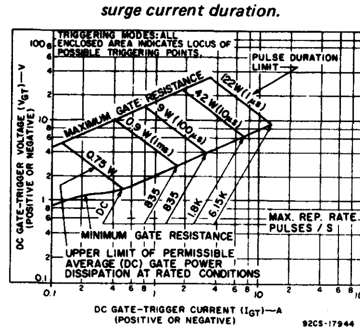


Fig. 6—Gate-trigger characteristics and limiting conditions for determination of permissible gate-trigger pulses.

T6404, T6405, T6414, T6415 Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS Min.	LIMITS Typ.	LIMITS Max.	UNITS
Peak Off-State Current:♠ Gate open, T_J = 110° C, V_{DROM} = Max. rated value	I_{DROM}	–	0.2	4	mA
Maximum On-State Voltage:♠ For i_T = 100 A (peak), T_C = 25° C:	V_{TM}				V
T6405 & T6415 Series		–	1.7	2.5	
T6404 & T6414 Series		–	1.7	2	
DC Holding Current:♠ Gate open, Initial principal current = 500 mA (DC), v_D = 12 V, T_C = 25° C	I_{HO}	–	30	90	mA
For other case temperatures			See Fig. 5		
Critical Rate-of-Rise of Commutation Voltage:♠ For v_D = V_{DROM}, $I_{T(RMS)}$ = rated value, gate unenergized,	dv/dt				V/μs
Commutating di/dt = 88 A/ms, T_C = 85° C (T6405 Series)		2	–	–	
= 80° C (T6415 Series)		2	–	–	
Commutating di/dt = 141 A/ms, T_C = 70° C (T6404 Series)		2	–	–	
= 65° C (T6414 Series)		2	–	–	
Critical Rate-of-Rise of Off-State Voltage:♠ For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 110° C:	dv/dt				V/μs
T6405 & T6415 Series		30	150	–	
T6404 & T6414 Series		50	200	–	
DC Gate-Trigger Current:♠† For v_D = 12 V (DC), R_L = 30 Ω, T_C = 25° C — Mode / V_{MT2} / V_G	I_{GT}				mA
I^+ positive positive		–	20	80	
III^- negative negative		–	50	80	
I^- positive negative		–	80	120	
III^+ negative positive		–	80	120	
For other case temperatures			See Figs. 7 & 8		
DC Gate-Trigger Voltage:♠† For v_D = 12 V(DC), R_L = 30 Ω, T_C = 25° C	V_{GT}	–	2	3	V
For other case temperatures			See Fig. 9		
For v_D = V_{DROM}, R_L = 125 Ω, T_C = 110° C		0.2	–	–	
Gate-Controlled Turn-On Time: (Delay Time + Rise Time) For v_D = V_{DROM}, I_{GT} = 150 mA, t_r = 0.1 μs, i_T = 60 A (peak), T_C = 25° C (See Fig. 10)	t_{gt}	–	1.6	2.5	μs
Thermal Resistance, Junction-to-Case: Steady-State	θ_{J-C}				°C/W
Press-fit types		–	–	0.8	
Stud		–	–	0.9	
Transient (Press-fit & stud types)			See Fig. 12		

♠ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
† For either polarity of gate voltage (V_G) with reference to main terminal 1.

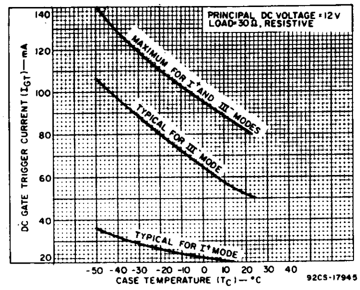


Fig. 7—DC gate-trigger current vs. case temperature (I^+ and III^- modes).

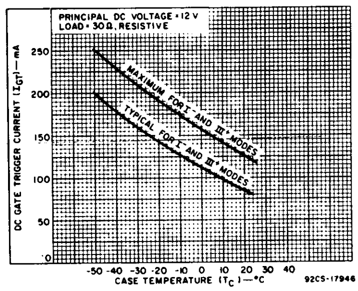


Fig. 8—DC gate-trigger current vs. case temperature (I^- and III^+ modes).

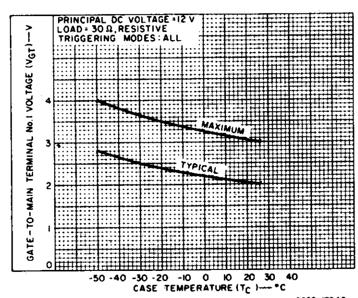


Fig. 9—DC gate-trigger voltage vs. case temperature.

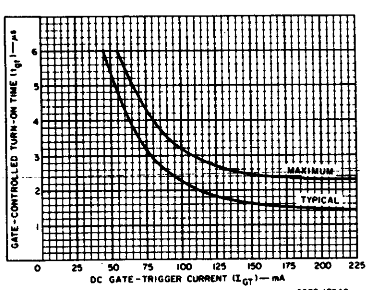


Fig. 10—Turn-on time vs. gate-trigger current.

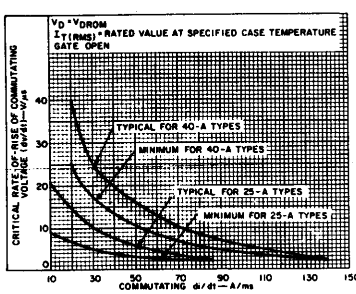


Fig. 11—Commutating voltage vs. commutating current.

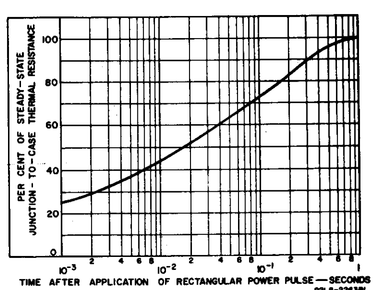


Fig. 12—Transient junction-to-case thermal resistance vs. time.

T8411, T8421 Series

60-A Silicon Triacs

Stud and Isolated-Stud "Overmolded" Packages
For General Purpose AC Power Switching

The RCA-T8411 and T8421 series triacs are gate-controlled full-wave silicon ac switches. They are designed to switch from an off-state to an on-state for either polarity of applied voltage with positive or negative-gate-triggering voltages. The T8411 and T8421 series are 60-A triacs.

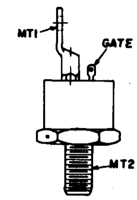
These triacs are intended for control of ac loads in applications such as heating controls, motor controls, arc-welding equipment, light dimmers, and power switching systems. They can also be used in airconditioning and photocopying equipment.

The T8411 series employ a stud "overmolded" package. The T8421 series employ an isolated-stud "overmolded" package.

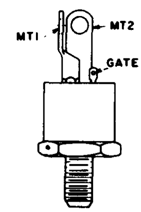
Features:

- di/dt Capability = 300 A/μs
- Shorted-Emitter Center-Gate Design
- Low Switching Losses
- Low On-State Voltage at High Current Levels
- Low Thermal Resistance
- 2.5 kV RMS Isolation (Isolated-Stud Types)

TERMINAL CONNECTIONS



T8411 Series
Stud "overmolded" types



T8421 Series
Isolated-Stud "overmolded" types

MAXIMUM RATINGS, ***Absolute-Maximum Values:***
For Operation with Sinusoidal Supply Voltage at Frequencies Up to 50/60 Hz and with Resistive or Inductive Load.

	T8411F T8421F	T8411B T8421B	T8411D T8421D	T8411M T8421M	T8411E T8421E	
V_{DROM}▲:						
Gate open, T_J = −40 to 110°C	50	200	400	600	500	V
$I_{T(RMS)}$ (θ = 360°):						
T_C = 80°C (T8411 series – Stud types)			60			A
= 75°C (T8421 series – Isolated-Stud types)			60			A
For other conditions			See Fig. 2			
I_{TSM}:						
For one cycle of applied principal voltage						
60 Hz (sinusoidal), $I_{T(RMS)}$ and T_C as above for T8411, 21 series			700			A
50 Hz (sinusoidal), $I_{T(RMS)}$ and T_C as above for T8411, 21 series			600			A
For more than one cycle of applied principal voltage			See Fig. 3			
di/dt:						
V_{DM} = V_{DROM}, I_{GT} = 300 mA, t_r = 0.1 μs			300			A/μs
I^2t: [At T_C shown for $I_{T(RMS)}$]:						
t = 20 ms						
T8411, T8421 series			2700			A^2s
t = 2.5 ms						
T8411, T8421 series			1350			A^2s
t = 0.5 ms						
T8411, T8421 series			800			A^2s
I_{GTM}●:						
For 10 μs max. (See Fig. 6)			7			A
P_{GM}:						
Peak (For 10 μs max., I_{GTM} ≤ 7 A (peak), (See Fig. 6)			42			W
$P_{G(AV)}$			0.75			W
T_{stg}			−40 to 150			°C
T_C			−40 to 110			°C
T_T■:						
During soldering for 10 ms maximum (terminals and case)			225			°C
τ_s:						
Recommended			125			in-lb
			1.44			kgf-m
Maximum (DO NOT EXCEED)			150			in-lb
			1.73			kgf-m

▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.
■ For temperature measurement reference point, see Dimensional Outline.

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

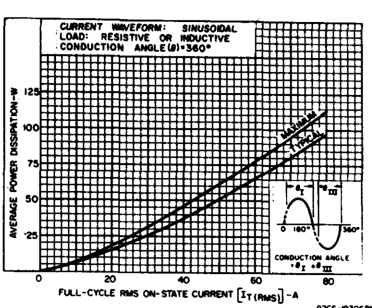


Fig. 1 – Power dissipation vs. on-state current for T8411 and T8421 series.

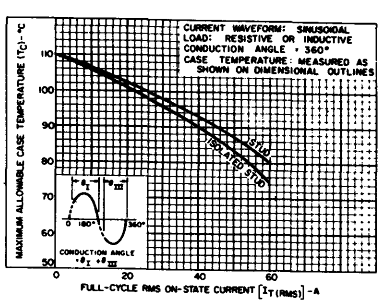


Fig. 2 – Maximum allowable case temperature vs. on-state current for T8411 and T8421 series.

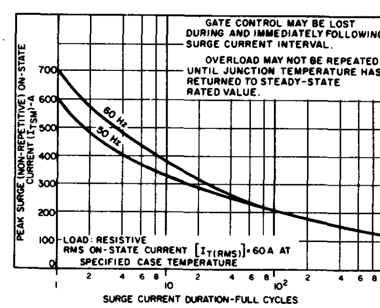


Fig. 3 – Peak surge on-state current vs. surge current duration for T8411 and T8421 series.

T8411, T8421 Series

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTIC	LIMITS			UNITS
	FOR ALL TYPES Except as Specified			
	Min.	Typ.	Max.	
I_{DROM}▲: Gate open, T_J = 110°C, V_{DROM} = Max. rated value	—	0.4	4	mA
V_{TM}▲:				V
i_T = 200 A (peak), T_C = 25°C	–	1.75	2	
i_T = 100 A (peak), T_C = 25°C	–	1.55	1.8	
I_{HO}▲: Gate open, Initial principal current = 500 mA (dc), v_D = 12 V				mA
T_C = 25°C	–	40	60	
= −40°C	–	–	85	
For other case temperatures *See Fig. 5*				
dv/dt (Commutating)▲: v_D = V_{DROM}, $I_{T(RMS)}$ = 60 A, commutating di/dt = 32 A/ms, gate unenergized				V/µs
T_C = 80°C (Stud types – T8411 series)	3	10	–	
= 75°C (Isolated-stud types – T8421 series)	3	10	–	
dv/dt (Off-State)▲: v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 110°C:				V/µs
T8411B, T8421B	50	200	–	
T8411D, T8421D	30	150	–	
T8411M, T8421M	20	100	–	
I_{GT}▲●: v_D = 12 V dc, R_L = 30Ω, T_C = 25°C				mA
Mode / V_{MT2} / V_G				
I⁺ positive positive	–	20	75	
III⁻ negative negative	–	40	75	
I⁻ positive negative	–	40	150	
III⁺ negative positive	–	100	150	
v_D = 12 V dc, R_L = 30Ω, T_C = −40°C				
Mode / V_{MT2} / V_G				
I⁺ positive positive	–	35	150	
III⁻ negative negative	–	80	150	
I⁻ positive negative	–	100	400	
III⁺ negative positive	–	280	400	
For other case temperatures *See Figs. 7 & 8*				
V_{GT}▲●: v_D = 12 V dc, R_L = 30Ω, T_C = 25°C	–	1.35	2.5	V
For other case temperatures *See Fig. 9*				
t_{gt}: v_D = V_{DROM}, I_{GT} = 300 mA, t_r = 0.1 µs, T_C = 25°C, i_T = 85 A(peak) (T8411, T8421 series)	–	1.2	2.5	µs
$R_{\theta JC}$: Steady-State				°C
Stud types	–	–	0.35	
Isolated-stud types	–	–	0.4	
Transient *See Fig. 11*				

▲ For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
● For either polarity of gate voltage (V_G) with reference to main terminal 1.
■ For temperature measurement reference point, see Dimensional Outline.

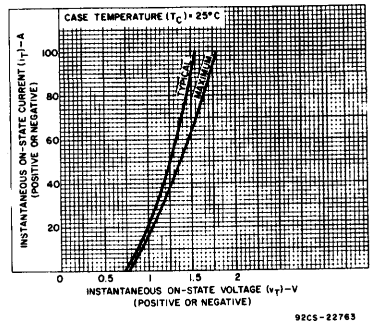


Fig. 4 – On-state current vs. on-state voltage for T8411 and T8421 series.

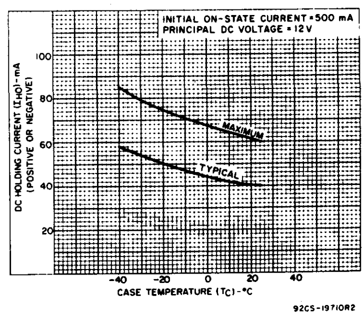


Fig. 5 – DC holding current vs. case temperature for T8411 and T8421 series.

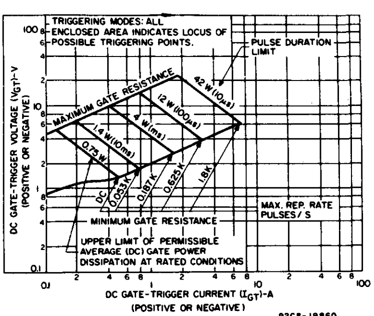


Fig. 6 – Gate-trigger characteristics and limiting conditions for determination of permissible gate-trigger pulses for T8411 and T8421.

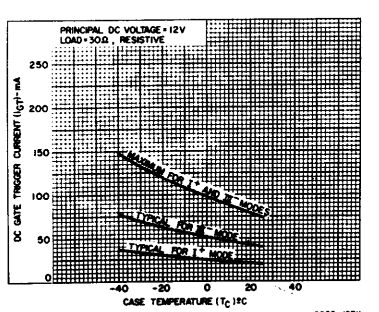


Fig. 7 – DC gate-trigger current vs. case temperature (I⁺ and III⁻ modes) for T8411 and T8421 series.

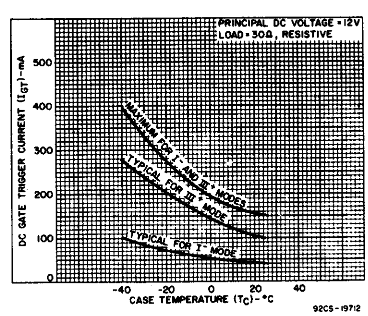


Fig. 8 – DC gate-trigger current vs. case temperature (I⁻ and III⁺ modes) for T8411 and T8421 series.

T8411, T8421 Series

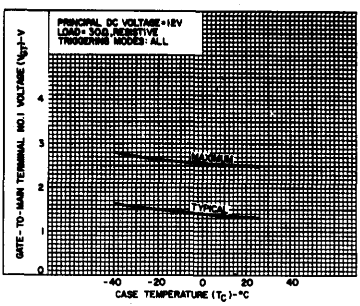


Fig. 9 — DC gate-trigger voltage vs. case temperature for T8411 and T8421 series.

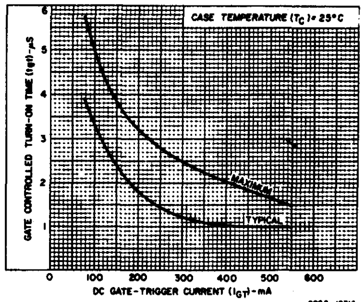


Fig. 10 — Turn-on time vs. gate-trigger current for T8411 and T8421 series.

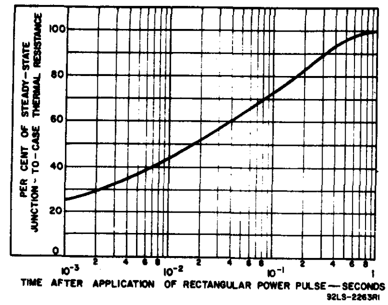


Fig. 11 — Transient junction-to-case thermal resistance vs. time for T8411 and T8421 series.

Zero-Voltage-Switched Types

2.5-40 A, 100-600 V Silicon Triacs for Use With IC Zero-Voltage Switches

For Power-Control and Switching Applications at 50-60 Hz with RCA-CA3058, CA3059, or CA3079 IC as Trigger Circuits

The triacs listed below are gate-controlled full-wave ac switches intended for load-control applications. They are especially useful in ac circuits for heating controls (proportional or on-off), lamp switching, motor switching, and a wide variety of other power-control applications.

These devices have gate characteristics which assure that an RCA-CA3058, CA3059, or CA3079 integrated circuit can supply sufficient drive current to trigger them over their full operating-temperature range (−40°C to +85°C).

The RCA-CA3058, CA3059, and CA3079 are monolithic silicon integrated-circuit zero-voltage switches which can operate directly from the ac line. They are designed to drive the triac gate directly and provide the gating signal at zero-voltage crossings for minimum radio-frequency interference.

These triacs have rms on-state current ratings that range from 2.5 to 40 amperes, and repetitive off-state voltage ratings from 100 to 600 volts. They are supplied in a variety of packages.

Technical information on RCA-CA3058, CA3059, and CA3079 is contained in bulletin File No. 490. For detailed application information, see Application Note ICAN-6182, "Features and Application of RCA Integrated-Circuit Zero-Voltage Switches".

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

RATINGS AND CHARACTERISTICS

All types, at case temperature (T_C) = 25°C, I^+ and III^+ triggering modes,▲ I_{GT} = 45 mA max., V_{GT} = 1.5 V max.

Type No.	Rep. Peak Off-State Voltage V_{DROM} (V)	RMS On-State Current $I_{T(RMS)}$ (A)	at Case Temp. (°C)	Typ. DC Holding Current at 25°C, I_{HO} (mA)	Package	For additional data, see Basic Family Types*
T2306A	100	2.5	70	6	Mod. TO-5	T2300
T2306B	200	2.5	70	6		
T2306D	400	2.5	70	6		
T2316A	100	2.5	70	6	Mod. TO-5 on Heat Radiator	T2310
T2316B	200	2.5	70	6		
T2316D	400	2.5	70	6		
T2506B	200	6	80	15	TO-220AB	T2500
T2506D	400	6	80	15		
T2706B	200	6	75	15	TO-66	T2700
T2706D	400	6	75	15		
T2716B	200	6	75	15	TO-66 with Heat Radiator	T2710
T2716D	400	6	75	15		
T2806B	200	8	80	15	TO-220AB	T2800
T2806C	300	8	80	15		
T2806D	400	8	80	15		
T2806M	600	8	80	15		
T2856B	200	8	75	15	Isolated-Tab	T2850
T2856C	300	8	75	15		
T2856D	400	8	75	15	TO-220AB	
T4106B	200	15	80	20	Press-fit	T4100
T4106D	400	15	80	20		
T4106M	600	15	80	20		
T4107B	200	10	85	15	Press-fit	T4101
T4107D	400	10	85	15		
T4107M	600	10	85	15		
T4116B	200	15	80	20	Stud	T4110
T4116D	400	15	80	20		
T4116M	600	15	80	20		
T4117B	200	10	85	15	Stud	T4111
T4117D	400	10	85	15		
T4117M	600	10	85	15		
T4126B	200	15	75	20	Isolated Stud	T4120
T4126D	400	15	75	20		
T4126M	600	15	75	20		
T4127B	200	10	85	15	Isolated Stud	T4121
T4127D	400	10	85	15		
T4127M	600	10	85	15		
T6406B	200	40	70	45	Press-fit	T6404
T6406D	400	40	70	45		
T6406E	500	40	70	45		
T6406M	600	40	70	45		
T6407B	200	30	65	25	Press-fit	T6401
T6407D	400	30	65	25		
T6407E	500	30	65	25		
T6407M	600	30	65	25		
T6426B	200	40	60	25	Isolated Stud	T6420
T6426D	400	40	60	25		
T6426M	600	40	60	25		
T6427B	200	30	55	25	Isolated Stud	T6420
T6427D	400	30	55	25		
T6427M	600	30	55	25		

▲ A triac driven directly from the output terminal of the CA3058, CA3059, or CA3079 should be characterized for operation in the I^+ or III^+ triggering mode, i.e., with positive gate current (current flows into the gate for both polarities of the applied ac voltage).

* Except for gate characteristics, data for basic family types also apply to the types listed in this chart.

Silicon Controlled Rectifiers (SCR's)

Technical Data

C106, C107, C108 Series

4-A Sensitive-Gate Silicon Controlled Rectifiers

For Power-Switching and Control Applications

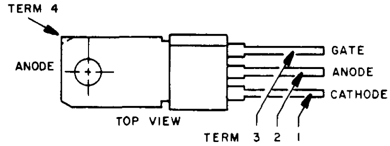
The RCA-C106,C107, and C108 series of sensitive-gate silicon controlled rectifiers are designed for switching ac and dc currents. These SCR's are divided into the three different series according to gate sensitivity. The types within each series differ in their voltage ratings; the voltage ratings are identified by suffix letters in the type designations.

These SCR's have microampere gate-current requirements which permit operation with low-level logic circuits. They can be used for lighting, power-switching, and motor-speed controls, and for gate-current amplification for driving larger SCR's.

All types in each series utilize the JEDEC-TO-202AB (RCA VERSATAB) plastic package.

Features:

- **Microampere gate sensitivity**
- **600-V capability**
- **5-A (rms) on-state current ratings**
- **30-A peak surge capability**
- **Glass-passivated chip for stability**
- **Low thermal resistances**
- **Surge capability curve**
- **Package and formed-lead options available**



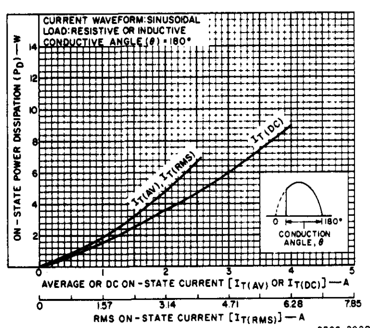
92CS-29320

JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

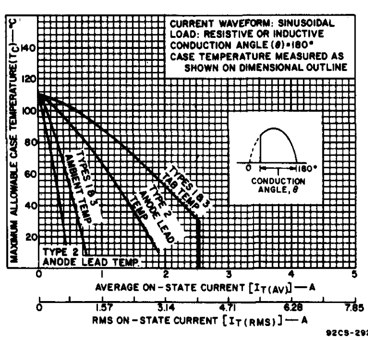
	C160Q C107Q C108Q	C106Y C107Y C108Y	C106F C107F C108F	C106A C107A C108A	C106B C107B C108B	C106C C107C C108C	C106D C107D C108D	C106E C107E C108E	C106M C107M C108M	
V_{RSXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C; V_{DSXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C	25	50	75	125	250	400	500	600	700	V
V_{RRXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C; V_{DRXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C	15	30	50	100	200	300	400	500	600	V

	C106 Series	C107 Series	C108 Series	
$I_{T(AV)}$ (T_C = 45°C, θ = 180°)	2.2	2	3.3	A
$I_{T(RMS)}$ (T_C = 45°C, θ = 180°)	3.5	3.14	5	A
$I_{T(DC)}$ (T_C = 70°C)	2.6	2.4	4	A
I_{TSM}: For one cycle of applied principal voltage, T_C = 45°C				
60 Hz (sinusoidal)	20	15	30	A
50 Hz (sinusoidal)	18.5	14	28	A
For more than one cycle of applied principal voltage		See Fig. 11		
I_{GM} (t = 10 μs)		0.2		A
V_{GRM}		6		V
di/dt: V_{DM}=V_{DROM}, I_{GT} = 1 mA, t_r = 0.5 μs, T_C = 110°C		100		A/μs
I^2t [At T_C shown for $I_{T(RMS)}$]: t = 10 ms	1.77	1	4	A^2s
8.33 ms	1.67	0.94	3.75	A^2s
1 ms	0.82	0.46	1.85	A^2s
P_{GM} (For 10 μs max.)		0.5		W
$P_{G(AV)}$ (Averaging time = 10 ms max.)		0.1		W
T_{stg}		−40 to +150		°C
T_C		−40 to +110		°C
T_T (During soldering for 10 s max.		250		°C



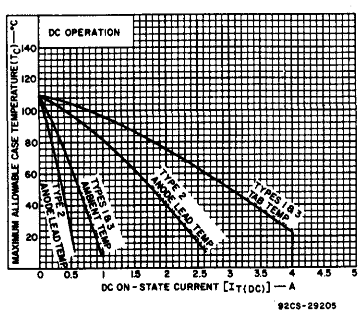
92CS-29203

Fig. 1 — Power dissipation as a function of average dc, or rms on-state current for C106 series.



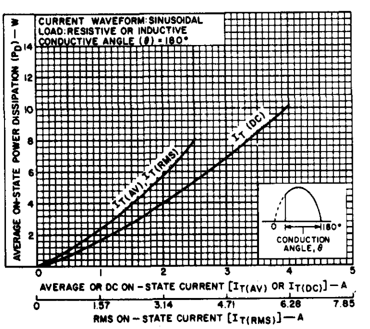
92CS-29204

Fig. 2 — Maximum allowable case temperature as a function of average or rms on-state current for C106 series.



92CS-29205

Fig. 3 — Maximum allowable case temperature as a function of dc on-state current for C106 series.



92CS-29206

Fig. 4 — Power dissipation as a function of average, dc, or rms on-state current for C107 series.

C106, C107, C108 Series

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	LIMITS FOR ALL TYPES UNLESS OTHERWISE SPECIFIED			UNITS
	Min.	Typ.	Max.	
I_{DRXM} or I_{RRXM}: $V_D = V_{DRXM}$ or $V_R = V_{RRXM}$, $R_{GK} = 1000\ \Omega$				
$T_C = 25°C$	–	0.1	10	μA
$T_C = 110°C$	–	10	100	μA
v_T:				
For $i_T = 4$ A and $T_C = 25°C$ (See Fig. 13) C106 Series	–	1.25	2.2	V
C107 Series	–	–	2.5	V
For $i_T = 5$ A and $T_C = 25°C$ (See Fig. 13) C108 Series	–	–	1.35	V
i_{HX}: $R_{GK}=1000\ \Omega$, $V_D=12$ V, $I_{T(INITIAL)}=50$ mA, $T_C=25°C$: All Series	–	1.7	3	mA
I_{LX}: $R_{GK} = 1000\ \Omega$, $V_D = 12$ V, $T_C = 25°C$:				
C106, C108 Series ($I_{GT} = 200\ \mu A$)	–	1.8	4	mA
C107 Series ($I_{GT} = 500\ \mu A$)	–	–	4	mA
dv/dt: $V_D=V_{DRXM}$, $R_{GK}=1000\ \Omega$, Exponential rise, $T_C=110°C$	–	8	–	V/μs
I_{GT}: $V_D=12$ V dc, $R_L=30\ \Omega$, $T_C=25°C$:				
C106, C108 Series	–	30	200	μA
C107 Series	–	–	500	μA
For other case temperatures.	See Figs. 18,19			
V_{GT}: $V_D = 12$ V dc, $R_L = 30\ \Omega$, $T_C = 25°C$	–	0.5	0.8	V
For other case temperatures.	See Fig. 20			
t_{gt}: $V_D = V_{DRXM}$, $i_T = 1$ A, $R_{GK} = 1000\ \Omega$, $I_{GT} = 1$ mA, Rise Time = 0.1 μs, $T_C = 25°C$.	–	1.7	2.5	μs
t_q: $V_D = V_{DRXM}$, $i_T = 1$ A, $R_{GK} = 1000\ \Omega$, Pulse Duration = 50 μs, dv/dt = 5 V/μs, di/dt = –10 A/μs, $I_{GT} = 1$ mA at turn-on, $T_C = 110°C$	–	30	100	μs
$R_{\theta JC}$	–	–	8	°C/W
$R_{\theta JA}$	–	–	60	°C/W

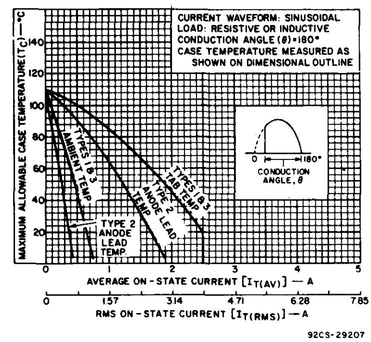


Fig. 5 — Maximum allowable case temperature as a function of average or rms on-state current for C107 series.

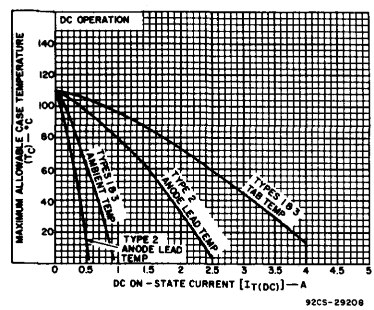


Fig. 6 — Maximum allowable case temperature as a function of dc on-state current for C107 series.

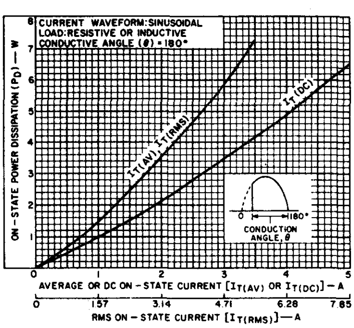


Fig. 7 — Power dissipation as a function of average, dc, or rms on-state current for C108 series.

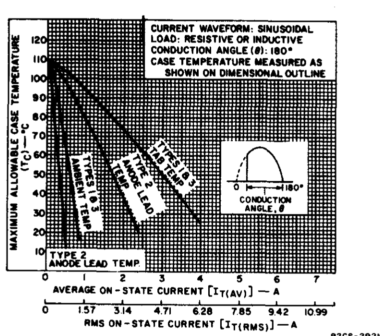


Fig. 8 — Maximum allowable case temperature as a function of average or rms on-state current for C108 series.

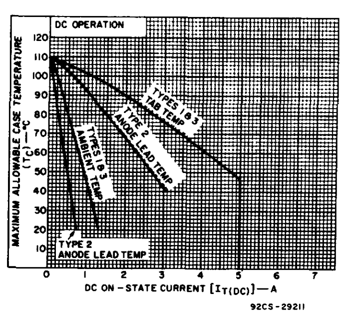


Fig. 9 — Maximum allowable case temperature as a function of dc on-state current for C108 series.

C106, C107, C108 Series

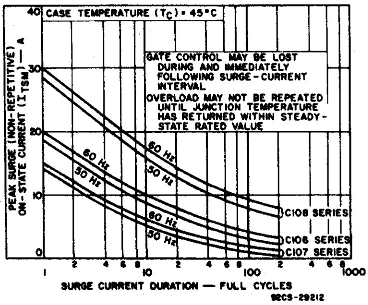


Fig. 10 — Peak surge on-state current as a function of surge current duration.

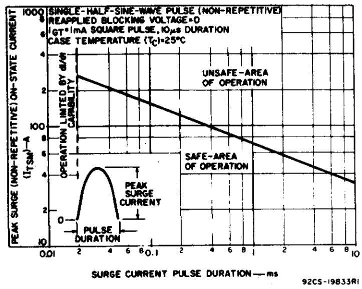


Fig. 11 — Surge capability without reapplied blocking voltage for all series.

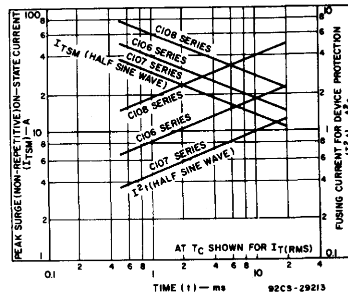


Fig. 12 — Peak surge on-state current and fusing current as a function of time.

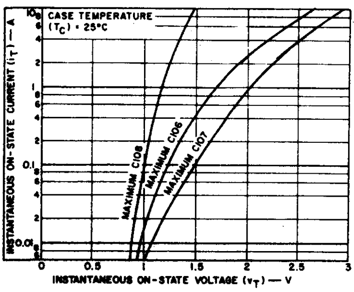


Fig. 13 — Maximum instantaneous on-state current as a function of on-state voltage.

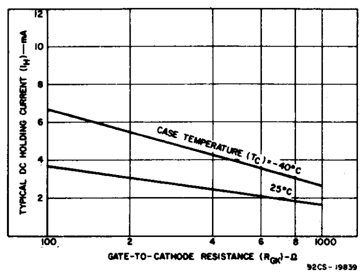


Fig. 14 — DC holding current as a function of gate-cathode resistance for the C106 series.

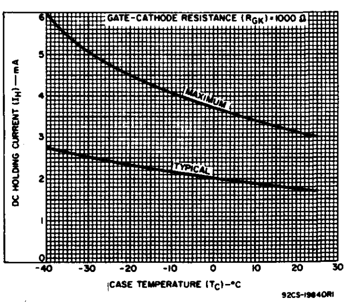


Fig. 15 — DC holding current as a function of case temperature for the C106 series.

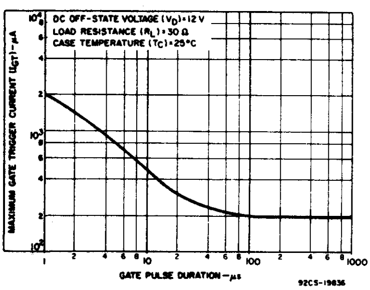


Fig. 16 — Maximum gate trigger current as a function of pulse duration for types in the C106 series.

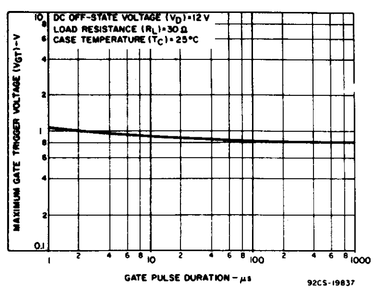


Fig. 17 — Maximum gate trigger voltage as a function of gate pulse duration for types in the C106 series.

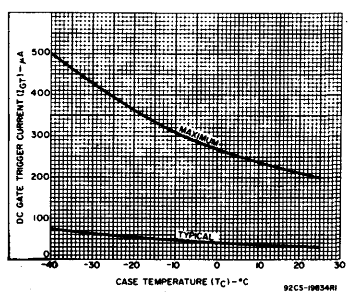


Fig. 18 — DC gate trigger current as a function of case temperature for C106 and C108 series.

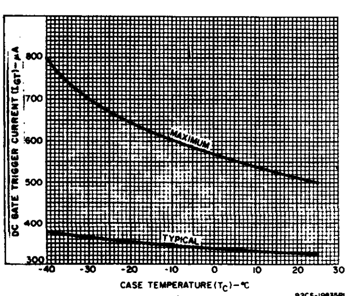


Fig. 19 — DC gate-trigger current as a function of case temperature for C107 series.

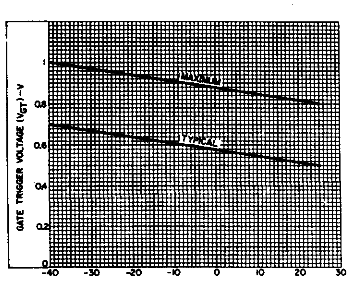


Fig. 20 — Gate trigger voltage as a function of case temperature for all series.

S106, S107 Series

4-A Sensitive-Gate Silicon Controlled Rectifiers

For Power Switching and Control Applications

The S106 and S107 series of sensitive-gate silicon controlled rectifiers are designed for switching ac and dc currents. These SCR's are divided into the three different series according to gate sensitivity. The types within each series differ in their voltage ratings; the voltage ratings are identified by suffix letters in the type designations.

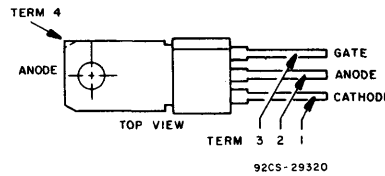
These thyristors have microampere gate-current requirements which permit operation with low-level logic circuits. They can be used for lighting, power-switching, and motor-speed controls, and for gate-current amplification for driving larger SCR's.

All types in each series utilize the JEDEC TO-202AB (RCA VERSATAB) plastic package.

Features:

- **Microampere gate sensitivity**
- **600-V capability**
- **4-A (rms) on-state current ratings**
- **20-A peak surge capability**
- **Glass-passivated chip for stability**
- **Low thermal resistances**
- **Surge capability curve**

TERMINAL DESIGNATIONS



JEDEC TO-202AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	S106Q S107Q	S106Y S107Y	S106F S107F	S106A S107A	S106B S107B	S106C S107C	S106D S107D	S106E S107E	S106M S107M	
V_{RSXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C; V_{DSXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C	25	50	75	125	250	400	500	600	700	V
V_{RRXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C; V_{DRXM}: R_{GK} = 1000 Ω, T_C = −40 to 110°C	15	30	50	100	200	300	400	500	600	V

Rating (all types)	Value	Unit
$I_{T(AV)}$ (T_C = 60°C, θ = 180°)	2.5	A
$I_{T(RMS)}$ (T_C = 60°C, θ = 180°)	4	A
$I_{T(DC)}$ (T_C = 70°C)	2.75	A
I_{TSM}: For one cycle of applied principal voltage, T_C=60°C		
60 Hz (sinusoidal)	20	A
50 Hz (sinusoidal)	17	A
For more than one cycle of applied principal voltage	See Fig. 5	
I_{GM} (t = 10 μs)	0.2	A
V_{GRM}	6	V
di/dt: V_{DM}=V_{DROM}, I_{GT} = 1 mA, t_r = 0.5 μs, T_C = 110°C	100	A/μs
I^2t (At T_C shown for $I_{T(RMS)}$): t = 10 ms	1.7	A^2s
1 ms	0.8	A^2s
P_{GM} (For 10 μs max.)	0.5	W
$P_{G(AV)}$ (Averaging time = 10 ms max.)	0.1	W
T_{stg}	−40 to +150	°C
T_C	−40 to +110	°C
T_T (During soldering for 10 s max.	250	°C

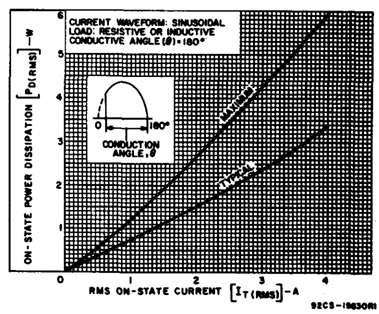


Fig. 1 — Power dissipation as a function of rms-on-state current for all series.

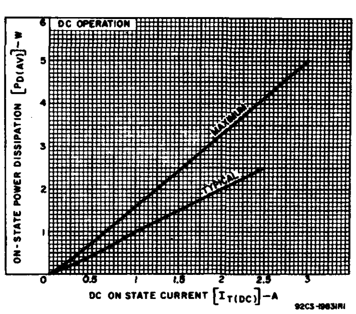


Fig. 2 — Power dissipation as a function of dc on-state current for all series.

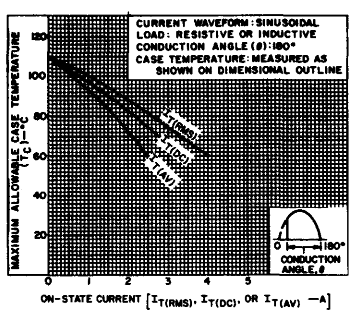


Fig. 3 — Maximum allowable case temperature as a function of on-state current for all series.

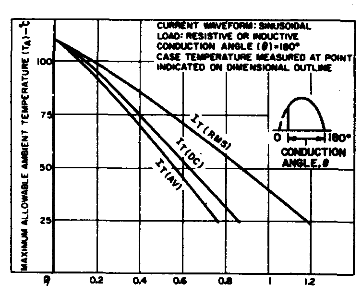


Fig. 4 — Maximum allowable ambient temperature as a function of on-state current for all series.

S106, S107 Series

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	LIMITS FOR ALL TYPES UNLESS OTHERWISE SPECIFIED			UNITS
	Min.	Typ.	Max.	
I_{DRXM} or I_{RRXM}:				
$V_D=V_{DRXM}$ or $V_R=V_{RRXM}$, $R_{GK}=1000\ \Omega$				
$T_C=25^oC$	–	0.1	10	μA
$T_C=110^oC$	–	10	100	
v_T:				
For i_T=4 A and T_C=25°C (See Fig. 9)	–	1.25	2.2	V
i_{HX}:				
$R_{GK}=1000\ \Omega$, V_D=12 V, $I_{T(INITIAL)}$=50 mA, T_C=25°C:				
S106 Series	–	1.7	3	
S107 Series	–	3.9	6	mA
i_{LX}:				
$R_{GK}=1000\ \Omega$, V_D=12 V, T_C=25°C:				
S106 Series (I_{GT}=200 μA)	–	1.8	4	
S107 Series (I_{GT}=500 μA)	–	2.5	8	mA
dv/dt:				
$V_D=V_{DRXM}$, $R_{GK}=1000\ \Omega$, Exponential rise, T_C=110°C	–	8	–	V/μs
I_{GT}:				
V_D=12 V dc, $R_L=30\ \Omega$, T_C=25°C:				
S106 Series	–	30	200	
S107 Series	–	–	500	μA
For other case temperatures	See Figs. 14, 15, 16			
V_{GT}:				
V_D=12 V dc, $R_L=30\ \Omega$, T_C=25°C	–	0.5	0.8	V
For other case temperatures	See Fig. 17			
t_{gt}:				
$V_D=V_{DRXM}$, i_T=1 A, $R_{GK}=1000\ \Omega$, I_{GT}=1 mA, Rise Time=0.1 μs, T_C=25°C	–	1.7	2.5	μs
t_q:				
$V_D=V_{DRXM}$, i_T=1 A, $R_{GK}=1000\ \Omega$, Pulse Duration=50 μs, dv/dt=5 V/μs, di/dt=–10 A/μs, I_{GT}=1 mA at turn-on, T_C=110°C	–	30	100	μs
$R_{\theta JC}$	–	–	8	°C/W
$R_{\theta JA}$	–	–	60	

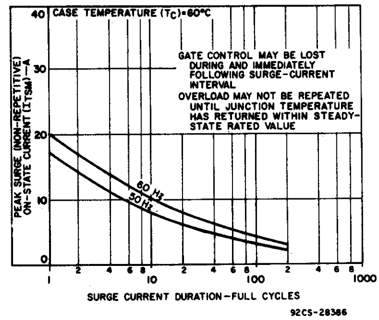


Fig. 5 – Peak surge on-state current as a function of surge-current duration for all series.

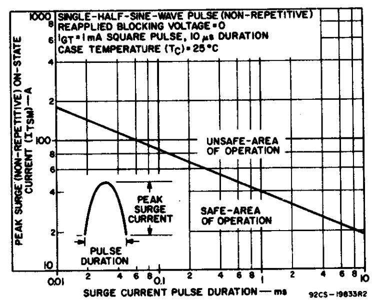


Fig. 6 – Surge capability without reapplied blocking voltage for all series.

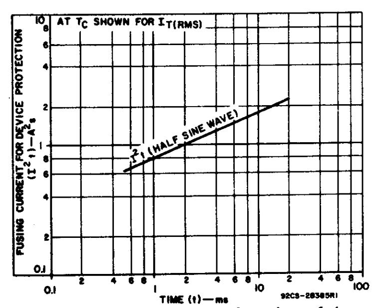


Fig. 7 – Fusing current as a function of time.

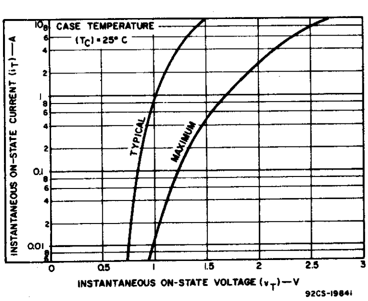


Fig. 8 – Instantaneous on-state current as a function of on-state voltage for all series.

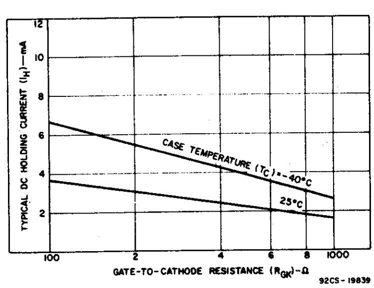


Fig. 9 – DC holding current as a function of gate-cathode resistance for the S106 series.

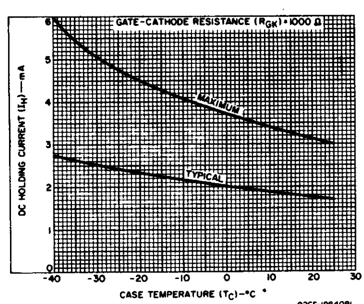


Fig. 10 – DC holding current as a function of case temperature for the S106 series.

S106, S107 Series

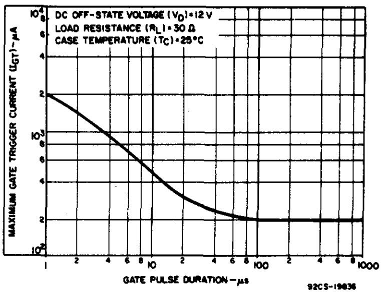


Fig. 11 – Maximum gate trigger current as a function of gate pulse duration for types in the S106 series.

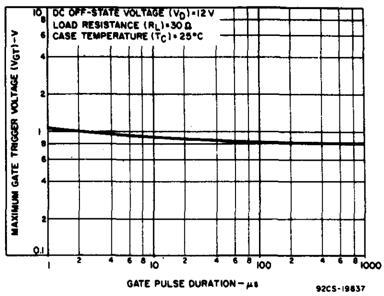


Fig. 12 – Maximum gate trigger voltage as a function of gate pulse duration for types in the S106 series.

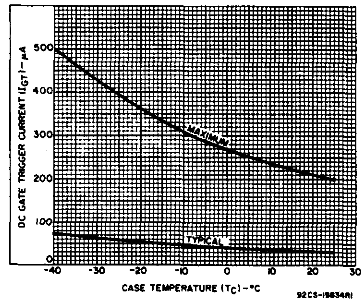


Fig. 13 – DC gate trigger current as a function of case temperature for S106 series.

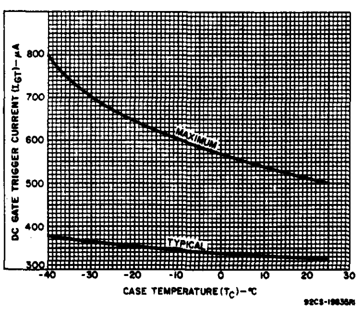


Fig. 14 – DC gate trigger current as a function of case temperature for S107 series.

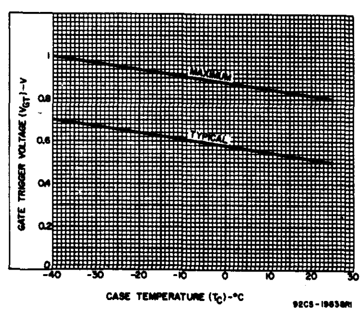


Fig. 15 – Gate trigger voltage as a function of case temperature for all series.

S2060, S2061, S2062 Series

4-A Sensitive-Gate Silicon Controlled Rectifiers

For Power Switching and Control Applications

The S2060, S2061, and S2062 series● are sensitive-gate silicon controlled rectifiers designed for switching ac and dc currents. These SCR's are divided into the three different series according to gate sensitivity. The types within each series differ in their voltage ratings; the voltage ratings are identified by suffix letters in the type designations.

These thyristors have microampere gate-current requirements which permit operation with low-level logic circuits. They can be used for lighting, power-switching, and motor-speed controls, and for gate-current amplification for driving larger SCR's.

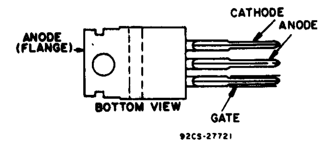
All types in each series utilize the JEDEC TO-220AB package. Upon request, each type is available in either of two variants of the TO-220AB package. For information on these package variations, contact the RCA Sales Office in your locale.

● Formerly the RCA106, RCA107, and RCA108 series.

Features:

- Microampere gate sensitivity
- Minimum gate current specified for the S2062 series
- 600-V capability
- 4-A (rms) on-state current ratings
- 35-A peak surge capability
- Glass-passivated chip for stability
- Low thermal resistances
- Surge capability curve

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		Suffix Letter Q	Y	F	A	B	C	D	E	M	
NON-REPETITIVE PEAK REVERSE VOLTAGE R_{GK} = 1000 Ω, T_C = -40 to 110°C	V_{RSXM}	25	50	75	125	250	400	500	600	700	V
NON-REPETITIVE PEAK OFF-STATE VOLTAGE R_{GK} = 1000 Ω, T_C = -40 to 110°C	V_{DSXM}										
REPETITIVE PEAK REVERSE VOLTAGE R_{GK} = 1000 Ω, T_C = -40 to 110°C	V_{RRXM}	15	30	50	100	200	300	400	500	600	V
REPETITIVE PEAK OFF-STATE VOLTAGE R_{GK} = 1000 Ω, T_C = -40 to 110°C	V_{DRXM}										
ON-STATE CURRENT: Conduction angle = 180°, T_C = 85°C											
Average ac value	$I_{T(AV)}$	2.5									A
RMS value	$I_{T(RMS)}$	4									A
DC operation	$I_{T(DC)}$	2.75									A
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT: For one cycle of applied principal voltage, T_C = 85°C	I_{TSM}										
60 Hz (sinusoidal)		35									A
50 Hz (sinusoidal)		28									A
60 Hz (sinusoidal)	I_{TSM}	35									A
For more than one cycle of applied principal voltage		See Fig. 5									
PEAK GATE CURRENT (t = 10 μsec)	I_{GM}	0.2									A
PEAK GATE REVERSE VOLTAGE	V_{RGM}	6									V
RATE OF CHANGE OF ON-STATE CURRENT: V_{DM} = V_{DROM}, I_{GT} = 1 mA, t_r = 0.5 μs, T_C = 110°C	di/dt	100									A/μs
FUSING CURRENT (for SCR protection): T_J = −40 to 110°C, t = 1 to 8.3 ms	I^2t	2.6									A^2s
GATE POWER DISSIPATION: PEAK FORWARD (for 10 μs max.)	P_{GM}	0.5									W
AVERAGE (averaging time = 10 ms max.)	$P_{G(AV)}$	0.1									W
TEMPERATURE RANGE: Storage	T_{stg}	-40 to +150									°C
Operating (case)*	T_C	-40 to +110									°C
TERMINAL TEMPERATURE (During soldering): For 10 s max.	T_T	250									°C

*Temperature measuring point is shown in the dimensional outline.

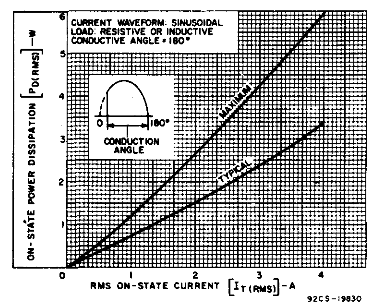


Fig. 1—Power dissipation vs. rms-on-state current for all series.

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	LIMITS FOR ALL TYPES UNLESS OTHERWISE SPECIFIED MIN.	TYP.	MAX.	UNITS
PEAK OFF-STATE CURRENT: Forward, V_D = V_{DRXM}, R_{GK} = 1000 Ω	I_{DRXM}				μA
T_C = 25°C		–	0.1	10	
T_C = 110°C		–	10	100	
Reverse, V_R = V_{RRXM}, R_{GK} = 1000 Ω	I_{RRXM}				
T_C = 25°C		–	0.1	10	
T_C = 100°C		–	10	100	
INSTANTANEOUS ON-STATE VOLTAGE: For i_T = 4 A and T_C = 25°C (See Fig. 7)	v_T	–	1.25	2.2	V
DC GATE TRIGGER CURRENT: V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C:	I_{GT}				μA
S2060 Series		–	–	200	
S2061 Series		–	–	500	
S2062 Series		100	–	2000	
For other case temperatures		See Figs. 10,11,12			
DC GATE TRIGGER VOLTAGE: V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C	V_{GT}	–	0.5	0.8	V
For other case temperatures		See Fig. 14			
INSTANTANEOUS HOLDING CURRENT: R_{GK} = 1000 Ω, V_D = 12 V, I_T (INITIAL) = 50 mA, T_C = 25°C:	i_H				mA
S2060 Series		–	1.7	3	
S2061 Series		–	3.9	6	
S2062 Series		–	6	10	

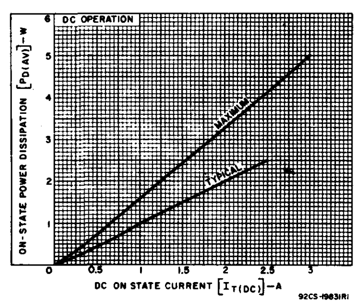


Fig. 2—Power dissipation vs. dc on-state current for all series.

S2060, S2061, S2062 Series

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	LIMITS FOR ALL TYPES UNLESS OTHERWISE SPECIFIED MIN.	TYP.	MAX.	UNITS
LATCHING CURRENT: R_{GK} = 1000 Ω, V_D = 12 V, T_C = 25°C:					
S2060 Series (I_{GT} = 200 μA)	i_L	–	1.8	4	mA
S2061 Series (I_{GT} = 500 μA)		–	2.5	8	
S2062 Series (I_{GT} = 2000 μA)		–	8	12	
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE: V_D = V_{DRXM}, R_{GK} = 1000 Ω, Exponential rise, T_C = 110°C	dv/dt	5	8	–	V/μs
GATE-CONTROLLED TURN-ON TIME: V_D = V_{DRXM}, i_T = 1 A, R_{GK} = 1000 Ω, I_{GT} = 1 mA, rise time = 0.1 μs, T_C = 25°C	t_{gt}	–	1.7	2.5	μs
CIRCUIT COMMUTATED TURN-OFF TIME: V_D = V_{DRXM}, i_T = 1 A, R_{GK} = 1000 Ω, Pulse Duration = 50 μs, dv/dt = 5 V/μs, di/dt = –10 A/μs, I_{GT} = 1 mA at turn on, T_C = 110°C	t_q	–	30	100	μs
THERMAL RESISTANCE: Junction-to-Case*	$R_{\theta JC}$	–	–	3.5	°C/W
Junction-to-Ambient	$R_{\theta JA}$	–	–	60	

* Temperature measuring point is shown in the dimensional outline.

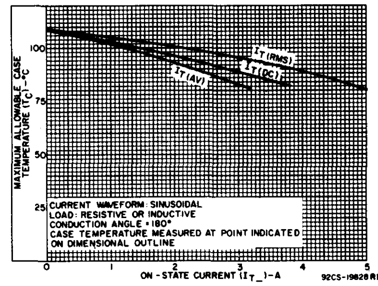


Fig. 3—Maximum allowable case temperature vs. on-state current for all series.

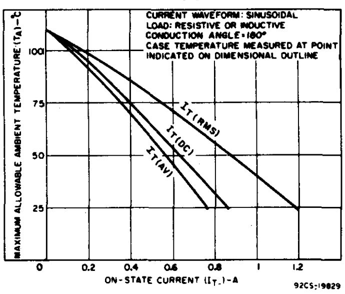


Fig. 4—Maximum allowable ambient temperature vs. on-state current for all series.

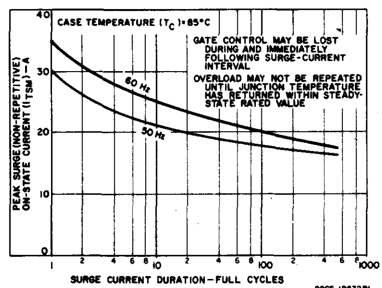


Fig. 5—Peak surge on-state current vs. surge-current duration for all series.

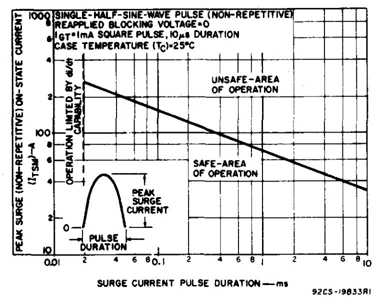


Fig. 6—Surge capability without reapplied blocking voltage for all series.

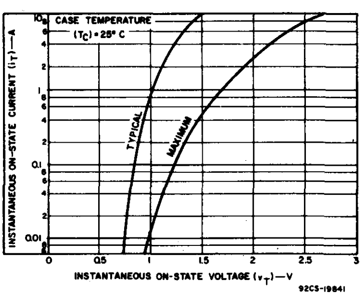


Fig. 7—Instantaneous on-state current vs. on-state voltage for all series.

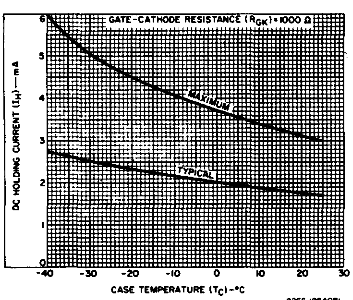


Fig. 8—DC holding current vs. case temperature for the S2060 series.

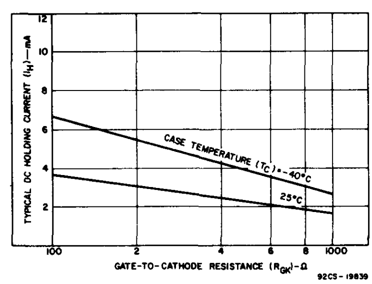


Fig. 9—DC holding current vs. gate-cathode resistance for the S2060 series.

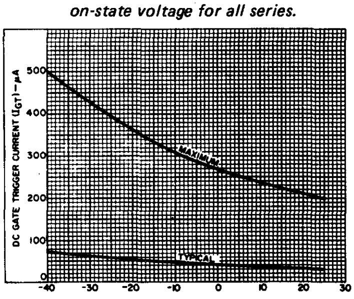


Fig. 10—DC gate-trigger current vs. case temperature for S2060 series.

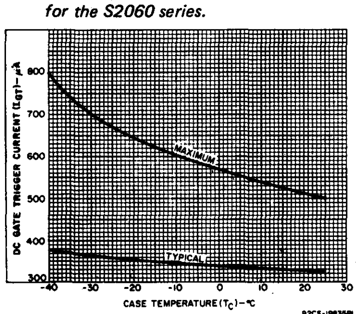


Fig. 11—DC gate-trigger current vs. case temperature for S2061 series.

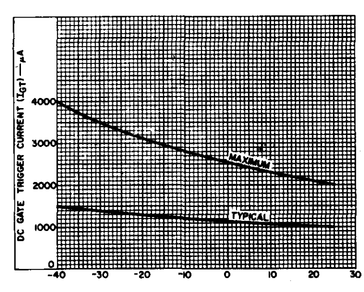


Fig. 12—DC gate-trigger current vs. case temperature for S2062 series.

S2060, S2061, S2062 Series

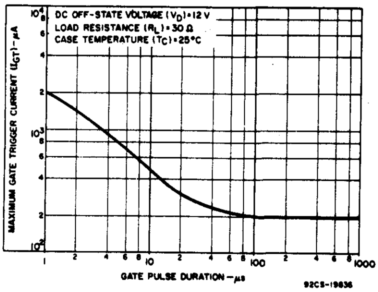


Fig. 13—Maximum gate-trigger current vs. gate-pulse duration for types in the S2060 series.

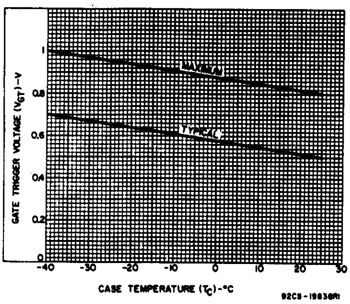


Fig. 14—Gate-trigger voltage vs. case temperature for all series.

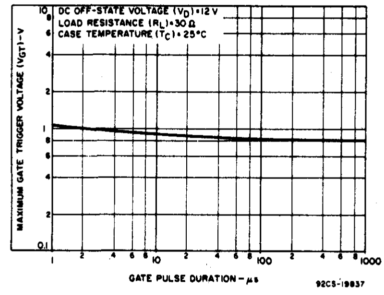


Fig. 15—Maximum gate-trigger voltage vs. gate pulse duration for types in the S2060 series.

S2200(2N3528, 2N3529,2N4102), S2710, S2700(2N3228,2N3525,2N4101, Series

5-A Silicon Controlled Rectifiers

For Low-Cost Power-Control and Power-Switching Applications

RCA 2N3228*, 2N3525*, 2N4101*, and 2N3528•, 2N3529•, and 2N4102• are all-diffused, three-junction, silicon controlled-rectifiers (SCR's) intended for use in power-control and power-switching applications.

Types 2N3228, 2N3525, and 2N4101 use the JEDEC TO-66 package and have a blocking voltage capability of up to 600 volts and a forward current rating of 5 amperes (rms value) at a case temperature of 75°C.

* Formerly Dev. Types TA1222, TA1225, and TA2773, respectively.

• Formerly Dev. Types TA2597, TA2617, and TA2774, respectively.

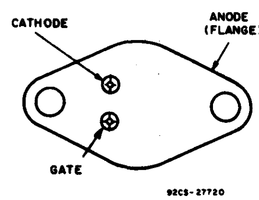
Types 2N3528, 2N3529, and 2N4102 use the JEDEC TO-8 package and have a blocking voltage capability of up to 600 volts and a forward current rating of 2 amperes (rms value) at an ambient temperature of 25°C.

S2710B, S2710D, and S2710M are all-diffused, three-junction silicon controlled-rectifiers having integral heat radiators. They are variants of the 2N3228, 2N3525, and 2N4101, respectively.*

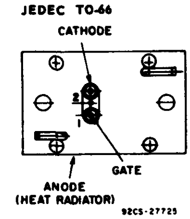
FEATURES

- Designed especially for high-volume systems
- Readily adaptable for printed-circuit boards and metal heat sinks
- Low switching losses
- High di/dt and dv/dt capabilities
- Shorted emitter gate-cathode construction
- Forward and reverse gate dissipation ratings
- All-diffused construction – assures exceptional uniformity and stability of characteristics
- Direct-soldered internal construction – assures exceptional resistance to fatigue
- Symmetrical gate-cathode construction – provides uniform current density, rapid electrical conduction, and efficient heat dissipation
- All-welded construction and hermetic sealing
- Low leakage currents, both forward and reverse
- Low forward voltage drop at high current levels
- Low thermal resistance

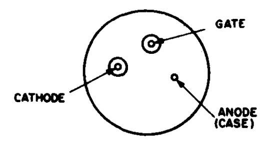
TERMINAL CONNECTIONS



BOTTOM VIEW
JEDEC TO-66



BOTTOM VIEW
TO-66 with Heat Radiator



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BOTTOM VIEW
JEDEC TO-8

Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at a Frequency between 50 and 400 Hz, and with Resistive or Inductive Load

RATINGS	CONTROLLED-RECTIFIER TYPES						UNITS
	2N3228 S2710B	2N3525 S2710D	2N4101 S2710M	2N3528	2N3529	2N4102	
Transient Peak Reverse Voltage (Non-Repetitive), v_{RM}(non-rep)	330	660	700	330	660	700	volts
Peak Reverse Voltage (Repetitive), v_{RM}(rep)	200	400	600	200	400	600	volts
Peak Forward Blocking Voltage (Repetitive), v_{FBOM}(rep)	200	400	600	200	400	600	volts
Forward Current:							
For case temperature (T_C) of + 75°C, and unit mounted on heat sink–							
Average DC value at a conduction angle of 180°, I_{FAV}	3.2	3.2	3.2	—	—	—	amperes
RMS value, I_{FRMS}	5.0	5.0	5.0	—	—	—	amperes
For other conditions, See Fig. 2							
For free-air temperature (T_{FA}) of 25°C, and with no heat sink employed–							
Average DC value at a conduction angle of 180°, I_{FAV}	1.7	1.7	1.7	1.3	1.3	1.3	amperes
RMS value, I_{FRMS}	—	—	—	2.0	2.0	2.0	amperes
For other conditions, See *Figs. 3 & 4*							
Peak Surge Current, i_{FM}(surge):							
For one cylce of applied principal voltage.							
60 Hz (sinusoidal), T_C = 75°C		60			60		amperes
50 Hz (sinusoidal), T_C = 75°C		50			50		amperes
For more than one cycle of applied voltage		See Fig. 5			See Fig. 5		
Fusing Current (for SCR protection): T_J = –40 to 100°C, t = 1 to 8.3 ns, I^2t		15			15		ampere^2 second
Rate of Change of Forward Current, di/dt		200			200		amperes/ microsecond
V_{FB} = v_{BOO}(min. value) I_{GT} = 200mA, 0.5 μs rise time							
Gate Power*:							
Peak, Forward or Reverse, for 10 μs duration, P_{GM} (See Figs. 7 and 9)		13			13		watts
Average, P_{GAV}		0.5			0.5		watt
Temperature:							
Storage, T_{stg}		-40 to +125			-40 to +125		°C
Operating (Case), T_C		-40 to +100			-40 to +100		°C

*Any values of peak gate current or peak gate voltage to give the maximum gate power is permissible.

S2200(2N3528, 2N3529, 2N4102), S2710, S2700(2N3228, 2N3525, 2N4101), Series

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

CHARACTERISTICS	CONTROLLED-RECTIFIER TYPES									UNITS
	2N3228, 2N3528 S2710B			2N3525, 2N3529 S2710D			2N4101, 2N4102 S2710M			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Breakover Voltage, v_{BOO}: At T_C = +100°C	200	—	—	400	—	—	600	—	—	volts
Peak Blocking Current, at T_C = +100°C: Forward, I_{FBOM} V_{FBO}^{P} = v_{BOO}(min. value)	—	0.10	1.5	—	0.20	3.0	—	0.40	4.0	mA
Reverse, I_{RBOM} V_{RBO}^{P} = v_{RM}(rep) value	—	0.05	0.75	—	0.10	1.5	—	0.20	2.0	mA
Forward Voltage Drop, v_F At a Forward Current of 30 amperes and a T_C = +25°C	—	2.15	2.8	—	2.15	2.8	—	2.15	2.8	volts
DC Gate-Trigger Current, I_{GT} At T_C = +25°C (See Fig. 9)	—	8	15	—	8	15	—	8	15	mA(dc)
Gate-Trigger Voltage, V_{GT} At T_C = +25°C (See Fig. 9)	—	1.2	2.0	—	1.2	2.0	—	1.2	2.0	volts(dc)
Holding Current, i_{HOO} At T_C = +25°C	—	10	20	—	10	20	—	10	20	mA
Critical Rate of Applied Forward Voltage, Critical dv/dt V_{FB} = v_{BOO}(min. value), exponential rise, T_C = +100°C	10	200	—	10	200	—	10	200	—	volts/microsecond
Turn-On Time, t_{on}, (Delay Time + Rise Time) V_{FB} = v_{BOO}(min. value), i_F = 4.5 amperes, I_{GT} = 200mA, 0.1 μs rise time, T_C = +25°C	0.75	1.5	—	0.75	1.5	—	0.75	1.5	—	microseconds
Turn-Off Time, t_{off}. i_F = 2 amperes, 50 μs pulse width, dv_{FB}/dt = 20 v/μs; di_r/dt = 30A/μs, I_{GT} = 200mA, T_C = +75°C	—	15	50	—	15	50	—	15	50	microseconds

	2N3228, 2N3525, 2N4101			2N3528, 2N3529, 2N4102			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Thermal Resistance: Junction-to-case	—	—	4	—	—	5	°C/W
Junction-to-ambient	—	—	40	—	—	40	°C/W
	S2710 series			—	—	—	
Junction-to-Ambient	—	—	28	—	—	—	°C/W

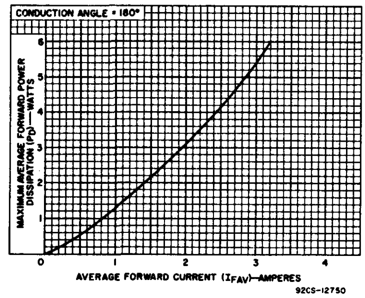


Fig. 1—Power dissipation chart for all types.

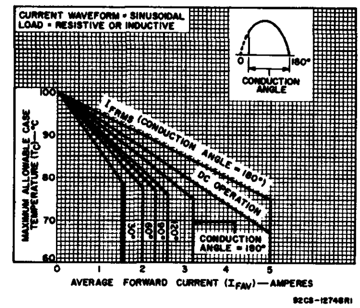


Fig. 2—Rating chart (case temperature) for types 2N3228, 2N3525, and 2N4101.

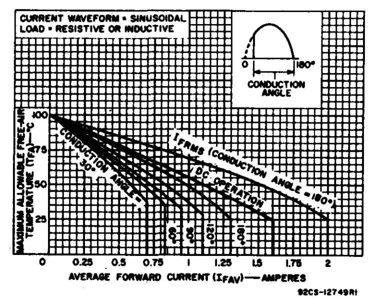


Fig. 3—Rating chart (free-air temperature) for types 2N3528, 2N3529, and 2N4102.

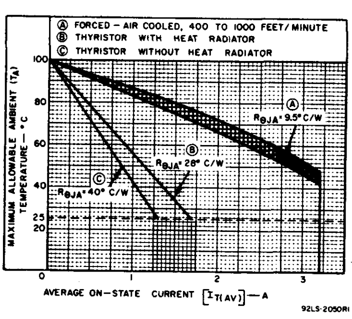


Fig. 4—Maximum allowable ambient temperature vs. on-state current for S2710 series only.

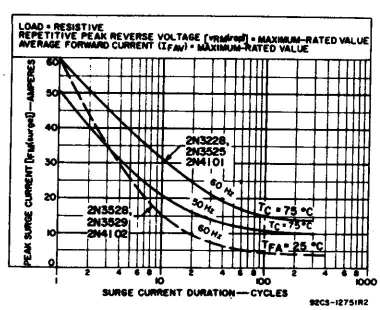


Fig. 5—Surge-current rating chart.

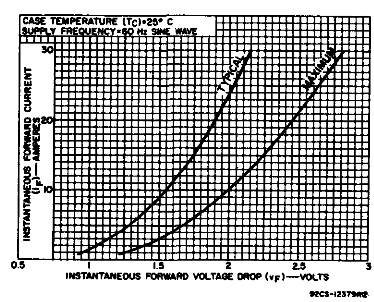


Fig. 6—Forward characteristics for all types.

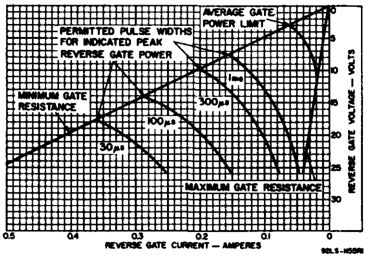


Fig. 7—Reverse gate characteristics.

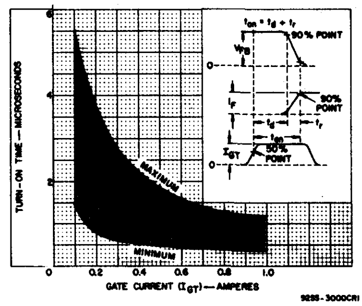


Fig. 8—Turn-on time characteristics.

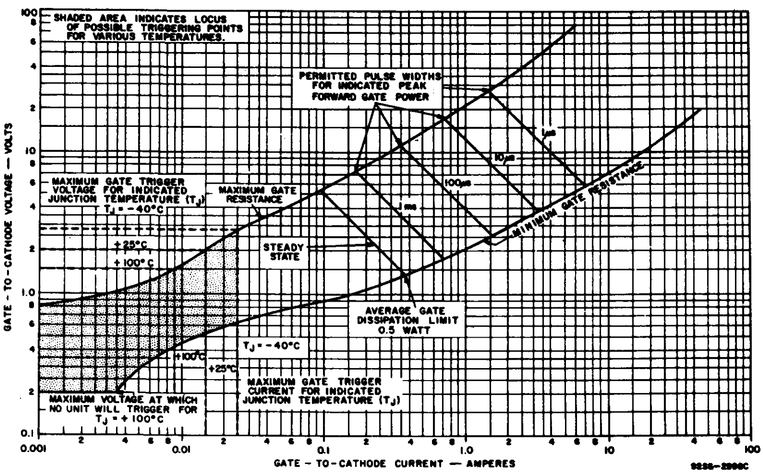


Fig. 9—Forward gate characteristics.

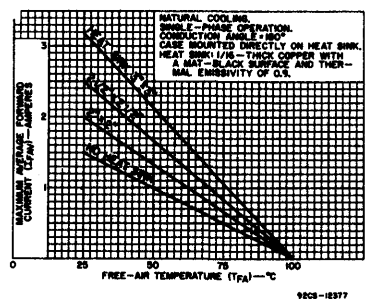


Fig. 10—Operation guidance chart for types 2N3228, 2N3525, and 2N4101.

S2600, S2610, S2620 Series

7-A "Low-Profile" Silicon Controlled Rectifiers

For Power Switching, Power Control, Power Crowbar, and Ignition Applications

The S2600, S2610, and S2620 series are all-diffused, silicon controlled rectifiers (reverse-blocking triode thyristors) for capacitor-discharge ignition systems, high-voltage generators, and power-switching and control applications. They may be used in capacitor-discharge ignition systems (battery or magneto types) for internal combustion engines, electronic igniters, and high-voltage generators. Other uses are power-control and power-switching circuits.

The S2600B, S2600D, and S2600M have a three-lead low-profile package (similar to the JEDEC TO-5). The S2610B, S2610D, and S2610M have integral heat radiators. The S2620B, S2620D, and S2620M have integral heat spreaders.

Features:

- Forward and reverse gate ratings
- All-diffused center gate construction
- Low leakage currents, both forward and reverse
- Low forward voltage drop at high current levels
- High pulse-current capability for capacitor-discharge ignition circuits
- High dv/dt capability
- Low switching losses
- Low thermal resistance
- Sub-cycle surge capability curve

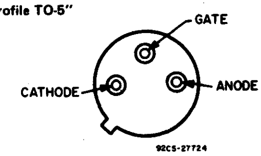
MAXIMUM RATINGS, *Absolute-Maximum Values:*
For Operation with Sinusoidal Supply Voltage at Frequencies up to 50/60 Hz and with Resistive or Inductive Load.

		S2600B S2610B S2620B	S2600D S2610D S2620D	S2600M S2610M S2620M	
NON-REPETITIVE PEAK REVERSE VOLTAGE•: Gate open	V_{RSOM}	250	500	700	V
NON-REPETITIVE PEAK OFF-STATE VOLTAGE:•: Gate open	V_{DSOM}	250	500	700	V
REPETITIVE PEAK REVERSE VOLTAGE•: Gate open	V_{RROM}	200	400	600	V
REPETITIVE PEAK OFF-STATE VOLTAGE•: Gate open	V_{DROM}	200	400	600	V
RMS ON-STATE CURRENT (Conduction angle = 180°)	$I_{T(RMS)}$		See Figs. 2-6		
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT: For one cycle of applied principal voltage	I_{TSM}				
60 Hz (sinusoidal)		100	100	100	A
50 Hz (sinusoidal)		85	85	85	A
For more than one cycle of applied principal voltage			See Fig. 7		
PEAK REPETITIVE ON-STATE CURRENT† (See Fig. 16): Duty factor = 0.1%, T_C = 75°C, Pulse duration = 5 µs (min.), 20 µs (max.)	I_{TRM}	100	100	100	A
RATE OF CHANGE OF ON-STATE CURRENT: $V_{DM} = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.5 µs	di/dt		200		A/µs
FUSING CURRENT (for SCR protection): T_J = −65 to 100°C, t = 1 to 8.3 ms	I^2t		40		A^2s
NON-REPETITIVE SUB-CYCLE SURGE CURRENT: T_C = 25°C, single pulse, I_{GT} = 50 mA, 10 µs square pulse			See Fig. 20		
GATE POWER DISSIPATION▲:					
PEAK FORWARD (for 1 µs max.)	P_{GM}	40	40	40	W
PEAK REVERSE	P_{RGM}		See Fig. 14		
AVERAGE (averaging time = 10 ms, max.)	$P_{G(AV)}$	0.5	0.5	0.5	W
TEMPERATURE RANGE♦:					
Storage	T_{stg}		-65 to +150		°C
Operating (case)	T_C		-65 to +100		°C
LEAD TEMPERATURE (During soldering)■: For 10 s max. for case or leads			225		°C

† When rms current exceeds 4 amperes (maximum rating for the anode lead), connection must be made to the case.
• These values do not apply if there is a positive gate signal. Gate must be open, terminated, or have negative bias.
▲ Any values of peak gate current or peak gate voltage that yield the maximum gate power are permissible.
♦ For information on the reference point of temperature measurement, see dimensional outlines.
■ When these devices are soldered directly to the heat sink, a 60/40 solder should be used. Case heating time should be a minimum . . . sufficient to allow the solder to flow freely.

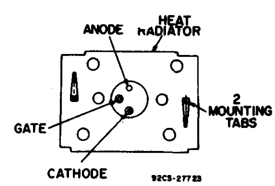
TERMINAL CONNECTIONS

"Low-Profile TO-5"



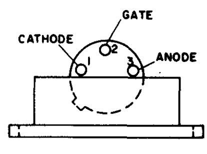
BOTTOM VIEW
S2600 Series

"Low-Profile TO-5" with Heat Radiator



BOTTOM VIEW
S2610 Series

"Low-Profile TO-5" with Heat Spreader



S2620 Series

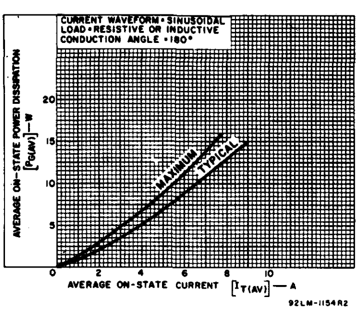


Fig. 1—Power dissipation vs. on-state current.

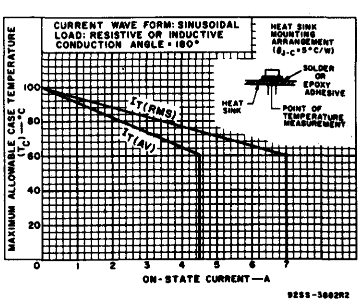


Fig. 2—Maximum allowable case temperature vs. on-state current for S2600 series.

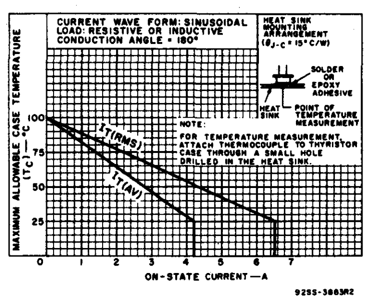


Fig. 3—Maximum allowable case temperature vs. on-state current for S2600 series.

S2600, S2610, S2620 Series

ELECTRICAL CHARACTERISTICS, *At maximum ratings and at indicated case temperature (T_C) unless otherwise specified*

CHARACTERISTIC	SYMBOL	LIMITS S2600 Series MIN.	TYP.	MAX.	S2610 Series S2620 Series MIN.	TYP.	MAX.	UNITS
PEAK OFF-STATE CURRENT: (Gate Open, T_C = +100°C) FORWARD, V_D = V_{DROM}	I_{DOM}	–	0.1	0.5	–	0.2	1.5	mA
REVERSE, V_R = V_{RROM}	I_{ROM}	–	0.05	0.5	–	0.1	1.5	mA
INSTANTANEOUS ON-STATE VOLTAGE: For i_T = 30 A and T_C = +25°C	v_T	–	1.9	2.6	–	1.9	2.6	V
DC GATE TRIGGER CURRENT: V_D = 12 V (DC), R_L = 30 Ω, T_C = +25°C	I_{GT}	–	6	15	–	6	15	mA
For other case temperatures		See Fig. 12						
DC GATE TRIGGER VOLTAGE: V_D = 12 V (DC), R_L = 30 Ω, T_C = +25°C	V_{GT}	–	0.65	1.5	–	0.65	1.5	V
For other case temperatures		See Fig. 13						
INSTANTANEOUS HOLDING CURRENT: Gate Open and T_C = +25°C	i_{HO}	–	9	20	–	9	20	mA
For other case temperatures		See Fig. 10						
CRITICAL RATE-OF-RISE OF OFF-STATE VOLTAGE: V_D = V_{DROM}, Exponential rise, T_C = +100°C (See Fig. 3)	dv/dt	20	200	–	20	200	–	V/µs
GATE CONTROLLED TURN-ON TIME: V_D = V_{DROM}, i_T = 4.5 A, I_{GT} = 200 mA, 0.1 µs rise time, T_C = +25°C (See Fig. 15)	t_{gt}	–	1	2	1	2	–	µs
CIRCUIT COMMUTATED TURN-OFF TIME: V_D = V_{DROM}, i_T = 2 A, Pulse Duration = 50 µs, dv/dt = 20V/µs, di/dt = -30A/µs, I_{GT} = 200 mA at turn on, T_C = +75°C	t_q	–	15	50	–	15	50	µs
THERMAL RESISTANCE: Junction-to-Case	$R_{\theta JC}$	–	–	5	–	–	5	°C/W
Junction-to-Ambient (See dimensional outlines)	$R_{\theta JA}$	–	–	120	–	–	30 (S2610 Series)	°C/W
Junction-to-Heat Spreader (See dimensional outline)	$R_{\theta JHS}$	–	–	–	–	–	7 (S2620 Series)	°C/W

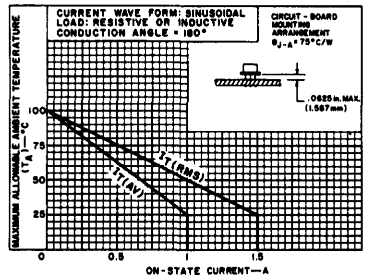


Fig. 4—Maximum allowable ambient temperature vs. on-state current for S2600 series.

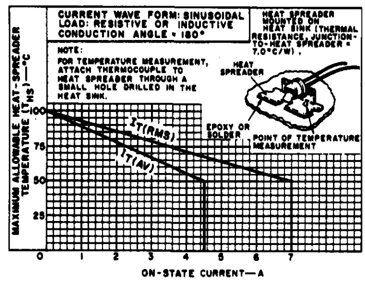


Fig. 5—Maximum allowable heat-spreader temperature vs. on-state current for S2620 series.

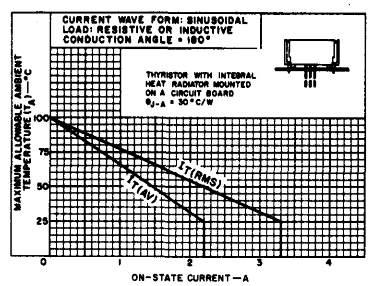


Fig. 6—Maximum allowable ambient temperature vs. on-state current for S2610 series.

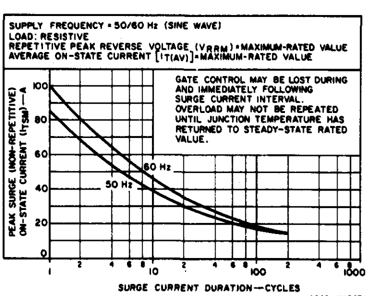


Fig. 7—Peak surge on-state current vs. surge-current duration for all types.

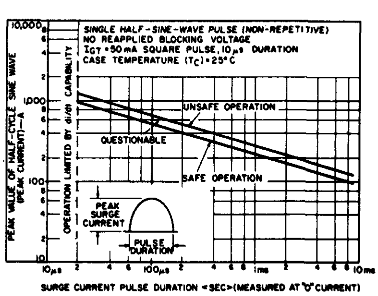


Fig. 8—Sub-cycle surge capability.

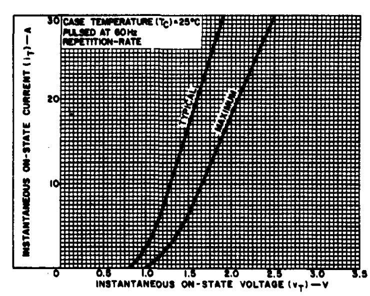


Fig. 9—Instantaneous on-state current vs. on-state voltage for all types.

S2600, S2610, S2620 Series

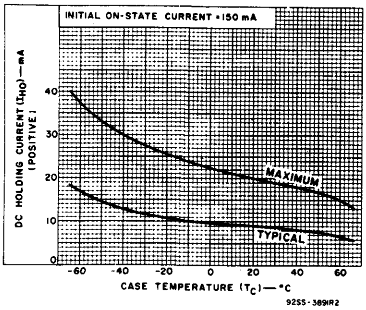


Fig. 10—DC holding current (positive) vs. case temperature.

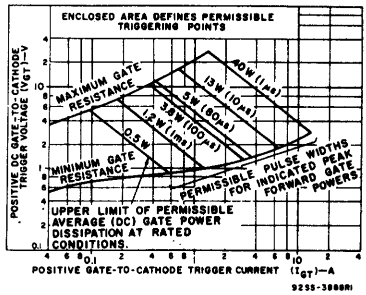


Fig. 11—Gate-pulse characteristics for forward-triggering mode.

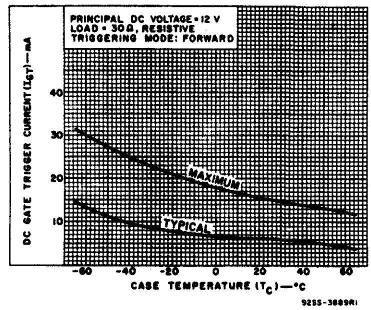


Fig. 12—DC gate-trigger current (forward) vs. case temperature.

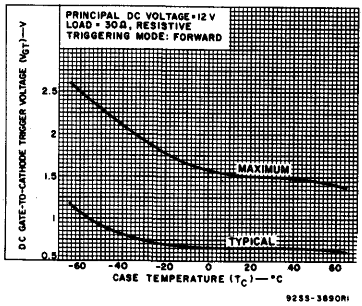


Fig. 13—DC gate-trigger voltage vs. case temperature.

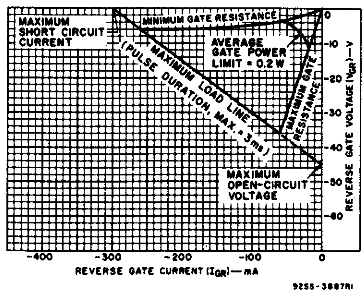


Fig. 14—Reverse-gate voltage vs. reverse-gate current.

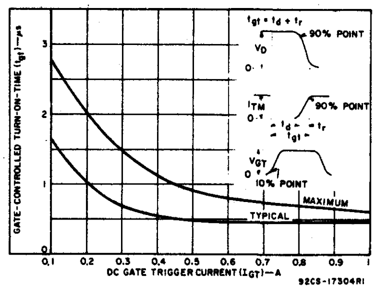


Fig. 15—Gate controlled turn-on time (t_{gt}) vs. gate-trigger current.

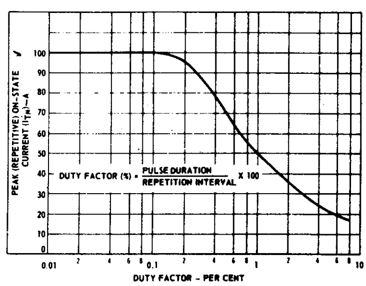


Fig. 16—Derating curve for peak pulse current (repetitive) vs. duty factor for the ignition circuit.

S2800, S122 Series

8-A and 10-A Silicon Controlled Rectifiers

For Power Switching, Power Control, and Ignition Applications

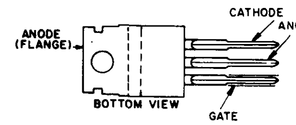
The RCA-S122 and RCA-S2800 series types are medium-power silicon controlled rectifiers (reverse-blocking triode thyristors) designed for switching ac and dc currents. These devices can switch from the off-state to the on-state when both the anode and gate voltages are positive. Negative anode voltages make these devices revert to the blocking state regardless of gate-voltage polarity.

The plastic TO-220AB package provides easy package mounting and low thermal resistance, allowing operation at high case temperatures and permitting reduced heat-sink size. These SCR's can be used in lighting and motor-speed controls, capacitor-discharge ignition circuits, high-voltage generators, automotive applications, and power-switching systems.

Features:

- High dv/dt capability
- Glass-passivated chip
- Low on-state voltage at high current levels
- Shorted-emitter gate-cathode construction
- Low thermal resistance
- Center-gate construction

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	S122F S2800F	S122A S2800A	S122B S2800B	S122C S2800C	S122D S2800D	S122E S2800E	S122M S2800M	S122S S2800S	
V_{RSOM}▲, V_{DSOM}▲	75	125	250	375	500	600	700	800	V
V_{RROM}▲, V_{DROM}▲	50	100	200	300	400	500	600	700	V
$I_{T(RMS)}$ (T_C = 75°C,									
θ = 180°) - S122 series	8								A
- S2800 series	10								A
I_{TSM}									
For one full cycle of applied principal voltage 400 Hz	200								A
60 Hz	100								A
50 Hz	85								A
For more than one full cycle of applied principal voltage	See Fig. 4								
di/dt									
$V_D = V_{DROM}$, I_{GT} = 80 mA, t_r = 0.5 μs	100								A/μs
I^2t									
T_J = −65 to 100°C; t = 1 to 8.3 ms	40								A^2s
P_{GM}● (for 10 μs max.)	16								W
P_{RGM}●	See Fig. 10								
$P_{G(AV)}$● (averaging time = 10 ms max.)	0.5								W
T_{stg}■	−65 to +150								°C
T_C■	−65 to +100								°C
T_T									
During soldering for 10 s maximum (terminal and case)	250								°C

▲These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

●Any values of peak gate current or peak gate voltage which result in an equal or lower power are permissible.

■For information on the reference point of temperature measurement, see Dimensional Outline.

ELECTRICAL CHARACTERISTICS,
At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS For All Types Except as Specified MIN.	TYP.	MAX.	UNITS
I_{DOM} or I_{ROM} $V_D = V_{DROM}$ or $V_R = V_{RROM}$, T_C = +100°C	–	0.1	2	mA
V_T See Fig. 5 & 6 i_T = 16 A, T_C = 25°C (S122 series) = 30 A, T_C = 25°C (S2800 series)	– –	1.45 1.7	1.83 2	V
I_{GT} See Fig. 11 & 12 V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C (S122 series) V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C (S2800 series)	– –	18 8	25 15	mA
V_{GT} V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C For other case temperatures	–	0.9 See Fig. 13	1.5	V
I_{HO} T_C = 25°C (S122 series) T_C = 25°C (S2800 series) For other case temperatures	– –	20 10 See Fig. 7 & 8	30 20	mA

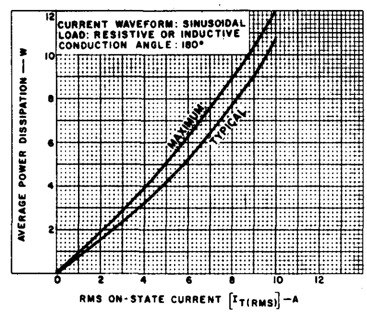


Fig. 1 – Power dissipation vs. on-state current for all types.

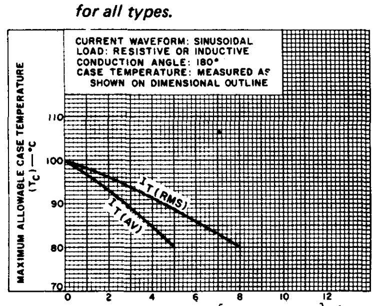


Fig. 2 – Maximum allowable case temperature vs. on-state current for S122 series.

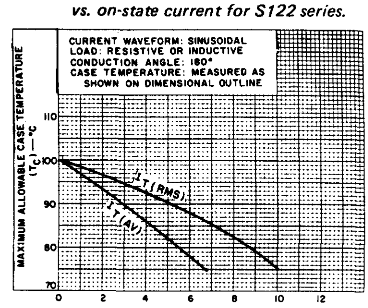


Fig. 3 – Maximum allowable case temperature vs. on-state current for S2800 series.

S2800, S122 Series

ELECTRICAL CHARACTERISTICS,

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS For All Types Except as Specified MIN.	TYP.	MAX.	UNITS
dv/dt				
$V_D = V_{DROM}$ Exponential voltage rise,				
$T_C = 100°C$ S122 series	10	100	–	V/μs
S2800F	100	–	–	V/μs
S2800A	75	–	–	V/μs
S2800B	50	–	–	V/μs
S2800C	40	–	–	V/μs
S2800D	30	–	–	V/μs
S2800E	25	–	–	V/μs
S2800M	20	–	–	V/μs
S2800S	15	–	–	V/μs
t_{gt} See Fig. 16 $V_D = V_{DROM}$, $i_T = 4.5$ A, $i_T = 2$ A $I_{GT} = 80$ mA, 0.1 μs rise time $T_C = +25°C$	–	1.6	2.5	μs
t_q $V_D = V_{DROM}$, $i_T = 2$ A, $t_p = 50$ μs dv/dt = 200 V/μs, di/dt = –10 A/μs $I_{GT} = 200$ mA at t_{ON}, $T_C = +75°C$	–	10	35	μs
$R_{\theta JC}$	–	–	2	°C/W
$R_{\theta JA}$	–	–	60	°C/W

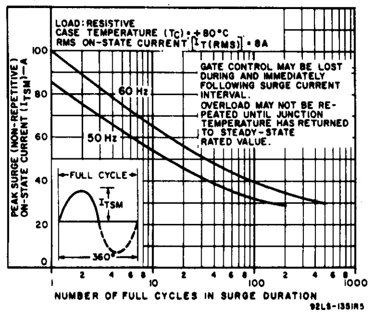


Fig. 4 – Allowable peak surge on-state current vs. surge duration for all types.

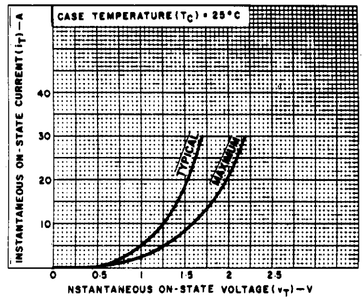


Fig. 5 – Instantaneous on-state current vs. on-state voltage for S122 series.

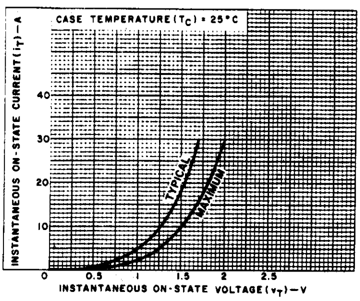


Fig. 6 – Instantaneous on-state current vs. on-state voltage for S2800 series.

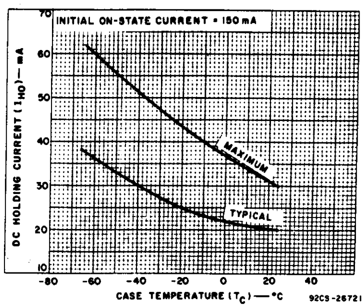


Fig. 7 – Holding current vs. case temperature for S122 series.

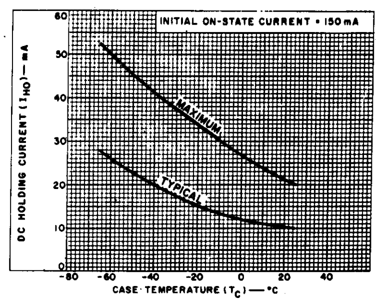


Fig. 8 – Holding current vs. case temperature for S2800 series.

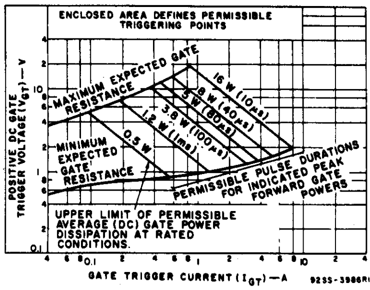


Fig. 9 – Typical forward-biased gate characteristics for all types.

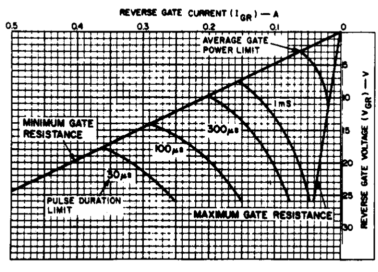


Fig. 10 – Reverse gate voltage vs. reverse gate current for all types.

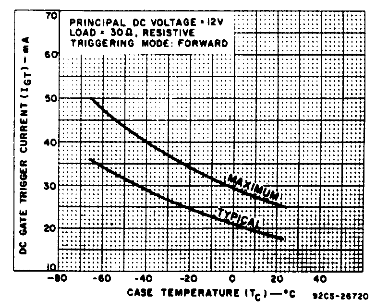


Fig. 11 – DC gate-trigger current vs. case temperature for S122 series.

S2800, S122 Series

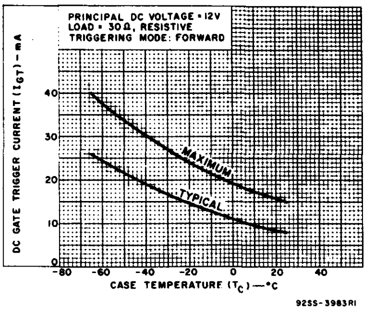


Fig. 12 – DC gate-trigger current vs. case temperature for S2800 series.

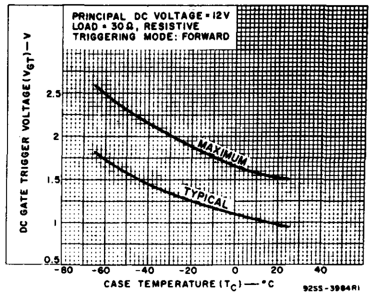


Fig. 13 – DC gate-trigger voltage vs. case temperature for all types.

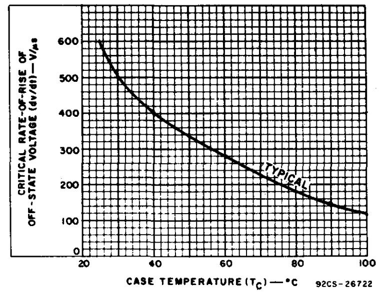


Fig. 14 – Critical rate-of-rise of off-state voltage vs. case temperature for S122 series.

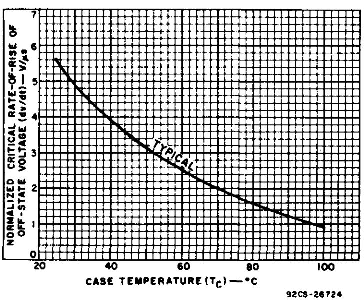


Fig. 15 – Normalized critical rate of rise of off-state voltage vs. case temperature for S2800 series.

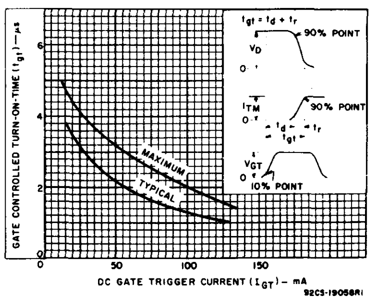


Fig. 16 – Gate-controlled turn-on time vs. gate trigger current for all types.

S3700, S3704, S3714 Series

5-A Silicon Controlled Rectifiers

For Inverter Applications

Features

- Fast turn-off time-8 μs max.
- High di/dt and dv/dt capabilities
- Shorted-emitter gate-cathode construction ... contains an internally diffused resistor between gate and cathode
- Center gate construction. . . . provides rapid uniform gate-current spreading for faster turn-on with substantially reduced heating effects

The RCA-S3700, S3704, and S3714-series types are all-diffused, silicon controlled rectifiers (reverse-blocking triode thyristors) designed for inverter applications such as ultrasonics, choppers, regulated power supplies, induction heaters, cycloconverters, and fluorescent lighting. These types may be used at frequencies up to 25 kHz.

The S3700 and S3704 series employ a hermetic JEDEC TO-66 package. The S3714 series employs a TO-66 with heat radiator package.

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

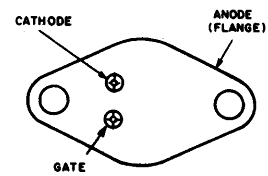
			S3700B	S3700D	S3700M		
		S3704A S3714A	S3704B S3714B	S3704D S3714D	S3704M S3714M	S3704S S3714S	
NON-REPETITIVE PEAK REVERSE VOLTAGE:■ Gate Open	V_{RSOM}	150	300	500	700	800	V
NON-REPETITIVE PEAK OFF-STATE VOLTAGE:■ Gate Open	V_{DSOM}	150	300	500	700	800	V
REPETITIVE PEAK REVERSE VOLTAGE:■ Gate Open	V_{RROM}	100	200	400	600	700	V
REPETITIVE PEAK OFF-STATE VOLTAGE:■ Gate Open	V_{DROM}	100	200	400	600	700	V
ON-STATE CURRENT: T_C = 60°C, conduction angle = 180°: RMS	$I_{T(RMS)}$	← 5 →					A
Average	$I_{T(AV)}$	← 3.2 →					A
For other conditions		← See Figs. 3, 4 →					
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT: For one full cycle of applied principal voltage, T_C = 60°C	I_{TSM}						
60 Hz (sinusoidal)		← 80 →					A
50 Hz (sinusoidal)		← 65 →					A
For more than one full cycle of applied principal voltage		← See Fig. 5 →					
RATE OF CHANGE OF ON-STATE CURRENT $V_D = V_{DROM}$, I_{GT} = 50 mA, t_r = 0.1 μs	di/dt	← 200 →					A/μs
FUSING CURRENT (for SCR protection): T_J = −40 to 100°C, t = 1 to 8.3 ms	I^2t	← 25 →					A
GATE POWER DISSIPATION:● Peak Forward (for 10 μs max., See Fig. 7)	P_{GM}	← 13 →					W
Peak Reverse (for 10 μs max., See Fig. 8)	P_{RGM}	← 13 →					W
Average (averaging time = 10 ms max.)	$P_{G(AV)}$	← 0.5 →					W
TEMPERATURE RANGE:▲ Storage	T_{stg}	← −40 to 150 →					°C
Operating (Case)	T_C	← −40 to 100 →					°C
PIN TEMPERATURE (During soldering): At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	T_P	← 225 →					°C

■ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.

▲ For temperature measurement reference point, *see Dimensional Outline.*

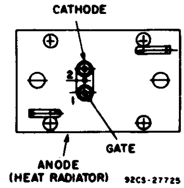
TERMINAL CONNECTIONS



BOTTOM VIEW

JEDEC TO-66

CATHODE



BOTTOM VIEW

JEDEC TO-66 with Heat Radiator

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	SYMBOL	LIMITS FOR ALL TYPES Except as Specified			UNITS
		MIN.	TYP.	MAX.	
Peak Off-State Current: (Gate open, T_C = 100°C) Forward Current (I_{DOM}) at $V_D = V_{DROM}$	I_{DOM}	–	0.5	3	mA
Reverse Current (I_{ROM}) at $V_R = V_{RROM}$	I_{ROM}	–	0.3	1.5	mA
Instantaneous On-State Voltage: i_T = 30 A (peak), T_C = 25°C	v_T	–	2.2	3	V
For other conditions			See Fig. 6		
Instantaneous Holding Current: Gate open, T_C = 25°C	i_{HO}	–	20	50	mA
Critical Rate of Rise of Off-State Voltage: $V_D = V_{DROM}$, exponential voltage rise, Gate open, T_C = 80°C	dv/dt	100	250	–	V/μs
DC Gate Trigger Current: V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C	I_{GT}	–	15	40	mA
For other conditions			See Fig. 7		
DC Gate Trigger Voltage: V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C	V_{GT}	–	1.8	3.5	V
For other conditions			See Fig. 7		
Gate Controlled Turn-On Time: (Delay Time + Rise Time) For $V_{DX} = V_{DROM}$, I_{GT} = 300 mA, t_r = 0.1 μs, I_T = 2 A (peak), T_C = 25°C (See Fig. 10)	t_{gt}	–	0.7	–	μs
Circuit Commutated Turn-Off Time: $V_{DX} = V_{DROM}$, i_T = 2 A, pulse duration = 50 μs, dv/dt = 100 V/μs, −di/dt = −10 A/μs, I_{GT} = 100 mA, V_{GT} = 0 V (at turn-off), T_C = 80°C (See Fig. 13) S3700 series	t_q	–	4	6	μs
S3704, S3714 series		–	4	8	μs
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	–	4	8	°C/W
Junction-to-Ambient	$R_{\theta JA}$	–	–	40	°C/W

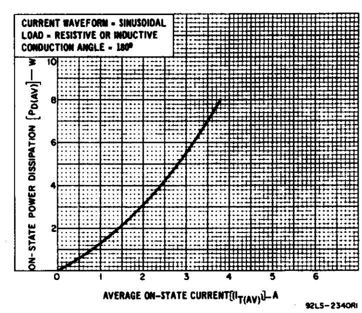


Fig. 1—Power dissipation vs. average on-state current.

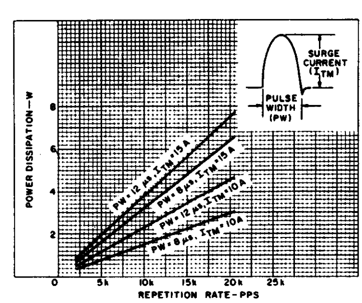


Fig. 2—Dissipation vs. repetition rate.

S3700, S3704, S3714 Series

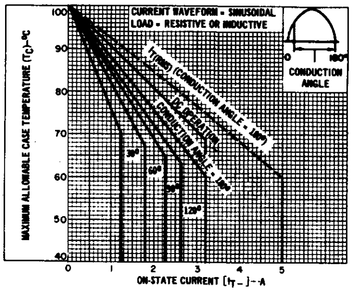


Fig. 3—Maximum allowable case temperature vs. on-state current.

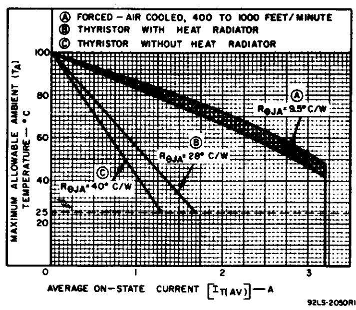


Fig. 4—Maximum allowable ambient temperature vs. average on-state current.

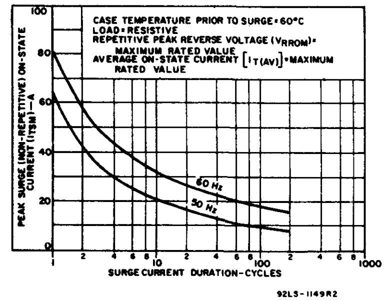


Fig. 5—Peak surge on-state current vs. surge-current duration.

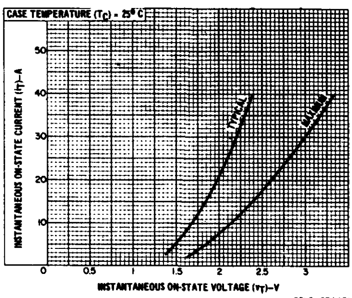


Fig. 6—Instantaneous on-state current vs. on-state voltage.

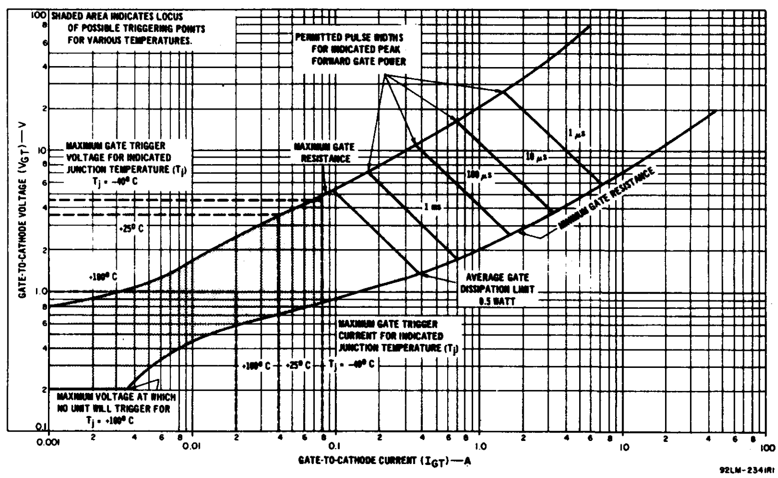


Fig. 7—Gate-trigger characteristics and limiting conditions for determination of permissible gate-trigger pulses.

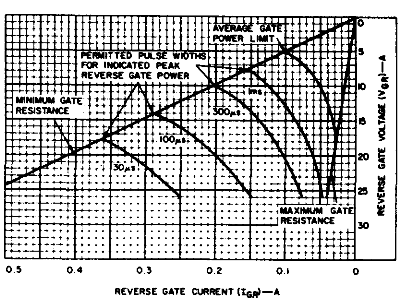


Fig. 8—Reverse-gate voltage vs. reverse-gate current.

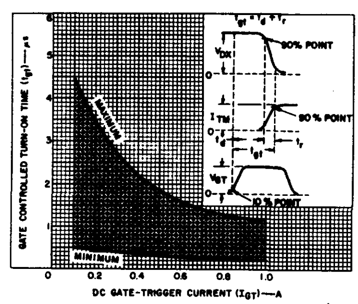


Fig. 9—Turn-on time vs. gate-trigger current.

S3701M

5-A Silicon Controlled Rectifier

For Applications in Pulse Power Supplies To Drive GaAs Laser Diodes

Type S3701M is a silicon controlled rectifier intended for use in circuits which generate pulses to drive injection laser diodes.

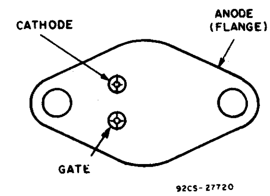
The S3701M SCR is designed for the good current-spreading and delay-time characteristics necessary to provide high-peak-current pulses to drive the laser diode. An additional significant characteristic of this device is its well controlled holding current, which assures operation only at currents sufficiently high to meet the circuit requirements.

The S3701M SCR employs a hermetic JEDEC TO-66 package.

Features:

- High peak-current capability
- Good current-spreading attributes
- Symmetrical gate-cathode construction for uniform current density, rapid electrical conduction, and efficient heat dissipation
- Controlled minimum holding current
- Hermetic construction
- Low thermal resistance

TERMINAL CONNECTIONS



BOTTOM VIEW

JEDEC TO-66

MAXIMUM RATINGS, *Absolute-Maximum Values:*
Case temperature (T_C) = 25°C, unless otherwise specified

REPETITIVE PEAK OFF-STATE VOLTAGE:			
Gate open	V_{DROM}	600	V
RMS ON-STATE CURRENT (Conduction angle = 180°)	$I_{T(RMS)}$	5	A
REPETITIVE PEAK ON-STATE CURRENT (0.2 μs Pulse Width):	I_{PM}		
Free-air cooling, f = 500 Hz		75	A
Free-air cooling, f = 5000 Hz		40	A
Infinite heat sink, f = 10,000 Hz		40	A
Infinite heat sink, f = 1,000 Hz		75	A
GATE POWER DISSIPATION:			
PEAK (For 10 μs pulse)	P_{GM}	25	W
TEMPERATURE RANGE:			
Storage	T_{stg}	-40 to 125	°C
Operating (Case)	T_C	-40 to 100	°C
TERMINAL TEMPERATURE (During soldering):	T_T		
For 10 s max. (terminals and case)		225	°C

ELECTRICAL CHARACTERISTICS
At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS		UNITS
		Min.	Max.	
Peak Off-State Current: Gate open, v_D = V_{DROM}, T_C = 25°C	I_{DROM}	–	0.65	mA
T_C = 75°C		–	1.2	
DC Gate-Trigger Current: T_C = 25°C	I_{GT}	–	35	mA
DC Gate-Trigger Voltage: T_C = 25°C	V_{GT}	–	4	V
DC Holding Current: Gate open, T_C = 25°C	I_{HO}	15	–	mA
T_C = 75°C		10	–	
Critical Rate-of-Rise of Off-State Voltage: For v_D = V_{DROM}, exponential voltage rise, gate open, T_C = 75°C	dv/dt	200	–	V/μs
Source Voltage for Functional Test (See Fig. 2): I_p = 75A, C = 0.022μF, R_s = 2Ω, f = 60Hz, pulse duration = 0.2μs, T_C = 25°C	V_s	–	550	V
Thermal Resistance: Junction-to-Case	$R_{\theta JC}$	–	7	°C/W
Junction-to-Ambient	$R_{\theta JA}$	–	40	

S3702S, S3703SF, D2101S, D2103S, D2103SF, S3705M, S3706E, D2600M, D2601E, D2601M

SCR's and Rectifiers for Horizontal-Deflection Circuts

For Large-Screen Color TV

The RCA SCR's S3702S, S3702SF, S3705M, and S3706E and the RCA rectifiers D2101S, D2103S D2103SF, D2600M, D2601E, and D2601M are designed for use in horizontal output circuits.

The S3703SF silicon controlled rectifier and the D2102SF silicon rectifier are designed to act as a bipolar switch that controls horizontal yoke current during the beam trace interval. The S3702S silicon controlled rectifier and the D2103S silicon rectifier act as the commutating switch to initiate trace-retrace switching and control yoke current during retrace.

The D2101S silicon rectifier may be used as a clamp to protect the circuit components from excessively high transient voltages which may be generated as a result of arcing in the picture tube or in a high-voltage rectifier tube.

To facilitate direct connection across each silicon controlled rectifier, S3702S and S3702SF, the anode connections of silicon rectifiers D2103S and D2103SF are reversed as compared to that of a normal power-supply rectifier diode.

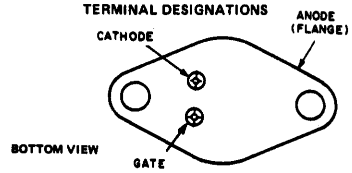
The S3705M silicon controlled rectifier and the D2601M silicon rectifier are designed to act as a bipolar switch that controls horizontal yoke current during the beam trace interval. The S3706E silicon controlled rectifier and the D2601E silicon rectifier act as the commutating switch to initiate trace-retrace switching and control yoke current during retrace.

The D2600M silicon rectifier may be used as a clamp to protect the circuit components from excessively high transient voltages which may be generated as a result of arcing in the picture tube or in a high-voltage rectifier tube.

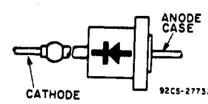
The SCR's employ a hermetic JEDEC TO-66 package. The rectifier types D2101S D2103S, and D2103SF employ a hermetic JEDEC TO-1 package. The rectifier types D2600M, D2601E, and D2601M employ a hermetic JEDEC DO-26 package.

Features:

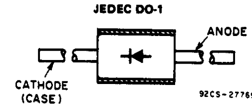
- **Operation from supply voltages between 150 and 270 V (nominal)**
- **Ability to handle high beam current; average 1.6 mA dc**
- **Ability to supply as much as 5 mJ to 8 mJ of stored energy to the deflection yoke, which is sufficient for 29-mm-neck picture tubes operated at 29 kV or 31 kV (nominal value)**
- **Highly reliable circuit which can also be used as a low-voltage power supply**



JEDEC TO-66



JEDEC DO-1



JEDEC DO-26

SILICON CONTROLLED RECTIFIERS

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		S3703SF (TRACE SCR)	S3705M (TRACE SCR)	S3702S (COMMUTATING SCR)	S3706E (COMMUTATING SCR)	
NON-REPETITIVE PEAK OFF-STATE VOLTAGE:●						
Gate Open	V_{DSOM}	800*	700*	750*	600*	V
REPETITIVE PEAK REVERSE VOLTAGE:●						
Gate Open	V_{RROM}	25	25	25	25	V
REPETITIVE PEAK OFF-STATE VOLTAGE:●						
Gate Open	V_{DROM}	750	600	700	500	V
ON-STATE CURRENT						
T_C = 60°C, 60 Hz sine wave, conduction angle = 180°:						
RMS	$I_{T(RMS)}$	5	5	5	5	A
Average DC	$I_{T(AV)}$	3.2	3.2	3.2	3.2	A
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}					
For one full cycle of applied principal voltage						
60 Hz (sinusoidal), T_C = 60°C		80	80	80	80	A
50 Hz (sinusoidal), T_C = 60°C		65	65	65	65	A
For one-half sine wave, 3 ms pulse width		130	150	130	150	A
RATE OF CHANGE OF ON-STATE CURRENT:						
$V_D = V_{DROM}$, I_{GT} = 50 mA, t_r = 0.1 μs	di/dt	200				A/μs
FUSING CURRENT (for SCR protection):						
T_J = −40 to 80°C, t = 1 to 10 ms	I^2t	20				A^2s
GATE POWER DISSIPATION:■	P_{GM}					
Peak (forward or reverse) for 10 μs duration, max.						
negative gate bias = −35 V (S3703SF, S3705M)		25				W
= −10 V (S3702S, S3706E)		25				W
TEMPERATURE RANGE:▲						
Storage	T_{stg}	−40 to 150				°C
Operating (Case)	T_C	−40 to 80				°C
PIN TEMPERATURE (During soldering)						
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	T_P	225				°C

* Protection against transients above these values induced by arcing or other causes must be provided.

● These values do not apply if there is a positive gate signal, Gate must be open or negatively biased.

■ Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted, provided that the maximum reverse gate bias (as specified) is not exceeded.

▲ For temperature measurement reference point, see Dimension Outline.

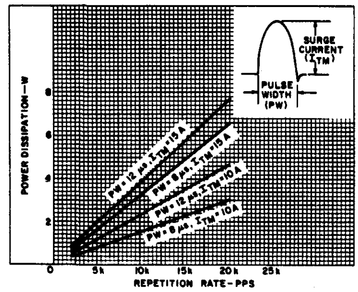


Fig. 1 — Dissipation vs. repetition rate for S3702S and S3702SF.

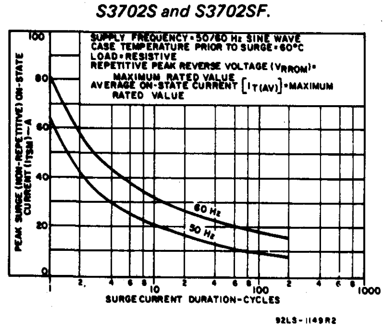


Fig. 2 — Peak surge on-state current vs. surge current duration for S3705M and S3706E.

S3702S, S3703SF, D2101S, D2103S, D2103SF, S3705M, S3706E, D2600M, D2601E, D2601M

SILICON CONTROLLED RECTIFIERS

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTIC	SYMBOL	LIMITS S3703SF S3705M TRACE SCR.		LIMITS S3702S S3706E COMMUT. SCR		UNITS
		TYP.	MAX.	TYP.	MAX.	
Peak Forward Off-State Current: Gate open, $V_D = V_{DROM}$, $T_C = 85°C$	I_{DOM}	0.5	1.5	0.5	1.5	mA
Instantaneous On-State Voltage: $i_T = 30$ A (peak), $T_C = 25°C$	v_T	2.2	3	2.2	3	V
Critical Rate-of-Rise of Off-State Voltage: $V_D = V_{DROM}$, exponential voltage rise, Gate open, $T_C = 70°C$ S3702S	dv/dt	–	–	700 (min.) $(dv/dt)_3$		V/μs
S3706E	dv/dt	175 (min.)		1000 (min.) $(dv/dt)_2$		V/μs
DC Gate Trigger Current: $V_D = 12$ V (dc), $R_L = 30\,\Omega$, $T_C = 25°C$	I_{GT}	15	32	15	45	mA
DC Gate Trigger Voltage: $V_D = 12$ V (dc), $R_L = 30\Omega$, $T_C = 25°C$	V_{GT}	1.8	4	1.8	4	V
Circuit Commutated Turn-Off Time:♦ $T_C = 70°C$, minimum negative gate bias during turn-off time = −20 V (S3703SF, S3705M) and −2.5 V (S3702S, S3706E), rate of reapplied voltage (dv/dt) = 175 V/μs S3703S	t_q	–	2.4	–	–	μs
S3705M		–	2.5	–	–	μs
= 400 V/μs S3702S		–	–	–	4.2	μs
S3706E		–	–	–	4.5	μs
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	–	4	–	4	°C/W

♦ This parameter, the sum of reverse recovery time and gate recovery time, is measured from the zero crossing of current to the start of the reapplied voltage. Knowledge of the current, the reapplied voltage, and the case temperature is necessary when measuring t_q. In the worst conditions (high line, zero-beam, off-frequency, minimum auxiliary load, etc.) turn-off time must not fall below the given values. Turn-off time increases with temperature; therefore, case temperature must not exceed 70°C,

SILICON RECTIFIERS

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		D2103SF (TRACE)	D2601M (TRACE)	D2103S (COMMUTATING)	D2601E (COMMUTATING)	D2101S (CLAMP)	D2600M (CLAMP)	
REVERSE VOLTAGE:**								
Repetitive Peak	V_{RRM}	750	600	700	500	700	600	V
Non-Repetitive Peak●●	V_{RSM}	800	700	800	600	800	700	V
FORWARD CURRENT (operating in 15 kHz deflection circuit):								
RMS	$I_{F(RMS)}$	3■■	1.9■■	3■■	1.6■■	1**	0.5**	A
Peak Surge (Non-Repetitive)●●	I_{FSM}	70♦♦	70♦♦	70♦♦	70♦♦	30♦♦	30♦♦	A
Peak (Repetitive)	I_{FRM}	7	6.5	12	6	0.5	0.5	A
TEMPERATURE RANGE								
Storage	T_{stg}			−30 to 150				°C
Operating (Case)	T_C			−30 to 80				°C
LEAD TEMPERATURE (During Soldering):▲▲								
For 10 s maximum	T_L			225				°C

** For ambient temperatures up to 45°C.

●● For a maximum of 3 pulses, each less than 10 μs duration, during any 64-μs period.

■■ Maximum current rating applies only if the rectifier is properly mounted to maintain junction temperature below 150°C.

♦♦ See Figs. 4 & 5 for I_{FSM} value for 60 Hz.

▲▲ At distances no closer to rectifier body than points A and B on outline drawing.

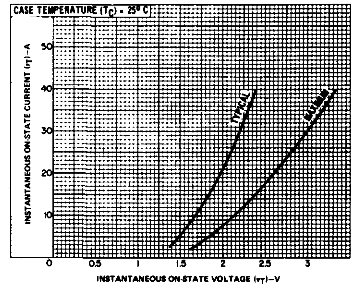


Fig. 3 — Instantaneous on-state current vs. on-state voltage for S3702S and S3703SF.

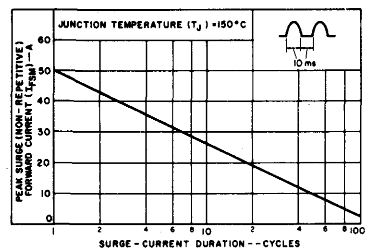


Fig. 4 — Peak surge (non-repetitive) forward current vs. surge-current duration for D2101S, D2103S, and D2103SF.

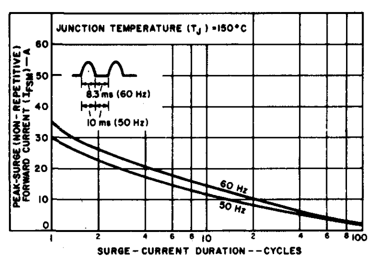


Fig. 5 — Peak-surge (non-repetitive) forward current vs. surge-current duration for D2600M, D2601E, and D2601M.

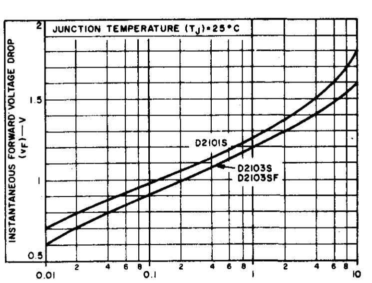


Fig. 6 — Forward-voltage drop vs. forward current for D2101S, D2103S, and D2103SF.

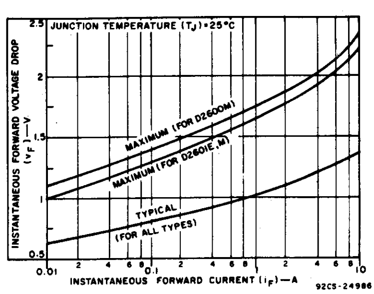


Fig. 7 — Forward-voltage drop vs. forward current for D2600M, D2601E, and D2601M.

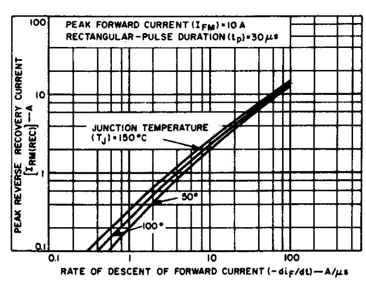


Fig. 8 — Typical peak reverse-recovery current vs. rate of descent of forward current for all rectifiers.

S3702S, S3703SF, D2101S, D2103S, D2103SF, S3705M, S3706E, D2600M, D2601E, D2601M

SILICON RECTIFIERS

ELECTRICAL CHARACTERISTICS,

CHARACTERISTIC	SYMBOL	LIMITS: D2103SF D2601M TRACE / D2103S D2601E COMMUT. — MAXIMUM	LIMITS: D2101S D2600M CLAMP — MINIMUM	UNITS
Reverse Current: *Static* For V_{RRM} = max. rated value, I_F = 0, T_C = 25°C . . . . For V_R = 500 V, T_C = 100°C.	I_{RM}	10 250	10 250	μA
Instantaneous Forward Voltage Drop: At i_F = 4 A, T_A = 25°C (See Fig. 6, 7)	v_F	1.4 (D2103SF, D2103S)	1.5 (D2101S)	V
		1.9 (D2601M, D2601E)	2 (D2600M)	
Reverse Recovery Time: At I_{FM} = 3.14 A, $-di_F/dt$ = −10 A/μs, pulse duration = 0.94 μs, T_C = 25°C	t_{rr}	0.5 (D2103SF, D2103S)	0.7 (D2101S)	μs
At I_{FM} = 20 A, $-di_F/dt$ = −20 A/μs, pulse duration = 2.8 μs, T_C = 25°C		0.5 (D2601M, D2601E)	0.7 (D2600M)	
In Tektronix type "S" plug-in unit (or equivalent): At I_F = 20 mA, I_R = 1 mA, T_C = 25°C		1.2	1.5	
Peak Forward Voltage Drop (at turn-on): In Tektronic type "S" plug-in unit (or equivalent): At I_F = 20 mA, T_C = 25°C	$V_{F(pk)}$	5	6	V
Thermal Resistance (Junction-to-Case)▲	$R_{\theta JC}$	10 (D2103SF, D2103S)	10 (D2101S)	°C/W
Thermal Resistance (Junction-to-Lead)▲ (See Fig. 11)	$R_{\theta JL}$	45 (D2601M, D2601E)	45 (D2600M)	

▲ Measured at point as indicated on Dimensional Outline.
♦ Measured on anode lead 1/8 in. (3.18 mm) from case.

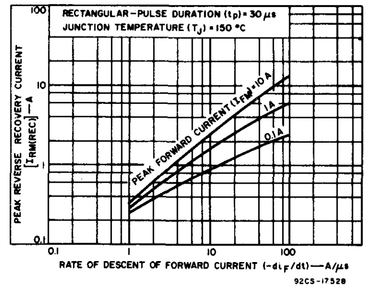


Fig. 9 — Typical peak reverse-recovery current vs. rate of descent of forward-current for all rectifiers.

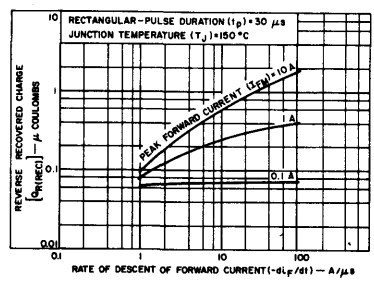


Fig. 10 — Typical reverse-recovered charge vs. rate of descent of forward current for all rectifiers.

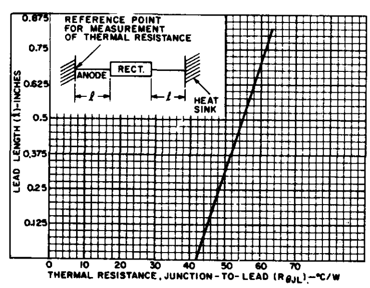


Fig. 11 — Junction-to-lead thermal resistance vs. lead length for D2600M, D2601E, and D2601M.

S3900, S3901, S3902DF, S3903MF Series

Monolithic Integrated Thyristor/Rectifiers (ITR's) for TV Horizontal-Deflection Circuits

Color and Monochrome

The RCA-S3900- and S3901-series and the S3902DF and S3903MF integrated thyristor/rectifiers are all-diffused power monolithic circuits that incorporate a silicon controlled rectifier and a silicon rectifier on a common pellet. The S3900-series and S3902DF types are used as bipolar switches to control horizontal yoke current during the beam trace interval; the S3901-series and S3903MF types are used as commutating switches to initiate trace-retrace switching.

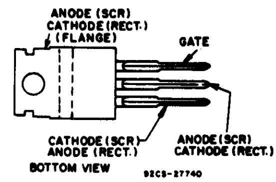
The S3900 and S3901-series ITR's are designed for use in color TV circuits. Devices in the S3900 series are capable of supplying 8 mJ of stored energy to the deflection yoke; this is sufficient for 29-mm-neck and 35-mm-neck color picture tubes operated at a nominal value of 31 kV.

The S3902DF and S3903MF types are intended for use in black-and-white TV circuits. The S3903DF ITR is capable of supplying 3 mJ of stored energy to the deflection yoke; this is sufficient for 29-mm-neck monochrome tubes operated at 19 kV nominal value.

All types in these four series are supplied in the JEDEC TO-220AB package. The plastic used in this package is a flame-retardant material.

Features:
- Operation from nominal supply voltages between:
  100 V and 240 V – S3902DF, S3903MF
  140 V and 270 V – S3900, S3901 Series
- Ability to handle high beam current:
  1 mA dc (avg.) – S3902DF, S3903MF
  1.6 mA dc (avg.) – S3900, S3901 Series
- Ability to supply stored energy to the deflection yoke, as much as:
  3 mJ for 19 kV (nom.) monochrome tubes – S3902DF
  8 mJ for 31 kV (nom.) color TV tubes – S3900 Series
- Highly reliable circuit which can also be used as a low-voltage power supply

TERMINAL CONNECTIONS



JEDEC TO-220AB

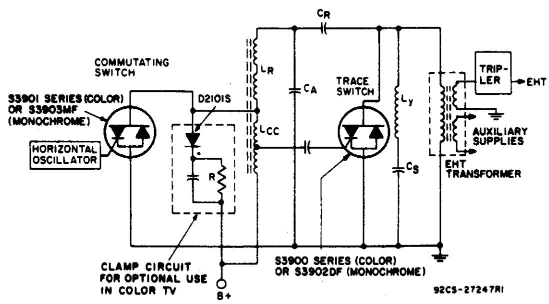


Fig. 1 – Simplified schematic diagram of horizontal output circuit.

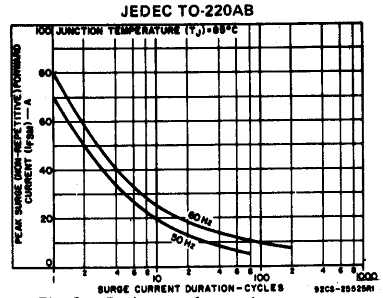


Fig. 2 – Peak surge forward current vs. surge-current duration for rectifier unit of ITR (all types).

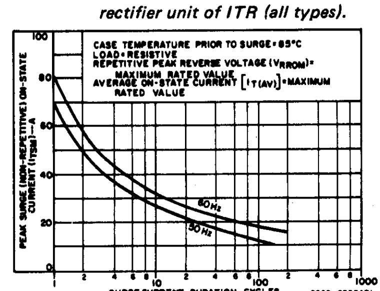


Fig. 3 – Peak surge on-state current vs. surge-current duration for SCR unit of ITR (all types).

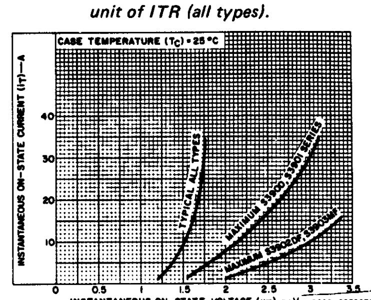


Fig. 4 – Instantaneous on-state current vs. on-state voltage for SCR unit of ITR (all types).

ITR's FOR COLOR TELEVISION

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TRACE				COMMUTATING			
	S3900E	S3900MF	S3900S	S3900SF	S3901M	S3901MF	S3901S	
V_{DSOM}:*• $T_C = 85°C$	550	700	750	800	650	700	750	V
V_{RROM}:• $T_C = 85°C$	4	4	4	4	4	4	4	V
V_{DROM}:• $T_C = 85°C$	500	650	700	750	600	650	700	V
CURRENT:								
$T_C = 60°C$, 50 Hz sine wave, $\theta = 180°$:								
Rectifier Unit:								
I_o				3				A
$I_{F(RMS)}$				4.5				A
SCR Unit:								
$I_{T(AV)}$				5				A
$I_{T(RMS)}$				8				A
I_{TSM}:								
For one full cycle of applied principal voltage:								
60 Hz (sinusoidal), T_C=85°C:								
Rectifier Unit, I_{FSM}				80				A
SCR Unit, I_{TSM}				80				A
50 Hz (sinusoidal), T_C=85°C:								
Rectifier Unit, I_{FSM}				70				A
SCR Unit, I_{TSM}				70				A
For more than one full cycle of applied principal voltage				See Figs. 6 and 7				
For one-half sine wave, t_p=3 ms:								
Rectifier Unit, I_{FSM}				150				A
SCR Unit, I_{TSM}				150				A

S3900, S3901, S3902DF, S3903MF Series

ITR's FOR COLOR TELEVISION

MAXIMUM RATINGS, *Absolute-Maximum Values:* **(Cont'd)**

	TRACE: S3900MF, S3900S, S3900SF / COMMUTATING: S3901M, S3901MF, S3901S	
di/dt: $V_D = V_{DROM}$, I_{GT} = 50 mA, t_r = 0.1 μs	200	A/μs
I^2t (For ITR protection): T_J = −40 to 85°C, t = 1 to 10 ms	30	A^2s
P_{GM}:■ Forward or reverse for 10 μs duration, max. negative gate bias = −10 V	25	W
T_{stg}:▲	−40 to 150	°C
T_C:▲	−40 to 85	°C
T_T (During soldering): At distances ⩾ 1/8 in. (3.17 mm) from case for 10 s max.	225	°C

*Protection against transients above these values induced by arcing or other causes must be provided.

●These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

■Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted, provided that the maximum reverse gate bias (as specified) is not exceeded.

▲For temperature measurement reference point, see Dimensional Outline.

ELECTRICAL CHARACTERISTICS FOR ITR's FOR COLOR-TELEVISION CIRCUITS
At Maximum Ratings and at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	LIMITS: S3900 Series TRACE ITR		LIMITS: S3901 Series COMMUTATING ITR		UNITS
	TYP.	MAX.	TYP.	MAX.	
I_{DOM}: $V_D = V_{DROM}$, T_C = 85°C	0.5	1.5	0.5	1.5	mA
V_T: SCR Unit: i_T = 30 A (See Fig. 4)	1.75	3	1.75	3	V
V_F: Rectifier Unit: i_F = 10 A (See Fig. 5)	1.35	1.7	1.35	2	V
dv/dt: $V_D = V_{DROM}$, T_C = 85°C V_G = −2.5 V min. (S3901 Series)	175 (min.)		1000 (min.) $(dv/dt)_2$		V/μs
I_{GT}: V_D = 12 V dc, R_L = 30 Ω	15	40	15	45	mA
V_{GT}: V_D = 12 V dc, R_L = 30 Ω	1.8	4	1.8	4	V
t_q: ♦ T_C = 80°C Minimum negative gate bias = −20 V (S3900 Series) = −2.5 V (S3901 Series) dv/dt = 175 V/μs (S3900 Series)	–	2.4	–	–	μs
dv/dt = 400 V/μs (S3901 Series)	–	–	–	4.2	μs

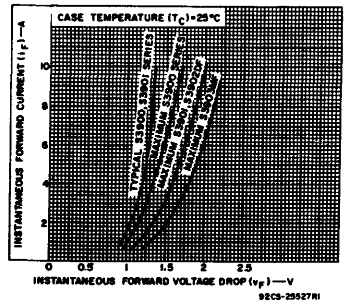


Fig. 5 — Instantaneous forward current vs. forward voltage drop for rectifier unit of ITR (all types).

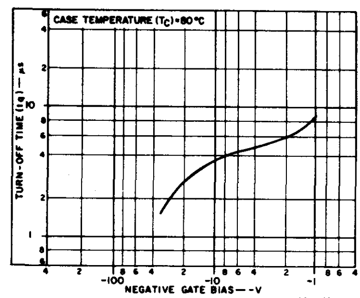


Fig. 6 — Typical turn-off time vs. gate bias for S3900-series types.

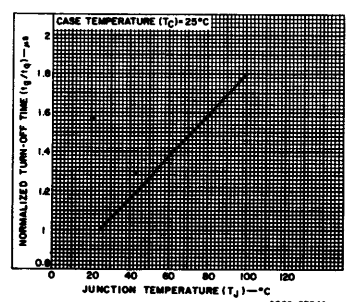


Fig. 7 — Normalized turn-off time vs. junction temperature for S3900- and S3901-series types.

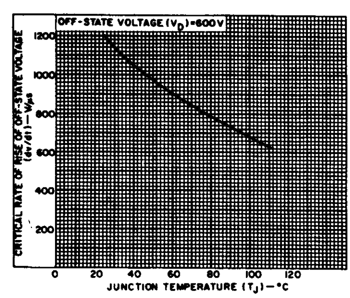


Fig. 8 — Typical dv/dt vs. junction temperature for S3900- and S3901-series types.

S3900, S3901, S3902DF, S3903MF Series

ELECTRICAL CHARACTERISTICS FOR ITR's FOR COLOR-TELEVISION CIRCUITS (Cont'd)
At Maximum Ratings and at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	LIMITS				UNITS
	S3900 Series TRACE ITR		S3901 Series COMMUTATING ITR		
	TYP.	MAX.	TYP.	MAX.	
t_{rr}: Rectifier Unit: I_{FM} = 10 A, $-di_F/dt$ = −10 A/µs, t_p = 3 µs	0.5	0.7	0.5	0.7	µs
V_{FM} (At t_g): Rectifier Unit: I_{FM} = 1 A	8	13	–	–	V
$R_{\theta JC}$▲	–	2.5	–	2.5	°C/W

♦ Turn-off time increases with temperature; therefore, case temperature must not exceed the level indicated.
▲ Measured at point indicated on Dimensional Outline.

ITR's FOR MONOCHROME TELEVISION

MAXIMUM RATINGS, ***Absolute-Maximum Values:***

	TRACE S3902DF	COMMUTATING S3903MF	
V_{DSOM}:*• T_C = 85°C	500	700	V
V_{RROM}:• T_C = 85°C	4	4	V
V_{DROM}:• T_C = 85°C	450	650	V
CURRENT:			
T_C = 60°C, 50 Hz sine wave, θ = 180°:			
Rectifier Unit:			
I_o	3		A
$I_{F(RMS)}$	4.5		A
SCR Unit:			
$I_{T(AV)}$	5		A
$I_{T(RMS)}$	8		A
I_{TSM}:			
For one full cycle of applied principal voltage:			
60 Hz (sinusoidal), T_C = 85°C:			
Rectifier Unit, I_{FSM}	80		A
SCR Unit, I_{TSM}	80		A
50 Hz (sinusoidal), T_C = 85°C:			
Rectifier Unit, I_{FSM}	70		A
SCR Unit, I_{TSM}	70		A
For more than one full cycle of applied principal voltage	See Figs. 2 and 3		
For one-half sine wave, t_p = 3 ms:			
Rectifier Unit, I_{FSM}	150		A
SCR Unit, I_{TSM}	150		A
di/dt:			
V_D = V_{DROM}, I_{GT} = 50 mA, t_r = 0.1 µs	200		A/µs
I^2t (For ITR protection):			
T_J = −40 to 85°C, t = 1 to 10 ms	30		A^2s
P_{GM}:●			
Forward or reverse for 10 µs duration, max. negative gate bias = −10 V	25		W
T_{stg}:▲	−40 to 150		°C
T_C:▲	−40 to 85		°C
T_T (During soldering):			
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	225		°C

*Protection against transients above these values induced by arcing or other causes must be provided.
•These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
●Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted, provided that the maximum reverse gate bias (as specified) is not exceeded.
▲For temperature measurement reference point, see Dimensional Outline.

ELECTRICAL CHARACTERISTICS FOR ITR's FOR MONOCHROME-TELEVISION CIRCUITS
At Maximum Ratings and at Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	LIMITS				UNITS
	S3902DF TRACE ITR		S3903MF COMMUTATING ITR		
	TYP.	MAX.	TYP.	MAX.	
I_{DOM}: V_D = V_{DROM}, T_C = 85°C	0.5	1.5	0.5	1.5	mA
V_T: SCR Unit: i_T = 10 A (See Fig. 4)	1.75	3	1.75	3	V
V_F: Rectifier Unit: i_F = 4 A (See Fig. 5)	1.35	1.6	1.35	1.8	V
dv/dt: V_D = V_{DROM}, T_C = 85°C, V_G = −2.5 V min. (S3903MF)	120 (min.)		700 (min.) $(dv/dt)_2$		V/µs
I_{GT}: V_D = 12 V dc, R_L = 30 Ω	15	40	15	45	mA
V_{GT}: V_D = 12 V dc, R_L = 30 Ω	1.8	4	1.8	4	V
t_q:♦ T_C = 80°C, Minimum negative gate bias = −20 V (S3902DF) = −2.5 V (S3903MF); dv/dt = 120 V/µs (S3902DF)	–	3	–	–	µs
dv/dt = 400 V/µs (S3903 Series)	–	–	–	5	µs
t_{rr}: Rectifier Unit: I_{FM} = 3.14 A, $-di_F/dt$ = −10 A/µs, t_p = 0.94 µs	0.3	0.5	0.3	0.5	µs
V_{FM} (At t_g): Rectifier Unit: I_{FM} = 1 A	8	13	–	–	V
$R_{\theta JC}$▲	–	2.5	–	2.5	°C/W

♦ Turn-off time increases with temperature; therefore, case temperature must not exceed the level indicated.
▲ Measured at point indicated on Dimensional Outline.

S4000(2N3668-2N3670,2N4103) Series

12.5-A Silicon Controlled Rectifiers

For Low-Cost Power-Control and Power-Switching Applications

RCA 2N3668*, 2N3669*, 2N3670*, and 2N4103* are all-diffused, three-junction, silicon controlled-rectifiers (SCR's). They are intended for use in power-control and power-switching applications requiring a blocking voltage capability of up to 600 volts and a forward-current capability of 12.5 amperes (rms value) or 8 amperes (average value) at a case temperature of 80°C.

The 2N3668 is designed for low-voltage power supplies, the 2N3669 for direct operation from 120-volt line supplies, the 2N3670 for direct operation from 240-volt line supplies, and the 2N4103 for high-voltage power supplies.

The 2N3668, 2N3669, 2N3670 and 2N4103 SCR's employ the hermetic JEDEC TO-3 package.

*Formerly Dev. Types TA2621, TA2598, TA2618, and TA2775, respectively.

Features:

- Low switching losses
- High di/dt and dv/dt capabilities
- Shorted emitter gate-cathode construction
- Forward and reverse gate dissipation ratings
- Designed especially for high-volume systems
- All-diffused construction – assures exceptional uniformity and stability of characteristics
- Direct-soldered internal construction – assures exceptional resistance to fatigue
- Symmetrical gate-cathode construction – provides uniform current density, rapid electrical conduction, and efficient heat dissipation
- All-welded construction and hermetic sealing
- Low leakage currents, both forward and reverse
- Low forward voltage drop at high current levels
- Low thermal resistance

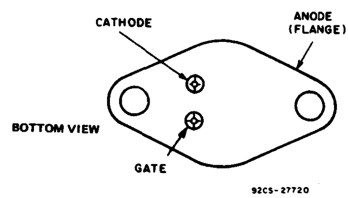
Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at a Frequency between 50 and 400 Hz, and with Resistive or Inductive Load

RATINGS	CONTROLLED-RECTIFIER TYPES				UNITS
	2N3668	2N3669	2N3670	2N4103	
Transient Peak Reverse Voltage (Non-Repetitive), v_{RM}(non-rep)	150	330	660	700	volts
Peak Reverse Voltage (Repetitive), v_{RM}(rep)	100	200	400	600	volts
Peak Forward Blocking Voltage (Repetitive), v_{FBOM}(rep)	100	200	400	600	volts
Forward Current:					
For case temperature (T_C) of +80° C					
Average DC value at a conduction angle of 180°, I_{FAV}	8	8	8	8	amperes
RMS value, I_{FRMS}	12.5	12.5	12.5	12.5	amperes
For other conditions, (See Fig. 4)					
Peak Surge Current, i_{FM}(surge):					
For one cycle of applied voltage	200	200	200	200	amperes
For one cycle of applied principal voltage					
60 Hz (sinusoidal), T_C = 80°C	200	200	200	200	amperes
50 Hz (sinusoidal), T_C = 80°C	170	170	170	170	amperes
For more than one cycle of applied voltage	See Fig. 2	See Fig. 2	See Fig. 2	See Fig. 2	
Fusing Current (for SCR protection):					
T_J = −40 to 100°C, t = 1 to 8.3 ms, I^2t	170	170	170	170	ampere²second
Rate of Change of Forward Current, di/dt V_{FB} = v_{BOO}(min. value) I_{GT} = 200mA, 0.5 μs rise time	200	200	200	200	amperes/microsecond
Gate Power*:					
Peak, Forward or Reverse, for 10 μs duration, P_{GM} (See Figs. 5 and 6)	40	40	40	40	watts
Average, P_{GAV}	0.5	0.5	0.5	0.5	watt
Temperature:					
Storage, T_{stg}•	-40 to +125	-40 to +125	-40 to +125	-40 to +125	°C
Operating (Case), T_C	-40 to +100	-40 to +100	-40 to +100	-40 to +100	°C

* Any values of peak gate current or peak gate voltage to give the maximum gate power is permissible.

• Temperature reference point is within 1/8 in. (3.17 mm) of the center of the underside of unit.

TERMINAL DESIGNATIONS



JEDEC TO-3

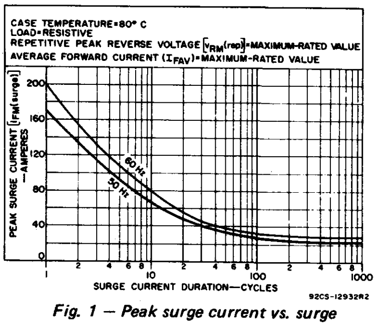


Fig. 1 – Peak surge current vs. surge current duration.

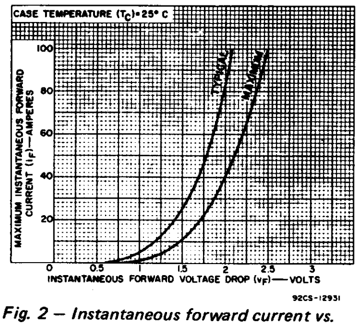


Fig. 2 – Instantaneous forward current vs. instantaneous forward voltage drop.

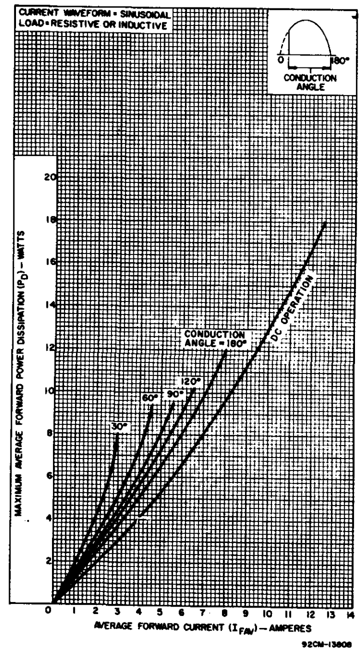


Fig. 3 – Power dissipation vs. forward current.

S4000(2N3668-2N3670,2N4103) Series

ELECTRICAL CHARACTERISTICS

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

CHARACTERISTICS	CONTROLLED-RECTIFIER TYPES												UNITS
	2N3668			2N3669			2N3670			2N4103			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Repetitive Blocking Voltage, V_{DROM} At T_C = +100°C	100	–	–	200	–	–	400	–	–	600	–	–	volts
Peak Blocking Current, at T_C = +100°C: Forward, I_{DOM} $V_D = V_{DROM}$	–	0.2	2	–	0.25	2.5	–	0.3	3	–	0.35	4	mA
Reverse, I_{ROM} $V_R = V_{RROM}$	–	0.05	1	–	0.1	1.25	–	0.2	1.5	–	0.3	3	mA
Forward Voltage Drop, v_F At a Forward Current of 25 amperes and a T_C = +25°C (See Fig. 2)	–	1.5	1.8	–	1.5	1.8	–	1.5	1.8	–	1.5	1.8	volts
DC Gate-Trigger Current, I_{GT}: At T_C = +25°C (See Fig. 5)	1	20	40	1	20	40	1	20	40	1	20	40	mA(dc)
Gate-Trigger Voltage, V_{GT}: At T_C = +25°C (See Fig. 5)	–	1.5	2	–	1.5	2	–	1.5	2	–	1.5	2	volts (dc)
Holding Current, i_{HOO}: At T_C = +25°C	0.5	25	50	0.5	25	50	0.5	25	50	0.5	25	50	mA
Critical Rate of Applied Forward Voltage, Critical dv/dt $V_{FB} = V_{BOO}$(min.value), exponential rise, T_C = +100°C	10	100	–	10	100	–	10	100	–	10	100	–	volts/ microsecond
Turn-On Time, t_{on}, (Delay Time + Rise Time) $V_{FB} = V_{BOO}$(min. value), i_F = 8 amperes, I_{GT} = 200 mA, 0.1 μs rise time, T_C = +25°C (See waveshapes of Fig. 3)	0.75	1.25	–	0.75	1.25	–	0.75	1.25	–	0.75	1.25	–	microseconds
Turn-Off Time, t_{off}, (Reverse Recovery Time + Gate Recovery Time) i_F = 8 amperes, 50 μs pulse width, dv_{FB}/dt = 20 v/μs, di_r/dt = 30 A/μs, I_{GT} = 200 mA, T_C = +80°C	–	20	50	–	20	50	–	20	50	–	20	50	microseconds
Thermal Resistance, Junction-to-Case	–	–	1.7	–	–	1.7	–	–	1.7	–	–	1.7	°C/W

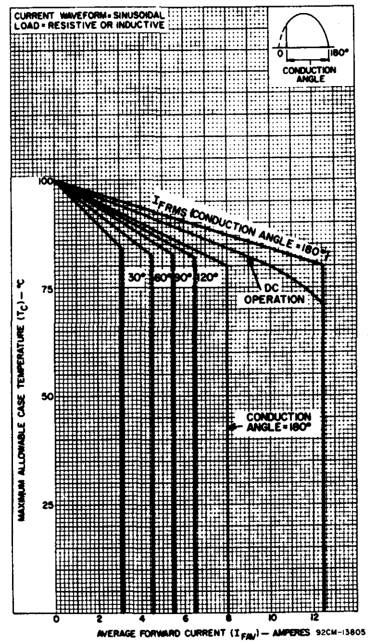


Fig. 4 – Maximum allowable case temperature vs. average forward current.

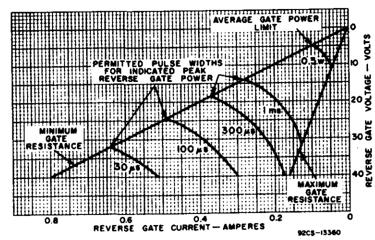


Fig. 6 – Reverse gate characteristics.

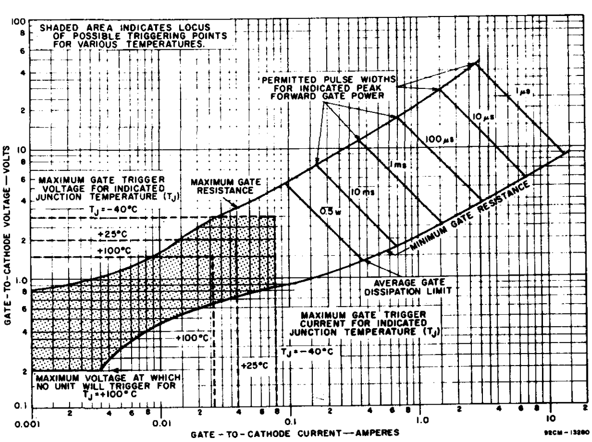


Fig. 5 – Forward gate characteristics.

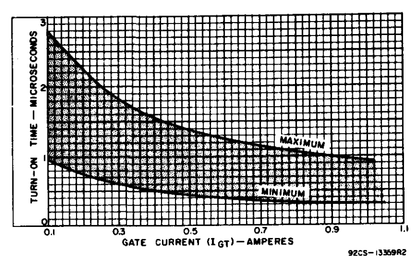


Fig. 7 – Turn-on time vs. gate current.

S4000(2N3668-2N3670, 2N4103) Series

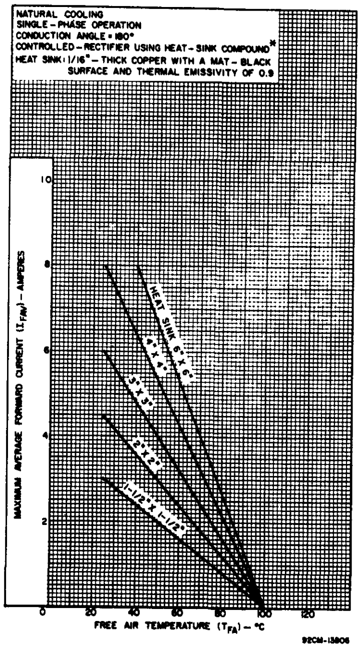


Fig. 8 — Natural-cooling operation guidance chart.

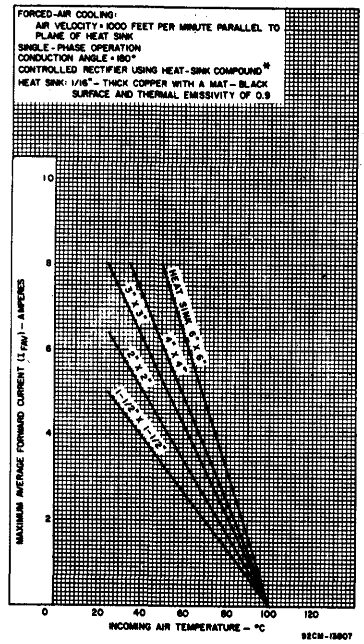


Fig. 9 — Forced-air cooling operation guidance chart.

*Dow Corning 340 Silicon Heat Sink Compound, or Equivalent.

S5800, S5801, S5802 Series

5-A Silicon Controlled Rectifiers

For Inverter/Regulator Applications

The RCA-S5800, S5801, and S5802 are all-diffused silicon controlled rectifiers (reverse-blocking triode thyristors) intended for high-speed switching applications such as power inverters, switching regulators, and high-current pulse applications. They feature fast turn-off, high dv/dt, and high di/dt characteristics and may be used at frequencies up to 25 kHz.

All types in each series utilize the JEDEC-TO-220AB (RCA VERSAWATT) plastic package.

Features:

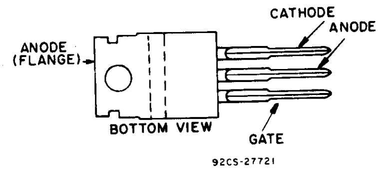
- Fast turn-off time (tq) = 6 μs max. (S5800 series)
- High di/dt and dv/dt capabilities
- Shorted-emitter gate-cathode construction. . .contains an internally diffused resistor between gate and cathode
- Low thermal resistance
- Center-gate construction . . .provides rapid uniform gate-current spreading for faster turn-on with substantially reduced heating effects

MAXIMUM RATINGS, *Absolute-Maximum Values:*

6 μs (t_q)	S5800B	S5800C	S5800D	S5800E	S5800M	
10 μs (t_q)	S5801B	S5801C	S5801D	S5801E	S5801M	
15 μs (t_q)	S5802B	S5802C	S5802D	S5802E	S5802M	
V_{RSOM}▲, V_{DSOM}▲	250	350	450	550	650	V
V_{RROM}▲, V_{DROM}▲	200	300	400	500	600	V
$I_{T(RMS)}$ (T_C = 60°C, t_1/t_2 = 0.5)			5			A
$I_{T(AV)}$ (T_C = 60°C, t_1/t_2 = 0.5)			3.2			A
I_{TSM}: For one full cycle of applied principal voltage						
60-Hz (sinusoidal)			80			A
50-Hz (sinusoidal)			75			A
For more than one cycle of applied principal voltage			See Fig. 4			
di/dt: (See Fig. 9) V_{DM} = V_{DROM}, I_{GT} = 500 mA, t_r = 0.5 μs			200			A/μs
I^2t [At T_C shown for $I_{T(RMS)}$]:						
t = 10 ms			28			A^2s
8.3 ms			26			A^2s
1 ms			13			A^2s
For other time values			See Fig. 5			
P_{GM}●: Peak forward for 10 μs max.			13			W
P_{RGM}●: Peak reverse for 10 μs max.			13			W
$P_{G(AV)}$●: Averaging time = 10 μs max.			0.5			W
T_{stg}■			−40 to 150			°C
T_C■			−40 to 100			°C
T_T■ (During soldering for 10 s maximum, terminals and case)			225			°C

■ For temperature measurement reference point, see Dimensional Outline.
▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.

TERMINAL CONNECTIONS



JEDEC TO-220AB

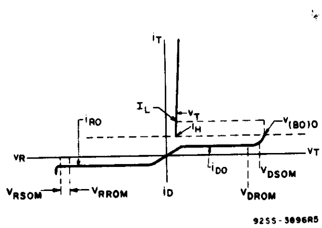


Fig. 1 – Principal voltage-current characteristic.

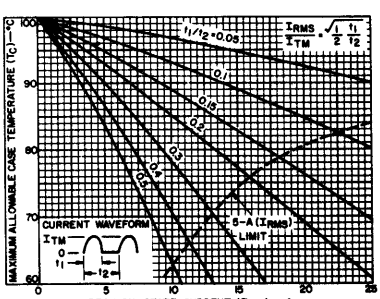


Fig. 2 – Maximum allowable case temperature as a function of peak on-state current.

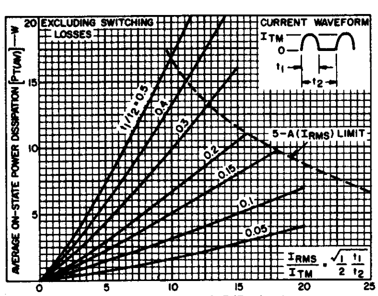


Fig. 3 – Average on-state power dissipation as a function of peak on-state current.

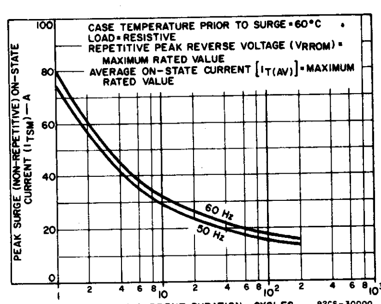


Fig. 4 – Peak surge on-state current as a function of surge duration.

S5800, S5801, S5802 Series

ELECTRICAL CHARACTERISTICS

As Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Min.	Typ.	Max.	UNITS
I_{DROM}: $V_D = V_{DROM}$, $T_C = 100°C$	–	0.5	3	mA
I_{RROM}: $V_R = V_{RROM}$, $T_C = 100°C$	–	0.3	1.5	mA
V_T: I_{TM} = 30 A (peak), $T_C = 25°C$: (See Fig. 6)				V
S5800 series	–	2.34	4	V
S5801 and S5802 series	–	1.96	4	V
i_{HO}: $T_C = 25°C$	–	20	50	mA
dv/dt: (Linear) (See Fig. 10) $V_D = V_{DROM}$, $T_C = 80°C$	100	250	–	V/µs
I_{GT}: V_D = 12 V dc, R_L = 30 Ω, $T_C = 25°C$	–	–	50	mA
V_{GT}: V_D = 12 V dc, R_L = 30 Ω, $T_C = 25°C$	–	1.2	2.5	V
t_{gt}: (See Fig. 11) $V_D = V_{DROM}$, i_T = 8 A (peak), I_{GT} = 300 mA, t_r = 0.1 µs, $T_C = 25°C$	–	0.7	–	µs
t_q: (See Figs. 8, 12, 13) ½ Sine Wave $V_D = V_{DROM}$, pulse duration = 50 µs, dv/dt = 100 V/µs, −di/dt = −10 A/µs, I_{GT} = 100 mA at turn on, V_{GK} = 0 V at turn off, $T_C = 75°C$:				µs
i_T = 4A S5800 series	–	4.4	–	µs
S5801 series	–	6.8	–	µs
S5802 series	–	11	–	µs
i_T = 8A S5800 series	–	4.7	6	µs
S5801 series	–	8	10	µs
S5802 series	–	12	15	µs
$R_{\theta JC}$	–	–	2.2	°C/W

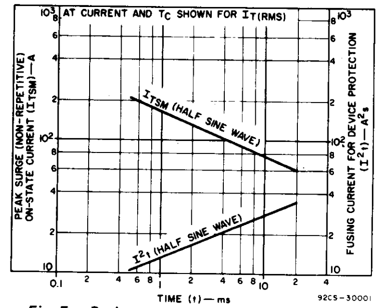


Fig. 5 – Peak surge on-state current and fusing current as a function of time.

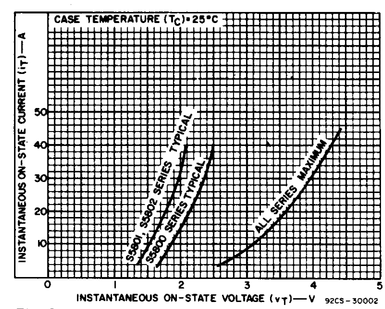


Fig. 6 – Instantaneous on-state current as a function of instantaneous on-state voltage.

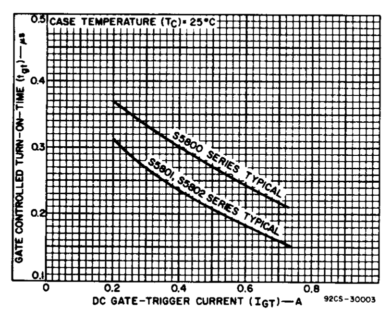


Fig. 7 – Gate-controlled turn-on-time as a function of gate current.

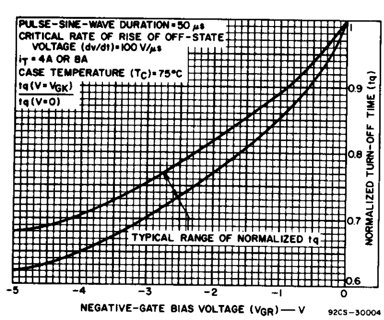


Fig. 8 – Normalized turn-off time as a function of negative-gate bias voltage.

S6000 (2N6394-2N6398; S6000C, S6000E, S6000S) S6100 (2N6400-2N6404; S6100C, S6100E, S6100S) Series

12-A and 16-A Silicon Controlled Rectifiers

For Power Switching, Power Control, and Ignition Applications

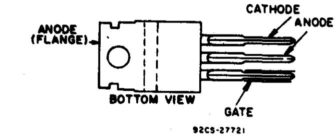
Features:

- High dv/dt capability
- Low thermal resistance
- Shorted-emitter center gate design
- Low on-state voltage at high current levels
- Glass passivated junctions

The RCA-2N6394 to 2N6398, inclusive, and 2N6400 to 2N6404, inclusive, and the S6000C, S6000E, S6000S, S6100C, S6100E, and S6100S are all-diffused silicon controlled rectifiers (reverse-blocking triode thyristors) designed for switching ac and dc currents. These devices can switch from the off-state to the on-state when both the anode and gate voltages are positive. Negative anode voltages make these devices revert to the blocking state.

The TO-220AB package provides easy package mounting and low thermal resistance, allowing operation at high case temperatures and permitting reduced heat-sink size. These SCR's can be used in lighting and motor-speed control, capacitor-discharge ignition circuits, high-voltage generators, automotive applications, and power-switching systems.

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6394 2N6400	2N6395 2N6401	2N6396 2N6402	S6000C S6100C	2N6397 2N6403	S6000E S6100E	2N6398 2N6404	S6000S S6100S	
* V_{RSOM} ▲	75	125	250	350	450	550	650	750	V
V_{DSOM} ▲	75	125	250	350	450	550	650	750	V
* V_{RROM} ▲	50	100	200	300	400	500	600	700	V
* V_{DROM} ▲	50	100	200	300	400	500	600	700	V
$I_{T(RMS)}$ θ = 180°C									
T_C = 90°C – 2N6394-98, S6000 series	12								A
T_C = 100°C – 2N6400-04, S6100 series	16								A
I_{TSM}:									
For one full cycle of applied principal voltage									
60-Hz† – 12-A types	125♦								A
16-A types	160								A
50-Hz† – 12-A types	105								A
– 16-A types	135								A
For more than one full cycle of applied principal voltage	See Fig. 7, 8								
di/dt									
$V_D = V_{DROM}$, I_{GT} = 80 mA, t_r = 0.1 μs	100								A/μs
I^2t:									
T_J = −40 to 125°C,									
t = 1 to 8.3 ms – 12-A types	65								A^2s
16-A types	100								A^2s
P_{GM} ●:									
Peak forward for 10 μs max.	16♠								W
Peak reverse	See Fig. 13								
* $P_{G(AV)}$ ●:									
Averaging time = 8 ms maximum	0.5								W
I_{GM}: (forward)	2								A
* T_{stg} ■	−40 to 150								°C
* T_C ■	−40 to 125								°C
T_T:									
During soldering for 10 s maximum (terminal and case)	250								°C

* In accordance with JEDEC registration data format (JS-22, RDF-1) filed for the JEDEC (2N series) types.
▲ These values do not apply if there is a positive gate signal, Gate must be open or negatively biased.
† At maximum rated $I_{T(RMS)}$.
♦ JEDEC registered value is 100 A at T_C = 90°C.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
♠ JEDEC registered value is 10 W.
■ For temperature measurement reference point, see Dimensional Outline.

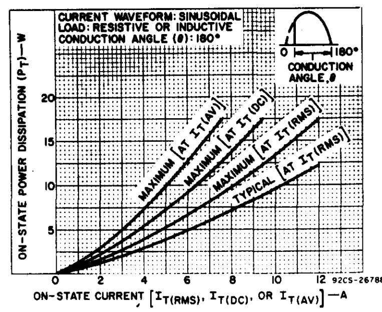


Fig. 1 – On-state power dissipation vs. on-state current for 2N6394-98, S6000 series.

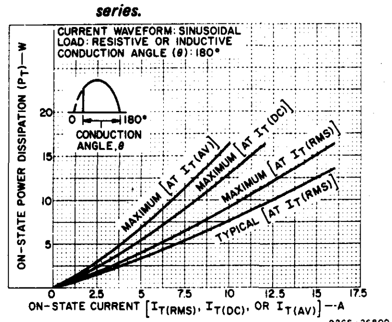


Fig. 2 – On-state power dissipation vs. on-state current for 2N6400-04, S6100 series.

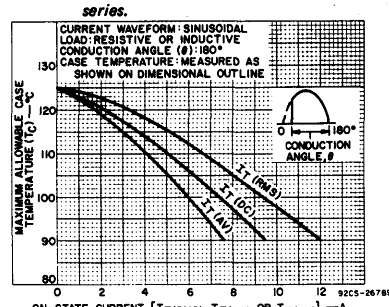


Fig. 3 – Maximum allowable case temperature vs. on-state current for 2N6394-98, S6000 series.

S6000 (2N6394-2N6398; S6000C, S6000E, S6000S) S6100 (2N6400-2N6404; S6100C, S6100E, S6100S) Series

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTIC	LIMITS For All Types MIN.	TYP.	MAX.	UNITS
I_{DOM} or I_{ROM}: $V_D = V_{DROM}$ or $V_R = V_{RROM}$, T_C = 125°C	–	0.1	2*	mA
v_T: (See Fig. 9, 10)				V
i_T = 24 A (peak), T_C = 25°C (12-A types)	–	1.7	2.2*	
= 32 A (peak), T_C = 25°C (16-A types)	–	1.4	1.7*	
i_{HO}: (See Fig. 11)				mA
T_C = 25°C	–	10	35	
T_C = −40°C	–	–	60*	
dv/dt: $V_D = V_{DROM}$, exponential voltage rise, T_C = 125°	50	–	–	V/μs
I_{GT} (See Fig. 14)				mA
V_D = 12 V (dc), R_L = 50Ω, T_C = 25°C	–	8	30	
V_D = 12 V (dc), R_L = 50Ω, T_C = −40°C	–	–	60*	
V_{GT}: (See Fig. 15)				V
V_D = 12 V (dc), R_L = 50Ω, T_C = 25°C	–	0.7	1.5	
V_D = 12 V (dc), R_L = 50Ω, T_C = −40°C	–	–	2.5*	
V_{GRD}: $V_D = V_{DROM}$, T_C = 125°C	0.2	–	–	V
t_{gt}: $V_D = V_{DROM}$, i_T = 24 A (peak), I_{GT} = 200 mA, t_r = 0.02 μs, T_C = 25°C	–	–	2*	μs
t_q: Rectangular Pulse $V_D = V_{DROM}$, $i_T = I_{T(RMS)}$, pulse duration = 50 μs, dv/dt = 50 V/μs, −di/dt = −10 A/μs, I_{GT} = 80 mA at turn-on, V_R = 20 V minimum, V_{GK} = 0 V at turn-off, T_C = 75°C	–	35	75	μs
$R_{\theta JC}$	–	–	2*	°C/W
$R_{\theta JA}$	–	–	50*	°C/W

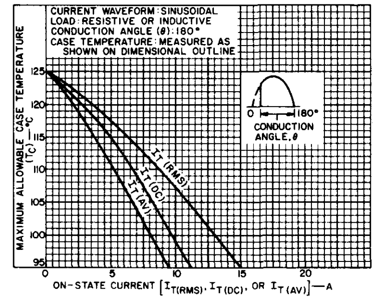


Fig. 4 — Maximum allowable case temperature vs. on-state current for 2N6400-04, S6100 series.

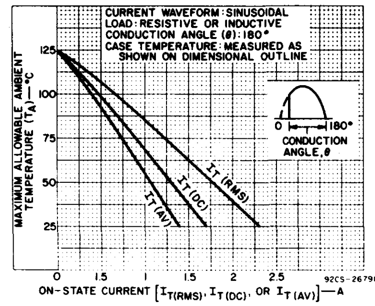


Fig. 5 — Maximum allowable ambient temperature vs. on-state current — no heat sinking for 2N6394-98, S6000 series.

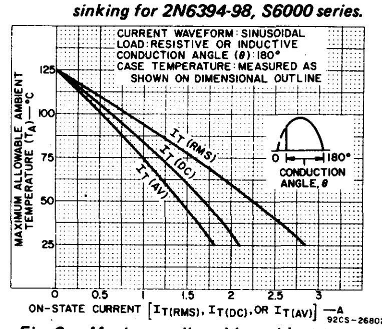


Fig. 6 — Maximum allowable ambient temperature vs. on-state current — no heat sinking for 2N6400-04, S6100 series.

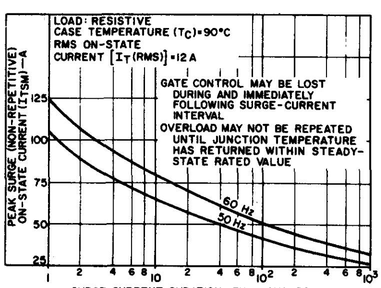


Fig. 7 — Allowable peak surge on-state current vs. surge duration for 2N6394-2N6398 and S6000 series.

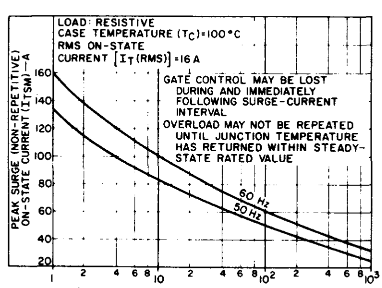


Fig. 8 — Allowable peak surge on-state current vs. surge duration for 2N6400-2N6404 and S6100 series.

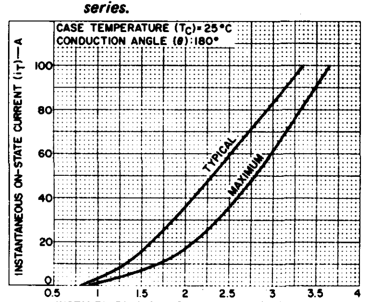


Fig. 9 — Instantaneous on-stage current vs. instantaneous on-state voltage for 2N6394–2N6398 and S6000 series.

S6000 (2N6394-2N6398; S6000C, S6000E, S6000S) S6100 (2N6400-2N6404; S6100C, S6100E, S6100S) Series

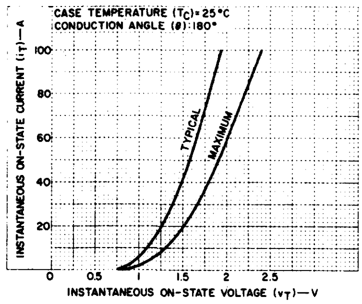


Fig. 10 – Instantaneous on-state current vs. instantaneous on-state voltage for 2N6400–2N6404 and S6100 series.

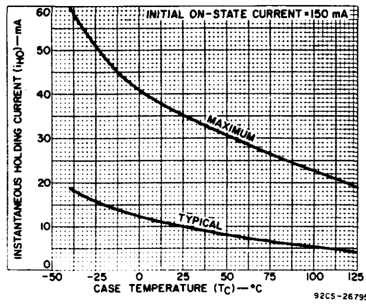


Fig. 11 – Instantaneous holding current vs. case temperature for all types.

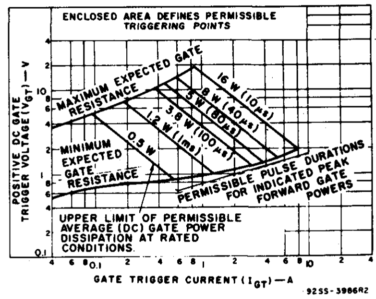


Fig. 12 – Gate trigger characteristics and limiting conditions for determination of permissible gate-trigger plulses for all types.

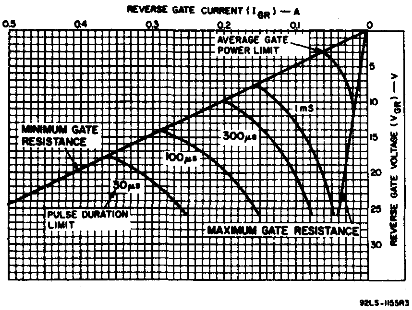


Fig. 13 – Reverse gate characteristics for all types.

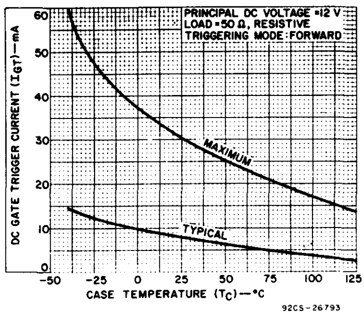


Fig. 14 – DC gate trigger current vs. case temperature for all types.

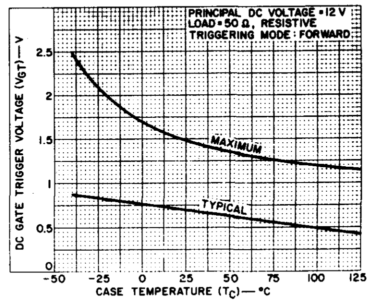


Fig. 15 – DC gate trigger voltage vs. case temperature for all types.

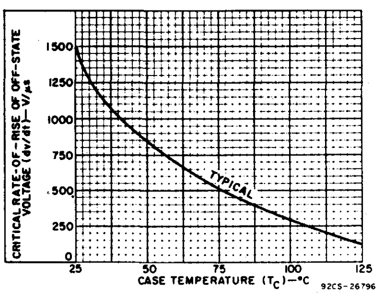


Fig. 16 – Critical rate of rise of off-state voltage vs. case temperature for all types.

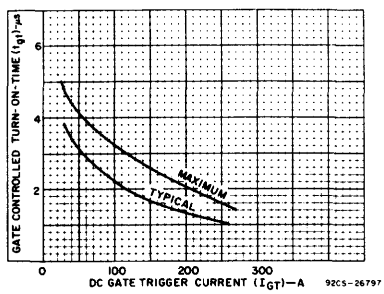


Fig. 17 – Typical gate-controlled turn-on time vs. gate trigger current for all types.

S6200, S6210, S6220 Series

20-A Silicon Controlled Rectifiers

Press-Fit, Stud, and Isolated-Stud Packages

These RCA types are all-diffused, silicon controlled rectifiers (reverse-blocking triode thyristors) designed for power switching and voltage regulator applications and for heating, lighting and motor speed-control circuits.

These SCRs have an RMS on-state current rating ($I_{T\,[RMS]}$) of 20 A and have voltage ratings (V_{DROM}) of 100, 200, 400, and 600 volts.

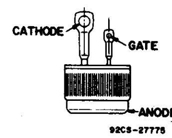
The S6200 SCR series employs a hermetic press-fit package, the S6210 series employs a hermetic stud package, and the S6220 series employs a hermetic isolated-stud package.

Features:
- Low switching losses
- High di/dt and dv/dt capabilities
- Shorted-emitter gate-cathode construction
- Forward and reverse gate dissipation ratings
- All-diffused construction—assures exceptional uniformity and stability of characteristics
- Symmetrical gate-cathode construction—provides uniform current density, rapid electrical conduction, and efficient heat dissipation
- Low leakage currents, both forward and reverse
- Low forward voltage drop at high current levels
- Low thermal resistance

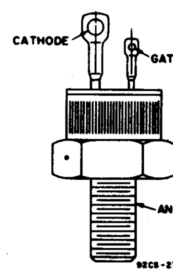
MAXIMUM RATINGS, *Absolute-Maximum Values:*

		S6200A S6210A S6220A	S6200B S6210B S6220B	S6200D S6210D S6220D	S6200M S6210M S6220M	
NON-REPETITIVE PEAK REVERSE VOLTAGE						
Gate Open	V_{RSOM}	150	250	500	700	V
NON-REPETITIVE PEAK FORWARD VOLTAGE						
Gate Open	V_{DSOM}	150	250	500	700	V
REPETITIVE PEAK REVERSE VOLTAGE						
Gate Open	V_{RROM}	100	200	400	600	V
REPETITIVE PEAK OFF-STATE VOLTAGE						
Gate Open	V_{DROM}	100	200	400	600	V
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:						
For one cycle of applied principal voltage $T_C = 75°C$	I_{TSM}					
50-Hz, (sinusoidal)		170				A
60-Hz, (sinusoidal)		200				A
For more than one full cycle of applied principal voltage		See Fig. 3				
ON-STATE CURRENT:						
For case temperature (T_C) = 75° C, conduction angle of 180°						
Average DC value	$I_{T(AV)}$	12.5				A
RMS value	$I_{T(RMS)}$	20				A
RATE-OF-CHANGE OF ON-STATE CURRENT:						
$V_{DM} = V_{(BO)O}$, I_{GT} = 200 mA, t_r = 0.5 μs	di/dt	200				A/μs
FUSING CURRENT (for SCR protection):						
T_J = −65 to 100°C, t = 1 to 8.3 ms	I^2t	170				A^2s
GATE POWER DISSIPATION:						
PEAK FORWARD (for 10 μs max.)	P_{GM}	40				W
AVERAGE (averaging time = 10 ms, max.)	$P_{G(AV)}$	0.5				W
PEAK REVERSE	P_{RGM}	See Fig. 10				
TEMPERATURE RANGE:						
Storage		−65 to 150				°C
Operating (Case)		−65 to 100				°C
Soldering (10 s max. for terminals)		225				°C

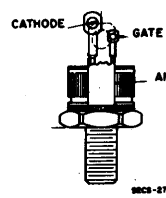
TERMINAL CONNECTIONS



Press-Fit Types



Stud Types



Isolated-Stud Types

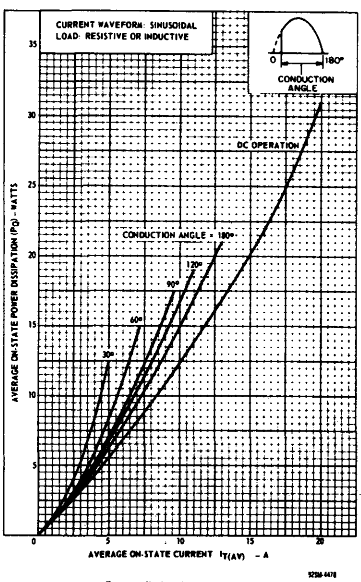


Fig. 1 —Power dissipation vs. on-state current.

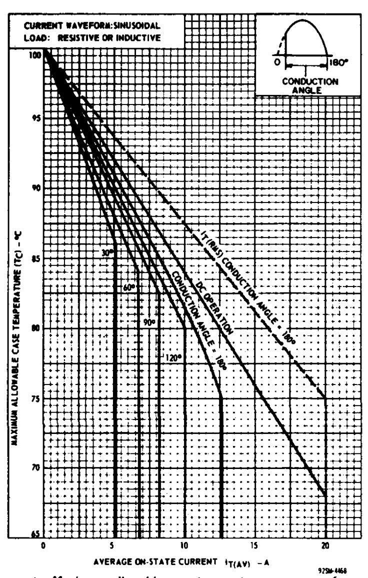


Fig. 2 —Maximum allowable case temperature vs. average forward current for stud and press-fit.

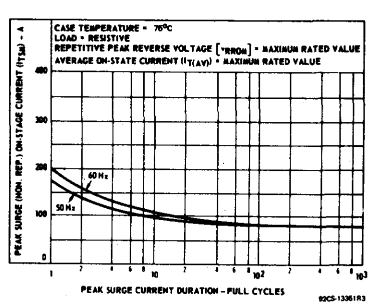


Fig. 3 —Peak surge on-state current vs. surge current duration.

S6200, S6210, S6220 Series

ELECTRICAL CHARACTERISTICS
At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified

CHARACTERISTIC	SYMBOL	LIMITS - ALL TYPES Min.	Typ.	Max.	UNITS
Instantaneous Forward Breakover Voltage: (Gate open, T_C = 100 °C)					
S6200A, S6210A, S6220A	$V_{(BO)O}$	100	-	-	V
S6200B, S6210B, S6220B		200	-	-	
S6200D, S6210D, S6220D		400	-	-	
S6200M, S6210M, S6220M		600	-	-	
Peak Off-State Current: (Gate open, T_C = 100 °C) Forward, V_{DO} = V_{DROM}	I_{DOM}	-	0.2	3	mA
Reverse, V_{RO} = V_{RROM}	I_{RROM}	-	0.1	2	
Instantaneous On-State Voltage: For i_T = 100 A, T_C = 25 °C	v_T	-	1.9	2.4	V
DC Gate Trigger Current: V_D = 12 V (DC), R_L = 30 Ω, T_C = 25 °C	I_{GT}	-	8	15	mA
At other case temperatures			See Fig. 8		
DC Gate Trigger Voltage: V_D = 12 V (DC), R_L = 30 Ω, T_C = 25 °C	V_{GT}		1.1	2	V
At other case temperatures			See Fig. 9		
Instantaneous Holding Current: Gate open, T_C = 25 °C	I_{HO}		9	20	mA
At other case temperatures			See Fig. 6		
Critical Rate-of-Rise of Off-State Voltage: (V_{DO} = $V_{(BO)O}$ Min. value, Exponential rise, T_C = 100°C)	dv/dt				V/µs
S6200A, S6200D, S6210A, S6210D, S6220A, S6220D		10	100	-	
S6200B, S6210B, S6220B		10	150	-	
S6200M, S6210M, S6220M		10	75	-	
Gate Controlled Turn-On Time: V_D = $V_{(BO)O}$ Min. value, i_T = 30 A, I_{GT} = 200 mA, 0.1 µs rise time, T_C = 25°C See Fig. 11	t_{gt}	-	2	-	µs
Circuit Commutated Turn-Off Time: V_D = $V_{F(BO)O}$ Min. value, i_T = 18 A, Pulse Duration = 50 µs, **dv/dt = 20 V/µs, di/dt = −30 A/µs, T_C = 75°C**	t_q	–	20	40	µs
Thermal Resistance: Junction-to-Case **(press-fit, stud packages)**	$R_{\theta JC}$	-	-	1.2	°C/W
Junction-to-Isolated Stud **(isolated-stud package)**	$R_{\theta JIS}$	-	-	1.4	

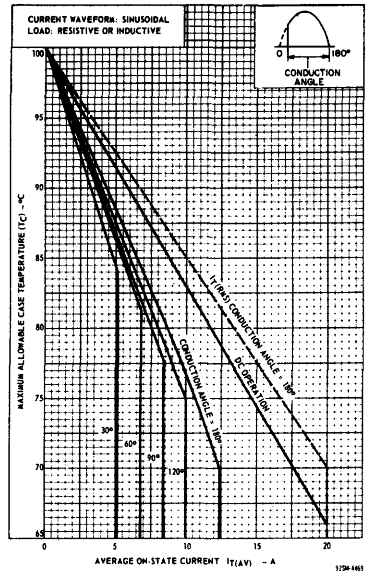


Fig. 4 – Maximum allowable case temperature vs. average forward current for isolated stud.

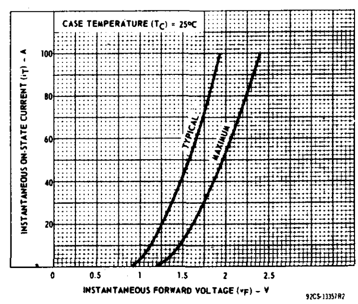


Fig. 5 – Instantaneous on-state current vs. on-state voltage.

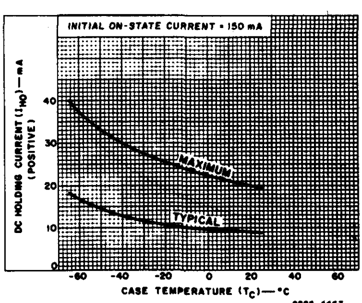


Fig. 6 – DC holding current vs. case temperature.

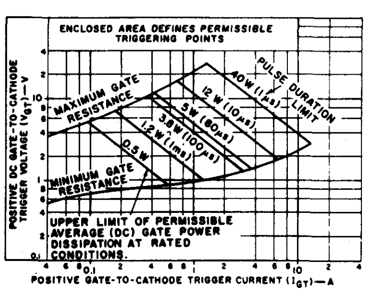


Fig. 7 – Typical forward-biased gate trigger characteristics.

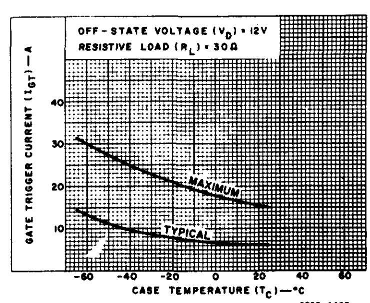


Fig. 8 – DC gate-trigger current (forward) vs. case temperature.

S6200, S6210, S6220 Series

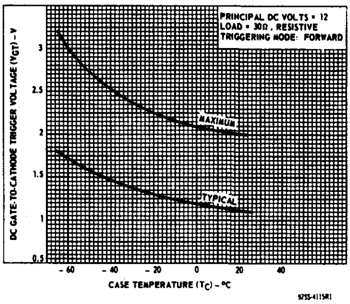


Fig. 9 – DC gate-trigger voltage vs. case temperature.

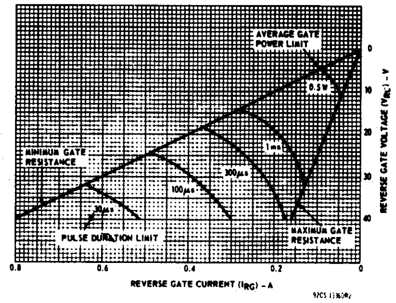


Fig. 10 – Reverse gate voltage vs. reverse gate current.

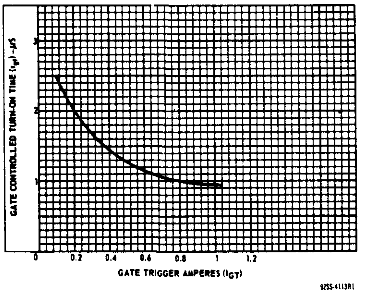


Fig. 11 – Gate controlled turn-on time (t_{gt}) vs. gate-trigger current.

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

S6230, S6240, S6250, S6430, S6440, S6450 Series

20- and 35-A Silicon Controlled Rectifiers

For General-Purpose Phase-Control Applications

These RCA silicon controlled rectifiers (reverse-blocking triode thyristors) are designed for general-purpose phase-control applications.

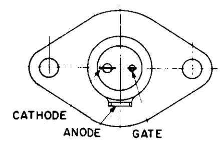
The S6230, S6240, and S6250 series have current ratings of 20 amperes. SCR's in each series have voltage ratings of 100, 200, 400, and 600 volts. The S6430, S6440, and S6450 series have current ratings of 35 amperes. SCR's in each series have voltage ratings of 100, 200, 400, 600, and 800 volts.

The S6230 and S6430 series employ a press-fit package with flexible leads, encapsulated on an isolated stud. The S6240 and S6440 series employ a press-fit package isolated on a TO-3 flange. The S6250 and S6450 series employ a press-fit package with flexible leads, encapsulated on an isolated TO-3 flange.

Features:

- **3-kV rms encapsulant (HYPOT) breakdown voltage**
- **Flame-resistant encapsulant (self-extinguishing)**
- **Rugged packages**
- **Standard RCA SCR features**

TERMINAL CONNECTIONS



S6240 S6440

FLEXIBLE-LEAD (TERMINAL) CONNECTIONS

Flexible-Lead (Insulation) Color	Terminal
White	Gate
Red	Cathode
Black	Anode

Note: Terminals are identified by color code only. Position of the flexible leads (relative to terminals of the device) leaving the encapsulant is random.

Press-Fit with Flexible Leads, Encapsulated on Isolated-Stud

S6230 S6430

Press-Fit with Flexible Leads, Encapsulated, Isolated on TO-3 Flange

S6250 S6450

WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

20-A SCR's – S6230, S6240, and S6250 Series Electrical and Mechanical Data

Type No.	Rep. Peak Off-State Voltage V_{DROM} (V)	On-State Current I_T (RMS) (A)	T_C (°C)	Package (Press-fit)	Wire Size: Cathode Anode Gage No.	Wire Size: Gate Gage No.	Wire Insulation Thickness: Cathode Anode in. (mm)	Wire Insulation Thickness: Gate in. (mm)	Refer to Bulletin File No.*
S6230A	100	20	70	With flex.leads, encap. on isolated-stud	14	22	0.031 (0.787)	0.016 (0.406)	418
S6230B	200								
S6230D	400								
S6230M	600								
S6240A	100	20	70	Isolated on TO-3 flange	–	–	–	–	418
S6240B	200								
S6240D	400								
S6240M	600								
S6250A	100	20	70	With flex.leads, encap., isolated on TO-3 flange	14	22	0.031 (0.787)	0.016 (0.406)	418
S6250B	200								
S6250D	400								
S6250M	600								

35-A SCR's – S6430, S6440, and S6450 Series Electrical and Mechanical Data

S6430A	100	35	65	With flex.leads, encap. on isolated-stud	12	22	0.034 (0.863)	0.016 (0.406)	578
S6430B	200								
S6430D	400								
S6430M	600								
S6440A	100	35	65	Isolated on TO-3 flange	–	–	–	–	578
S6440B	200								
S6440D	400								
S6440M	600								
S6450A	100	35	65	With flex.leads, encap., isolated on TO-3 flange	12	22	0.034 (0.863)	0.016 (0.406)	578
S6450B	200								
S6450D	400								
S6450M	600								

* Electrical characteristics and ratings given in these bulletins also apply to the types listed in this chart.

S6400(2N3870-2N3873)S6410(2N3896-2N3899) S6420 Series

35-A Silicon Controlled Rectifiers

These RCA types are all-diffused, silicon controlled rectifiers (reverse-blocking triode thyristors) designed for power switching, power control, and voltage regulator applications and for heating, lighting, and motor speed-control circuits.

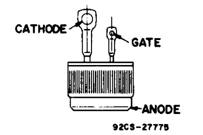
The 2N3870-73 and S6400N employ a hermetic press-fit package.

The 2N3896-99 and S6410N employ a hermetic stud package. The S6420 series employ a hermetic isolated-stud package.

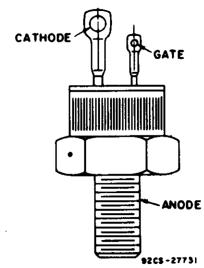
Features:

- **High di/dt and dv/dt capabilities**
- **Low on-state voltage at high current levels**
- **Low thermal resistance**
- **Shorted-emitter center-gate construction**

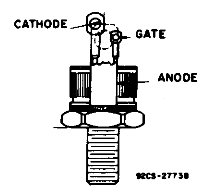
TERMINAL CONNECTIONS



Press-Fit Types



Stud Types



Isolated-Stud Types

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3870 2N3896 S6420A	2N3871 2N3897 S6420B	2N3872 2N3898 S6420D	2N3873 2N3899 S6420M	
•NON-REPETITIVE PEAK REVERSE VOLTAGE▲						
Gate Open	V_{RSOM}	150	330	660	700	V
NON-REPETITIVE PEAK OFF-STATE VOLTAGE▲						
Gate Open	V_{DSOM}	150	330	660	700	V
•REPETITIVE PEAK REVERSE VOLTAGE▲						
Gate Open	V_{RROM}	100	200	400	600	V
•REPETITIVE PEAK OFF-STATE VOLTAGE▲						
Gate Open	V_{DROM}	100	200	400	600	V
ON-STATE CURRENT:						
T_C = 65°C♦, conduction angle = 180°:						
RMS	$I_{T(RMS)}$	35				A
• Average	$I_{T(AV)}$	22				A
For other conditions		See Figs. 2 & 4				
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}					
For one full cycle of applied principal voltage, T_C = 65°C						
• 60 Hz (sinusoidal)		350				A
50 Hz (sinusoidal)		300				A
For more than one full cycle of applied principal voltage		See Fig. 3				
RATE OF CHANGE OF ON-STATE CURRENT						
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.5 μs	di/dt	200				A/μs
FUSING CURRENT (for SCR protection):						
T_J = -40 to 100°C, t = 1 to 8.3 ms	I^2t	300				A^2s
GATE POWER DISSIPATION●:						
Peak Forward (for 10 μs max., See Fig. 7)	P_{GM}	40				W
Peak Reverse	P_{RGM}	See Fig. 8				
Average (averaging time = 10 ms max.)	$P_{G(AV)}$	0.5				W
•TEMPERATURE RANGE■:						
Storage	T_{stg}	-40 to 125				°C
Operating (Case)	T_C	-40 to 100				°C
TERMINAL TEMPERATURE (During soldering):	T_T					
For 10 s max. (terminals and case)		225				°C

• In accordance with JEDEC registration data filed for the JEDEC (2N-series) types.
▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
♦ T_C = 60° for isolated-stud package types.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
■ Temperature measurement point is shown on the DIMENSIONAL OUTLINE.

WARNING: The ceramic of the isolated stud package contains beryllium oxide. Do not crush, grind, or abrade this part because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

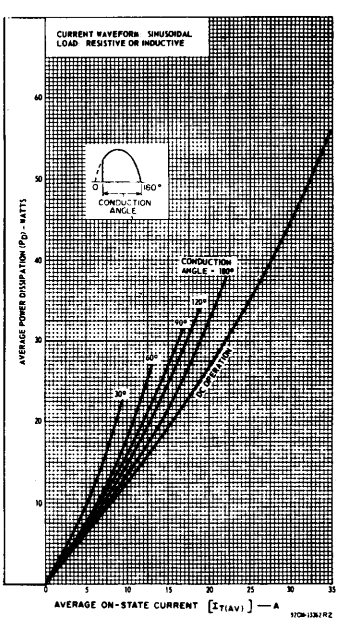


Fig.1 — Power dissipation vs. on-state current.

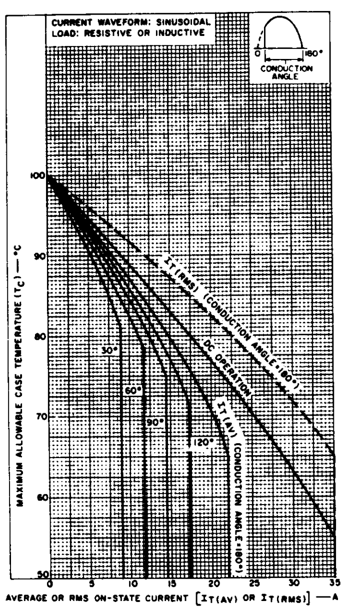


Fig.2 — Maximum allowable case temperature vs. on-state current for press-fit and stud types.

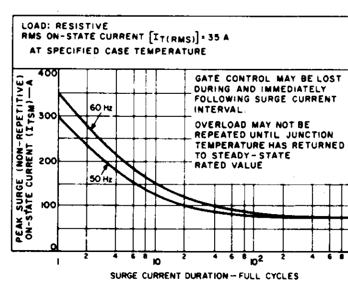


Fig.3 — Peak surge on-state current vs. surge current duration.

S6400(2N3870-2N3873) S6410(2N3896-2N3899) S6420 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	SYMBOL	LIMITS FOR ALL TYPES Unless Otherwise Specified			UNITS
		MIN.	TYP.	MAX.	
Peak Off-State Current: (Gate open, T_C = 100°C) Forward Current (I_{DOM}) at $V_D = V_{DROM}$ Reverse Current (I_{ROM}) at $V_R = V_{RROM}$	I_{DOM} or I_{ROM}				mA
2N3870, 2N3896, S6420A		–	0.2	2*	
2N3871, 2N3897, S6420B		–	0.25	2.5*	
2N3872, 2N3898, S6420D / 2N3873, 2N3899, S6420M,		–	0.3	3*	
Instantaneous On-State Voltage:	v_T				V
i_T = 69 A (peak), T_C = 25°C		–	–	1.85*	
i_T = 100 A (peak), T_C = 25°C		–	1.7	2.1	
DC Gate Trigger Voltage:	V_{GT}				V
V_D = 12 V (dc), R_L = 30 Ω, T_C = -40°C		–	1.5	3*	
V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C		–	1.1	2	
For other case temperatures			See Fig. 10		
DC Gate Trigger Current:	I_{GT}				mA
V_D = 12 V (dc), R_L = 30 Ω, T_C = -40°C		–	46	80*	
V_D = 12 V (dc), R_L = 30 Ω, T_C = 25°C		1	25	40	
For other case temperatures			See Fig. 9		
Instantaneous Holding Current: Gate open, T_C = 25°C	i_{HO}	0.5	30	70	mA
For other case temperatures			See Fig. 6		
Gate Controlled Turn-On Time: (Delay Time + Rise Time) For $V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 μs, I_T = 30 A (peak), T_C = 25°C	t_{gt}	–	1.25	2	μs
Circuit Commutated Turn-Off Time: $V_D = V_{DROM}$, i_T = 18 A, pulse duration = 50 μs, dv/dt = 20 V/μs, -di/dt = -30 A/μs, I_{GT} = 200 mA, T_C = 80°C	t_q	–	20	40	μs
Critical Rate of Rise of Off-State Voltage: $V_D = V_{DROM}$, exponential voltage rise, Gate open, T_C = 100°C	dv/dt	10	100	–	V/μs
Thermal Resistance, Junction-to-Case: Steady-State	$R_{\theta JC}$				°C/W
Press-fit & stud types		–	–	0.9*	
Isolated-stud types		–	–	1	

*In accordance with JEDEC registration data filed for the JEDEC (2N-series) types.

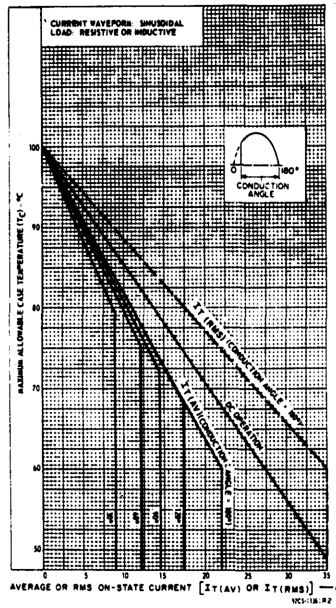


Fig.4 — Maximum allowable case temperature vs. on-state current for isolated-stud types.

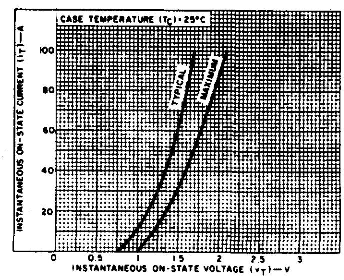


Fig.5 — Instantaneous on-state current vs. on-state voltage.

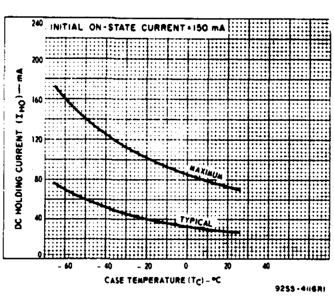


Fig.6 — DC holding current vs. case temperature.

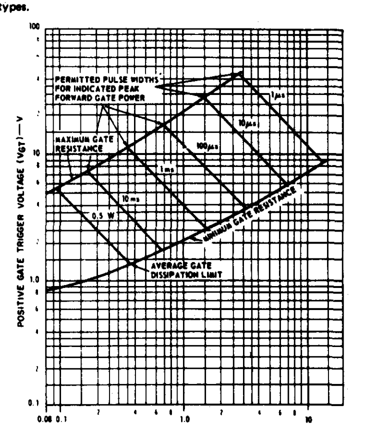


Fig.7 — Gate pulse characteristics for forward triggering mode.

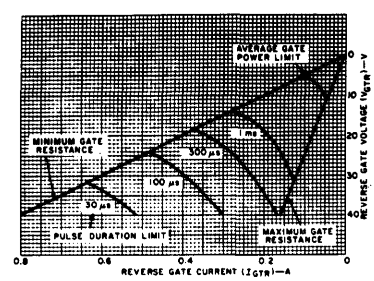


Fig.8 — Reverse gate voltage vs. reverse gate current.

S6400(2N3870-2N3873) S6410(2N3896-2N3899) S6420 Series

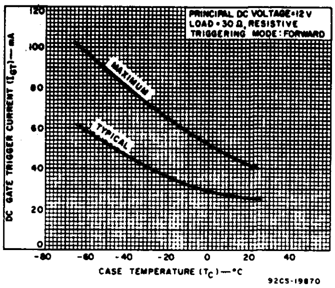


Fig.9 — DC gate trigger current (forward) vs. case temperature.

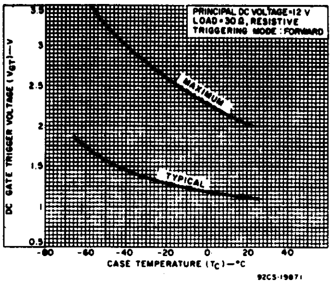


Fig.10 — DC gate trigger voltage (forward) vs. case temperature.

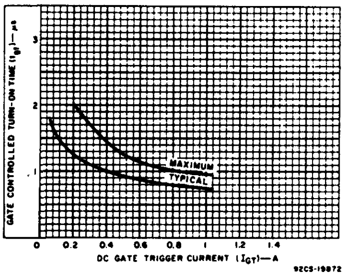


Fig.11 — Gate-controlled turn-on time vs. gate trigger current.

S6491 (2N681-2N690), S6492 (2N1842A-2N1850) Series

16-A and 25-A Silicon Controlled Rectifiers

For Power-Control and Power-Switching Applications

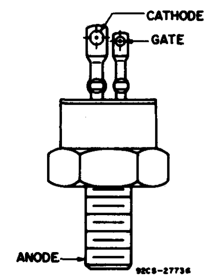
The RCA 2N681-2N690 and the 2N1842A-2N1850A are all-diffused silicon controlled rectifiers (reverse-blocking triode thrysistors) designed for switching ac and dc currents. These devices can switch from the off-state to the on-state when both the anode and gate voltages are positive. Negative anode voltages make these devices revert to the blocking state.

These SCR's employ a hermetic JEDEC TO-48 package.

Features:

- **High di/dt capability**
- **Low on-state voltage at high current levels**
- **Low thermal resistance**
- **Shorted-emitter center-gate construction**

TERMINAL CONNECTIONS



JEDEC TO-48

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N681 2N1842A	2N682 2N1845A	2N683 2N1844A	2N684 2N1845A	2N685 2N1846A	2N686 2N1847A	2N687 2N1848A	2N688 2N1849A	2N689 2N1850A	2N690 –	
* V_{RSOM} ▲	35	75	150	225	300	350	400	500	600	700	V
* V_{RROM} ▲	25	50	100	150	200	250	300	400	500	600	V
* V_{DROM} ▲	25	50	100	150	200	250	300	400	500	600	V

$I_{T(RMS)}$ (θ = 180°):		
T_C = 80°C, (2N1842A-2N1850A)	16	A
= 65°C, (2N681-2N690)	25	A
* $I_{T(AV)}$ (θ = 180°):		
T_C = 80°C (2N1842A-2N1850A)	10	A
= 65°C (2N681-2N690)	16	A
I_{STM}:		
For one full cycle of applied principal voltage		
* 60Hz† (2N1842A-2N1850A)	125	A
* 60Hz♠ (2N681-2N690)	150	A
50Hz† (2N1842A-2N1850A)	115	A
50Hz♠ (2N681-2N690)	140	A
For more than one full cycle of applied principal voltage	See Figs. 3, 4	
di/dt:		
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.5 µs	200	A/µs
I^2t [at T_C shown for $I_{T(RMS)}$]:		
t = 10 ms (2N1842A-2N1850A)	68	A^2s
(2N681-2N690)	100	A^2s
= 1 ms (2N1842A-2N1850A)	32	A^2s
(2N681-2N690)	46	A^2s
* P_{GM} ●	5	W
* $P_{G(AV)}$ ●	0.5	W
* I_{GM}	2	A
* V_{GM}	10	V
* V_{GRM}	5	V
* T_{stg} ■ (2N1842A-2N1850A)	−65 to 125	°C
(2N681-2N690)	−65 to 150	°C
* T_C ■	−65 to 125	°C
T_T:		
During soldering for 10 s maximum (terminal and case)	225	°C
T_s: Recommended	35	in-lb
	0.4	kgf-m
Maximum (DO NOT EXCEED)	50	in-lb
	0.57	kgf-m

* In accordance with JEDEC registration data.
▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
† At $I_{T(RMS)}$ = 16 A and T_C = 80°C
♠ At $I_{T(RMS)}$ = 25 A and T_C = 65°C
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
■ For temperature measurement reference point, see Dimensional Outline.

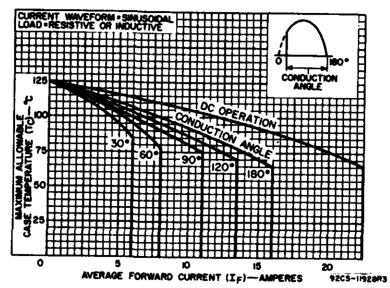


Fig. 1 — Maximum allowable case temperature vs. on-state current for 2N681-2N690.

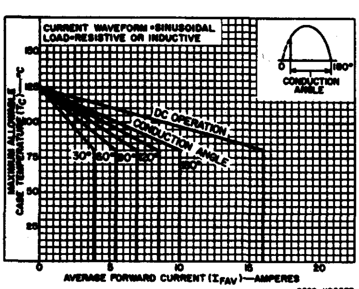


Fig. 2 — Maximum allowable case temperature vs. on-state current for 2N1842A-2N1850A.

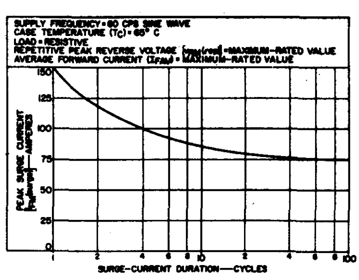


Fig. 3 — Peak surge on-state current vs. surge duration for 2N681-2N690.

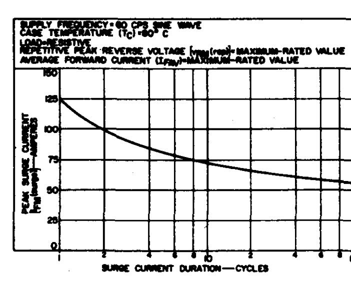


Fig. 4 — Peak surge on-state current vs. surge duration for 2N681-2N690.

S6491 (2N681-2N690), S6492 (2N1842A-2N1850) Series

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)*

CHARACTERISTIC	LIMITS						UNITS
	2N681-2N690			2N1842A-2N1850A			
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
I_{DROM} or I_{RROM}:							
$V_D = V_{DROM}$ or $V_R = V_{RROM}$, T_C = 125°C:							
2N681, 2N682, 2N683, 2N684	–	–	6.5	–	–	–	mA
2N685	–	–	6	–	–	–	mA
2N686	–	–	5.5	–	–	–	mA
2N687	–	–	5	–	–	–	mA
2N688	–	–	4	–	–	–	mA
2N689	–	–	3	–	–	–	mA
2N690	–	–	2.5	–	–	–	mA
$V_D = V_{DROM}$ or V_{RROM}, T_C = 80°C:							
2N1842A	–	–	–	–	–	22.5	mA
2N1843A	–	–	–	–	–	19	mA
2N1844A	–	–	–	–	–	12.5	mA
2N1845A	–	–	–	–	–	6.5	mA
2N1846A	–	–	–	–	–	6	mA
2N1847A	–	–	–	–	–	5.5	mA
2N1848A	–	–	–	–	–	5	mA
2N1849A	–	–	–	–	–	4	mA
2N1850A	–	–	–	–	–	3	mA
• v_T:							
i_T = 30 A (peak), T_C = 25°C	–	–	–	–	–	2.5	V
= 50 A (peak), T_C = 25°C	–	–	2	–	–	–	V
$v_{T(AV)}$:							
$I_T = I_{T(RMS)}$ = T_C = 65°C	–	–	0.86	–	–	–	V
= 80°C	–	–	–	–	–	1.2	V
i_{HO}:							
T_C = 125°C	–	15	–	–	8	–	mA
I_{GT}:							
T_C = 125°C	–	–	25	–	–	4.5	mA
V_D = 12 V (dc), R_L = 50Ω, T_C = 25°C	–	–	80*	–	–	150*	mA
• V_{GT}:							
V_D = 12 V (dc), R_L = 50Ω, T_C = −65 to 125°C	–	–	3	–	–	–	V
= 125°C	0.25	–	–	0.25	–	–	V
= −40°C	–	–	–	–	–	3.5	V
= −65°C	–	–	–	–	–	3.7	V
= 100°C	–	–	–	0.3	–	–	V
$R_{\theta JC}$	–	–	2	–	–	2	°C/W

*In accordance with JEDEC registration data.

▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.

S6491 (2N681-2N690), S6492 (2N1842A-2N1850) Series

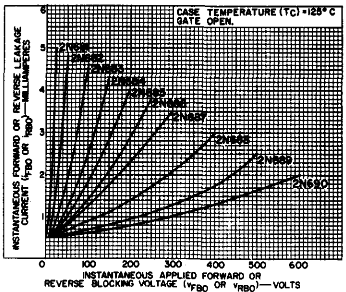


Fig. 5 — Typical peak off-state current or peak reverse current vs. off-state or reverse voltage for 2N681-2N690.

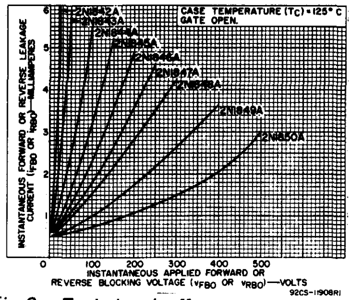


Fig. 6 — Typical peak off-state current or peak reverse current vs. off-state or reverse voltage for 2N1842A-2N1850A.

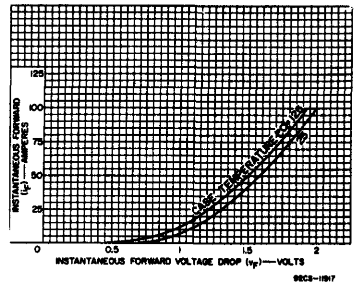


Fig.7 — Typical on-state current vs. instantaneous on-state voltage for 2N681—2N690.

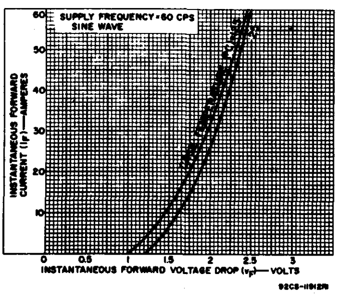


Fig.8 — Typical on-state current vs. instantaneous on-state voltage for 2N1842A—2N1850A.

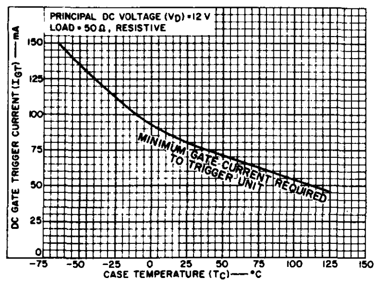


Fig. 9 — DC gate-trigger current vs. case temperature for 2N1842A-2N1850A.

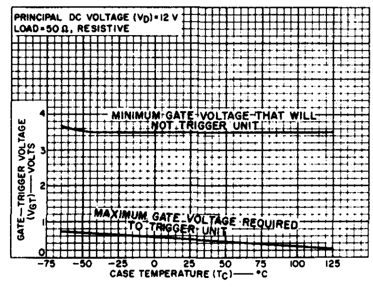


Fig. 10 — DC gate-trigger voltage vs. case temperature for 2N1842A-2N1850A.

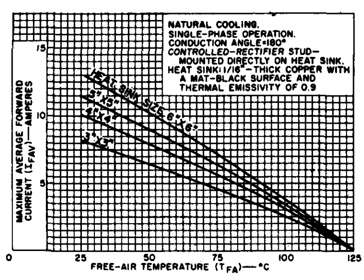


Fig.11 — Average on-state forward current vs. ambient temperature for 2N681—2N690.

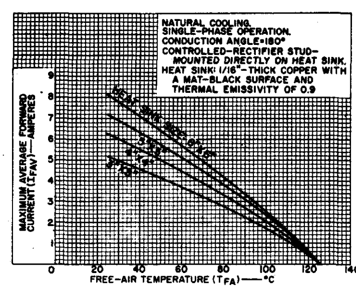


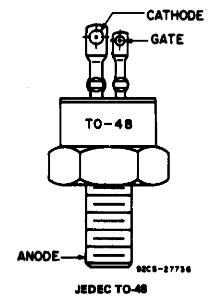
Fig.12 — Average on-state forward current vs. ambient temperature for 2N1842A—2N1850A.

Silicon Controlled Rectifier for High-Current Pulse Applications

Features:

- Up to 900 A peak pulse on-state current
- 30 W maximum average dissipation
- On-state current of 35 A (rms value)
- Shorted-emitter center-gate design

TERMINAL CONNECTIONS



JEDEC TO-48

The RCA-S6493M* is an all-diffused silicon controlled rectifier (reverse-blocking triode thyristor) designed especially for use in radar pulse modulators, inverters, switching regulators, and other applications requiring a large ratio of peak to average current.

It is especially constructed for rapid spread of forward current over the full junction area to achieve a high rate of change of forward current (di/dt) capability and low switching dissipation.

The S6493M employs a hermetic JEDEC TO-48 package.

*Formerly RCA Type No. S6431M.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

V_{RSOM}▲	700	V
V_{DSOM}▲	700	V
V_{RROM}▲	600	V
V_{DROM}▲	600	V
$I_{T(RMS)}$ (T_C = 65°C, θ = 180°)	35	A
$I_{TM(pulse)}$:		
T_C = 65°C, See Figs. 1 and 2	900	A
I^2t:		
T_J = −65 to 125°C, t = 1 to 8.3 ms	2000	A^2s
$P_{D(AV)}$ (T_C = 65°C, See Fig. 3)	30	W
P_{GM}●:		
Peak (forward or reverse) for 10 μs maximum, See Fig. 4	40	W
$P_{G(AV)}$●:		
Averaging time = 10 ms maximum	1	W
T_{stg}■	−65 to 150	°C
T_C■	−65 to 125	°C
T_T:		
During soldering for 10 s maximum (terminals and case)	225	°C
τ_s:		
Recommended	35	in·lbf
	0.4	kgf·m
Maximum (DO NOT EXCEED)	50	in·lbf
	0.57	kgf·m

▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
■ For temperature measurement reference point, *see Dimensional Outline.*

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS			UNITS
	MIN.	TYP.	MAX.	
I_{DOM} or I_{ROM}: V_D = V_{DROM} or V_R = V_{RROM}, T_C = 125°C	–	2	10	mA
$V_{T(I)}$ $I_{TM(pulse)}$ = 600 A, t = 2 μs, T_C = 65°C (See Fig. 7)	–	–	19	V
I_{HO}: T_C = 25°C	0.5	20	70	mA
dv/dt: V_D = V_{DROM}, exponential voltage rise, T_C = 125°C	20	50	–	V/μs
I_{GT} (T_C = 25°C), See Fig.4	1	25	80	mA
V_{GT} (T_C = 25°C), See Fig.4	–	1.1	2	V
t_{gt}: V_D = V_{DROM}, i_T = 30 A (peak), I_{GT} = 200 mA, t_r = 0.1 μs, T_C = 25°C	–	1.25	–	μs
t_q: Rectangular Pulse V_{DX} = V_{DROM}, i_T 18 A, pulse duration = 50 μs, dv/dt = 20 V/μs, – di/dt = −30 A/μs, I_{GT} = 200 mA at turn-on, T_C = 80°C	15	20	40	μs
$R_{\theta JC}$	–	–	2	°C/W

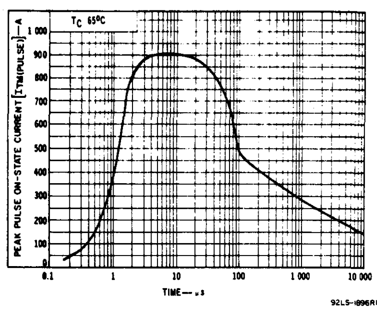


Fig.1 — Peak pulse on-state current vs. time.

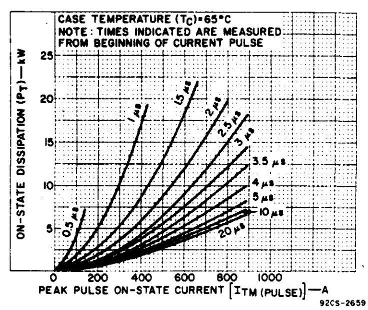


Fig.2 — On-state dissipation vs. peak pulse on-state current and time.

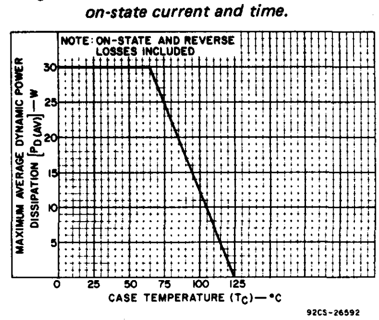


Fig.3 — Dissipation derating curve.

S6493M

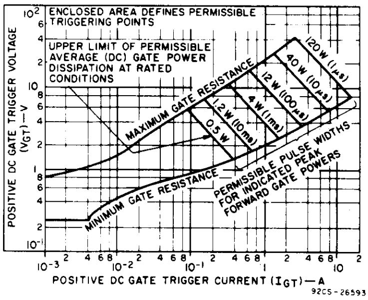


Fig.4 – Forward-bias gate-trigger characteristics and limiting conditions for determination of premissible gate-trigger pulses.

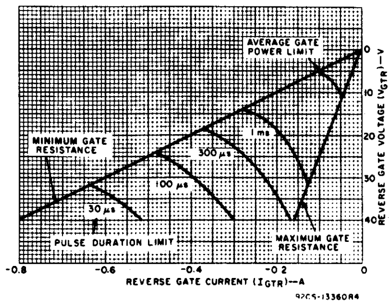


Fig.5 – Reverse bias gate-trigger characteristics.

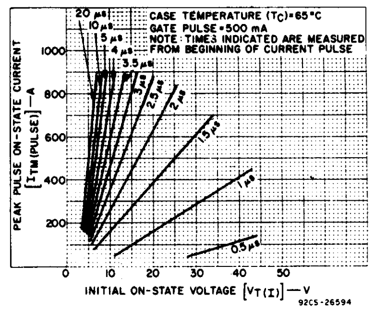


Fig.6 – Initial on-state voltage characteristics.

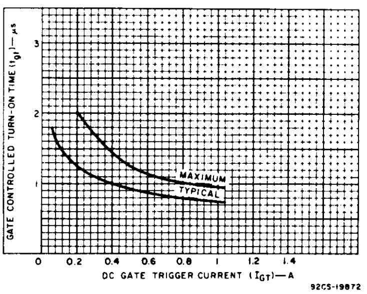


Fig.7 – Gate-controlled turn-on time vs. gate trigger current.

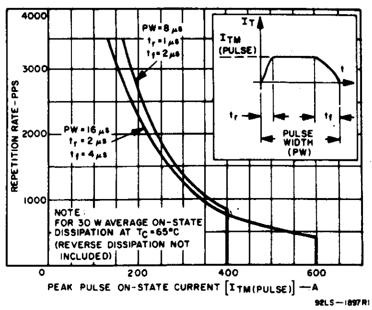


Fig.8 – Peak pulse on-state current as a function of repetition rate, rectangular pulse.

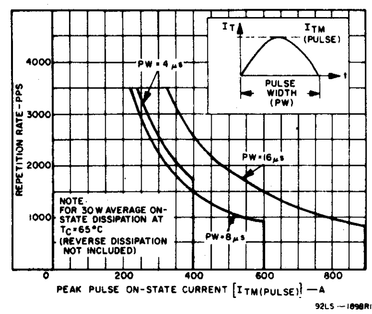


Fig.9 – Peak pulse on-state current as a function of repetition rate, half sine wave pulse.

S7310 Series

40-A Asymmetrical Silicon Controlled Rectifiers (ASCR)

For Induction Cooking Appliances, Pulse Modulators, High-Frequency Inverters, Electronic Welders, and Other Switching Applications Up to 40 kHz

The RCA-S7310-series types are asymmetrical silicon controlled rectifiers designed for high-frequency power-switching applications such as induction-cooking-appliance controls, inverters, electronic welders, switching regulators, and high-current pulse modulators. These types may be used at frequencies up to 40 kHz. They are supplied in the JEDEC TO-48 package.

Features:

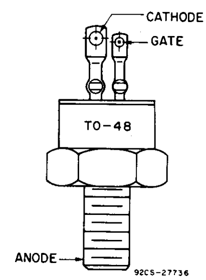
- **Fast turn-off-time-4μs max.**
- **High di/dt and dv/dt capabilities**
- **Shorted-emitter gate-cathode construction. . .contains an internally diffused resistor between gate and cathode**
- **Low thermal resistance**
- **Center-gate construction . . .provides rapid uniform gate-current spreading for faster turn-on with substantially reduced heating effects**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	S7310B	S7310C	S7310D	S7310E	S7310M	
V_{RROM}▲			7			V
V_{DROM}▲	200	300	400	500	600	V
$I_{T(RMS)}$ (T_C = 75°C, θ = 180°)			40			A
$I_{T(AV)}$ (T_C = 75°C, θ = 180°)			25			A
I_{TSM}:						
For one full cycle of applied principal voltage						
60-Hz (sinusoidal)			400			A
50-Hz (sinusoidal)			370			A
For more than one cycle of applied principal voltage			*See Fig. 5*			
di/dt:						
V_{DM} = V_{DROM}, I_{GT} = 500 mA, t_r = 0.5 μs			2000			A/μs
I^2T (at T_C = 75°C):						
t = 10 ms			700			A^2s
t = 1 ms			325			A^2s
P_{GM}●:						
Peak forward for 10 μs max.			40			W
$P_{G(AV)}$●:						
Averaging time = 10 ms maximum			2			W
T_{stg}■			−40 to 150			°C
T_C■			−40 to 125			°C
T_T:						
During soldering for 10 s maximum (terminal and case)			225			°C
τ_s:						
Recommended			35			in-lbf
			0.4			kgf-m
Maximum (DO NOT EXCEED)			50			in-lbf
			0.57			kgf-m

▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
■ For temperature measurement reference point, see Dimensional Outline.

TERMINAL DESIGNATIONS



JEDEC TO-48

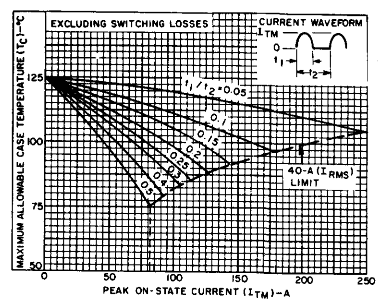


Fig. 1 — Maximum allowable case temperature vs. peak on-state current.

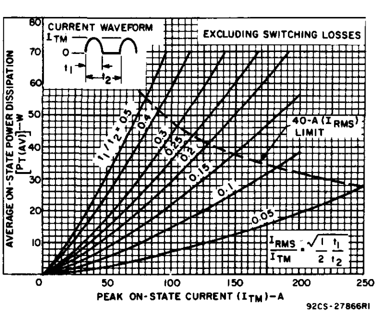


Fig. 2 — Average on-state power dissipation vs. peak on-state current.

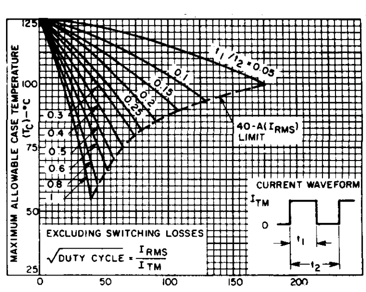


Fig. 3 — Maximum allowable case temperature vs. peak on-state current.

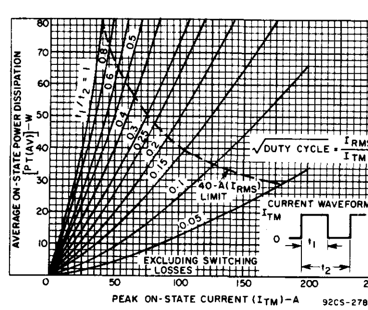


Fig. 4 — Average on-state power dissipation vs. peak on-state current.

S7310 Series

ELECTRICAL CHARACTERISTICS

As Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Min.	Typ.	Max.	UNITS
I_{DROM}: $V_D = V_{DROM}$, $T_C = 125°C$	–	–	4	mA
I_{RROM}: $V_R = V_{RROM}$, $T_C = 125°C$	–	–	5	mA
V_T: I_{TM} = 100 A (peak), $T_C = 25°C$	–	1.7	2.5	V
$V_{T(I)}$: I_{TM} = 100 A (peak), I_{GT} = 0.5 A, t_r = 0.1 μs, $T_C = 25°C$ (measured 0.5 μs after 10% of I_{TM})	–	14	22	V
i_{HO}: $T_C = 25°C$	10	35	110	mA
dv/dt: (Linear) $V_D = V_{DROM}$, $T_C = 125°C$	250	550	–	V/μs
I_{GT}: V_D = 12 V dc, R_L = 30 Ω, $T_C = 25°C$	–	50	80	mA
V_{GT}: V_D = 12 V dc, R_L = 30 Ω, $T_C = 25°C$	–	1	3	V
t_{gt}: $V_D = V_{DROM}$, i_T = 100 A (peak), I_{GT} = 500 mA, t_r = 0.1 μs, $T_C = 25°C$, t_{gt}	–	250	290	ns
t_r	–	90	110	ns
t_d	–	160	180	ns
t_q: 1/2 Sine Wave $V_D = V_{DROM}$, i_T = 100 A, pulse duration = 2 μs, dv/dt = 200 V/μs, I_{GT} = 500 mA at turn-on, V_{GK} = −10 V at turn-off, $T_C = 115°C$	–	2.8	4	μs
R_{GK} (Reverse)	–	30	50	Ω
$R_{\theta JS}$	–	–	0.9	°C/W

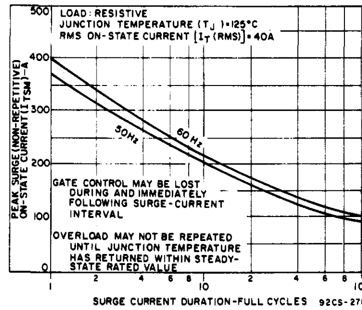


Fig. 5 – Peak surge on-state vs. surge duration.

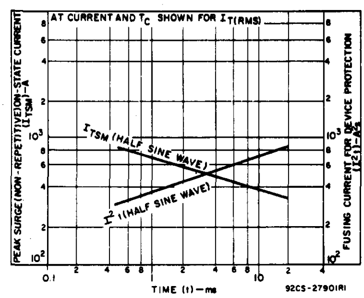


Fig. 6 – Peak surge on-state and fusing current vs. time.

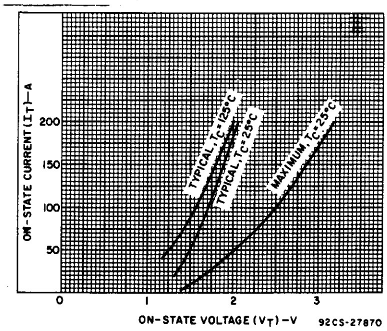


Fig. 7 – On-state current vs. on-state voltage.

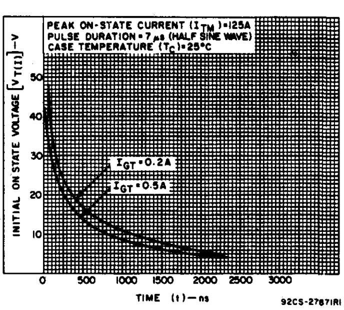


Fig. 8 – Typical initial on-state voltage vs. time. [Zero time is the time at which the initial on-state current is equal to 0.10I_{TM} (See Fig. 17)]

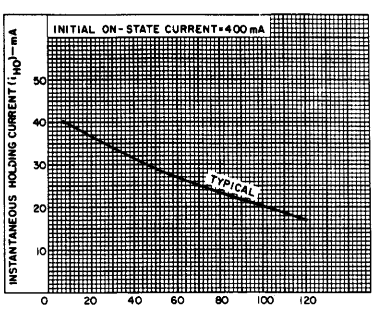


Fig. 9 – Typical instantaneous holding current vs. case temperature.

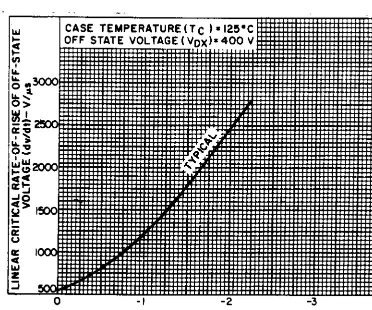


Fig. 10 – Typical linear critical rate of rise of off-state voltage vs. gate voltage.

S7310 Series

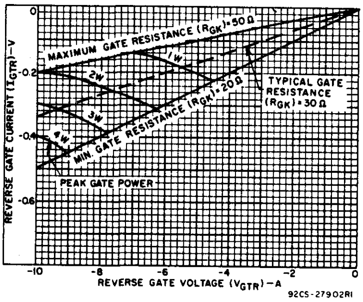


Fig. 11 — Reverse gate-trigger characteristics.

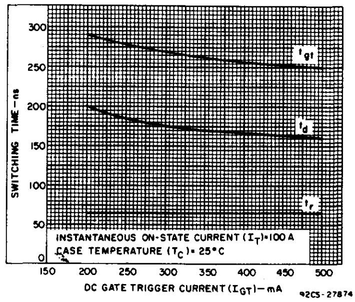


Fig. 12 — Typical switching time (t_{gt}, t_d, t_r) vs. gate-trigger current.

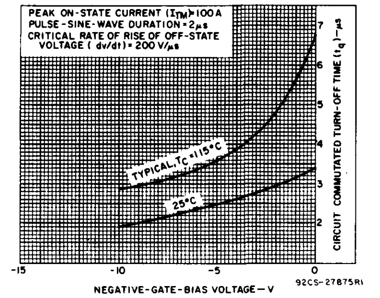


Fig. 13 — Typical circuit commutated turn-off time vs. gate-trigger voltage.

S7410 (2N3650-2N3653; S7410M) S7412 (2N3654-2N3658; S7412M) Series

35-A Silicon Controlled Rectifiers

For Inverter Applications

RCA-2N3650 to 2N3658, inclusive, and the S7410M* and S7412M• are all-diffused silicon controlled rectifiers (reverse-blocking triode thyristors) intended for high-speed switching applications such as power inverters, switching regulators, and high-current pulse applications. They feature fast turn-off, high dv/dt, and high di/dt characteristics and may be used at frequencies up to 25 kHz.

This SCR series has forward and reverse off-state voltage ratings of 50, 100, 200, 300, and 400 volts. Types S7410M and S7412M has a forward and reverse off-state voltage rating of 600 volts.

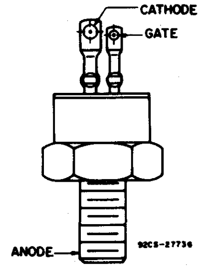
These SCR's employ a hermetic JEDEC TO-48 package.

• Formerly RCA Type No. S7432M.
* Formerly RCA Type No. S7430M.

Features

- Fast turn-off time — 10 μs to 15 μs max.
- High di/dt and dv/dt capabilities
- Shorted-emitter center gate design
- Low thermal resistance

TERMINAL CONNECTIONS



JEDEC TO-48

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3650	2N3651	2N3652	2N3653	S7410M	
	2N3654	2N3655	2N3656	2N3657	2N3658	S7412M	
* V_{RSOM}▲	75	150	300	400	500	700	V
V_{DSOM}▲	75	150	300	400	500	700	V
* V_{RROM}▲	50	100	200	300	400	600	V
* V_{DROM}▲	50	100	200	300	400	600	V
$I_{T(RMS)}$ ($T_C = 40°C$, $\theta = 180°$)	35						A
* $I_{T(AV)}$ ($T_C = 40°C$, $\theta = 180°$)	25						A
* I_{TSM}: Peak rectangular pulse, $t_p = 5$ ms, $t_r = 50$ μs max.	180						A
* di/dt: $V_D = V_{DROM}$, $I_{GT} = 200$ mA, $t_r = 0.1$ μs	400						A/μs
I^2t: $T_J = -65$ to 120°C, t = 1 to 8.3 ms	165						A^2s
* P_{GM}•: Peak (forward or reverse) for 10 μs maximum, See Fig. 6)	40						W
* $P_{G(AV)}$•: Averaging time = 10 ms maximum	1						W
* T_{stg}■	−65 to 150						°C
* T_C■	−65 to 120						°C
T_T: During soldering for 10 s maximum (terminal and case)	225						°C
τ_s: Recommended	35						in-lbf
	0.4						kgf-m
Maximum (DO NOT EXCEED)	50						in-lbf
	0.57						kgf-m

* In accordance with JEDEC registration data format (JS-14, RDF-1) filed for the JEDEC (2N series) types.

▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

• Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.

■ For temperature measurement reference point, see Dimensional Outline.

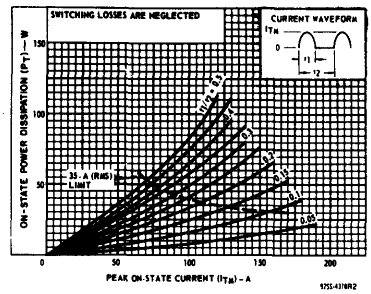


Fig. 1 - Maximum allowable case temperature as a function of on-state current.

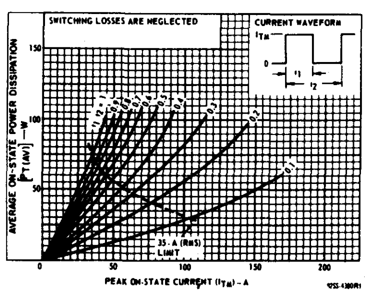


Fig. 2 - Maximum allowable case temperature as a function of on-state current.

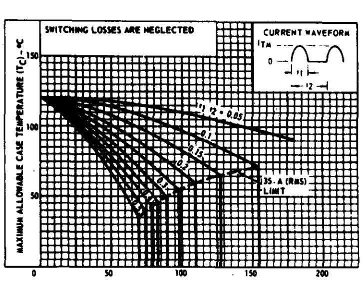


Fig. 3 - Peak surge on-state current as a function of surge duration.

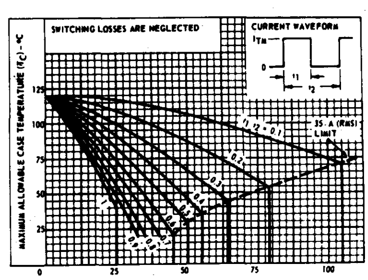


Fig. 4 - Peak surge on-state current as a function of surge duration.

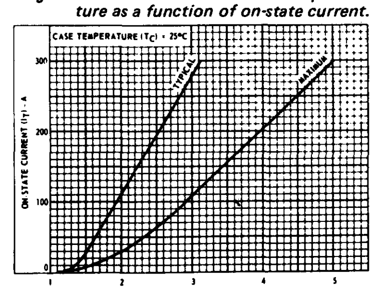


Fig. 5 - Maximum allowable case-temperature as a function of peak on-state current.

S7410 (2N3650-2N3653; S7410M) S7412 (2N3654-2N3658; S7412M) Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Except as Specified			UNITS
	MIN.	TYP.	MAX.	
I_{DOM} or I_{ROM}: $V_D = V_{DROM}$ or $V_R = V_{RROM}$, T_C = 120°C				
2N3654, 2N3655, 2N3656, S7412M	–	2	6*	mA
2N3657	–	2	5.5*	mA
2N3658	–	2	4*	mA
v_T: i_T = 25 A (peak), T_C = 25°C	–	1.5	2.05*	V
i_{HO}:				
T_C = 25°C	–	75	150	mA
T_C = −65°C	–	150	350*	mA
* dv/dt: $V_D = V_{DROM}$, exponential voltage rise, T_C = 120°C	200	–	–	V/µs
I_{GT}:				
V_D = 6 V (dc), R_L = 4 Ω, T_C = 25°C	–	80	180	mA
V_D = 6 V (dc), R_L = 2 Ω, T_C = −65°C	–	150	500*	mA
V_{GT}:				
V_D = 6 V (dc), R_L = 4 Ω, T_C = 25°C	–	1.5	3	V
* V_D = 6 V (dc), R_L = 200 Ω, T_C = 120°C	0.25	–	–	V
V_D = 6 V (dc), R_L = 2 Ω, T_C = −65°C	–	2	4.5*	V
* tq:				
Rectangular Pulse: $V_{DX} = V_{DROM}$, i_T = 10 A▲, pulse duration = 50 µs, dv/dt = 200 V/µs, −di/dt = 5 A/µs, I_{GT} = 200 mA at turn-on, V_{RX} = 15 V minimum, V_{GK} = 0 V at turn-off, T_C = 120°C	–	–	15	µs
Sinusoidal Pulse: $V_{DX} = V_{DROM}$, i_T = 100 A, pulse duration = 2 µs, dv/dt = 200 V/µs, V_{RX} = 30 V minimum, V_{GK} = 0 at turn-off, T_C = 115°C	–	–	15	µs
$R_{\theta JC}$	–	0.85	1.7*	°C/W

* In accordance with JEDEC registration data format (JS-14, RDF-1) filed for the JEDEC (2N series) types.

▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.

■ For temperature measurement reference point, see Dimensional Outline.

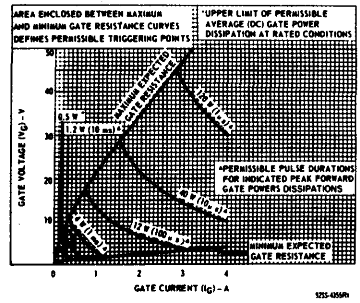


Fig.6 – Typical forward-biased gate characteristics.

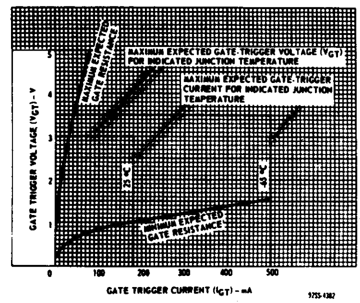


Fig.7 – Typical gate-trigger characteristics.

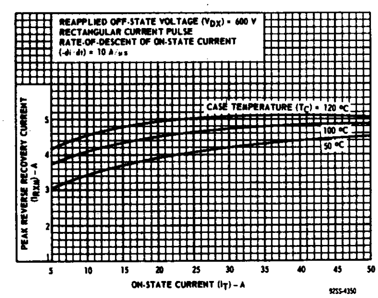


Fig.8 – Typical variation of peak reverse-recovery current with on-state current (rectangular pulse).

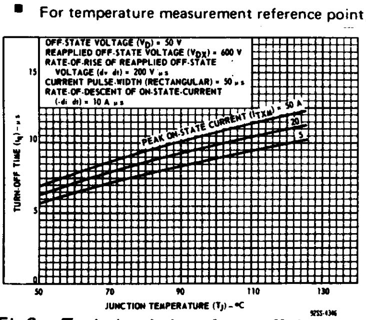


Fig.9 – Typical variation of turn-off time with junction temperature (rectangular pulse).

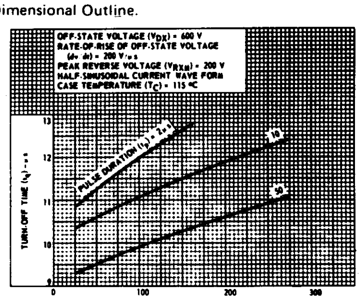


Fig.10 – Typical variation of turn-off time with peak on-state current (half-sine-wave pulse).

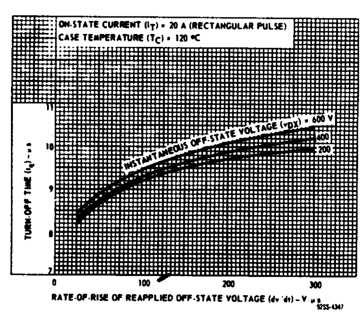


Fig.11 – Typical variation of turn-off time with rate-of-rise of reapplied off-state voltage (rectangular pulse).

S8610-S8613 Series, S8620-S8623 Series

75- and 100-A Silicon Controlled Rectifiers

For General-Purpose Phase-Control Applications

The RCA-S8610 through S8613 and S8620 through S8623 series of silicon controlled rectifiers (reverse-blocking triode thyristors) are designed for general-purpose phase-control applications, such as power switching and control and voltage regulators for heating, lighting, and motor speed control. Each series includes 100-, 200-, 400-, and 600-volt (V_{DROM} rating) SCR's.

SCR's in the S8610 through S8613 series are supplied in a stud package; SCR's in the S8620 through S8623 series are supplied in an isolated-stud package. These eight series of SCR's also offer a choice of on-state current ratings (100 or 75 amperes rms) and static dv/dt capabilities (1000 or 200 volts per microsecond).

Features:

- **Stud and isolated-stud "overmolded" packages**
- **High peak-surge full-cycle current ratings**
- **Operating temperature range to 125°C**
- **High static dv/dt capability**
- **Shorted-emitter, center-gate design**
- **Low thermal resistance**
- **2.5 kV rms isolation (isolated-stud types)**

Maximum Ratings, *Absolute-Maximum Values:*

	Suffix Letter A	B	D	M	
V_{RSOM}▲	125	250	500	700	V
V_{DSOM}▲	125	250	500	700	V
V_{RROM}▲	100	200	400	600	V
V_{DROM}▲	100	200	400	600	V

ON-STATE CURRENT:

	$I_{T(RMS)}$ θ=180°	$I_{T(AV)}$ θ=180°	$I_{T(DC)}$	
Stud types, T_C = 75°C				
S8610, S8611 series	100	63	70	A
S8612, S8613 series	75	47	63	A
Isolated-stud types, T_C = 70°C				
S8620, S8621 series	100	63	70	A
S8622, S8623 series	75	47	63	A

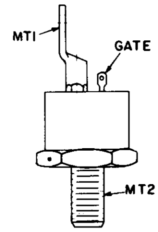
I_{TSM}:

For one cycle of applied principal voltage	60 Hz (sinusoidal)	50 Hz (sinusoidal)	
S8610, S8611 series, T_C = 75°C	1000	850	A
S8620, S8621 series, T_C = 70°C	1000	850	A
S8612, S8613 series, T_C = 75°C	750	640	A
S8622, S8623 series, T_C = 70°C	750	640	A
For more than one full cycle of applied principal voltage	See Fig. 4		

di/dt:		
$V_D = V_{DROM}$, I_{GT} = 200 mA, t_r = 0.1 µs	300	A/µs
I^2t: [For Half-Sine Wave at T_C shown for $I_{T(RMS)}$]:		
t = 10 ms (S8610, S8611, S8620, S8621)	4400	A^2s
(S8612, S8613, S8622, S8623)	2450	A^2s
= 1 ms (S8610, S8611, S8620, S8621)	2050	A^2s
(S8612, S8613, S8622, S8623)	1150	A^2s
P_{GM}●:		
Peak (forward or reverse) for 10 µs maximum	40	W
$P_{G(AV)}$●:		
Averaging time = 10 ms maximum	1	W
T_{stg}■	−40 to 150	°C
T_C■	−40 to 125	°C
T_T:		
During soldering for 10 s maximum (terminals and case)	225	°C
τ_s:		
Recommended	125	in-lb
	1.44	kgf-m
Maximum (DO NOT EXCEED)	150	in-lb
	1.73	kgf-m

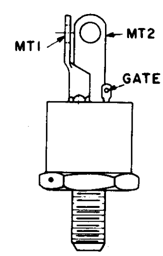
▲ These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.
● Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted.
■ Temperature measurement point is shown on the DIMENSIONAL OUTLINE.

TERMINAL CONNECTIONS



92CS-27733

S8610 series
S8611 series
S8612 series
S8613 series
Stud "overmolded" types



92CS-27739

S8620 series
S8621 series
S8622 series
S8623 series
Isolated-stud "overmolded" types

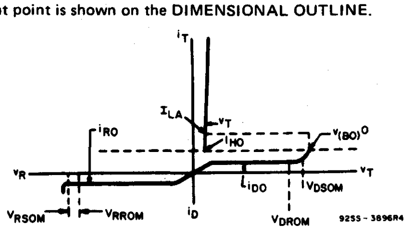


Fig.1 — Principal voltage-current characteristic.

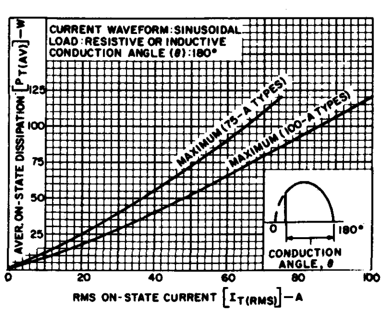


Fig.2 — Power dissipation vs. rms on-state current.

S8610-S8613 Series, S8620-S8623 Series

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	LIMITS FOR ALL TYPES Except as Specified			UNITS
	MIN.	TYP.	MAX.	
I_{DOM} or I_{ROM}: $V_D = V_{DROM}$ or $V_R = V_{RROM}$, $T_C = 125^oC$	–	0.3	3	mA
v_T: i_T = 200 A (peak), $T_C = 25^oC$ (See Fig.6)				
S8610, S8611, S8620, S8621 series	–	–	2.2	V
S8612, S8613, S8622, S8623 series	–	–	2.7	V
i_{HO}: $T_C = 25^oC$	–	100	200	mA
dv/dt: $V_D = V_{DROM}$, exponential voltage rise, $T_C = 125^oC$				
S8610, S8612, S8620, S8622 series	1000	1500	–	V/μs
S8611, S8613, S8621, S8623 series	200	500	–	V/μs
I_{GT}: V_D = 12 V (dc), $R_L = 30\ \Omega$, $T_C = 25^oC$, (See Fig.7)				
S8610, S8611, S8620, S8621 series	25	100	200	mA
S8612, S8613, S8622, S8623 series	–	35	200	mA
V_{GT}: V_D = 12 V (dc), $R_L = 30\ \Omega$, $T_C = 25^oC$ (See Fig.8)	–	1.5	3	V
t_{gt}: $V_D = V_{DROM}$, i_T = 200 A (peak), I_{GT} = 400 mA, t_r = 0.1 μs, $T_C = 25^oC$	–	1.5	2.5	μs
t_q: $V_D = V_{DROM}$, i_T = 50 A, pulse duration = 50 μs, dv/dt = 200 V/μs, –di/dt = –5 A/μs, I_{GT} = 200 mA at turn-on, V_{GK} = 0 at turn-off, $T_C = 85^oC$	–	15	75	μs
$R_{\theta JS}$	–	–	0.4	$^oC/W$
$R_{\theta JIS}$	–	–	0.45	$^oC/W$

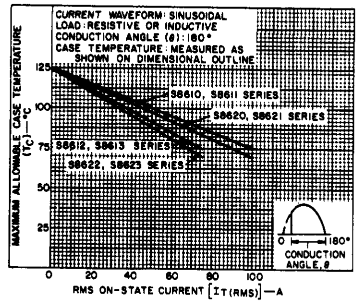


Fig.3 – Maximum allowable case temperature as a function of rms on-state current.

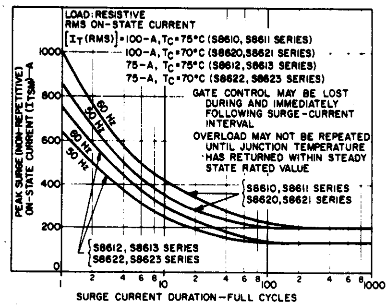


Fig.4 – Peak surge on-state current as a function of surge current duration.

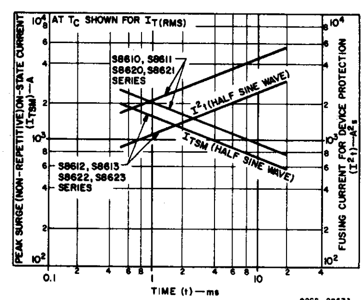


Fig.5 – Peak surge on-state current and fusing current as a function of time.

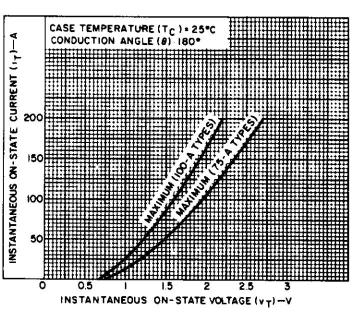


Fig.6 – Instantaneous on-state current vs. instantaneous on-state voltage.

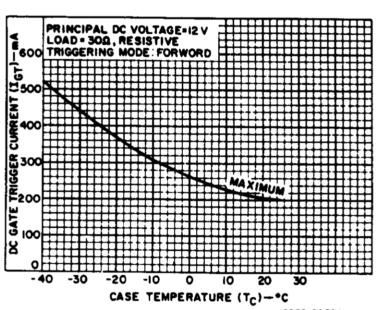


Fig.7 – Maximum dc gate trigger current vs. case temperature.

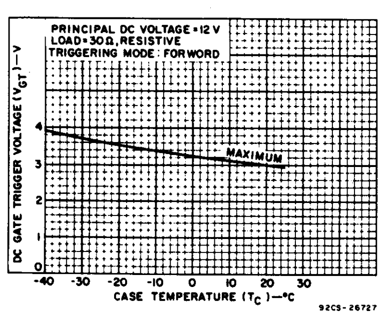


Fig.8 – Maximum dc gate trigger voltage vs. case temperature.

Gate-Turn-off (GTO) Silicon Controlled Rectifiers

Technical Data

G4000, G4001 Series Preliminary Data

5- and 10-A Gate-Turn-Off (GTO) Silicon Controlled Rectifiers

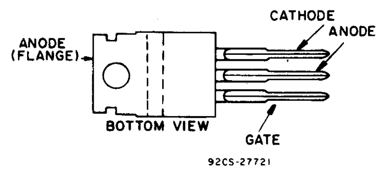
For Automotive and Other Power-Switching Applications

The RCA-G4000 and G4001 series devices are gate-turn-off silicon controlled rectifiers (GTO's). GTO devices employ the same basic four-layer, three-junction regenerative semiconductor structure and exhibit a pulse turn-on capability similar to that of conventional silicon controlled rectifiers (SCR's). GTO devices, however, differ from conventional SCR's in that they can be turned off by a short pulse of reverse gate current.

The G4000 and G4001 series gate-turn-off SCR's employ the JEDEC TO-220AB (RCA VERSAWATT) plastic package. The two series of devices differ in their gate-controlled turn-on and turn-off capabilities and peak reverse gate-voltage ratings. The types in each series differ in their off-state voltage ratings. The suffix letter indicates the voltage (V_{DRXM}) rating for each type.

Features:
- **Turn-off capability at gate terminal**
- **Operating temperature range to 125°C**
- **Glass-passivated junctions**

TERMINAL CONNECTIONS



JEDEC TO-220AB

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	G4000A G4001A	G4000B G4001B	G4000D G4001D	
V_{RROM}	16	16	16	V
V_{DRXM}	100	200	400	V
V_{GRRM}	16	16	16	V
I_{TGQM}:				
G4000 Series		10		A
G4001 Series		5		A
I_T (T_C = 80°C):				
G4000 Series		15		A
G4001 Series		12		A
I_{TSM}: For one full cycle of applied principal voltage, 60 Hz (sinusoidal), T_C = 100°C:				
G4000 Series		85		A
G4001 Series		75		A
I_{GM} (10 μs)		3		A
I_{GRM} (20 μs max.):				
G4000 Series		10		A
G4001 Series		5		A
T_{stg}▲		−40 to 150		°C
T_C▲		−40 to 125		°C
T_L: At distance ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		250		°C

▲For temperature measurement reference point, see Dimensional Outline.

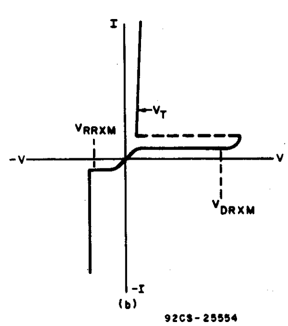


Fig. 1 – Anode-cathode voltage-current characteristic.

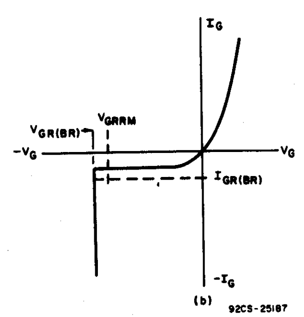


Fig. 2 – Gate-cathode voltage-current characteristic.

G4000, G4001 Series

ELECTRICAL CHARACTERISTICS,
At Maximum Ratings and T_C = 25°C Unless Otherwise Specified

CHARACTERISTIC	LIMITS — FOR ALL TYPES UNLESS OTHERWISE SPECIFIED			UNITS
	Min.	Typ.	Max.	
I_{DRXM} (R_{GK} = 1000 Ω; T_C = 125°C)				
$V_{DM} = V_{DRXM}$	–	–	5	mA
V_D = 30 V	–	–	100	μA
I_{RROM}: V_R = 16 V, T_C = 125°C	–	–	5	mA
I_{GRRM}: V_{GR} = 16 V, T_C = 125°C	–	–	5	mA
V_T (T_C = 25°C):				V
G4000 Series @ 10 A	–	–	103	
G4001 Series @ 5 A	–	–	102	
I_{GT} (V_D = 12 V, R_L = 30 Ω):				mA
T_C = 25°C	–	–	3	
T_C = –40°C	–	–	20	
V_{GT} (V_D = 12 V, R_L = 30 Ω):				V
T_C = 25°C	–	–	1	
T_C = –40°C	–	–	1.5	
I_H (V_D = 12 V, Gate open):				mA
T_C = 25°C	–	10	–	
T_C = –40°C	–	50	–	
I_L (V_D = 6 V, I_{GT} = 20 mA):				mA
T_C = 25°C	–	–	20	
T_C = –40°C	–	–	100	
dv/dt: $V_D = V_{DRXM}$, I_{GT} = 0, R_{GK} = 1000 Ω, T_C = 125°C	–	300	–	V/μs
t_{gqk} (t_{OFF}): $I_T = I_{TGQM}$, $I_{GQM} = 0.6\ I_T$, $V_{GG} < 0.2$ V @ I_{GQ} = 300 mA, T_C = 100°C			T_{GQ} = 25, t_s = 5, t_f = 2	μs
$R_{\theta JC}$▲	–	–	2	°C/W
$R_{\theta CA}$	–	–	50	°C/W

▲ For temperature measurement reference point, see Dimensional Outline.

Diacs
Technical Data

D3202Y, D3202U

Silicon Bidirectional Diacs

Plastic-Packaged Two-Terminal Trigger Devices for Applications in Military, Industrial, and Commercial Equipment

Features:

- **For critical triggering applications requiring narrow breakover voltage range (29-35V)—D3202Y**
- **Typical breakover voltage: $V_{(BO)}$ = 32 V**
- **Low breakover current (at breakover voltage): $I_{(BO)}$ = 25 μA max.**
- **High peak pulse current capability**
- **Breakover voltage symmetry: $|+V_{(BO)}| - |-V_{(BO)}|$ = ±3 V max.**

RCA D3202Y (45411)* and D3202U (45412)* are all-diffused, three-layer, two-terminal devices in an axial-lead plastic package designed specifically for triggering thyristors. Both units exhibit bidirectional negative-resistance characteristics.

These diacs are intended for use in thyristor phase-control circuits for lamp-dimming, universal-motor speed control, and heat controls. Their small size and plastic package of high insulation resistance make these diacs especially suitable for applications in which high packing densities are employed.

*Number in parentheses is a former RCA type number.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DEVICE DISSIPATION:
At case temperature up to 40°C . . . . 1 W
At case temperatures above 40°C . . . Derate 0.016 W/°C

TEMPERATURE RANGE:
Storage . . . . −40 to +150 °C
Operating (Junction) . . . . −40 to +100 °C

LEAD TEMPERATURE (During Soldering)
At distance ≥ 1/16 in. (1.59 mm) from case
for 10 s max. . . . . 240 °C

ELECTRICAL CHARACTERISTICS: At Case Temperature (T_C) = 25°C

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS D3202Y MIN.	LIMITS D3202Y MAX.	LIMITS D3202U MIN.	LIMITS D3202U MAX.	UNITS
Breakover Voltage (Forward or Reverse)	$V_{(BO)}$		29	35	25	40	V
Breakover Voltage Symmetry	$\|+V_{(BO)}\| - \|-V_{(BO)}\|$		–	±3	–	±3	V
Peak Output Current	i_{pk}	V_{SUPPLY} = 30 V_{RMS}, C_T = 0.1 μF, R_L = 20 Ω	190	–	190	–	mA
Peak Breakover Current	$I_{(BO)}$	At breakover voltage	–	25	–	25	μA
Dynamic Breakback Voltage	$\|\Delta V\pm\|$	V_{SUPPLY} = 30 V_{RMS}, C_T = 0.1 μF, R_L = 20 Ω	9	–	9	–	V
Thermal Impedance Junction-to-ambient	$I_{\theta JA}$		–	60	–	60	°C/W

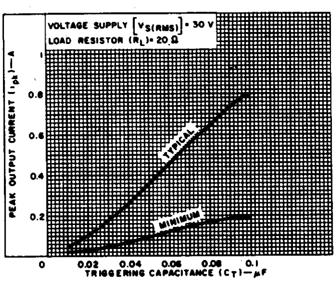


Fig.1 — Peak output current vs. triggering capacitance.

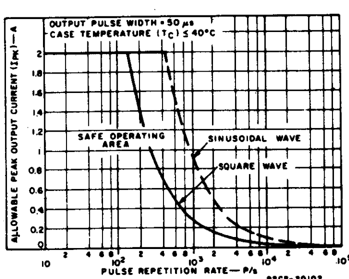


Fig.2 — Peak output-current derating curves.

Silicon Rectifiers

Technical Data

General Purpose Rectifiers

RCA TYPE	Forward Current Av. I_o A	Surge I_{FSM} A	Temp.-T_A °C	Package	Voltage V_{RRM} V	Temp. Range Operating °C	Voltage Drop V_F V	I_o A
6-A TYPES								
1N1341B	6	160	150	DO-4/ DO-203MA	50	-65 to 200	0.65▪	6
1N1342B	6	160	150		100	-65 to 200	0.65▪	6
1N1344B	6	160	150		200	-65 to 200	0.65▪	6
1N1345B	6	160	150		300	-65 to 200	0.65▪	6
1N1346B	6	160	150		400	-65 to 200	0.65▪	6
1N1347B	6	160	150		500	-65 to 200	0.65▪	6
1N1348B	6	160	150		600	-65 to 200	0.65▪	6
12-A TYPES								
1N1199A	12	240	150	DO-4/ DO-203MA	50	-65 to 200	0.55▪	12
1N1200A	12	240	150		100	-65 to 200	0.55▪	12
1N1202A	12	240	150		200	-65 to 200	0.55▪	12
1N1203A	12	240	150		300	-65 to 200	0.55▪	12
1N1204A	12	240	150		400	-65 to 200	0.55▪	12
1N1205A	12	240	150		500	-65 to 200	0.55▪	12
1N1206A	12	240	150		600	-65 to 200	0.55▪	12
20-A TYPES								
1N248C	20	350	150	DO-5/ DO-203MB	50	-65 to 175	0.6▪	20
1N249C	20	350	150		100	-65 to 175	0.6▪	20
1N250C	20	350	150		200	-65 to 175	0.6▪	20
1N1195A	20	350	150		300	-65 to 175	0.6▪	20
1N1196A	20	350	150		400	-65 to 175	0.6▪	20
1N1197A	20	350	150		500	-65 to 175	0.6▪	20
1N1198A	20	350	150		600	-65 to 175	0.6▪	20
40-A TYPES								
1N1183A	40	800	150	DO-5/ DO-203MB	50	-65 to 200	0.65▪	40
1N1184A	40	800	150		100	-65 to 200	0.65▪	40
1N1186A	40	800	150		200	-65 to 200	0.65▪	40
1N1187A	40	800	150		300	-65 to 200	0.65▪	40
1N1188A	40	800	150		400	-65 to 200	0.65▪	40
1N1189A	40	800	150		500	-65 to 200	0.65▪	40
1N1190A	40	800	150		600	-65 to 200	0.65▪	40

▪ At full cycle average

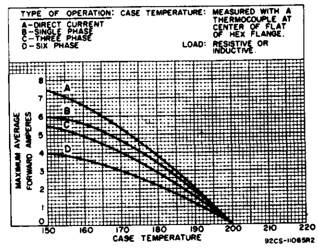


Fig. 1 – Maximum average forward current vs. case temperature for 1N1341B, 1N1342B, 1N1344B–1N1348B.

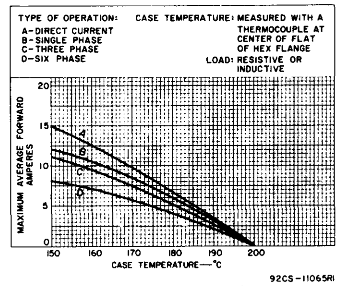


Fig. 2 – Maximum average forward current vs. case temperature for 1N1199A, 1N1200A, 1N1202A–1N1206A.

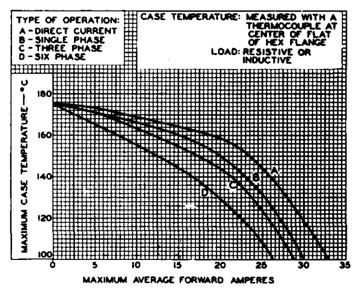


Fig. 3 – Maximum average forward current vs. case temperature for 1N248C, 1N250C, 1N1195A–1198A.

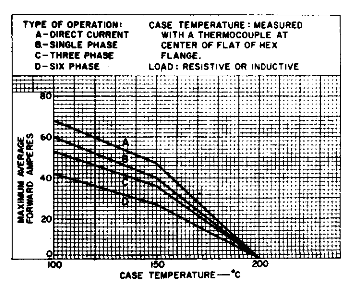


Fig. 4 – Maximum average forward current vs. case temperature for 1N1183A, 1N1184A, 1N1186A–1N1190A.

Fast Recovery Rectifiers

RCA TYPE	Forward Current RMS $I_{F(RMS)}$ A	Av. I_o A	Surge I_{FSM} A	Temp.-T_A °C	Package	Voltage V_{RRM} V	Temp. Range Operating °C	Voltage Drop v_F V	i_F A	Rev. Recovery Time t_{rr} µs	I_{FM} A	T_C °C
9-A TYPES												
D2406F	9	6	125	100		50	-40 to 150	1.4	6	0.35	19	25
D2406A	9	6	125	100		100	-40 to 150	1.4	6	0.35	19	25
D2406B	9	6	125	100		200	-40 to 150	1.4	6	0.35	19	25
D2406C	9	6	125	100		300	-40 to 150	1.4	6	0.35	19	25
D2406D	9	6	125	100		400	-40 to 150	1.4	6	0.35	19	25
D2406M	9	6	125	100	DO-4/ DO-203MA	600	-40 to 150	1.4	6	0.35	19	25
1N3879	9	6	75	100		50	-65 to 150	1.4	6	0.20	1	25
1N3880	9	6	75	100		100	-65 to 150	1.4	6	0.20	1	25
1N3881	9	6	75	100		200	-65 to 150	1.4	6	0.20	1	25
1N3882	9	6	75	100		300	-65 to 150	1.4	6	0.20	1	25
1N3883	9	6	75	100		400	-65 to 150	1.4	6	0.20	1	25
18-A TYPES												
D2412F	18	12	250	100		50	-40 to 150	1.4	12	0.35	38	25
D2412A	18	12	250	100		100	-40 to 150	1.4	12	0.35	38	25
D2412B	18	12	250	100		200	-40 to 150	1.4	12	0.35	38	25
D2412C	18	12	250	100		300	-40 to 150	1.4	12	0.35	38	35
D2412D	18	12	250	100		400	-40 to 150	1.4	12	0.35	38	25
D2412M	18	12	250	100	DO-4/ DO-203MA	600	-40 to 150	1.4	12	0.35	38	25
1N3889	18	12	150	100		50	-65 to 150	1.4	12	0.20	1	25
1N3890	18	12	150	100		100	-65 to 150	1.4	12	0.20	1	25
1N3891	18	12	150	100		200	-65 to 150	1.4	12	0.20	1	25
1N3892	18	12	150	100		300	-65 to 150	1.4	12	0.20	1	25
1N3893	18	12	150	100		400	-65 to 150	1.4	12	0.20	1	25

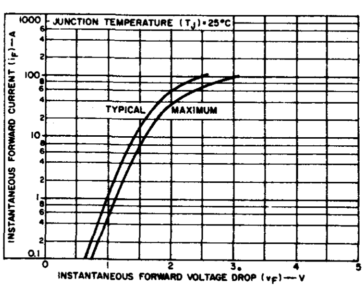


Fig. 5 – Forward current vs. forward voltage drop for D2406 series.

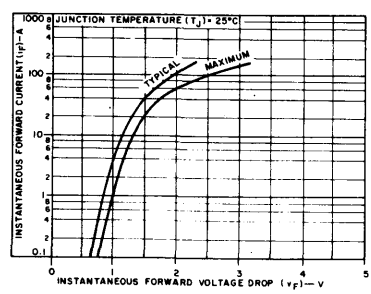


Fig. 6 – Forward current vs. forward voltage drop for D2412 series.

Fast Recovery Rectifiers

RCA TYPE	Forward Current RMS $I_{F(RMS)}$ A	Av. I_o A	Surge I_{FSM} A	Temp.-T_C °C	Package	Voltage V_{RRM} V	Temp. Range Operating °C	Voltage Drop v_F V	i_F A	Rev. Recovery Time t_{rr} µs	I_{FM} A	T_C °C
30-A TYPES												
D2520F	30	20	300	100	DO-5/ DO-203MB	50	-40 to 150	1.4	20	0.35	63	25
D2520A	30	20	300	100		100	-40 to 150	1.4	20	0.35	63	25
D2520B	30	20	300	100		200	-40 to 150	1.4	20	0.35	63	25
D2520C	30	20	300	100		300	-40 to 150	1.4	20	0.35	63	25
D2520D	30	20	300	100		400	-40 to 150	1.4	20	0.35	63	25
D2520M	30	20	300	100		600	-40 to 150	1.4	20	0.35	63	25
1N3899	30	20	225	100		50	-65 to 150	1.4	20	0.20	1	25
1N3900	30	20	225	100		100	-65 to 150	1.4	20	0.20	1	25
1N3901	30	20	225	100		200	-65 to 150	1.4	20	0.20	1	25
1N3902	30	20	225	100		300	-65 to 150	1.4	20	0.20	1	25
1N3903	30	20	225	100		400	-65 to 150	1.4	20	0.20	1	25
45-A TYPES												
1N3909	45	30	300	100	DO-5/ DO-203MB	50	-65 to 150	1.4	30	0.20	1	25
1N3910	45	30	300	100		100	-65 to 150	1.4	30	0.20	1	25
1N3911	45	30	300	100		200	-65 to 150	1.4	30	0.20	1	25
1N3912	45	30	300	100		300	-65 to 150	1.4	30	0.20	1	25
1N3913	45	30	300	100		400	-65 to 150	1.4	30	0.20	1	25
60-A TYPES												
D2540F	60	40	700	165	DO-5/ DO-203MB	50	-40 to 150	1.8	100	0.35	125	25
D2540A	60	40	700	165		100	-40 to 150	1.8	100	0.35	125	25
D2540B	60	40	700	165		200	-40 to 150	1.8	100	0.35	125	25
D2540D	60	40	700	165		400	-40 to 150	1.8	100	0.35	125	25
D2540M	60	40	700	165		600	-40 to 150	1.8	100	0.35	125	25

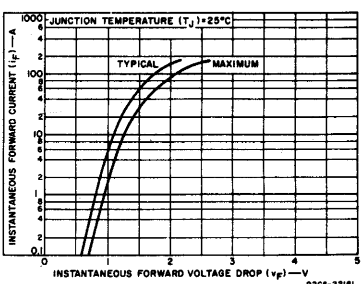


Fig. 7 — Forward current vs. forward voltage drop for D2520 series.

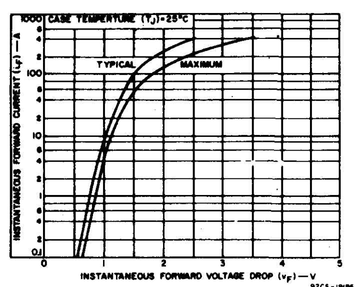


Fig. 8 — Forward current as a function of forward voltage drop for D2540 series.

High-Reliability Power Devices
Preconditioning and Screening

High-Reliability Power Devices

Solid-state devices classified as high-reliability types have come to be primarily associated with military and aerospace applications. In many ways, this association is misleading because the commercial equipment market is probably the largest user of high-reliability products, but not necessarily by that label. Military and aerospace agencies, however, have been largely responsible for establishment of comprehensive published reliability specifications and standards which have been accepted by the solid-state industry. MIL standards dominate the procedures used to specify high-reliability solid-state devices and represent a common reference point frequently used by commercial users to define their requirements.

Military and aerospace requirements for high-reliability solid-state devices are extremely large and diverse, not only in terms of performance, operating conditions, and reliability, but also in terms of logistics and procurement. As a result of these requirements, the military services have jointly developed specifications and standards under which most military end-use solid-state devices are procured. To simplify procurement, logistics, and the development of reliability data, MIL specs are not issued for the full spectrum of devices manufactured; rather, they are restricted to those devices for which significant need is demonstrated and are specified so that the device can have as wide applicability as possible. Although the limits for operating conditions may exceed those required for some applications, they simplify procurement and assure a supply of devices for the majority of military equipment. These standards also cover a wide range of requirements for the manufacturer on such things as:

(a) The procedure and requirements for a manufacturer to become certified to manufacture MIL-spec parts.
(b) The requirements for qualifying parts.
(c) Product-assurance provisions in such areas as quality control, inspection procedures, personnel training, cleanliness, failure analysis, and documentation.
(d) Test methods and procedures.
(e) Marking and identification of product.
(f) Preservation and packing.

JAN, JANTX, SOLID-STATE DEVICES

The major military specification used for the procurement of standard solid-state devices by the military is MIL-S-19500, which covers devices such as discrete transistors, thyristors, and diodes.

MIL-S-19500 is the specification for the familiar "JAN"-type solid-state device. Detailed electrical specifications are prepared as needed by the three military services and coordinated by the Defense Electronic Supply Center. At present, approximately five hundred detailed electrical specifications are included in the MIL-S-19500 system.

Levels of reliability are defined by MIL-S-19500. Devices designated as JAN types receive lot screening only and are the least expensive. Devices designated as JANTX receive some 100-per-cent screening (primarily burn-in) and a tight lot-sampling plan. Not all detailed specifications include JANTX requirements.

Fig. 1 shows the processing requirements specified by MIL-S-19500 for JAN and JANTX, solid-state power devices.

The Defense Electronic Supply Center maintains a "Qualified Products List" of all vendors qualified to produce devices in accordance with MIL-S-19500. This list is published periodically and is available to manufacturers of military equipment.

RCA offers a number of solid-state power devices that have been qualified as JAN, and JANTX, devices in accordance with MIL-S-19500.

Table I shows the wide product line of JAN, and JANTX, military-specification solid-state power devices available from RCA for high-reliability applications in military, aerospace, and critical industrial usage. These devices, which include power transistors, rf power transistors, and silicon controlled rectifiers (SCR's), are processed in accordance with the MIL-S-19500 general specifications. MIL-STD-750 test methods are used as required by the individual military detail specification. This table lists the individual MIL-S-19500 specification number for each family of devices.

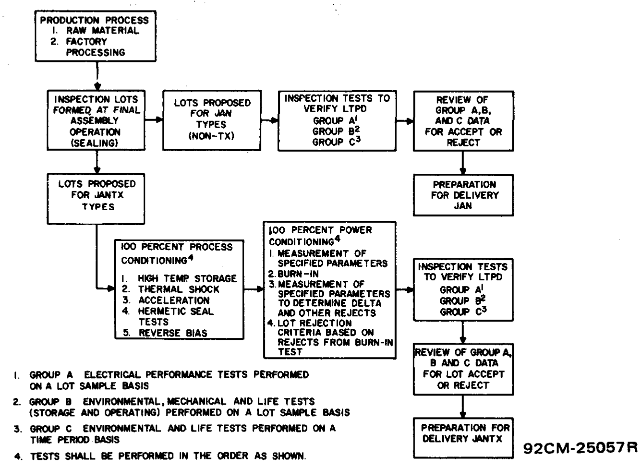


Fig. 1 — Order of procedure diagram for JAN and JANTX solid-state devices.

TABLE I — RCA JAN and JANTX Solid-State Power Devices

Parent Type	Military Specification Type	MIL-S-19500/*
	POWER TRANSISTORS	
	Hometaxial-Base Types	
2N1479	JAN2N1479	207
2N1480	JAN2N1480	207
2N1481	JAN2N1481	207
2N1482	JAN2N1482	207
2N1483	JAN2N1483, JANTX2N1483	180
2N1484	JAN2N1484, JANTX2N1484	180
2N1485	JAN2N1485, JANTX2N1485	180
2N1486	JAN2N1486, JANTX2N1486	180
2N1487	JAN2N1487	208
2N1488	JAN2N1488	208
2N1489	JAN2N1489	208
2N1490	JAN2N1490	208
2N3055	JAN2N3055, JANTX2N3055	407
2N3441	JAN2N3441, JANTX2N3441	369
2N3442	JAN2N3442	370
2N3771	JAN2N3771, JANTX2N3771	413
2N3772	JAN2N3772, JANTX2N3772	413

* MIL-S-19500 specifications can be obtained from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphis, Pa. 19120.

TABLE I – RCA JAN, JANTX, Solid-State Power Devices (cont'd)

Parent Type	Military Specification Type	MIL-S-19500/*
	POWER TRANSISTORS (Cont'd)	
	High-Voltage Types	
2N3439	JAN2N3439, JANTX2N3439	368
2N3440	JAN2N3440, JANTX2N3440	368
2N3584	JAN2N3584, JANTX2N3584,	384
2N3585	JAN2N3585, JANTX2N3585,	384
2N5415	JAN2N5415, JANTX2N5415	485
2N5416	JAN2N5416, JANTX2N5416	485
2N5838	JAN2N5838, JANTX2N5838	487
2N5839	JAN2N5839, JANTX2N5839	487
2N5840	JAN2N5840, JANTX2N5840	487
2N6211	JAN2N6211, JANTX2N6211	461
2N6212	JAN2N6212, JANTX2N6212	461
2N6213	JAN2N6213, JANTX2N6213	461
2N6249	JAN2N6249, JANTX2N6249,	510
2N6250	JAN2N6250, JANTX2N6250,	510
2N6251	JAN2N6251, JANTX2N6251,	510
2N6306	JAN2N6306, JANTX2N6306,	498
2N6308	JAN2N6308, JANTX2N6308,	498
2N6383	JAN2N6383, JANTX2N6383	523
2N6384	JAN2N6384, JANTX2N6384	523
2N6385	JAN2N6385, JANTX2N6385	523
2N6648	JAN2N6648, JANTX2N6648	527
2N6649	JAN2N6649, JANTX2N6649	527
2N6650	JAN2N6650, JANTX2N6650	527
	High-Speed Types	
2N3879	JAN2N3879, JANTX2N3879	526
2N5038	JAN2N5038, JANTX2N5038,	439
2N5039	JAN2N5039, JANTX2N5039,	439
2N5671	JAN2N5671, JANTX2N5671	488
2N5672	JAN2N5672, JANTX2N5672	488
	RF POWER TRANSISTORS	
2N2857	JAN2N2857, JANTX2N2857	343
2N3375	JAN2N3375, JANTX2N3375	341
2N3553	JAN2N3553, JANTX2N3553	341
2N4440	JAN2N4440, JANTX2N4440	341
2N3866	JAN2N3866, JANTX2N3866	398
2N5071	JAN2N5071, JANTX2N5071	442
2N5109	JAN2N5109 JANTX2N5109	453
	SILICON CONTROLLED RECTIFIERS (SCR's)	
2N682	JAN2N682, JANTX2N682	108
2N683	JAN2N683, JANTX2N683	108
2N685	JAN2N685, JANTX2N685	108
2N687	JAN2N687, JANTX2N687	108
2N688	JAN2N688, JANTX2N688	108
2N690	JAN2N690, JANTX2N690	108
	TRIACS	
2N5806	JAN2N5806	438
2N5807	JAN2N5807	438
2N5808	JAN2N5808	438
2N5809	JAN2N5809	438

* MIL-S-19500 specifications can be obtained from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pa. 19120.

Note: Ratings and characteristics data shown for the parent types earlier in this DATABOOK are also applicable to the JAN and JANTX types.

TABLE II – LTPD sampling plans 1/ 2/ 3/

Minimum size of sample to be tested to assure, with a 90 percent confidence, that a lot having percent-defective equal to the specified LTPD will not be accepted (single sample).

Max. Percent Defective (LTPD) or λ	20	15	10	7	5	3	2	1.5	1	0.7	0.5	0.3
Acceptance Number (c) (r = c + 1)	Minimum Sample Sizes (For device-hours required for life test, multiply by 1000)											
0	11 (0.46)	15 (0.34)	22 (0.23)	32 (0.16)	45 (0.11)	76 (0.07)	116 (0.04)	153 (0.03)	231 (0.02)	328 (0.02)	461 (0.01)	767 (0.007)
1	18 (2.0)	25 (1.4)	38 (0.94)	55 (0.65)	77 (0.46)	129 (0.28)	195 (0.18)	258 (0.14)	390 (0.09)	555 (0.06)	778 (0.045)	1296 (0.027)
2	25 (3.4)	34 (2.24)	52 (1.6)	75 (1.1)	105 (0.78)	176 (0.47)	266 (0.31)	354 (0.23)	533 (0.15)	759 (0.11)	1065 (0.080)	1773 (0.045)
3	32 (4.4)	43 (3.2)	65 (2.1)	94 (1.5)	132 (1.0)	221 (0.62)	333 (0.41)	444 (0.31)	668 (0.20)	953 (0.14)	1337 (0.10)	2226 (0.062)
4	38 (5.3)	52 (3.9)	78 (2.6)	113 (1.8)	158 (1.3)	265 (0.75)	398 (0.50)	531 (0.37)	798 (0.25)	1140 (0.17)	1599 (0.12)	2663 (0.074)
5	45 (6.0)	60 (4.4)	91 (2.9)	131 (2.0)	184 (1.4)	308 (0.85)	462 (0.57)	617 (0.42)	927 (0.28)	1323 (0.20)	1855 (0.14)	3090 (0.085)
6	51 (6.6)	68 (4.9)	104 (3.2)	149 (2.2)	209 (1.6)	349 (0.94)	528 (0.62)	700 (0.47)	1054 (0.31)	1503 (0.22)	2107 (0.155)	3509 (0.093)
7	57 (7.2)	77 (5.3)	116 (3.5)	166 (2.4)	234 (1.7)	390 (1.0)	589 (0.67)	783 (0.51)	1178 (0.34)	1680 (0.24)	2355 (0.17)	3922 (0.101)
8	63 (7.7)	85 (5.6)	128 (3.7)	184 (2.6)	258 (1.8)	431 (1.1)	648 (0.72)	864 (0.54)	1300 (0.36)	1854 (0.25)	2599 (0.18)	4329 (0.108)
9	69 (8.1)	93 (6.0)	140 (3.9)	201 (2.7)	282 (1.9)	471 (1.2)	709 (0.77)	945 (0.58)	1421 (0.38)	2027 (0.27)	2842 (0.19)	4733 (0.114)
10	75 (8.4)	100 (6.3)	152 (4.1)	218 (2.9)	306 (2.0)	511 (1.2)	770 (0.80)	1025 (0.60)	1541 (0.40)	2199 (0.28)	3082 (0.20)	5133 (0.120)

1/ Sample sizes are based upon the Poisson exponential binomial limit.
2/ The minimum quality (approximate AQL) required to accept (on the average) 19 of 20 lots is shown in parenthesis for information only.
3/ This sampling plan is derived from Table C-1 in Appendix C of MIL-S-19500.

RCA NON-JAN TYPE SOLID-STATE DEVICES

Many solid-state devices are not covered by military specifications, either because they are too new or are not used in sufficient quantities. Many of these devices offer the most recent technological advances or have special performance characteristics which offer advantages to the designer of high-reliability equipment. RCA cooperates with the users of such devices in establishment of high-reliability specifications patterned after MIL standards, which allow these designs to be approved for use in military and aerospace systems, as well as commercial equipment. If the use warrants, these specifications may be submitted by RCA, or the user, to the cognizant military specification agency as candidates for MIL approval as a standard type.

Most procurements of solid-state devices for military systems are made by the equipment contractor from the MIL-STD parts list as awards are received for electronic equipment. Some military and aerospace programs, because of their size, duration, or special requirements (Minuteman and Apollo are two examples), require that special specifications and process methods, or even special production lines, be established and tailored to the particular functional, reliability, and economic needs of the program. RCA Solid State Division has frequently used the resources of its laboratories, production facilities, and expert technical staff to contribute to the success of such programs.

All RCA high-reliability solid-state power devices are processed in accordance with the provisions of MIL-S-19500. These provisions include the following items:

1. A clearly defined procedure for the conversion of a customer specification into an RCA internal specification with built-in safeguards to assure the customer that the delivered parts meet or exceed his specification requirements.
2. A formalized personnel training and testing program which assures that each operation is performed correctly.
3. A complete inspection of incoming materials, utilities, and work in process using on-site facilities such as scanning-electron-microscope and X-ray equipment.
4. Maintenance of cleanliness in work areas.
5. Rigorous control over changes in design, materials, and processes with documentation kept in active files for a minimum of three years.
6. Tool and test equipment maintenance and calibration in strict accordance with MIL-C-45662, "Calibration System Requirements."
7. A quality-assurance program in accordance with MIL-Q-9858, "Quality Program Requirements."

The *Lot Sampling* plans used for RCA high-reliability solid-state power devices, as defined by MIL-S-19500 and MIL-STD 105D, are shown in Tables II, III, and IV. Detailed processing and screening requirements for RCA high-reliability power transistors, thyristors (triacs and SCR's), and rf power transistors are described in the following paragraphs.

TABLE III – Sample Size Code Letters*

Lot or batch size			General inspection levels		
			I	II	III
2	to	8	A	A	B
9	to	15	A	B	C
16	to	25	B	C	D
26	to	50	C	D	E
51	to	90	C	E	F
91	to	150	D	F	G
151	to	280	E	G	H
281	to	500	F	H	J
501	to	1200	G	J	K
1201	to	3200	H	K	L
3201	to	10000	J	L	M
10001	to	35000	K	M	N
35001	to	150000	L	N	P
150001	to	500000	M	P	Q
500001	and	over	N	Q	R

* Derived from Table I of MIL-STD-105D

TABLE IV – Single Sampling Plans for Normal Inspection*

Sample size code letter	Sample size	Acceptable Quality Levels (normal inspection)																	
		0.010	0.015	0.025	0.040	0.065	0.10	0.15	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10	15	25
		Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
A	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↓	↓	1 2
B	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3
C	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4
D	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6
E	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8
F	20	↓	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11
G	32	↓	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15
H	50	↓	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22
J	80	↓	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑
K	125	↓	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑
L	200	↓	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑
M	315	↓	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑
N	500	↓	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑
P	800	↓	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑	↑
Q	1250	0 1	↑	↓	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑	↑	↑
R	2000	↑	↑	1 2	2 3	3 4	5 6	7 8	10 11	14 15	21 22	↑	↑	↑	↑	↑	↑	↑	↑

↓ = Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
↑ = Use first sampling plan above arrow.

Ac = Acceptance number.
Re = Rejection number.

* Derived from Table II-A of MIL-STD-105D

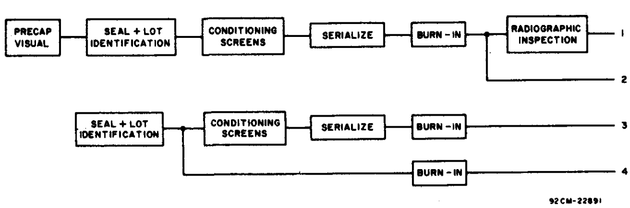


Fig. 2 – Process-flow chart for four reliability levels of RCA high-reliability power transistors.

Power Transistors

In addition to JAN, JANTX, and JANTXV types, high-reliability selections of all RCA power transistors can be obtained on a custom basis. Such power transistors are subjected to high-reliability preconditioning and screening in accordance with the Group A, B, and C Sampling Tests as specified in MIL-STD-750 or special customer requirements. These power transistors can be supplied to four basic reliability levels. The preconditioning and screening for Level 1 is the same as that for JANTXV devices and, in addition, includes X-ray inspection. Level 2 corresponds directly to the JANTXV level. Level 3 devices are equivalent to JANTX devices. For RCA Level 4 devices, the preconditioning consists of burn-in only.

Fig. 2 shows the basic processing steps required for RCA high-reliability power transistors for each reliability level, and Table V lists the screening tests to which these devices are subjected. Tables VI, VII, and VIII list the Groups A, B, and C Sampling Tests and the test methods specified by MIL-STD-750.

Thyristors (Triacs and SCR's)

RCA high-reliability thyristors that are subjected to high-reliability preconditioning and screening in accordance with the Group A, B, and C Sampling Tests as specified in MIL-STD-750 or special customer requirements can be obtained on a custom basis. These thyristors can be supplied to four basic reliability levels that are approximately equivalent to, or exceed, the reliability classes (JAN, JANTX, JANTXV) defined by MIL-S-19500.

Fig. 3 shows the basic processing steps required for RCA high-reliability thyristors for each reliability level, and Table IX lists the screening tests to which these devices are subjected. Tables X, XI, and XII list the Groups A, B, and C Sampling Tests and the test methods specified by MIL-STD-750.

TABLE V – Screening Tests for RCA High-Reliability Power Transistors

Test	Conditions	MIL-STD-750 Method	MIL-STD-750 Conditions	Screening Levels 1	2	3	4
1. Precap Visual		2072		X	X		
2. Seal and Lot Identification				X	X	X	X
3. High Temp Storage	24 hrs at 200°C			X	X	X	
4. Temperature Cycling	10 cycles	1051	C	X	X	X	
5. Acceleration	Y_1 direction	2006		X	X	X	
6. Fine Leak		1071	G or H	X	X	X	
7. Gross Leak		1071	A,C,D or F	X	X	X	
8. Reverse Bias	24 hrs at 150°C	1039	A	X	X	X	
9. Serialize				X	X	X	
10. Pre Burn-in Electrical				X	X	X	
11. Burn-in	168 hrs at 25°C	1039	B	X	X	X	X
12. Post Burn-in Electrical				X	X	X	
13. Final Electrical				X	X	X	X
14. Radiographic Inspection		2076		X			
15. External Visual		2071		X	X	X	

Specific test conditions and limits determined by each type of transistor.

TABLE VI – Group A Inspections (power transistors)

Subgroup	Test	MIL-STD-750 Method
1	Visual & Mech Examination	2071
2	BV_{CEO}, BV_{CER}, or BV_{CEX}	3011
	I_{CEO}, I_{CER}, or I_{CEX}	3041
	I_{EBO}	3061
3	h_{FE}	3076
	$V_{CE(sat)}$	3071
	V_{BE}	3066
4	h_{FE}	3306
	C_{obo}	3236
	t_{on}	3251
	t_{off}	3251
5	150°C I_{CEX}	3041
	−65°C h_{FE}	3076

TABLE VII – Group B Inspections (power transistors)

Subgroup	Test	MIL-STD-750 Method
1	Physical dimensions	2066
2	Solderability	2026
	Temperature Cycling	1051
	Moisture Resistance	1021
3	Shock	2016
	Vibration, Variable Frequency	2056
	Constant Accleration	2066
4	Safe Operating Area	3051
5	High Temperature Life	1031
6	Steady-State Operation Life	1026

TABLE VIII – Group C Inspections (power transistors)

Subgroup	Test	MIL-STD-750 Method
1	Barometric Pressure	1001
2	Salt Atmosphere	1041

TABLE IX – Screening Test for High-Reliability Thyristors

Test	Condition	MIL-STD-750 Method	MIL-STD-750 Conditions	Screening Levels 1	2	3	4
1. Precap visual	20 power			X			
2. Seal and lot identification				X	X	X	X
3. High-temperature Storage	24 hrs. at 150°C	1031		X	X		
4. Temperature cycling	Low temperature per device	1051	F	X	X		
5. Acceleration	Y_1 direction	2006		X	X		
6. Hermeticity-fine leak		1071	H	X	X	X	
7. Hermeticity-gross leak		1071	D	X	X		
8. Serialize				X			
9. Preburn-in electrical-record				X			
10. Preburn-in electrical					X	X	X
11. Burn-in	24 to 168 hrs.; 100°C to 125°C			X	X	X	X
12. Post burn-in electrical					X	X	X
13. Post burn-in electrical-record Δ's				X			
14. Final electrical				X	X		
15. Hermeticity-fine leak				X	X		
16. Hermeticity-gross leak				X			
17. Radiographic		2076		X			
18. External visual		2071		X			

TABLE X – Group A Tests (triacs and SCR's)

Subgroup	Test	MIL-STD-750 Method
1	Visual	2071
2	Forward blocking current	4206.1
2	Reverse blocking current	4211.1
3	High-temp. forward blocking current	
3	High-temp. reverse blocking current	
3	High-temp. gate-trigger voltage or gate-trigger current	4221.1
3	Exponential rate of voltage rise	4231.2
4	Gate-trigger voltage or gate-trigger current at 25°C	
4	Gate-controlled turn-on time	4223
4	Circuit-commutated turn-off time	4224
4	Gate-controlled turn-off time	4225
4	Forward "on" voltage	4226.1
4	Holding current	4201.2

TABLE XI – Group B Tests (triacs and SCR's)

Test	MIL-STD-750 Method
Reverse gate current	4219
Surge current	4066
Temperature cycling	1051
Thermal shock (glass strain)	1056
Terminal strength	2036
Moisture resistance	1021
AC blocking voltage	-

TABLE XII – Group C Tests (triacs and SCR's)

Subgroup	Test	MIL-STD-750 Method
1	Physical dimensions	2066
2	Shock	2016
2	Vibration, variable-frequency	2056
2	Constant acceleration	2006
3	Barometric pressure	1001
4	Salt atmosphere	1041
5	Solderability	2026
6	Intermittent life	

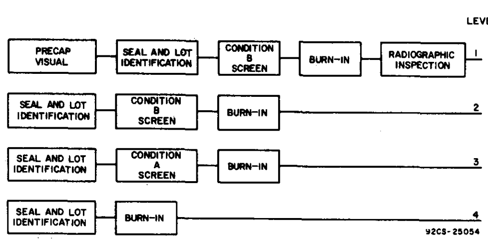


Fig. 3 – Basic processing and screening required for RCA high-reliability triacs and SCR's.

Appendix

General Characteristics, Test Circuits, and Waveforms

POWER TRANSISTORS

Dissipation Derating Chart

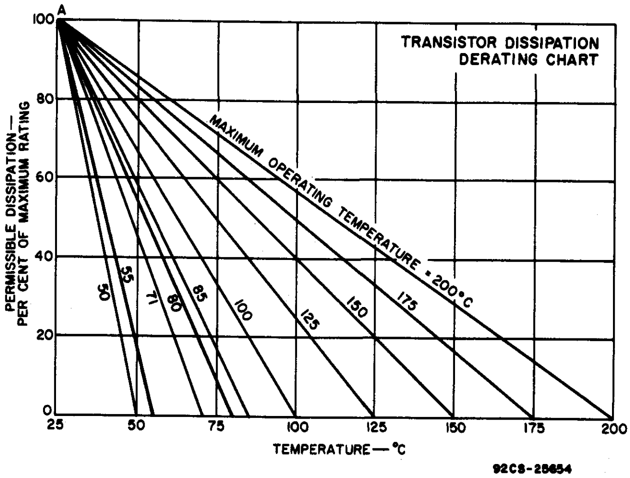


Fig. 1 – Dissipation derating chart for silicon power transistors operated at temperatures above 25°C.

For many transistors, the maximum value of dissipation is specified for ambient, case, or mounting-flange temperatures up to 25°C, and must be reduced linearly for higher temperatures. For such types, the chart above can be used to determine maximum permissible dissipation values at particular temperature conditions above 25°C. (This chart cannot be assumed to apply to types other than those for which it is specified that the maximum allowable dissipation is derated linearly to zero at the maximum allowable operating temperature, T_J (max.).) The curves show the permissible percentage of the maximum dissipation ratings as a function of ambient or case temperature. Individual curves are plotted for maximum operating temperatures of 50, 55, 75, 80, 85, 100, 125, 150, 175, and 200°C. If the maximum operating temperature of a transistor is some other value, a new curve can be drawn from point A in the figure to the desired temperature value on the abscissa.

To use the chart, it is necessary to know the maximum dissipation rating and the maximum operating temperature for a given transistor. The calculation involves only two steps:

1. A vertical line is drawn at the desired operating temperature value on the abscissa to intersect the curve representing the maximum operating temperature for the transistor.

2. A horizontal line drawn from this intersection point to the ordinate establishes the permissible percentage of the maximum dissipation at the given temperature.

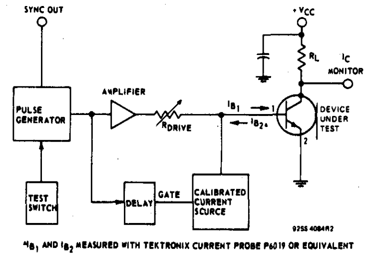
The following example illustrates the calculation of the maximum permissible dissipation for transistor type 2N1487 at a case temperature of 100°C. This type has a maximum dissipation rating of 75 watts at a case temperature of 25°C, and a maximum permissible case-temperature rating of 200°C.

1. A perpendicular line is drawn from the 100-degree point on the abscissa to the 200-degree curve.

2. Projection of this point to the ordinate shows a percentage of 57.5.

Therefore, the maximum permissible dissipation for the 2N1487 at a case temperature of 100°C is 0.575 times 75, or approximately 43 watts.

Switching-Time Measurements



* For p-n-p types, direction of currents and polarities of voltages are reversed.

Fig.2 – Circuit used to measure switching times.

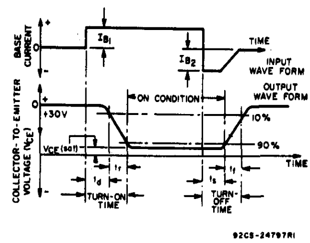


Fig.3 – Oscilloscope display for measurement of switching times.

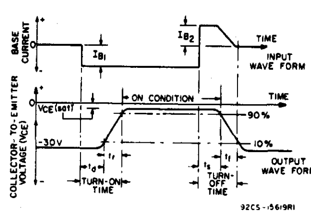
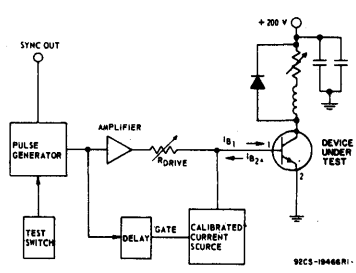


Fig.4 – Oscilloscope display for measurement of switching times for p-n-p types.



* For p-n-p types, direction of currents and polarities of voltages are reversed.

Fig.5 – Circuit used to measure inductive-load switching times.

POWER TRANSISTORS (Cont'd)

Breakdown (Sustaining) Voltage Tests

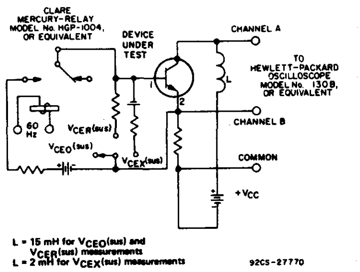


Fig.6 – Basic configuration used to measure sustaining voltage $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEX}(sus)$ for n-p-n power transistors.

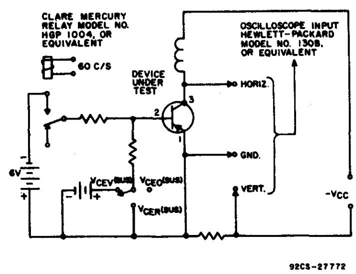


Fig.8 – Basic circuit configuration used to measure sustaining voltages $V_{CEO}(sus)$, $V_{CER}(sus)$, and $V_{CEV}(sus)$ for p-n-p power transistors.

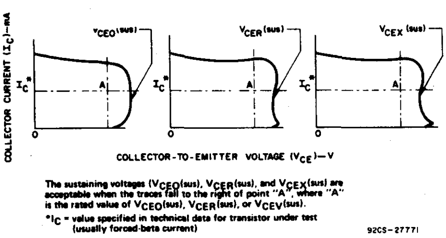


Fig.7 – Oscilloscope display for measurement of sustaining voltages of n-p-n power transistors.

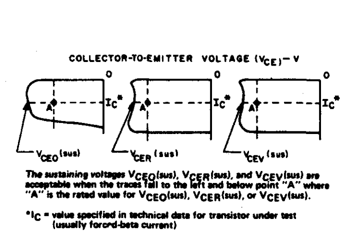


Fig.9 – Oscilloscope display for measurement of sustaining voltages of p-n-p power transistors.

Inductive Load-Switching Measurements

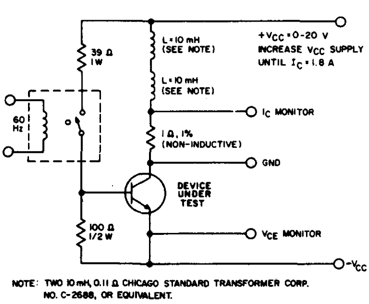


Fig.10 – Circuit for measuring inductive-load switching for all types.

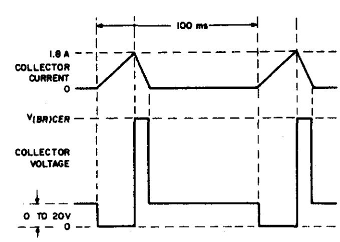


Fig.11 – Inductive-load switching voltage and current waveforms.

HC2000H POWER HYBRID OPERATIONAL AMPLIFIER TEST CIRCUITS

PROCEDURE FOR MEASUREMENT OF COMMON-MODE INPUT IMPEDANCE

a) Insert unit
b) Apply ±37.5 V
c) Close S1
d) Adjust signal generator for 1 V on voltmeter V1
e) Open S1
f) Read voltmeter V1
g) Input impedance = $(10\ k) \times \frac{V1}{1 - V1}$

Note: Circuit under test must have a heat sink so that $T_C \approx 25°C$, unless otherwise noted.

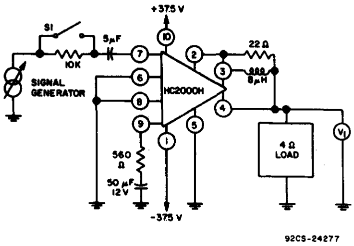


Fig. 12 — Circuit for measurement of common-mode input impedance.

PROCEDURE FOR MEASUREMENT OF OFFSET VOLTAGE AND QUIESCENT CURRENT

A = DC ammeter 100 mA range
V = DC voltmeter ± 250 mV range
a) Close S1
b) Insert unit
c) Apply ± 37.5 V
d) Read offset voltage on voltmeter. Change polarity if required.
e) Open S1
f) Read positive and negative quiescent current on ammeter.

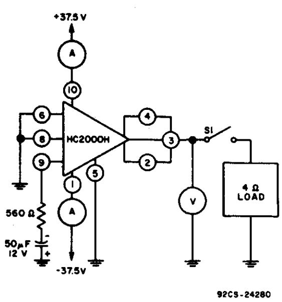


Fig. 13 — Circuit for measurement of offset voltage and quiescent current.

HC2000H

TERMINAL CONNECTIONS

Pin No.	Connection	
1	$-V_S$	Negative supply voltage
2	V_{FB}	Feedback voltage
3	V_{OUT}	Output voltage
4	PC	Phase compensation
5	GND	Ground
6	BP	Base plate (internal connection)
7	$+V_{IN}$	Non-inverting input
8	GND	Ground
9	$-V_{IN}$	Inverting input
10	$+V_S$	Positive supply voltage

PROCEDURE FOR MEASUREMENT OF OPEN-LOOP GAIN

a) Insert unit
b) Apply ± 37.5 V
c) Set generator at 1 kHz and adjust until V1 = 10 V rms
d) Read V2
e) Open-loop gain = V1/V2

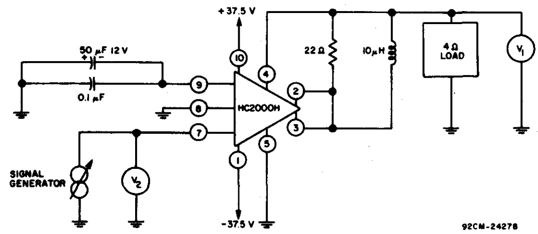


Fig. 14 — Circuit for measurement of open-loop gain.

PROCEDURE FOR MEASUREMENT OF CLOSED-LOOP VOLTAGE GAIN

a) Insert unit
b) Adjust signal generator to 1 kHz, V2 = 0
c) Apply ± 37.5 V
d) Adjust signal generator for 2 V rms on voltmeter V1
e) Read voltmeter V2
f) Voltage gain = $\frac{V1}{V2}$

PROCEDURE FOR MEASUREMENT OF TOTAL HARMONIC DISTORTION

a) Adjust signal generator for 15.5 V rms on V1
b) Adjust distortion analyzer. Record the meter reading as Total Harmonic Distortion (THD).

PROCEDURE FOR MEASUREMENT OF MAXIMUM VOLTAGE SWING AND MAXIMUM POWER

a) Adjust signal generator for maximum output on scope No. 1 with no clipping. Read peak voltage as maximum voltage swing.
b) Read V1
c) Maximum power = $\frac{V1^2}{4}$

PROCEDURE FOR MEASUREMENT OF SHORT-CIRCUIT CURRENT

a) Lower power supply to ± 26 V
b) Momentarily replace 4-ohm load with 0.5-ohm load
c) Scope No. 1 must show symmetrical square wave of less than ± 1.75 V

PROCEDURE FOR MEASUREMENT OF BANDWIDTH

a) Raise power supply to ± 37.5 V
b) Adjust signal generator at 43 kHz to 2 V rms on V1
c) Adjust distortion analyzer and verify that THD < 0.5%

PROCEDURE FOR MEASUREMENT OF SLEW RATE

a) Replace signal generator with square-wave generator.
b) Adjust generator for 500 Hz and V1 = 40 V peak-to-peak.
c) Read time required for swing from peak to peak.
d) Slew rate = $\frac{40\ V}{\text{Measured time}}$

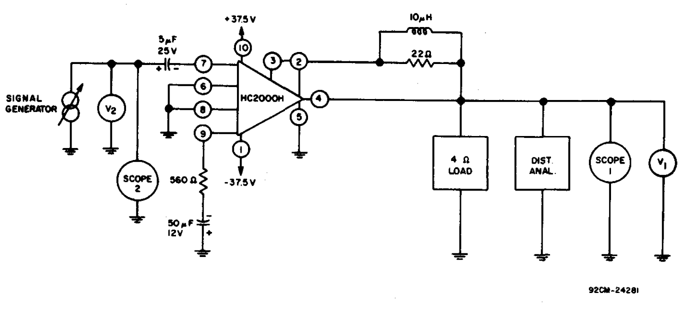


Fig. 15 — Circuit for measurement of closed-loop voltage gain, total harmonic distortion, maximum voltage swing, maximum power, short-circuit current, bandwidth, and slew-rate.

HC2500 POWER HYBRID OPERATIONAL AMPLIFIER TEST CIRCUITS

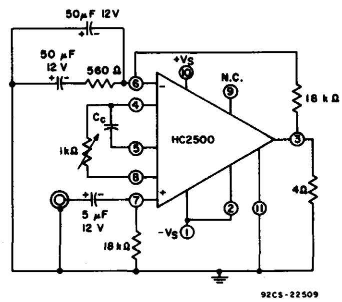


Fig.16 – Test circuit for open-loop gain and phase response.

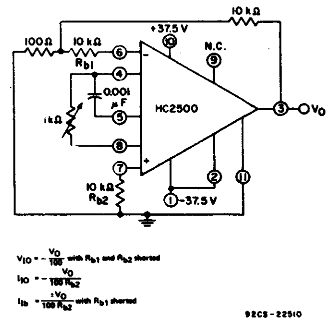


Fig.17 – Test circuit for input offset voltage and current test.

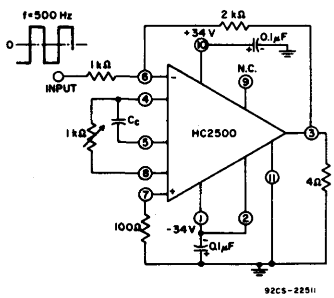


Fig.18 – Circuit used to test slew rate.

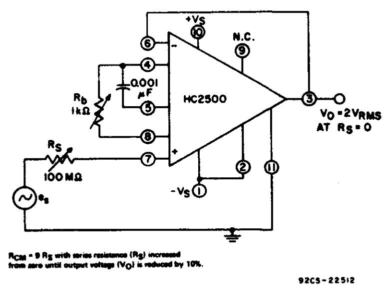


Fig.19 – Test circuit for measuring common-mode input resistance.

HC2500
TERMINAL CONNECTIONS

Pin No.		Connection
1		Drive 2
2	$-V_S$	Negative supply voltage
3	V_{OUT}	Output Voltage
4		Bias adjust
5		Frequency compensation
6	$-V_{IN}$	Inverting input
7	$+V_{IN}$	Noninverting input
8		Bias adjust
9		Drive 1
10	$+V_S$	Positive supply voltage
11	BP	Base plate (electrically isolated from internal circuitry)

THYRISTORS

Voltage-Current Characteristics

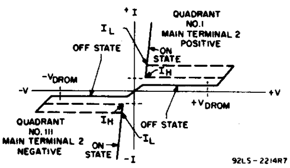


Fig.20 – Principal voltage-current characteristic for a triac.

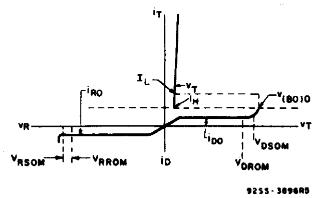


Fig.21 – Principal voltage-current characteristic for a conventional SCR.

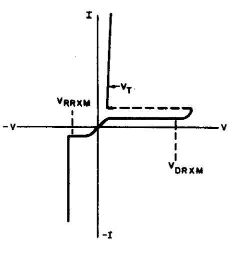


Fig.22 – Anode-cathode voltage-current characteristic for a gate-turn-off SCR (GTO).

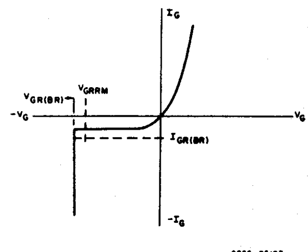


Fig. 23 - Gate-cathode voltage-current characteristic for a gate-turn-off SCR (GTO).

Critical Rate of Rise of On-State Current (di/dt)

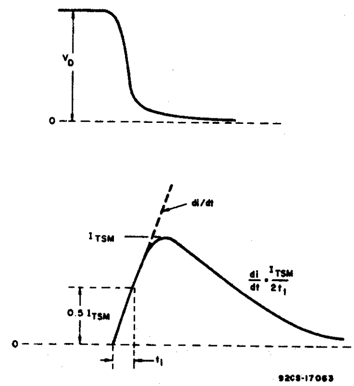


Fig.24 – Rate of change of on-state current with time (defining di/dt) for a triac.

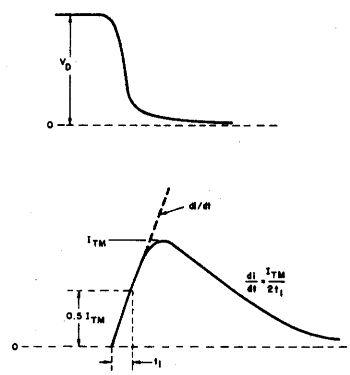


Fig.25 – Rate of change of on-state current with time (defining di/dt) for an SCR.

Critical Rate of Rise of Off-State Voltage (Static and Commutating dv/dt)

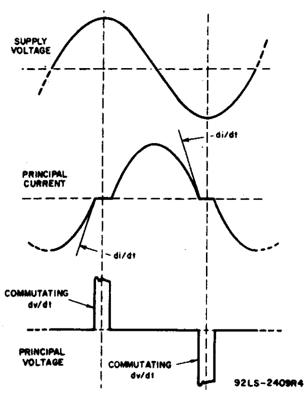


Fig.26 – Relationship between supply voltage and principal current (inductive load) showing reference points for definition of commutating voltage (dv/dt) for a triac.

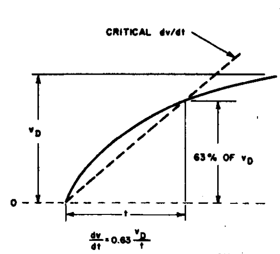


Fig.27 – Rate of rise of off-state voltage with time (defining critical dv/dt) for general-purpose SCR's, gate-turn-off SCR's, and triacs.

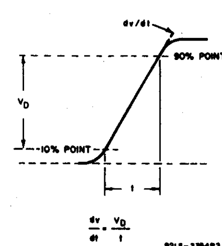


Fig.28 – Rate of rise of off-state voltage with time (defining dv/dt) for an inverter SCR.

THYRISTORS (Cont'd)

Subcycle Surge-Current Test for SCR's

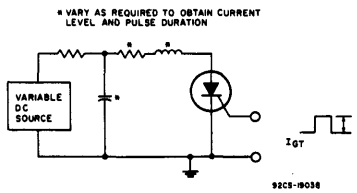


Fig.29 – Sub-cycle surge capability test circuit.

Turn-On-Time Waveforms

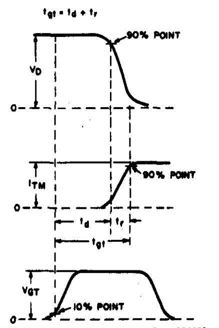


Fig.30 – Relationship between off-state voltage, on-state current, and gate-trigger voltage showing reference points for definition of turn-on time (t_{gt}) for triacs and SCR's.

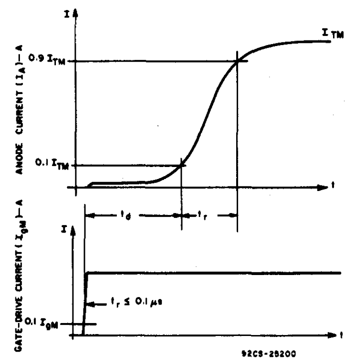


Fig.31 – Relationship between anode current (on-state), gate drive current, and time showing reference points for definition of gate controlled turn-on time (t_{gt}) for gate-turn-off SCR's.

Turn-Off-Time Test Circuits and Waveforms for SCR's

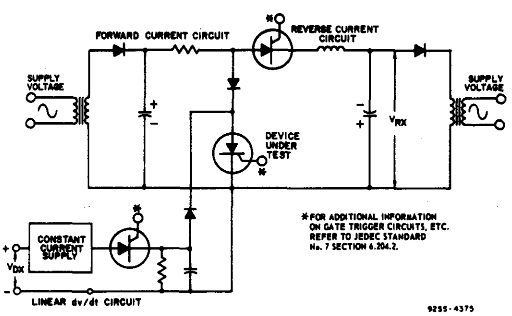


Fig. 32 - Circuit used to measure turn-off time (t_q) rectangular pulse.

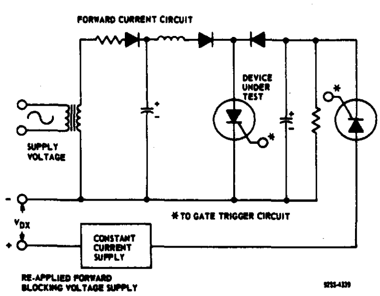


Fig.33 – Circuit used to measure turn-off time (t_q) half-sine wave pulse.

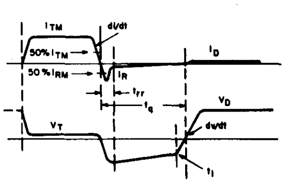


Fig.34 – Relationship between instantaneous on-state current and voltage showing reference points for definition of circuit commutated turn-off time (t_q) for general-purpose SCR's (rectangular pulse).

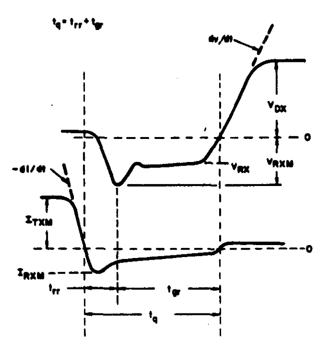


Fig.35 – Relationship between off-state voltage, reverse voltage, on-state current, and reverse current showing reference points defining turn-off time (t_q) for inverter SCR's (rectangular pulse).

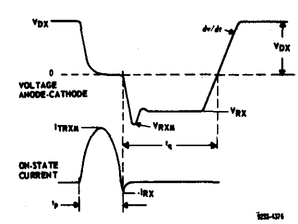


Fig.36 – Relationship between off-state voltage, reverse voltage, on-state current, and reverse current showing reference points for specification of turn-off time (t_q) for an inverter SCR (half-sine-wave pulse).

THYRISTORS (Cont'd)

Switching-Time Waveforms for Gate-Turn-Off SCR's

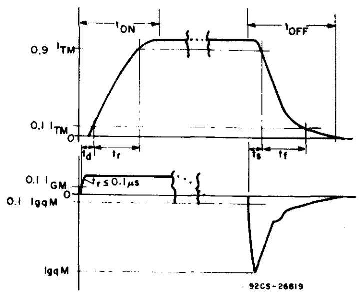


Fig.37 – Relationship between anode current (on-state), gate-drive current, and time showing reference points for definition of t_{gt} (t_{ON}) and t_{gq} (t_{OFF}).

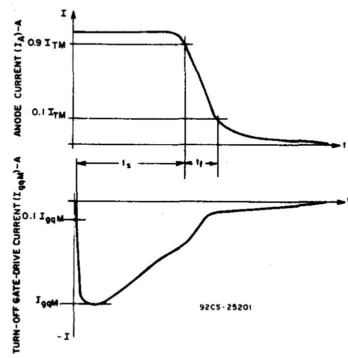
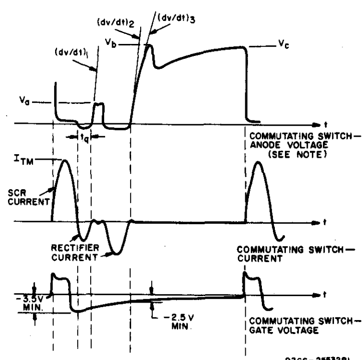


Fig.38 – Relationship between anode current (on-state), turn-off gate-drive current, and time showing reference points for definition of gate-controlled turn-off time (t_{gq}).

Switching Waveforms for Deflection-Circuit ITR's



NOTE: "Commutating Switch-Anode Voltage" oscilloscope display has been modified graphically to show the measurement points of dv/dt more effectively.

Fig.39 – Oscilloscope display of commutating switching ITR's showing circuit-commutated turn-off time (t_q).

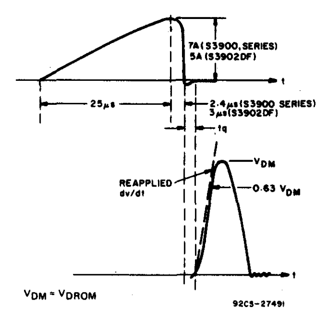


Fig.40 – Oscilloscope display of trace switching ITR's (S3900 Series, S3902DF) showing circuit-commutated turn-off time (t_q).

Notes for Figs. 39 and 40

Circuit-commutated turn-off time (t_q), the sum of reverse recovery time and gate recovery time, is measured from the zero crossing of current to the start of the reapplied voltage. Knowledge of the current, the reapplied voltage, and the case temperature is necessary when measuring t_q. In the worst conditions (high line, zero beam, off-frequency, minimum auxiliary load, etc), turn-off time must not fall below the given values. Turn-off time increases with temperature, therefore, case temperature must not exceed 75°C for all types.

THYRISTORS (Cont'd)

Reverse-Recovery-Time Measurements for Rectifier Unit of ITR

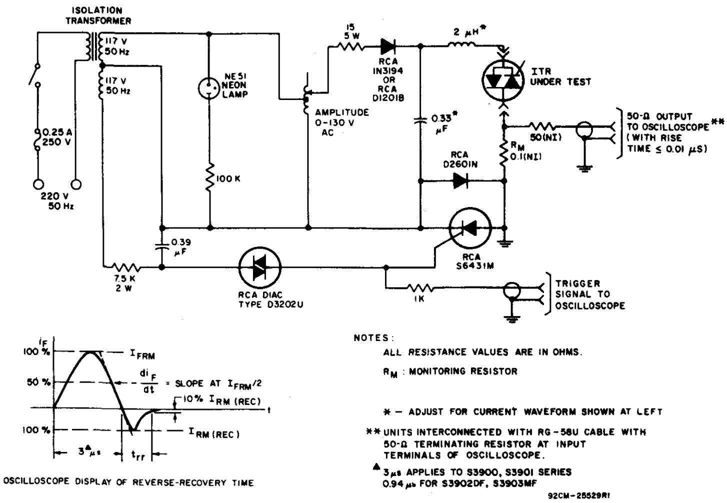


Fig.41 – Test circuit (pulsed sine wave) oscilloscope display for measurement of reverse-recovery time for rectifier unit of ITR.

Peak Forward-Voltage Measurements for Rectifier Unit of ITR

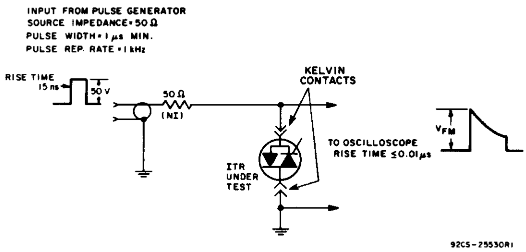


Fig.42 – Test circuit for measurement of peak forward voltage drop at turn-on for rectifier unit of ITR.

DIACS

Voltage-Current Characteristic

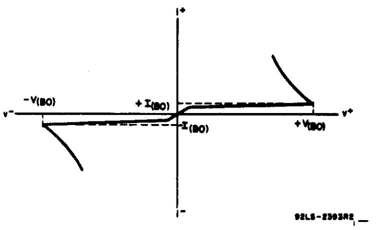


Fig.43 – Voltage-current characteristic for a diac.

Switching Measurements

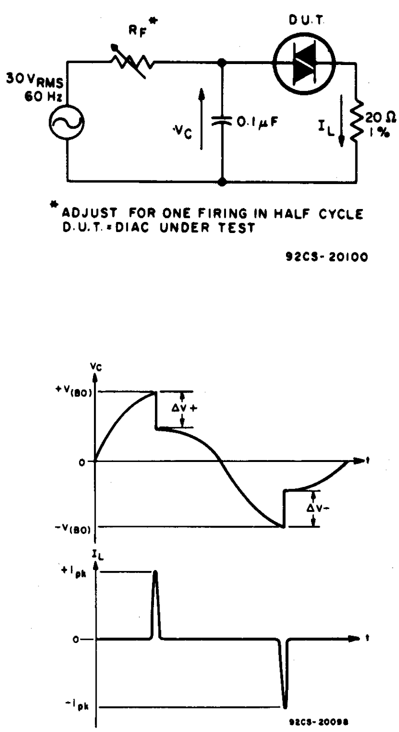


Fig.44 – Circuit and waveforms used to measure diac characteristics.

RECTIFIERS

Reverse-Recovery-Measurements

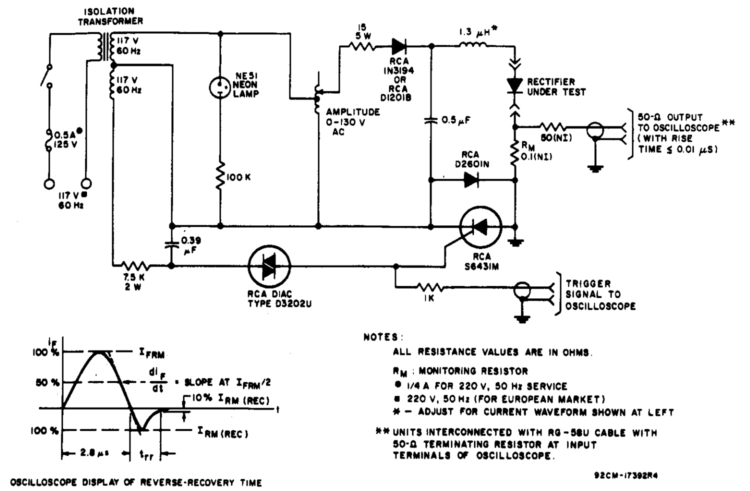


Fig.45 – Test circuit (pulsed sine wave) for measurement of reverse-recovery time.

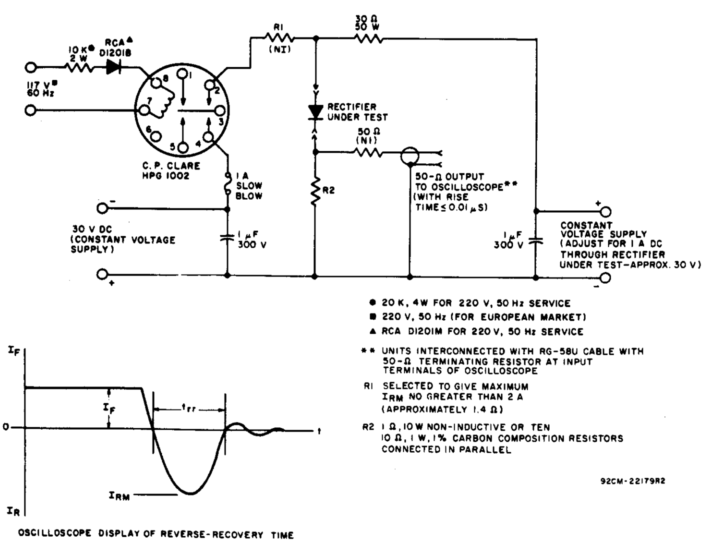
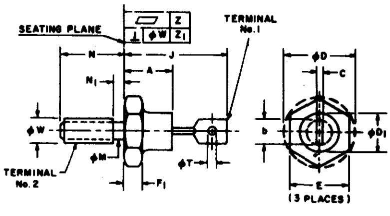


Fig.46 – Test circuit (pulsed dc) for measurement of reverse-recovery time.

Dimensional Outlines

DO-203MA/DO-4

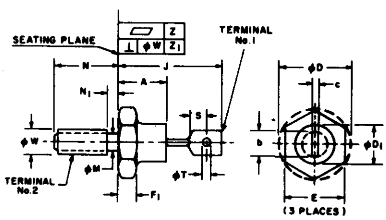


92CS-20472

SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTES
A	–	0.405	–	10.28	
b	–	0.250	–	6.35	2
c	0.020	0.065	0.51	1.65	
φD	–	0.505	–	12.82	
$φD_1$	0.265	0.424	6.74	10.76	
E	0.423	0.438	10.75	11.12	
F_1	0.075	0.175	1.91	4.44	1
J	0.600	0.800	15.24	20.32	
φM	0.163	0.189	4.15	4.80	
N	0.422	0.453	10.72	11.50	
N_1	–	0.078	–	1.98	
φT	0.060	0.095	1.53	2.41	
φW	10-32 UNF-2A		10-32 UNF-2A		3
Z	–	0.002	–	0.050	
Z_1	–	0.006	–	0.152	

NOTES:
1: Chamfer or undercut on one or both sides of hexagonal base is optional.
2: Angular orientation and contour of Terminal No. 1 is optional.
3: φW is pitch diameter of coated threads. REF: Screw Thread Standards for Federal Services, Handbook H 28 Part I. Recommended torque: 15 inch-pounds.

DO-203MB/DO-5

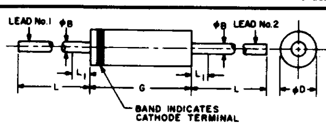


92CS-20473R1

SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTES
A	–	0.450	–	11.43	
b	–	0.375	–	9.52	
c	0.030	0.080	0.77	2.03	
φD	–	0.794	–	20.16	
$φD_1$	–	0.667	–	16.94	
E	0.669	0.688	17.00	17.47	
F_1	0.115	0.200	2.93	5.08	
J	0.750	1.000	19.05	25.40	
φM	0.220	0.249	5.59	6.32	
N	0.422	0.453	10.72	11.50	
N_1	–	0.090	–	2.28	
S	0.156	–	3.97	–	
φT	0.140	0.175	3.56	4.44	
φW	1/4-28 UNF 2A		1/4-28 UNF 2A		1
Z	–	0.002	–	0.050	
Z_1	–	0.006	–	0.152	

NOTE
1: φW is pitch diameter of coated threads. REF: Screw-Thread Standards for Federal Services, Handbook H 28 Part I. Recommended torque: 30 inch-pounds.

DO-204AC/DO-15

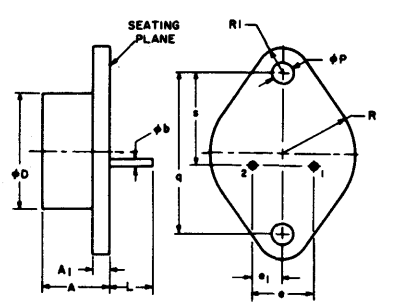


92CS-17313R1

SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.
φb	0.027	0.035	0.686	0.889
φD	0.104	0.140	2.64	3.56
G	0.230	0.300	5.84	7.62
L	1.000	–	25.40	–
L_1*	–	0.050	–	1.27

*Within this zone the diameter may vary to allow for lead finishes and irregularities.

TO-204MA/TO-3

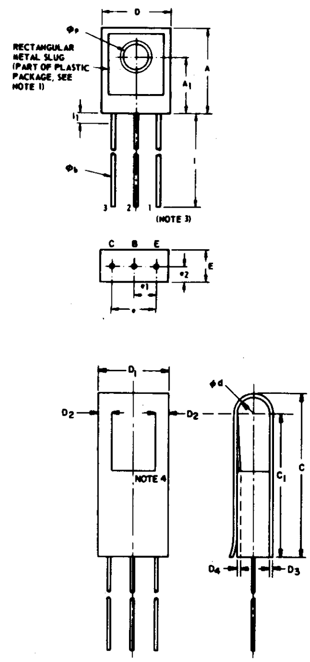


SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTES
A	0.250	0.450	6.4	11.4	
A_1	–	0.135	–	3.42	
φb	0.038	0.043	0.966	1.092	1
φD	–	0.875	–	22.22	
e	0.420	0.440	10.67	11.17	
e_1	0.205	0.225	5.21	5.71	
L	0.312	–	7.93	–	1
φP	0.151	0.161	3.84	4.08	2
q	1.177	1.197	29.90	30.40	
R	–	0.525	–	13.33	
R_1	–	0.188	–	4.77	3
S	0.655	0.675	16.64	17.14	

NOTES:
1. Two pins.
2. Two holes.
3. At both ends

92CS-15222R2

PLASTIC PACKAGES
PLASTIC TO-5 AND PLASTIC TO-5 WITH HEAT CLIP



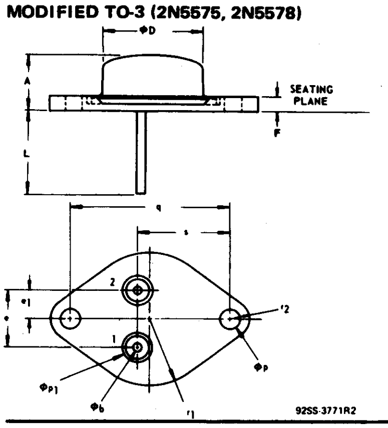
92CS-19280

SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTES
A	0.385	0.395	9.78	10.03	
A_1	0.251	0.261	6.37	6.63	
φb	0.016	0.019	0.41	0.48	2
C	0.858		21.79		
C_1	0.750		19.05		
D	0.305	0.315	7.75	8.00	
D_1	0.300		7.62		
D_2	0.070		1.77		
D_3	0.0320		0.813		
D_4	0.021	0.041	0.533	1.04	
φd	0.073	0.077	1.85	1.95	
E	0.145	0.155	3.68	3.94	
e	0.195	0.205	4.95	5.21	
e_1	0.095	0.105	2.41	2.67	
e_2	0.070	0.080	1.78	2.03	
ℓ	0.725	0.745	18.41	18.91	
ℓ_1	0.125	0.250	3.17	6.35	
φp	0.112	0.118	2.84	2.99	

NOTE 1: To attach to heat-sink, use a 4-40 binding-head screw and a No. 4 flat washer. The recommended screw torque (for even distribution of mounting pressure and optimum thermal contact) is 6 in.-lb.
NOTE 2: Three leads. Leads are pretinned to the ℓ_1 dimension.
NOTE 3: Lead numbering from right to left with rectangular metal slug facing observer.
NOTE 4: Tab to be sheared through and set inward as shown.

Dimensional Outlines

MODIFIED TO-3 (2N5575, 2N5578)

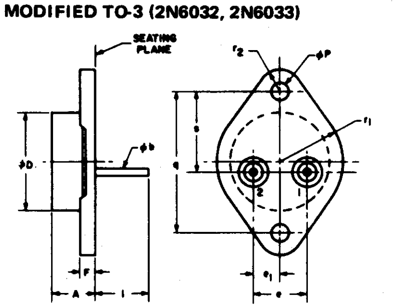


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.416	0.450	10.57	11.43	
ϕb	0.059	0.064	1.499	1.626	
ϕD	0.750	0.771	19.05	19.583	
e	0.420	0.440	10.67	11.18	
e_1	0.205	0.225	5.21	5.72	
F	0.100	0.114	2.54	2.89	
L	0.595	0.625	15.12	15.87	1
ϕp	0.151	0.161	3.84	4.09	
ϕp_1	0.200	0.285	5.08	7.239	2
q	1.177	1.197	29.90	30.40	
r_1	–	0.525	–	13.34	
r_2	–	0.188	–	4.78	
s	0.655	0.675	16.64	17.15	

NOTES:

1. Two pins.
2. Clearance holes for both pins should be 0.285 in. (7.24 mm) min. dia.

MODIFIED TO-3 (2N6032, 2N6033)



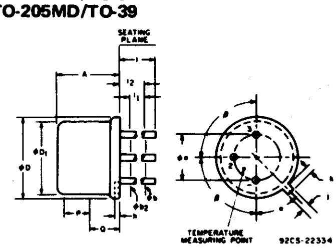
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.300	0.350	7.62	8.89	
ϕb	0.059	0.064	1.499	1.626	2
ϕD		0.800		20.32	
e	0.420	0.440	10.67	11.18	
e_1	0.205	0.225	5.21	5.72	
F		0.114		2.90	
l	0.440	0.470	11.18	11.94	2
ϕp	0.151	0.161	3.84	4.09	
q	1.177	1.197	29.90	30.40	
r_1		0.525		13.34	
r_2		0.188		4.78	
s	0.655	0.675	16.64	17.15	1

NOTES

1. THESE DIMENSIONS SHOULD BE MEASURED AT POINTS 0.050" (1.27 mm) TO 0.055" (1.40 mm) BELOW SEATING PLANE. WHEN GAGE IS NOT USED MEASUREMENT WILL BE MADE AT SEATING PLANE.
2. TWO LEADS

92CS-17432R1

TO-205MA/TO-5
TO-205MD/TO-39



Note 1: This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010 in. (0.254 mm).

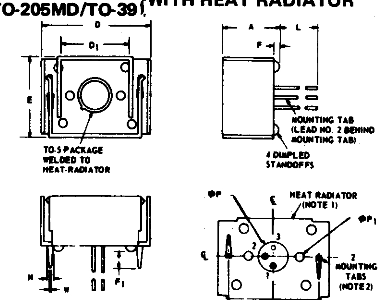
Note 2: (Three leads) ϕb_2 applies between l_1 and l_2. ϕb applies between l_2 and l. Diameter is uncontrolled in l_1.

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕa	0.190	0.210	4.83	5.33	
A	0.240	0.260	6.10	6.60	
ϕb	0.016	0.021	0.406	0.533	2
ϕb_2	0.016	0.019	0.406	0.483	2
ϕD	0.350	0.370	8.89	9.40	
ϕD_1	0.305	0.335	8.00	8.51	
h	0.009	0.041	0.229	1.04	
j	0.028	0.034	0.711	0.864	
k	0.029	0.040	0.737	1.02	3
L TO-5	1.500		38.10		2
L TO-39	0.500		12.70		2
l_1		0.050		1.27	2
l_2	0.250		6.35		2
P	0.100		2.54		1
Q					4
α	45° NOMINAL				
β	90° NOMINAL				

Note 3: Measured from maximum diameter of the actual device.

Note 4: Details of outline in this zone optional.

TO-205MA/TO-5 } WITH HEAT RADIATOR
TO-205MD/TO-39 }



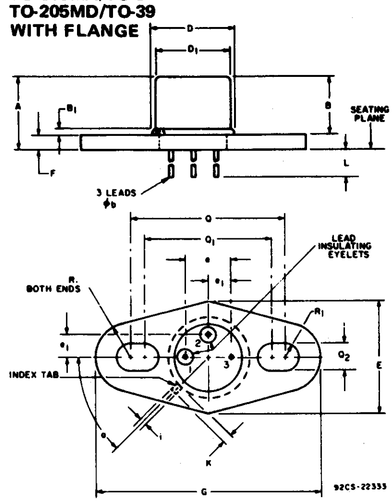
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.630	–	16.00	
D	1.205	1.235	30.61	31.37	
D_1	0.775	0.785	19.69	19.93	
E	0.875	0.905	22.22	22.99	
F	0.040	0.055	1.02	1.40	
F_1	0.160	0.195	4.06	4.95	
L long lead	1.410		35.81		
L short lead	0.410		10.41		
ϕP	0.295	0.305	7.493	7.747	
ϕP_1	0.093	0.095	2.362	2.413	
N	0.048	0.062	1.21	1.57	
N_1	0.998	1.002	25.349	25.450	3
W	0.048	0.052	1.219	1.320	

NOTES:

1. 0.035 C.R.S., finish—electroless nickel plate.
2. Recommended hole size for printed-circuit board is 0.070 in. (1.78 mm) dia.
3. Measured at bottom of heat-radiator.

92CS-22335

TO-205MA/TO-5
TO-205MD/TO-39
WITH FLANGE

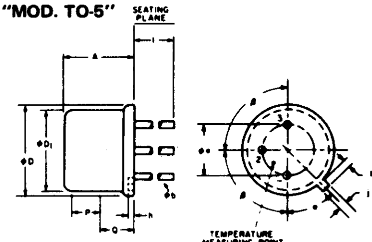


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.328	–	8.33	
B	0.240	0.260	6.10	6.60	
B_1	0.009	0.125	0.229	3.18	
ϕb	0.016	0.019	0.406	0.483	
D	0.335	0.370	8.51	9.40	
D_1	0.305	0.335	7.75	8.51	
E	0.495	0.505	12.57	12.83	
e	0.200 T.P.		5.08 T.P.		1
e_1	0.100 T.P.		2.54 T.P.		1
F	0.062	0.068	1.57	1.74	
G	0.995	1.005	25.27	25.53	
i	0.028	0.034	0.711	0.864	
k	0.029	0.045	0.737	1.14	
L long lead	1.430		36.32		
L short lead	0.430	–	10.92		
Q	0.685	0.691	17.40	17.55	
Q_1	0.559	0.565	14.20	14.35	
Q_2	0.128	0.132	3.25	3.35	
R	0.156 T.P.		3.96 T.P.		1
R_1	0.064	0.066	1.63	1.67	
α	45° T.P.				1, 2

NOTES:

1. True position. 2. Tab centerline.

"MOD. TO-5"

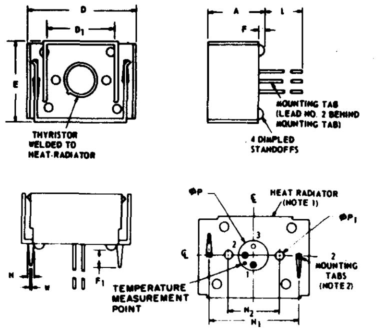


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕa	.190	.210	4.83	5.33	
A	.240	.260	6.10	6.60	
ϕb	.017	.021	.44	.53	
ϕ	.335	.366	8.51	9.30	
ϕD_1		.330	8.13	8.38	
h	.015	.035	.38	.89	
i	.028	.035	.71	.89	
k	.029	.045	.74	1.14	
l	.975	1.025	24.76	26.03	
P	.100	–	2.54	–	
Q	–	–	–	–	1
α	45° NOMINAL				
β	50° NOMINAL				

Note 1: Details of outline in this zone optional. 92LM-2048R2

Dimensional Outlines

"MOD. TO-5" WITH HEAT RADIATOR

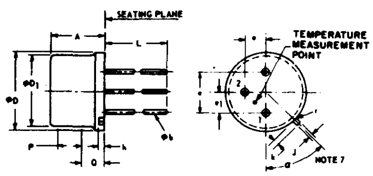


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	.630	–	16.00	
D	1.205	1.235	30.61	31.37	
D_1	.745	.755	18.923	19.177	
E	.875	.905	22.22	22.99	
F	.040	.055	1.02	1.40	
F_1	.170	.225	4.32	5.72	
L	.920	–	23.37	–	
ΦP	.295	.305	7.493	7.747	
$ΦP_1$	.093	.095	2.362	2.413	
N	.048	.062	1.21	1.57	
N_1	.998	1.002	25.349	25.450	3
N_2	.687	.689	17.45	17.50	3
W	.048	.052	1.219	1.320	

92LM-2109R1

NOTES:
1. 0.035 C.R.S., finish: electroless nickel plate
2. Recommended hole size for printed-circuit board is 0.070 in. (1.78 mm) dia.
3. Measured at bottom of heat radiator

"LOW-PROFILE TO-5"

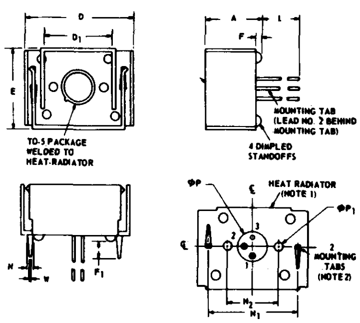


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.160	.180	4.06	4.57	
Φb	.017	.021	.432	.533	2
ΦD	.355	.366	9.017	9.296	
$ΦD_1$	.323	.335	8.204	8.51	
e	.190	.210	4.83	5.33	
e_1	.100 TRUE POSITION		2.54 TRUE POSITION		4,5
h	.015	.035	.381	.889	
j	.028	.035	.711	.889	5
k	.029	.045	.737	1.14	3,5
L	.985	1.015	25.02	25.78	2
P	.100		2.54		1
Q					6
r		.007		.179	
α	42°	48°			5,7

NOTES:
1. This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed .012 in. (.279 mm).
2. (Three Leads) ø b applies between seating plane and 1.015 in. (25.78 mm).
3. Measured from maximum diameter of the actual device.
4. Leads having maximum diameter .021 in. (.533 mm) measured at the seating plane of the device shall be within .007 in. (.178 mm) of their true positions relative to the maximum-width tab.
5. The device may be measured by direct methods or by the gage and gaging procedure described on gage drawing GS-1 of JEDEC publication 12E, May 1964.
6. Details of outline in this zone optional.
7. Tab centerline.

92SS-3901R1

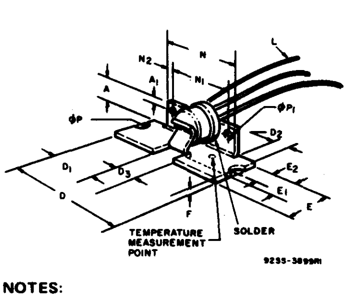
"LOW-PROFILE TO-5" WITH HEAT RADIATOR



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	.630	–	16.00	
D	1.205	1.235	30.61	31.37	
D_1	.745	.755	18.923	19.177	
E	.875	.905	22.22	22.99	
F	.040	.055	1.02	1.40	
F_1	.170	.225	4.32	5.72	
L	.885	–	22.48	–	
ΦP	.295	.305	7.493	7.747	
$ΦP_1$	.093	.095	2.362	2.413	
N	.048	.062	1.21	1.57	
N_1	.998	1.002	25.349	25.450	3
N_2	.687	.689	17.45	17.50	3
W	.048	.052	1.219	1.320	

NOTES:
1. 0.035 C.R.S., finish: electroless nickel plate
2. Recommended hole size for printed-circuit board is 0.070 in. (1.78 mm) dia.
3. Measured at bottom of heat-radiator

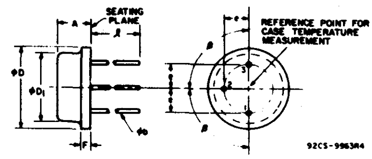
"LOW-PROFILE TO-5" WITH HEAT SPREADER



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.22		5.58		
A_1	0.75		19.05		
D	1.0		25.4		
D_1	0.406		10.31		
D_2	0.14	0.16	3.55	4.06	
D_3	0.188		4.77		
E	0.40		10.16		
E_1	0.32		8.12		
E_2	0.156		3.96		
F	0.02		0.05		
L	0.95	—	24.13	–	1
N	0.69	0.71	17.52	18.03	
N_1	0.55		13.97		
N_2	0.75		19.05		
øP	0.072 Rad.		1.83 Rad.		
$øP_1$	0.094 Dia.		2.39 Dia.		2

NOTES:
1. Min. length, 3 leads.
2. Two holes.

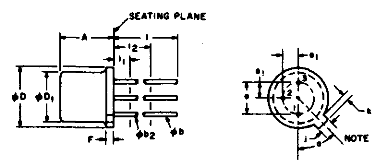
TO-8



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.270	0.330	6.86	8.38	–
øb	0.027	0.033	0.686	0.838	1
øD	0.550	0.650	13.97	16.51	–
$øD_1$	0.444	0.524	11.28	13.31	–
e	0.136	0.146	3.45	3.71	–
F	–	0.115	–	2.92	–
ℓ	0.360	0.440	9.14	11.18	1
β	90 NOMINAL				

NOTE:
1. Three leads.

TO-206MA/TO-18

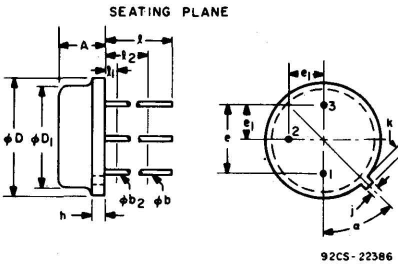


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.170	0.210	4.32	5.33	
øb	0.016	0.021	0.406	0.533	1
$øb_2$	0.016	0.019	0.406	0.483	1
øD	0.209	0.230	5.31	5.84	
$øD_1$	0.178	0.195	4.52	4.95	
e	0.100 T.P.		2.54 T.P.		2, 4
e_1	0.050 T.P.		1.27 T.P.		2, 4
F		0.030		0.762	
j	0.036	0.046	0.914	1.17	4
k	0.028	0.048	0.711	1.22	3
l	0.500		12.70		1
l_1		0.050		1.27	1
l_2	0.250		6.35		1
α	45° T.P.				5

NOTES:
1. (Three leads) $øb_2$ applies between l_1 and l_2. øb applies between l_2 and 0.5 in. (12.70 mm) from seating plane. Diameter is uncontrolled in l_1 and beyond 0.5 in. (12.70 mm) from seating plane.
2. Leads having maximum diameter 0.019 in. (0.483 mm) measured in gaging plane 0.054 in. (1.37 mm) + 0.001 in. (0.025 mm) – 0.00 in. (0.00 mm) below the seating plane of the device shall be within 0.007 in. (0.178 mm) of their true positions relative to a maximum-width tab.
3. Measured from maximum diameter of the actual device.
4. The device may be measured by direct methods or by the gage and gaging procedure described on gage drawing GS-2.
5. Tab centerline.

Dimensional Outlines

TO-206MB/TO-46

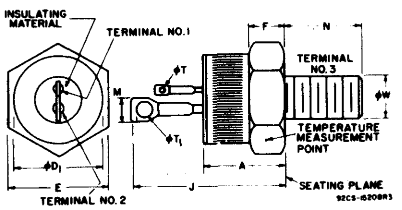


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.065	0.085	1.65	2.16	
φb	0.016	0.021	0.406	0.533	1
φb2	0.012	0.019	0.305	0.483	1
φD	0.209	0.230	5.31	5.84	
φD1	0.178	0.195	4.52	4.95	
e	0.100 T.P.		2.54 T.P.		2
e1	0.050 T.P.		1.27 T.P.		2
h		0.040		1.02	
j	0.036	0.046	0.914	1.17	
k	0.028	0.048	0.711	1.22	4
ℓ	0.500		12.70		1
ℓ1		0.050		1.27	1
ℓ2	0.250		6.35		1
α	45° T.P.		45° T.P.		3, 5

NOTES:

1. (THREE LEADS) φb2 APPLIES BETWEEN ℓ1 AND ℓ2. φb APPLIES BETWEEN ℓ2 AND 0.5 IN. (12.70 MM) FROM SEATING PLANE. DIAMETER IS UNCONTROLLED IN ℓ1 AND BEYOND 0.5 IN. (12.70 MM) FROM SEATING PLANE.
2. MAXIMUM DIAMETER LEADS AT A GAGING PLANE 0.054 IN. (1.37 MM) + 0.001 IN. (0.025 MM) - 0.000 IN. (0.000 MM) BELOW SEATING PLANE TO BE WITHIN 0.007 IN. (0.178 MM) OF THEIR POSITION RELATIVE TO MAXIMUM-WIDTH TAB AND TO THE MAXIMUM 0.230 IN. (5.84 MM) DIAMETER MEASURED WITH A SUITABLE GAGE. WHEN GAGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.
3. INDEX TAB FOR VISUAL ORIENTATION ONLY.
4. MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.
5. TAB CENTERLINE.

TO-208MA/TO-48

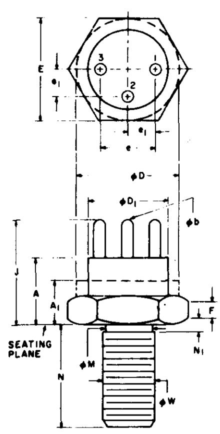


NOTE
1. φW is pitch diameter of coated threads.

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	8.4	12.8	–
φD1	–	0.544	–	13.81	–
E	0.544	0.562	13.82	14.28	–
F	0.113	0.200	2.87	5.08	–
J	0.950	1.100	24.13	27.94	–
M	0.215	0.225	5.46	5.71	–
N	0.422	0.453	10.72	11.50	–
φT	0.060	0.068	1.47	1.73	–
φT1	0.138	0.148	3.51	3.75	–
φW	1/4-28 UNF-2A		1/4-28 UNF-2A		1

REF: Screw-Thread Standards for Federal Services, Handbook H28, Part I. Recommended Torque: 25 inch-pounds.

TO-212MA/TO-60



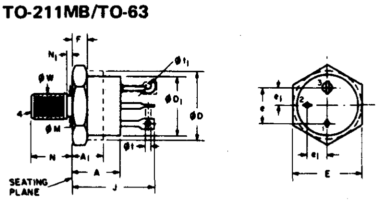
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.215	0.320	5.46	8.13	
A1	–	0.165	–	4.19	2
φb	0.030	0.046	0.762	1.17	4
φD	0.360	0.437	9.14	11.10	2
φD1	0.320	0.360	8.13	9.14	
E	0.424	0.437	10.77	11.10	
e	0.185	0.215	4.70	5.46	
e1	0.090	0.110	2.29	2.79	
F	0.090	0.135	2.29	3.43	1
J	0.355	0.480	9.02	12.19	
φM	0.163	0.189	4.14	4.80	
N	0.375	0.455	9.53	11.56	
N1	–	0.078	–	1.98	
φW	0.1658	0.1697	4.212	4.310	3, 5

MILLIMETER DIMENSIONS ARE DERIVED FROM ORIGINAL INCH DIMENSIONS

NOTES:

1. Dimension does not include sealing flanges
2. Package contour optional within dimensions specified
3. Pitch diameter – 10-32 UNF 2A thread (coated)
4. Pin spacing perimts insertion in any socket having a pin-circle diameter of 0.200 in. (5.08 mm) and contacts which will accommodate pins with a diameter of 0.030 in. (0.762 mm) min., 0.046 in. (1.17mm) max.
5. The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.

TO-211MB/TO-63



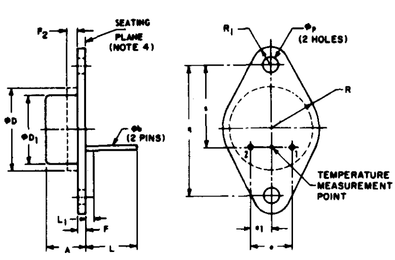
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.480	0.535	12.19	13.59	
A1	–	0.300	–	7.62	2
φD	0.775	0.875	19.69	22.23	2
φD1	0.745	0.775	18.92	19.69	
E	0.855	0.875	21.72	22.23	
e	0.485	0.515	12.32	13.08	5
e1	0.240	0.260	6.10	6.60	5
F	0.090	0.167	2.29	4.24	1
J	0.937	1.030	23.80	26.16	
φM	0.278	0.312	7.06	7.92	
N	0.460	0.495	11.68	12.57	
N1	–	0.105	–	2.67	
φt	0.060	0.105	1.52	2.67	
φt1	0.060	0.105	1.52	2.67	4
φW	0.2806	0.2854	7.127	7.249	3

NOTES:

92CS-20225

1. DIMENSION DOES NOT INCLUDE SEALING FLANGES.
2. PACKAGE CONTOUR OPTIONAL WITHIN DIMENSIONS SPECIFIED.
3. PITCH DIAMETER - THREAD 5/16-24 UNF-2A (COATED). REFERENCE (SCREW THREAD STANDARDS FOR FEDERAL SERVICES - HANDBOOK H-28).
4. THIS TERMINAL CAN BE FLATTENED AND PIERCED OR HOOK TYPE.
5. POSITION OF LEADS IN RELATION TO THE HEXAGON IS NOT CONTROLLED.

TO-213MA/TO-66



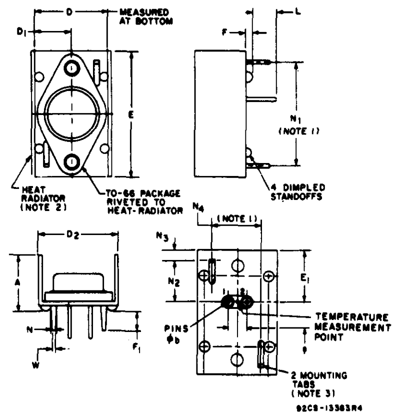
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.340	6.35	8.64	
φb	0.028	0.034	0.711	0.863	
φD	–	0.620	–	15.75	1
φD1	0.470	0.500	11.94	12.70	
e	0.190	0.210	4.83	5.33	2
e1	0.093	0.107	2.36	2.72	2
F1	0.050	0.075	1.27	1.91	
F2	–	0.050	–	1.27	1
L	0.360	–	9.14	–	
L1	–	0.050	–	1.27	3
φp	0.142	0.152	3.61	3.86	
q	0.958	0.962	24.33	24.43	
R	–	0.350	–	8.89	
R1	–	0.145	–	3.68	
s	0.570	0.590	14.48	14.99	

NOTES:

1. Body contour is optional within zone defined by φD and F_2.
2. These dimensions should be measured at points 0.050 in. (1.27 mm) to 0.055 in. (1.40 mm) below seating plane. When gage is not used, measurement will be made at seating plane.
3. φb applies between L_1 and L. Diameter is uncontrolled in L_1.
4. The seating plane of header shall be flat within 0.001 in. (0.025 mm) concave to 0.004 in. (0.10 mm) convex inside a 0.520 in. (13.21 mm) diameter circle on the center of the header and flat within 0.001 in (0.025 mm) concave to 0.006 in. (0.15 mm) convex overall.

Dimensional Outlines

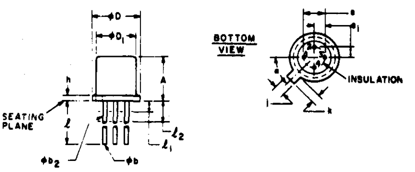
TO-66 WITH HEAT RADIATOR



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.620	–	15.75	
ϕb	0.028	0.034	0.711	0.864	
D	0.750	0.760	19.05	19.30	
D_1	0.370	0.385	9.40	9.78	
D_2	0.820	0.920	20.83	23.37	
E	1.297	1.327	32.94	33.70	
E_1	0.546	0.566	13.87	14.37	
e	0.190	0.210	4.83	5.33	
F	0.30	0.55	7.62	13.97	
F_1	0.175	0.210	4.44	5.33	
L	0.270	–	6.86	–	
N	0.052	0.065	1.32	1.65	
N_1	1.098	1.102	27.89	27.99	
N_2	0.448	0.452	11.38	11.47	
N_3	0.009	0.113	0.25	0.29	
N_4	0.498	0.502	12.65	12.75	
W	0.048	0.060	1.22	1.52	

NOTES:
1. Measured at bottom of heat radiator.
2. 0.035 in. (0.889) C.R.S., tin plated.
3. Recommended hole size for printed-circuit board is 0.070 in. (1.778) dia.

TO-206MD/TO-72



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0 170	0 210	4 32	5 33	
ϕb	0 016	0 021	0 406	0 533	2
$ϕb_2$	0 016	0 019	0 406	0 483	2
ϕD	0 209	0 230	5 31	5 84	
$ϕD_1$	0 178	0 195	4 52	4 95	
e	0 100 T P		2 54 T P		4
e1	0 050 T P		1 27 T P		4
h		0 030		0 762	
j	0 036	0 046	0 914	1 17	
k	0 028	0 048	0 711	1 22	3
l	0 500		12 70		2
l_1		0 050		1 27	2
l_2	0 250		6 35		2
α	45 T P		45 T P		4, 6

92CS-17444R1

Note 1: (Four leads). Maximum number leaus omitted in this outline, "none" (0). The number and position of leads actually present are indicated in the product registration. Outline designation determined by the location and minimum angular or linear spacing of any two adjacent leads.

Note 2: (All leads) $ϕb_2$ applies between l_1 and l_2. ϕb applies between l_2 and 0.50 in. (12.70 mm) from seating plane. Diameter is uncontrolled in l_1 and beyond 0.50 in. (12.70 mm) from seating plane.

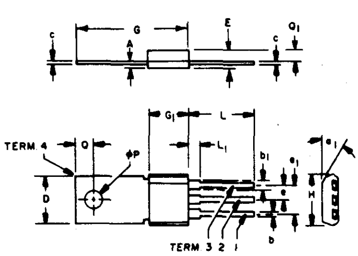
Note 3: Measured from maximum diameter of the product.

Note 4: Leads having maximum diameter 0.019 in. (0.484 mm) measured in gaging plane 0.054 in. (1.37 mm) +0.001 in. (0.025 mm) – 0.000 (0.000 mm) below the seating plane of the product shall be within 0.007 in. (0.178 mm) of their true position relative to a maximum width tab.

Note 5: The product may be measured by direct methods or by gage.

Note 6: Tab centerline.

TO-202AB VERSATAB



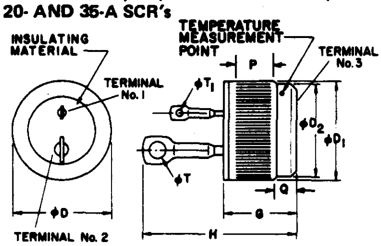
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.05	–	1.270	1
b	0.023	0.029	0.584	0.736	
b_1	0.045	0.055	1.143	1.397	1
c	0.018	0.026	0.457	0.660	
D	0.305	0.325	7.747	8.255	
E	0.130	0.150	3.302	3.810	
e	0.095	0.105	2.413	2.667	
e_1	0.190	0.210	4.826	5.334	
F	–	0.08	–	2.032	1
G	0.760	0.840	19.31	21.33	
G_1	0.230	0.250	5.842	6.350	
H	0.330	0.370	8.382	9.398	
L	0.400	0.450	10.16	11.43	
L_1	0.050	0.100	1.27	2.54	1,2
ϕP	0.123	0.127	3.124	3.225	
Q	0.120	0.130	3.048	3.302	
Q_1	0.039	0.050	0.990	1.270	
$α_1$	–	50°	–	50°	1

TEMPERATURE MEASUREMENT: 92CS-24062R2

1/16 in. (1.58 mm) from plastic encapsulment on either mounting flange (terminal No. 4) or anode lead (terminal No. 2).

NOTES:
1. Package contour optional within dimensions specified.
2. Lead dimensions uncontrolled in this zone.
3. Chamfer on tab optional.
4. Controlling dimensions: *inch*.

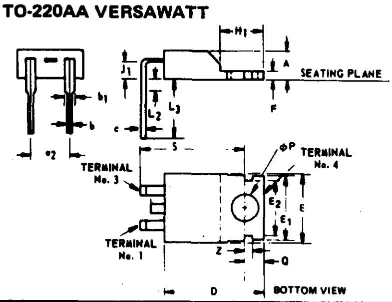
TO-203AA
PRESS-FIT 6-, 10-, AND 15-A TRIACS; 20- AND 35-A SCR's



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕD	–	0.510	–	12.95	1
$ϕD_1$	0.501	0.505	12.726	12.827	2
$ϕD_2$	0.465	0.475	11.82	12.06	
G	0.330	0.380	8.39	9.65	
H	–	0.800	–	20.32	
P	0.100	–	2.54	–	2
Q	0.080	0.097	–	–	
ϕT	0.065	0.090	1.66	2.28	3,4
$ϕT_1$	0.035	0.068	0.89	1.72	

NOTES:
1. Outline contour is optional within zone defined by ϕD and G min. and H max.
2. Straight knurl surface.
3. Elongated hole in terminal is optional.
4. Contour and orientation of terminal 1 and terminal 2 are not defined.
5. Terminal 1 to be shorter than terminal 2 for identification. 92CS-23134R1

TO-220AA VERSAWATT

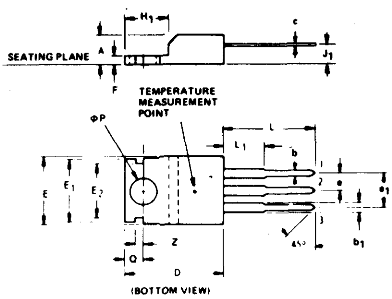


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	–
b	0.020	0.045	0.51	1.14	–
b_1	0.045	0.070	1.14	1.77	–
c	0.015	0.025	0.38	0.63	–
D	0.560	0.625	14.23	15.87	–
E	0.380	0.420	9.66	10.66	1
E_1	0.365	0.385	9.28	9.77	–
E_2	0.300	0.320	7.62	8.12	–
e_2	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	–
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	–
L_2	–	0.050	–	1.27	–
L_3	0.360	0.422	9.15	10.71	–
ϕP	0.139	0.147	3.531	3.733	–
Q	0.100	0.120	2.54	3.04	–
S	0.580	0.610	14.74	15.49	–
Z	0.040	0.060	1.02	1.52	–

NOTES: 92CS-17990R2
1. Tab contour optional within H_1 and E.
2. Position of lead to be measured 0.050 – 0.055 in. (1.270 – 1.397 mm) below seating plane.

Dimensional Outlines

TO-220AB VERSAWATT

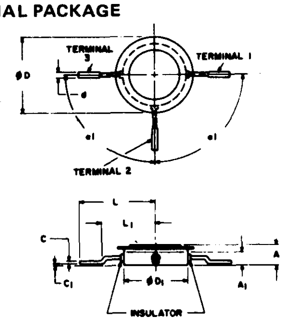


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	–
b	0.020	0.045	0.51	1.14	–
b_1	0.045	0.070	1.14	1.77	–
c	0.015	0.025	0.38	0.63	–
D	0.560	0.625	14.23	15.87	–
E	0.380	0.420	9.66	10.66	1
E_1	0.365	0.385	9.28	9.77	–
E_2	0.300	0.320	7.62	8.12	–
e	0.090	0.110	2.29	2.79	2
e_1	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	–
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	–
L	0.500	0.562	12.70	14.27	–
L_1	–	0.250	–	6.35	–
ϕP	0.139	0.147	3.531	3.733	–
Q	0.100	0.120	2.54	3.04	–
Z	0.040	0.060	1.02	1.52	–

92SS-17991R2

NOTES:
1. Tab contour optional within H_1 and E.
2. Position of lead to be measured 0.250 – 0.255 in. (6.350 – 6.477 mm) from case.

RADIAL PACKAGE

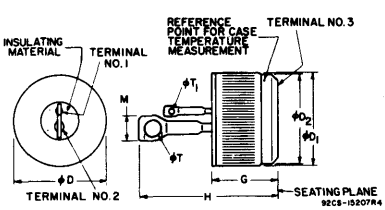


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.200	–	5.08	
A_1	–	0.125	–	3.17	1
c	0.015	0.019	0.38	0.48	
c_1	–	0.015	–	0.38	
ϕD	–	0.710	–	18.03	
ϕD_1	0.615	0.690	15.62	17.52	1
d	0.042	0.046	1.06	1.16	
L	–	0.705	–	17.90	
L_1	–	0.510	–	12.95	
e_1	90° ± 2°		90° ± 2°		

92CS-20224

NOTE:
1. CONTROLLED AREA OF THE DIAMETER DOES NOT INCLUDE THE BRAZED AREA AROUND THE CERAMIC AND TERMINAL 2

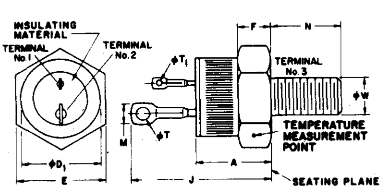
PRESS-FIT 25-, 30-, AND 40-A TRIACS



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
G	–	0.380	–	9.65	–
ϕD	0.501	0.510	12.73	12.95	–
ϕD_1	–	0.505	–	12.83	1
ϕD_2	0.465	0.475	11.81	12.07	–
H	0.825	1.000	20.95	25.40	–
M	0.215	0.225	5.46	5.71	–
ϕT_1	0.058	0.068	1.47	1.73	–
ϕT	0.138	0.148	3.51	3.75	–

NOTE:
1. Outer diameter of knurled surface.

STUD 6-, 10-, AND 15-A TRIACS; 20- AND 35-A SCR's

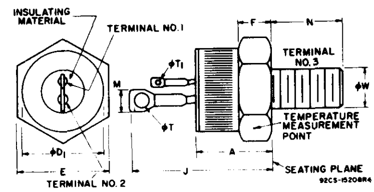


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	8.40	12.80	
ϕD_1	–	0.544	–	13.81	
E	0.544	0.562	13.82	14.28	
F	0.113	0.200	2.87	5.08	
J	–	0.950	–	24.13	
M	–	0.155	–	3.94	
N	0.422	0.453	10.72	11.50	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.080	0.090	2.03	2.29	
ϕW	1/4-28 UNF-2A		1/4-28 UNF-2A		1

NOTE. 1.
ϕW is pitch diameter of coated threads.
REF: Screw-Thread Standards for Federal Services, Handbook H28,
Part I. Recommended Torque: 35 in-lbf (0.4 kg f-m)
Maximum Torque: 50 in-lb (0.57 kg f-m)

92CS-23135

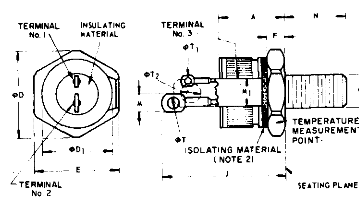
STUD 25-, 30-, AND 40-A TRIACS



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	8.4	12.8	–
ϕD_1	–	0.544	–	13.81	–
E	0.544	0.562	13.82	14.28	–
F	0.113	0.200	2.87	5.08	–
J	0.950	1.100	24.13	27.94	–
M	0.215	0.225	5.46	5.71	–
N	0.422	0.453	10.72	11.50	–
ϕT_1	0.058	0.068	1.47	1.73	–
ϕT	0.138	0.148	3.50	3.75	–
ϕW	1/4-28 UNF-2A		1/4-28 UNF-2A		1

NOTE
1. ϕW is pitch diameter of coated threads.
REF: Screw-Thread Standards for Federal Services, Handbook H28, Part I. Recommended Torque: 35 in-lbf (0.4 kg f-m).
Maximum Torque: 50 in-lbf (0.57 kg f-m)

ISOLATED-STUD 6-, 10-, AND 15-A TRIACS; 20- AND 35-A SCR's



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.673	–	17.09	
ϕD	0.604	0.614	15.34	15.59	
ϕD_1	0.501	0.505	12.72	12.82	
E	0.551	0.557	13.99	14.14	
F	0.100	0.185	2.50	4.69	
J	–	1.055	–	26.79	
M	–	0.155	–	3.94	
M_1	0.200	0.210	5.08	5.33	
N	0.422	0.452	10.72	11.48	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.080	0.090	2.03	2.29	
ϕT_2	0.138	0.148	3.50	3.75	
ϕW	1/4-28 UNF-2A		1/4-28 UNF-2A		1

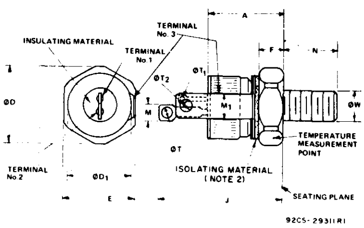
NOTES:
1. ϕW is pitch diameter of coated threads.
REF: Screw-Thread Standards for Federal Services, Handbook H28,
Part I. Recommended Torque: 35 in-lbf (0.4 kg f-m)
Maximum Torque: 50 in-lb (0.57 kg f-m)
2. Isolating material (ceramic) between hex (stud) and terminal No. 3 is beryllium oxide. Minimum isolation breakdown voltage is 2100 V rms for 1 minute duration.

92CS-23133R2

WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

Dimensional Outlines

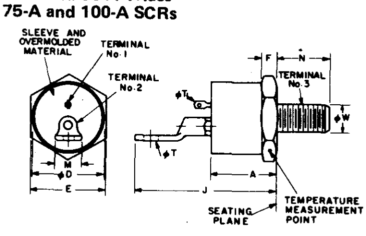
ISOLATED-STUD
25-, 30-, and 40-A Triacs



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	–	0.673	–	17.09	–
φD	0.604	0.614	15.34	15.59	–
φD1	0.501	0.505	12.72	12.82	–
E	0.551	0.557	13.99	14.14	–
F	0.100	0.185	2.50	4.69	–
J	–	1.298	–	32.96	–
M	0.210	0.230	5.33	5.84	–
M1	0.200	0.210	5.08	5.33	–
N	0.422	0.452	10.72	11.48	–
φT1	0.058	0.068	1.47	1.73	–
φT	0.138	0.148	3.50	3.75	–
φT2	0.138	0.148	3.50	3.75	–
φW	¼-28 UNF-2 A		¼-28 UNF-2 A		1

NOTES:
1. φW is pitch diameter of coated threads.
   REF: Screw-Thread Standards for Federal Services, Handbook H28,
   Part I. Recommended Torque: 35 in-lbf (0.4 kg f-m)
   Maximum Torque: 50 in-lb (0.57 kg f-m)
2. Isolating material (ceramic) between hex (stud) and terminal No. 3 is beryllium oxide. Minimum isolation breakdown voltage is 2100 V rms for 1 minute duration.

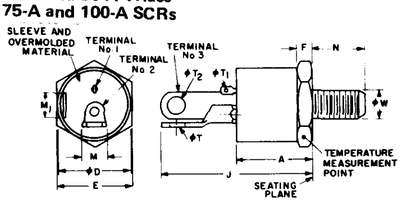
OVERMOLD STUD
60-A and 80-A Triacs
75-A and 100-A SCRs



SYMBOL	INCHES		MILLIMETERS		NOTE
	MIN.	MAX.	MIN.	MAX.	
A	0.7	0.8	17.78	20.32	
φD	0.9	1.1	22.86	27.94	
E	1.050	1.060	26.67	26.92	
F	0.175	0.192	4.44	4.88	
J	–	1.75	–	44.45	
M	0.37	0.39	9.40	9.91	
N	0.73	0.77	18.54	19.56	
φT1	0.060	0.065	1.52	1.65	
φT	0.19	0.21	4.83	5.33	
φW	½–20	NF–2A	½–20	NF–2A	1

1. φW is pitch diameter of coated threads. REF: Screw-Thread Standards for Federal Services, Handbook H28, Part I. Recommended torque: 125 in-lb (1.44 kgf-m). Maximum torque: 150 in-lb (1.73 kgf-m).

OVERMOLD ISOLATED-STUD
60-A and 80-A Triacs
75-A and 100-A SCRs

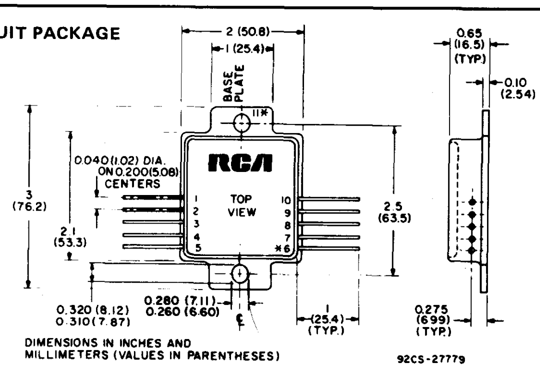


1. φW is pitch diameter of coated threads. REF: Screw-Thread Standards for Federal Services, Handbook H28, Part I. Recommended torque: 125 in-lb (1.44 kgf-m). Maximum torque: 150 in-lb (1.73 kgf-m).

SYMBOL	INCHES		MILLIMETERS		NOTE
	MIN.	MAX.	MIN.	MAX.	
A	0.8	1.0	20.32	25.4	
φD	0.9	1.1	22.86	27.94	
E	1.050	1.060	26.67	26.92	
F	0.175	0.192	4.44	4.88	
J	–	1.9	–	48.26	
M	0.37	0.39	9.40	9.91	
M1	0.37	0.39	9.40	9.91	
N	0.73	0.77	18.54	19.56	
φT1	0.060	0.065	1.52	1.65	
φT	0.19	0.21	4.83	5.33	
φT2	0.19	0.21	4.83	5.33	
φW	½–20	NF–2A	½–20	NF–2A	1

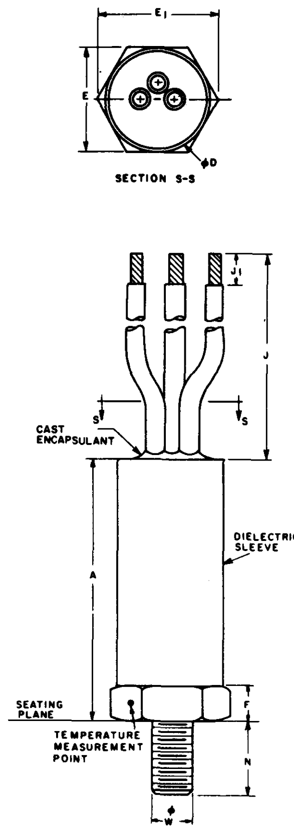
2. Isolating material (ceramic) between hex (stud) and terminal No. 3 is beryllium oxide.

HYBRID-CIRCUIT PACKAGE



*For HC2000H, Terminal 11 is internally connected to Terminal 6.
For HC2500, Terminal 11 is electrically isolated from internal circuitry.

PRESS-FIT WITH FLEXIBLE LEADS, ENCAPSULATED ON ISOLATED-STUD



Symbol	INCHES		MILLIMETERS		Note
	Min.	Max.	Min.	Max.	
A	1.498	1.622	38.05	41.20	
φD	0.619	0.629	15.72	15.98	
E	0.677	0.683	17.20	17.35	
E1	0.745	0.755	18.92	19.17	
F	0.117	0.123	2.97	3.12	
J	–	6.500	–	165.10	
J1	0.125	0.500	3.17	12.70	
N	0.430	0.450	10.92	11.43	
φW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

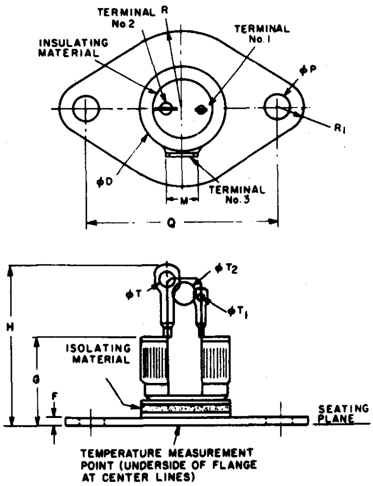
Note 1: φW is pitch diameter of coated threads.
Ref.: Screw-Thread Standard for Federal Services Handbook H28, Part I.
Recommended torque: 35 in.-lbf (0.4 kgf m).

92CM-26375

WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

Dimensional Outlines

PRESS-FIT, ISOLATED ON TO-3 FLANGE FOR SCR's AND TRIACS FOR 25-A, 30-A, AND 40-A TRIACS; SEE NOTES 1 AND 2

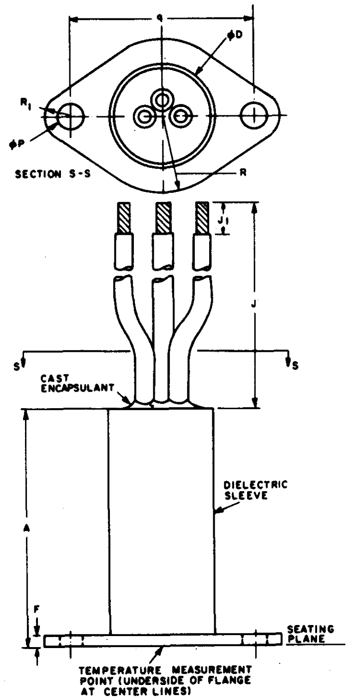


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
G	–	0.635	–	16.13	
ϕD	–	0.510	–	12.95	
F	0.060	0.065	1.52	1.65	
H	–	1.015	–	25.78	
M	0.200	0.210	5.08	5.33	
Q	1.184	1.190	30.07	30.22	
ϕP	0.152	0.159	3.86	4.04	
R	0.497	0.503	12.62	12.77	
R_1	0.169	0.176	4.29	4.47	
ϕT	0.065	0.090	1.66	2.28	1
$ϕT_1$	0.035	0.068	0.89	1.72	2
$ϕT_2$	0.138	0.148	3.50	3.76	

NOTES:

1. For 25-A, 30-A, and 40-A triacs, ϕT = 0.138–0.148 in. (3.50–3.75 mm)
2. For 25-A, 30-A, and 40-A triacs, $ϕT_1$ = 0.058–0.068 in. (1.47 – 1.73 mm)

PRESS-FIT WITH FLEXIBLE LEADS, ENCAPSULATED, ISOLATED ON TO-3 FLANGE



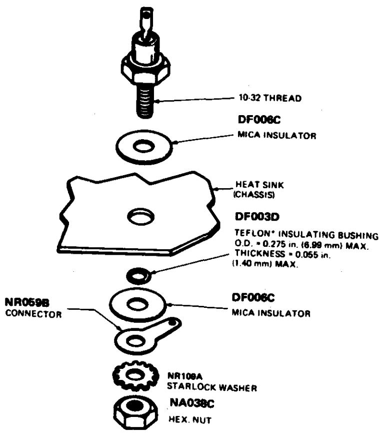
Symbol	INCHES		MILLIMETERS	
	Min.	Max.	Min.	Max.
A	1.470	1.535	37.34	38.99
ϕD	0.619	0.629	15.72	15.98
F	0.060	0.065	1.52	1.65
J	–	6.500	–	165.10
J_1	0.125	0.500	3.17	12.70
q	1.184	1.190	30.07	30.22
ϕP	0.152	0.159	3.86	4.04
R	0.497	0.503	12.62	12.77
R_1	0.169	0.176	4.29	4.47

92CM-28376

WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

Suggested Hardware and Mounting Arrangements

DO-203MA/DO-4

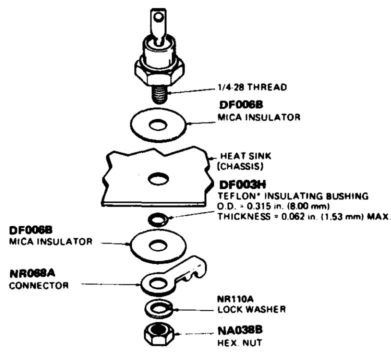


* REGISTERED TRADEMARK OF E. I. DUPONT DE NEMOUR & CO

92CS-22573

Maximum torque: 25 in.-lb (0.29 kgf-m)

DO-203MB/DO-5

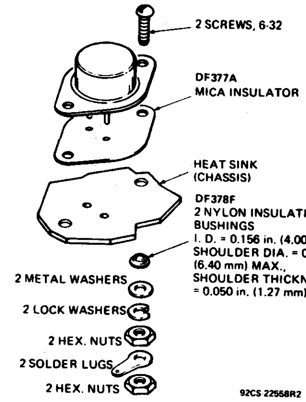


* REGISTERED TRADEMARK OF E. I. DUPONT DE NEMOUR & CO

Maximum torque: 50 in.-lb (0.58 kgf-m)

92CS-22565

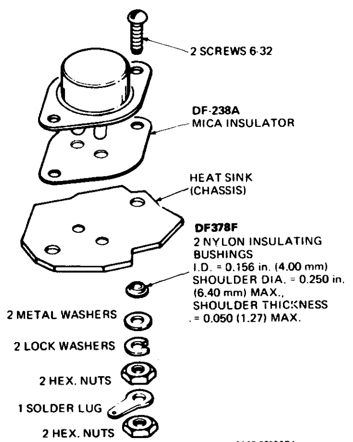
TO-204MA/TO-3



92CS-22558R2

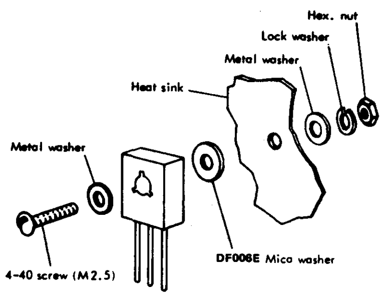
NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 12 in.-lbs. (0.14 kgf-m).

MODIFIED TO-3



92CS-22556R1

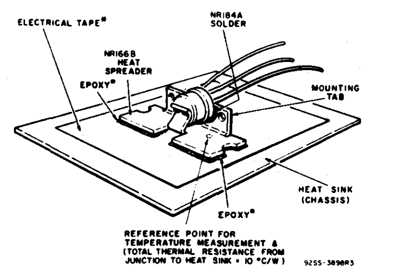
PLASTIC TO-5



Recommended torque (for even distribution of mounting pressure and optimum thermal contact): 6 lbs. in (0.07 kgf-m).

92CS-27783

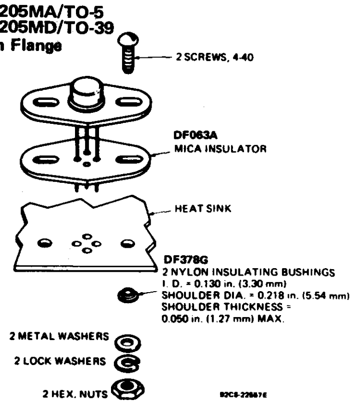
"LOW - Profile TO-5" with Heat Spreader



92SS-3898R3

- * Scotch brand electrical tape No.27 (thermo setting one side), Minnesota Mining & Mfg. Co., St Paul, Minnesota, or equivalent.
- ■ An epoxy such as Hysol Epoxy Patch Kit 6C, Hysol Corporation, Olean, N. Y. 14761, or equivalent.
- ▲ For heat-sink temperature measurement, the thermocouple (wire no larger than AWG No. 26) should be inserted in a small, shallow hole drilled in (but not through) the heat sink at the indicated temperature reference point.

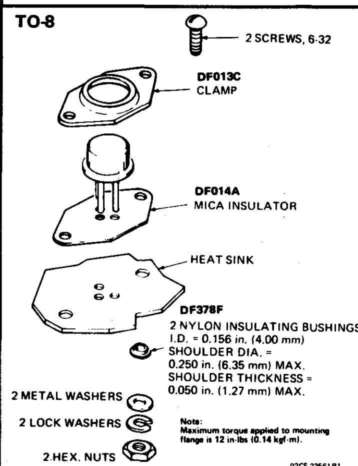
TO-205MA/TO-5
TO-205MD/TO-39
With Flange



92CS-22567E

Note: Maximum torque applied to mounting flange is 8 in-lb (0.09 kgf-m).

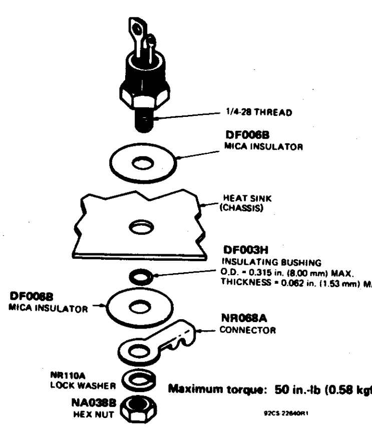
TO-8



Note: Maximum torque applied to mounting flange is 12 in-lbs (0.14 kgf-m).

92CS 22561R1

TO-208MA/TO-48

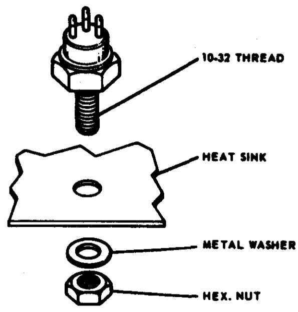


Maximum torque: 50 in.-lb (0.58 kgf-m)

92CS-22640R1

Suggested Hardware and Mounting Arrangements

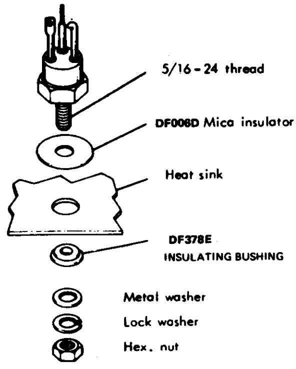
TO-212MA/TO-60



Maximum torque: 12 in.-lb (0.14 kgf-m)
(d)

92CS-26378

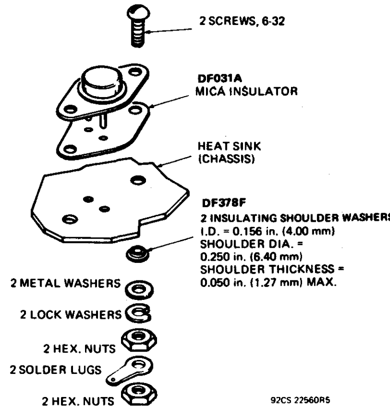
TO-211MB/TO-63



Maximum torque: 30 lbf in (0.35 kgf m)

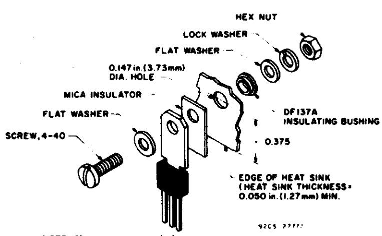
92CS-27781

TO-213MA/TO-66



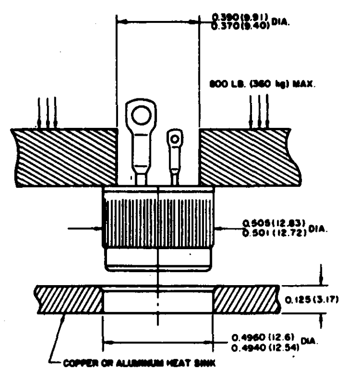
NOTE. MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 12 in. lb. (0.14 kgf m)

TO-202AB

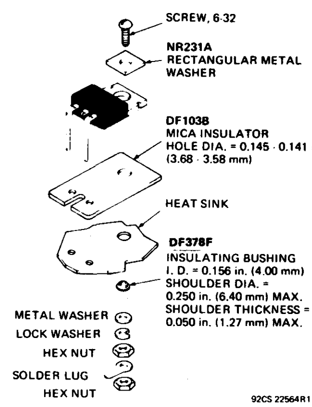


NOTE: Maximum torque applied to mounting flange is 8 in. lb (0.09 kgf m)

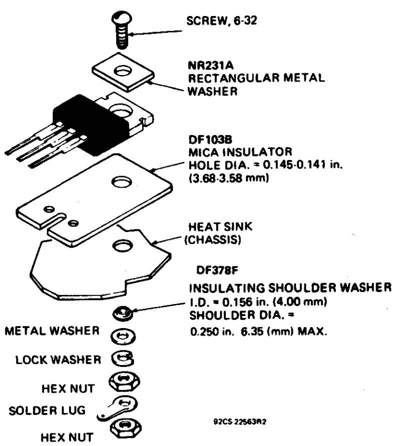
TO-203AA
6-, 10-, and 15-A Triacs, 20- and 35-A SCR's



TO-220AA

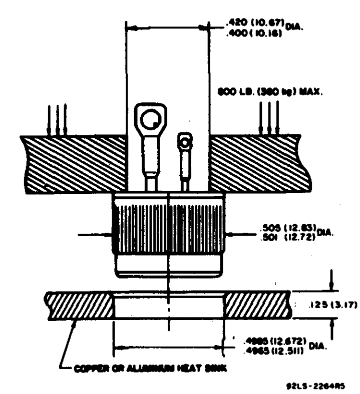


TO-220AB



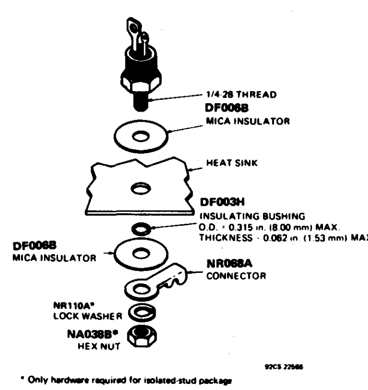
NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 8 in. lb. (0.09 kgf m)

Press-Fit
25-, 30-, and 40-A Triacs



NOTE: Dimensions in parentheses are in millimeters.

Stud and Isolated-Stud
Triacs and SCR's except 60- and 80-A Triacs

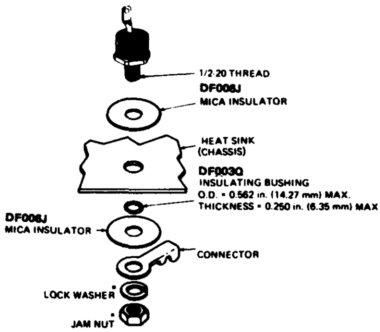


* Only hardware required for isolated-stud package

Maximum torque: 50 in.-lb (0.58 kgf-m)

Suggested Hardware and Mounting Arrangements

Overmold
Stud and Isolated-Stud
60- and 80-A Triacs
75-A and 100-A SCRs



* Only hardware required for isolated-stud package.
Maximum torque: 150 in-lb (1.73 kgf-m)

92CS-22843R2

Case-to-Heat Sink Thermal Resistance for Different Mounting Arrangements – 60- and 80-A Triacs

Package	Type of Mounting Employed	Resistance-°C/W
Stud	Directly mounted on heat sink with or without the use of heat sink compound	0.05 to 0.15
Isolated Stud		

Case-to-Heat Sink Thermal Resistance for Different Mounting Arrangements- Triacs and SCR's except 60- and 80-A Triacs

Package	Type of Mounting Employed	Resistance-°C/W
Stud & Isolated-Stud	Directly mounted on heat sink with or without the use of heat-sink compound.	0.6
Stud	Mounted on heat sink with a 0.004 to 0.006 in. (0.102 to 0.152 mm) thick mica insulating washer used between unit and heat sink. Without heat sink compound	2.5
	With heat sink compound	1.5

Case-to-Heat Sink Thermal Resistance for Different Mounting Arrangements- Triacs and SCR's except 60- and 80-A Triacs

Package	Type of Mounting Employed	Thermal Resistance-°C/W
Press-Fit	Press-fitted into heat sink. Minimum required thickness of heat sink = 1/8 in. (3.17 mm).	0.5
	Soldered directly to heat sink. (60-40 solder which has a melting point of 188°C should be used. Heating time should be sufficient to cause solder to flow freely).	0.1 to 0.35

Press-Fit
Triacs and SCR's

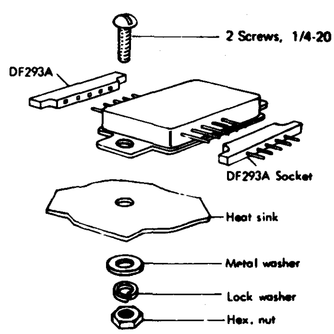
MOUNTING CONSIDERATIONS

Mounting of press-fit package types depends upon an interference fit between the thyristor case and the heat sink. As the thyristor is forced into the heat-sink hole, metal from the heat sink flows into the knurl voids of the thyristor case. The resulting close contact between the heat sink and the thyristor case assures low thermal and electrical resistances.

A recommended mounting method, Press-Fit (TO-203AA) or Press-Fit (25-, 30-, and 40-A triacs) shows press-fit knurl and heat-sink hole dimensions. If these dimensions are maintained, a "worst-case" condition of 0.0085 in. (0.2159 mm) interference fit will allow press-fit insertion below the maximum allowable insertion force of 800 pounds. A slight chamfer in the heat-sink hole will help center and guide the press-fit package properly into the heat sink. The insertion tool should be a hollow shaft having an inner diameter of 0.380 ± 0.010 in. (9.65 ± 0.254 mm) for PF-1 package, and 0.410 ± 0.010 in. (10.41 ± 0.254 mm) for PF-2 package and an outer diameter of 0.500 in (12.70 mm). These dimensions provide sufficient clearance for the leads and assure that no direct force will be applied to the glass seal of the thyristor.

The press-fit package is not restricted to a single mounting arrangement; direct soldering and the use of epoxy adhesives have been successfully employed. The press-fit case is tin-plated to facilitate direct soldering to the heat sink. A 60-40 solder should be used and heat should be applied only long enough to allow the solder to flow freely.

Power Hybrid Circuit Package

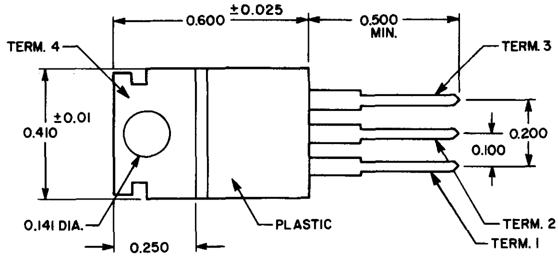


Note: Maximum torque applied to mounting flange is 24 in-lb (0.3 kgf-m).
DF293A is a socket to enable simple connection of this module

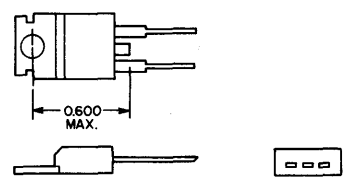
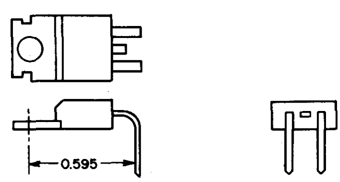
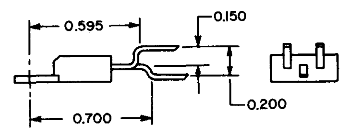
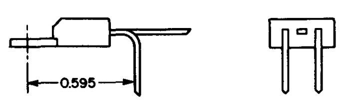
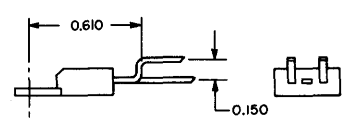
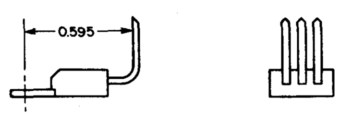
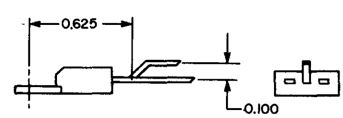
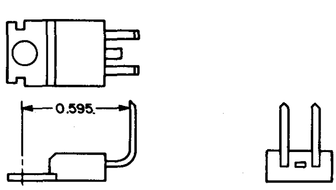
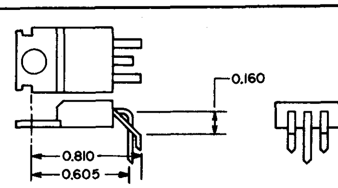
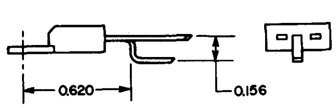
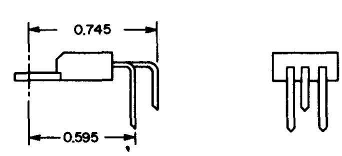
92CS-27782

Lead Forms for RCA Plastic Power Packages

TO-220 (VERSAWATT)

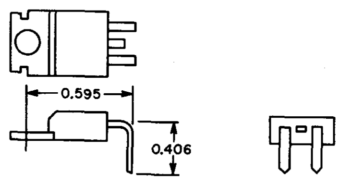
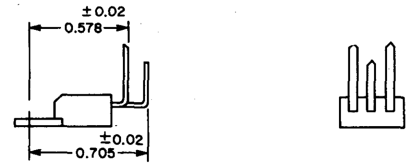
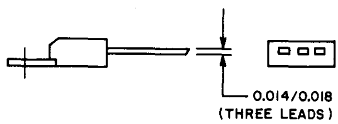
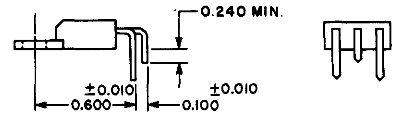
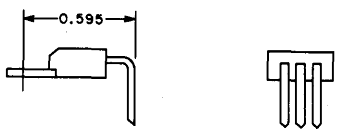
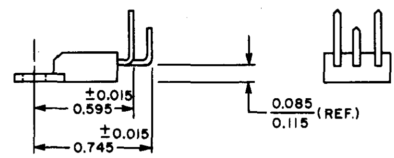
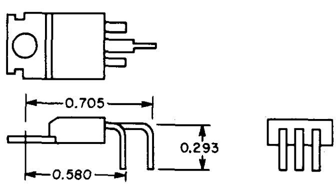
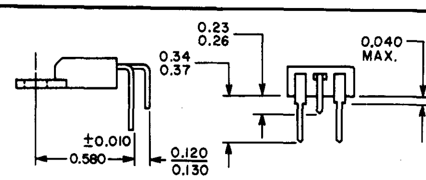
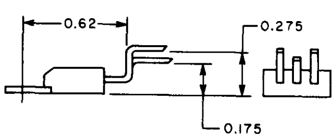
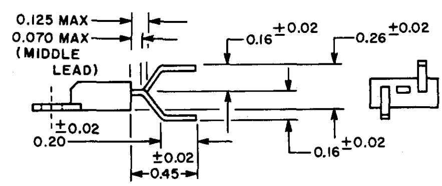
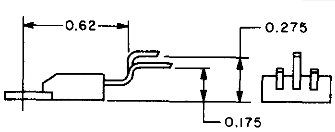
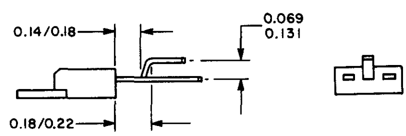
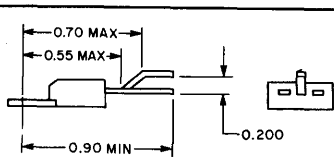
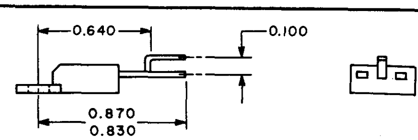
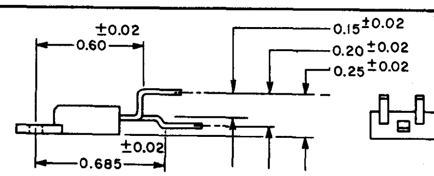


Top View

Lead Form No.	Outline	Lead Form No.	Outline
6200		6206	
6201		6207	
6202		6209	
6203		6210	
6204		6211	
6205		6212	

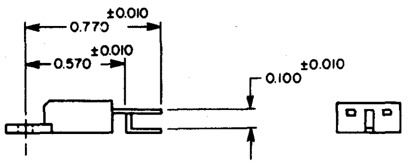
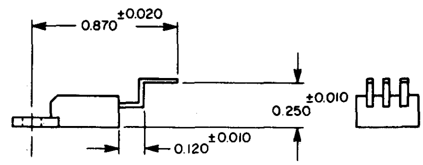
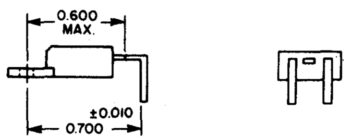
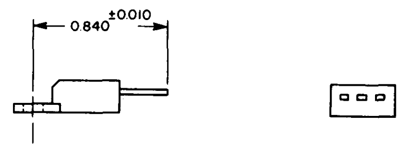
Lead Forms for RCA Plastic Power Packages

TO-220 (VERSAWATT) [cont'd]

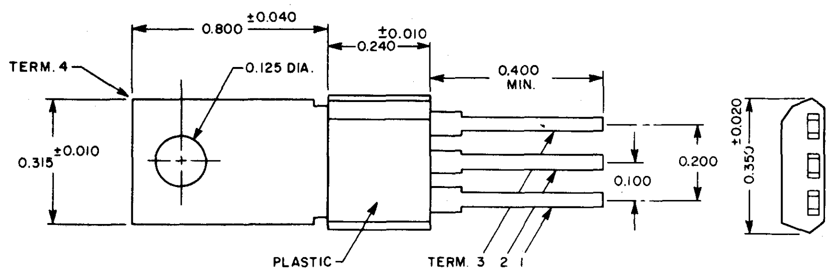
Lead Form No.	Outline		Outline
6216		6227	
6217		6231	
6220		6233	
6221		6234	
6223		6235	
6224		6237	
6226		6242	
		6245	

Lead Forms for RCA Plastic Power Packages

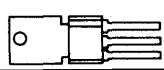
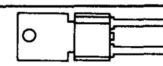
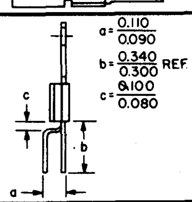
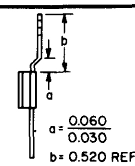
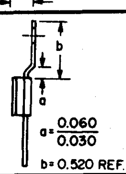
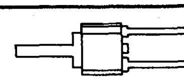
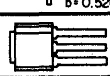
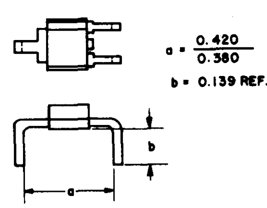
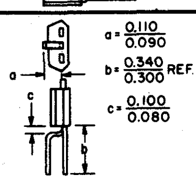
TO-220 (VERSAWATT) [cont'd]

Lead Form No.	Outline	Lead Form No.	Outline
6246		6248	
6247		6249	

TO-202 (VERSATAB)



Top View

Lead Form No.	Outline	Lead Form No.	Outline
Type 1		Type 3	
Type 11		Type 32	
Type 12		Type 4	
Type 2		Type 41	
Type 21			

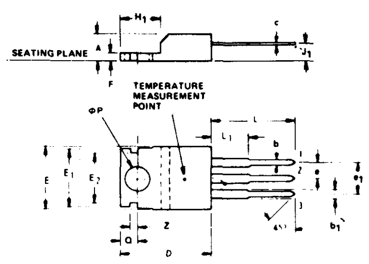
Handling and Mounting of RCA Molded-Plastic Transistors and Thyristors

AN-4124

RCA power transistors and thyristors (SCR's and triacs) in VERSAWATT molded-silicone-plastic packages are specially designed for ease of use in a wide range of medium-power applications. This Note provides detailed guidelines for handling and mounting of these plastic-package devices, and shows different package options and suggested mounting hardware to accommodate various mounting arrangements. Recommendations are made for handling of the packages during the forming of leads to meet specific mounting requirements. Various mounting arrangements, thermal considerations, and cleaning methods are described. This information is intended to augment the data on electrical characteristics, safe operating area, and performance capabilities in the technical data bulletin for each type of plastic-package transistor or thyristor.

Package Options

Figs. 1 through 3 show the options currently available for devices in RCA VERSAWATT (JEDEC TO-220) packages. The JEDEC Type TO-220AB in-line-lead version, shown in Fig. 1, represents the basic style. This configuration features leads that can be formed to meet a variety of specific mounting requirements. Fig. 2 shows a package configuration that allows a VERSAWATT package to be mounted on a printed-circuit board with a 0.100-inch grid and a minimum lead spacing of 0.200 inch. Fig. 3 shows a JEDEC Type TO-220AA version of the VERSAWATT package. The dimensions of this type of transistor package are such that it can replace the JEDEC TO-66 transistor package in a commercial socket or printed-circuit board without retooling.

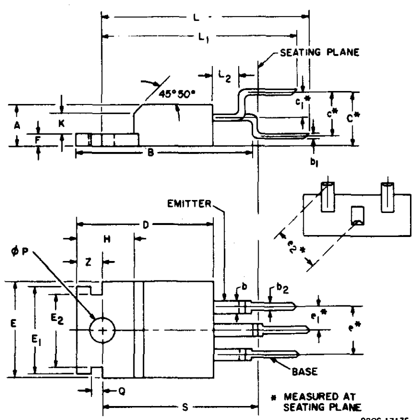


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	–
b	0.020	0.045	0.51	1.14	–
b_1	0.045	0.070	1.14	1.77	–
c	0.015	0.025	0.38	0.63	–
D	0.560	0.625	14.23	15.87	–
E	0.380	0.420	9.66	10.66	1
E_1	0.365	0.385	9.28	9.77	–
E_2	0.300	0.320	7.62	8.12	–
e	0.090	0.110	2.29	2.79	2
e_1	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	–
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	–
L	0.500	0.562	12.70	14.27	–
L_1	–	0.250	–	6.35	–
ϕP	0.139	0.147	3.531	3.733	–
Q	0.100	0.120	2.54	3.04	–
Z	0.040	0.060	1.02	1.52	–

92CS-17991R2

NOTES:
1. Tab contour optional within H_1 and E.
2. Position of lead to be measured 0.250 – 0.255 in. (6.350 – 6.477 mm) from case

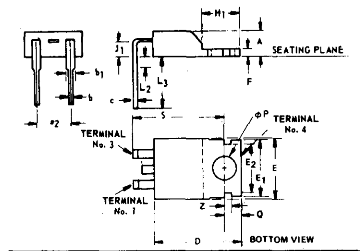
Fig. 1 - Dimensional outline of the JEDEC TO-220AB in-line-lead VERSAWATT package.



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	–
B		0.850	–	21.59	–
b	0.045	0.070	1.15	1.17	–
b_1	0.015	0.030	0.382	0.762	–
b_2	0.020	0.038	0.508	0.965	–
C	0.230	0.270	5.85	6.85	–
c	0.180	0.220	4.58	5.58	–
c_1	0.130	0.170	3.31	4.31	–
D	0.560	0.625	14.23	15.87	–
E	0.380	0.420	9.66	10.66	1
E_1	0.365	0.385	9.28	9.77	–
E_2	0.300	0.320	7.62	8.12	–
e	0.190	0.210	4.83	5.33	–
e_1	0.090	0.110	2.29	2.79	–
e_2	0.203	0.243	5.16	6.17	–
F	0.045	0.055	1.15	1.39	–
H	0.230	0.270	5.85	6.85	1
K	0.080	0.085	2.032	2.159	–
L	0.993	1.033	25.22	26.23	–
L_1	0.895	0.935	22.73	23.74	–
L_2	0.070	0.090	1.78	2.28	–
ϕP	0.139	0.147	3.531	3.734	–
Q	0.040	0.060	1.02	1.52	–
S	0.655	0.685	16.64	17.39	–
Z	0.100	0.120	2.54	3.04	–

Note: 92CS-17175
1. Tab contour optional within H and E.

Fig. 2 - Dimensional outline of VERSAWATT package designed for mounting on printed-circuit boards.



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	–
b	0.020	0.045	0.51	1.14	–
b_1	0.045	0.070	1.14	1.77	–
c	0.015	0.025	0.38	0.63	–
D	0.560	0.625	14.23	15.87	–
E	0.380	0.420	9.66	10.66	1
E_1	0.365	0.385	9.28	9.77	–
E_2	0.300	0.320	7.62	8.12	–
e_2	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	–
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	–
L_2	–	0.050	–	1.27	–
L_3	0.360	0.422	9.15	10.71	–
ϕP	0.139	0.147	3.531	3.733	–
Q	0.100	0.120	2.54	3.04	–
S	0.580	0.610	14.74	15.49	–
Z	0.040	0.060	1.02	1.52	–

92CS-17990R2

NOTES:
1. Tab contour optional within H_1 and E.
2. Position of lead to be measured 0.050 – 0.055 in. (1.270 – 1.397 mm) below seating plane.

Fig. 3 - JEDEC TO-220AA VERSAWATT package designed for direct replacement of the JEDEC TO-66 package.

The pin-connection arrangement of thyristors supplied in TO-220AA packages, however, differs from that of thyristors supplied in conventional TO-66 packages so that some hardware changes are required to effect a replacement.

Lead-Forming Techniques

RCA VERSAWATT plastic packages are both rugged and versatile within the confines of commonly accepted standards for such devices. Although these versatile packages lend themselves to numerous arrangements, provision of a wide variety of lead configurations to conform to the specific requirements of many different mounting arrangements is highly impractical. However, the leads of the VERSAWATT in-line package can be formed to a custom shape, provided that they are not indiscriminately twisted or bent. Although these leads can be formed, they are not flexible in the general sense, nor are they sufficiently rigid for unrestrained wire wrapping.

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Before an attempt is made to form the leads of an in-line package to meet the requirements of a specific application, the desired lead configuration should be determined, and a lead-bending fixture should be designed and constructed. The use of a properly designed fixture for this operation eliminates the need for repeated lead bending. When the use of a special-bending fixture is not practical, a pair of long-nosed pliers may be used. The pliers should hold the lead firmly between the bending point and the case, but should not touch the case. Fig. 4 illustrates the use of long-nosed pliers for lead bending. Fig. 4(a) shows techniques that should be avoided; Fig. 4(b) shows the correct method.

When the leads of an in-line plastic package are to be formed, whether by use of long-nosed pliers or a special bending fixture, the following precautions must be observed to avoid internal damage to the device:

1. Restrain the lead between the bending point and the plastic case to prevent relative movement between the lead and the case.
2. When the bend is made in the plane of the lead (spreading), bend only the narrow part of the lead.
3. When the bend is made in the plane perpendicular to that of the leads, make the bend at least 1/8 inch from the plastic case.
4. Do not use a lead-bend radius of less than 1/16 inch.
5. Avoid repeated bending of leads.

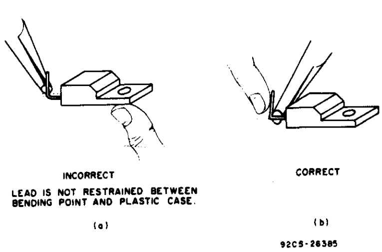
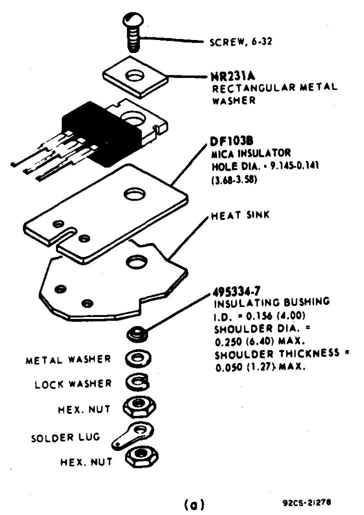


Fig. 4 - Use of long-nosed pliers for lead bending: (a) incorrect method; (b) correct method.

The leads of the TO-220AB VERSAWATT in-line package are not designed to withstand excessive axial pull. Force in this direction greater than 4 pounds may result in permanent damage to the device. If the mounting arrangement tends to impose axial stress on the leads, some method of strain relief should be devised. Fig. 2 illustrates an acceptable lead-forming method that provides this relief.

Wire wrapping of the leads is permissible, provided that the lead is restrained between the plastic case and the point of the wrapping. Soldering to the leads is also allowed; the maximum soldering temperature, however, must not exceed 235°C and must be applied for not more than 10 seconds at a distance greater than 1/8 inch from the plastic case. When wires are used for connections, care should be exercised to assure that movement of the wire does not cause movement of the lead at the lead-to-plastic junctions.



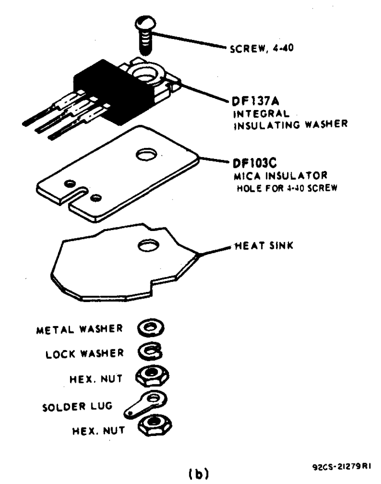


Fig. 5 - Methods of mounting JEDEC TO-220AB in-line-lead version of RCA VERSAWATT transistors and thyristors.

Mounting

Figs. 5 through 8 show recommended mounting arrangements and suggested hardware for the VERSAWATT transistors. The rectangular washer (NR231A) shown in Fig. 5(a) is designed to minimize distortion of the mounting flange when the transistor is fastened to a heat sink. Excessive distortion of the flange could cause damage to the transistor. The washer is particularly important when the size of the mounting hold exceeds 0.140 inch (6-32 clearance). Larger holds are needed to accommodate insulating bushings; however, the holds should not be larger than necessary to provide hardware clearance and, in any case, should not exceed a diameter of 0.250 inch. Flange distortion is also possible if excessive torque is used during mounting. A maximum torque of 8 inch-pounds is specified. Care should be exercised to assure that the tool used to drive the mounting screw never comes in contact with the plastic body during the driving operation. Such contact can result in damage to the plastic body and internal device connections. An excellent method of avoiding this problem is to use a spacer or combination spacer-isolating bushing which raises the screw head or nut above the top surface of the plastic body, as shown in Fig. 8. The material used for such a spacer or spacer-isolating bushing should, of course, be carefully selected to avoid "cold flow" and consequent reduction in mounting force. Suggested materials for these bushings are diallphthalate, fiberglass-filled nylon, or fiberglass-filled polycarbonate. Unfilled nylon should be avoided.

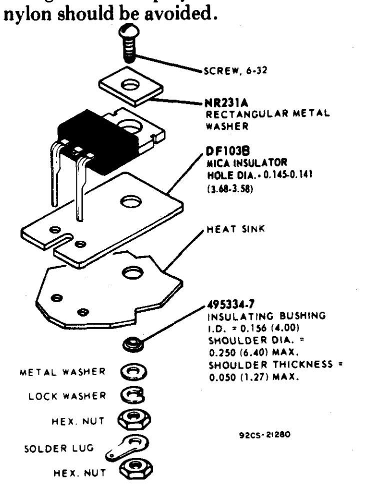


Fig. 6 - Chassis mounting of JEDEC TO-220AA version of RCA VERSAWATT devices.

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Modification of the flange can also result in flange distortion and should not be attempted. The package should not be soldered to the heat sink by use of lead-tin solder because the heat required with this type of solder will cause the junction temperature of the package to become excessive.

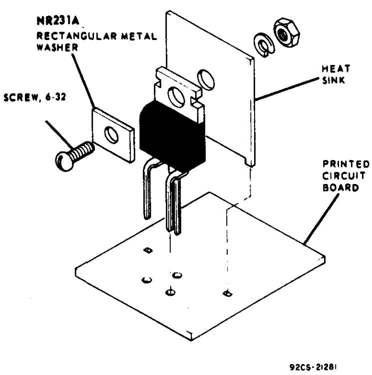

Fig. 7 - Method of mounting RCA VERSAWATT packages on printed-circuit boards.

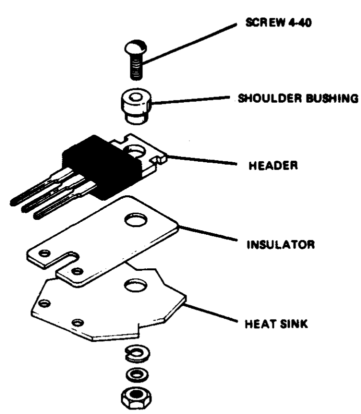

Fig. 8 - Mounting arrangements in which an isolating bushing is used to raise the head of the mounting screw above the plastic body of the VERSAWATT package.

The TO-220AA plastic package can be mounted in commercially available TO-66 sockets, such as UID Electronics Corp. Socket No. PTD-4 or equivalent. For testing purposes, the TO-220AB in-line package can be mounted in a Jetron Socket No. CD74-104 or equivalent. Regardless of the mounting method, the following precautions should be taken:

1. Use appropriate hardware.
2. Always fasten the transistor to the heat sink before the leads are soldered to fixed terminals.
3. Never allow the mounting tool to come in contact with the plastic case.
4. Never exceed a torque of 8 inch-pounds.
5. Avoid oversize mounting holes.
6. Provide strain relief if there is any probability that axial stress will be applied to the leads.
7. Use insulating bushings to prevent hot-creep problems. Such bushings should be made of diallphthalate, fiberglass-filled nylon, or fiberglass-filled polycarbonate.

Thermal-Resistance Considerations

The maximum allowable power dissipation in a solid-state device is limited by its junction temperature. An important factor to assure that the junction temperature remains below the specified maximum value is the ability of the associated thermal circuit to conduct heat away from the device.

When a solid-state device is operated in free air, without a heat sink, the steady-state thermal circuit is defined by the junction-to-free-air thermal resistance given in the published data on the device. Thermal considerations require that there by a free flow of air around the device and that the power dissipation be maintained below that which would cause the junction temperature to rise above the maximum rating. When the device is mounted on a heat sink, however, care must be taken to assure that all portions of the thermal circuit are considered.

Fig. 9 shows the thermal circuit for a heat-sink-mounted transistor. This figure shows that the junction-to-ambient thermal circuit includes three series thermal-resistance components, i.e., junction-to-case, $R_{\theta JC}$; case-to-heat-sink, $R_{\theta CS}$; and heat-sink-to-ambient, $R_{\theta SA}$. The junction-to-case thermal resistance of the various device types is given in the individual technical bulletins on specific types. The heat-sink-to-ambient thermal resistance can be

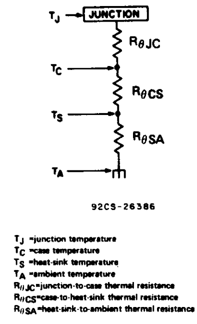

Fig. 9 - Thermal equivalent circuit for a transistor mounted on a heat sink.

determined from the technical data provided by the heat-sink manufacturer, or from published heat-sink nomographs. The case-to-heat-sink thermal resistance depends on several factors, which include the condition of the heat-sink surface, the type of material and thickness of the insulator, the type of thermal compound, the mounting torque, and the diameter of the mounting hold in the heat-sink.

Fig. 10 shows a set of curves of typical case-to-heat-sink thermal resistance of the VERSAWATT package as a function of mounting torque for several mounting arrangements. Curves A through D show typical case-to-heat-sink thermal resistance for the mounting arrangements shown in Fig. 5. Curves E and F are representative of a VERSAWATT package mounted over a heat-sink mounting hold that has a diameter of 0.140 inch (No. 6 screw clearance). Curve E shows the wide variation in thermal resistance with torque when the transistor is mounted dry. Curve F shows the effect on contact thermal resistance of a thin layer of Dow Corning No. 340 silicone grease applied between transistor and heat sink. For torques within the recommended range of 4 to 8 inch-pounds, contact thermal resistance is reduced to between 18 and 25 per cent of the dry values.

Operation of the transistor with heat-sink temperatures of 100°C or greater results in some shrinkage of the insulating bushing normally used to mount power transistors and thyristors. The degradation of contact thermal resistance (refer to Fig. 10) is usually less than 25 per cent if a good thermal compound is used.

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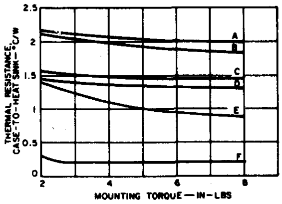

CURVE	MOUNTING ARRANGEMENT FIGURE	HEAT SINK HOLE DIA. (IN.)	MICA THICKNESS (MILS)	THERMAL COMPOUND
A	5 (a)	.250	4	Dow Corning No.340
B	5 (b)	.113	4	Dow Corning No.340
C	5 (a)	.250	2	Dow Corning No.340
D	5 (b)	.113	2	Dow Corning No.340
E	—	.140	None	None
F	—	.140	None	Dow Corning No.340

Fig. 10 — Typical case-to-heat-sink thermal resistance as a function of mounting torque for an RCA VERSAWATT package.

During the mounting of RCA molded-plastic solid-state power devices, the following special precautions should be taken to assure efficient heat transfer from case to heat sink:

1. Mounting torque should be between 4 and 8 inch-pounds.
2. The mounting holes should be kept as small as possible.
3. Holes should be drilled or punched clean with no burrs or ridges, and chamfered to a maximum radius of 0.010 inch.
4. The mounting surface should be flat within 0.002 inch/inch.
5. Thermal grease (Dow Corning 340 or equivalent) should always be used (on both sides on the insulating washer if one is employed).
6. Thin insulating washers should be used (thickness of factory-supplied mica washers ranges from 2 to 4 mils).
7. A lock washer or torque washer should be used, together with materials that have sufficient creep strength to prevent degradation of heat-sink efficiency during life.

Cleaning After Mounting

A wide variety of solvents is available for degreasing and flux removal. The usual practice is to submerge components in a solvent bath for a specified time. From a reliability standpoint, however, it is extremely important that the solvent, together with other chemicals in the solder-cleaning system (such as flux and solder covers), not adversely affect the life of the component. This consideration applies to all non-hermetic and molded-plastic components.

It is, of course, impractical to evaluate the effect on long-term transistor life of all cleaning solvents, which are marketed under a variety of brand names with numerous additives. These solvents can, however, be classified with respect to their component parts, as either acceptable or unacceptable. Chlorinated solvents tend to dissolve the outer package and, therefore, make operation in a humid atmosphere unreliable. Gasoline and other hydrocarbons cause the inner encapsulant to swell and damage the package. Alcohols are acceptable solvents and are recommended for flux removal whenever possible. Examples of suitable alcohols are methanol, isopropanol, and special denatured ethyl alcohols, such as SDA1, SDA30, SDA34, and SDA44.

When considerations such as solvent flammability are of concern, selected freon-alcohol blends are usable when exposure is limited. Solvent such as the following should be safe for normal flux-removal operations, but care should be taken to assure their suitability in the cleaning procedure:

Freon TE
Freon TE-35
Freon TP-35 (Freon PC)

The solvents may be used for a maximum of 4 hours at 25°C or for a maximum of 1 hour at 50°C.

Care must also be used in the selection of fluxes in the soldering of leads. Rosin or activated rosin fluxes are recommended, while organic or acid fluxes are not. Examples of acceptable fluxes are:

Alpha Reliaros No. 320-33
Alpha Reliaros No. 346
Alpha Reliaros No. 711
Alpha Reliafoam No. 807
Alpha Reliafoam No. 809
Alpha Reliafoam No. 811-13
Alpha Reliafoam No. 815-35
Kester No. 44

If the completed assembly is to be encapsulated, the effect on the molded-plastic transistor must be studies from both a chemical and a physical standpoint.

Note:
Silicone-oil fluids that come into direct physical contact with the molded-plastic packages may react chemically with and cause damage to the packages. Such fluids, therefore, are unacceptable as baths for degreasing and flux removal. Silicone oils contained in thermal compounds or other materials used in mounting the molded-plastic packages, however, do not cause damage to the packages provided the bleed rate of such materials is not excessive. For example, in mounting arrangements that employ an insulating washer, a thermal-grease heat-sink compound, such as Dow Corning No. 340 or equivalent, for which the bleed rate does not exceed 0.5 per cent after 24 hours at 200°C is recommended for use on both sides of the insulating washer.

Application Note Abstracts

Power Transistors

AN-3565 . . . . 4 pages
A 100-Watt, 18-KHz Inverter Using RCA-2N5202 Silicon Power Transistors
A two-transistor, two transformer inverter that demonstrates the excellent switching capabilities of the RCA-2N5202 power transistor is described.

AN-4124 . . . . 8 pages
Handling and Mounting of RCA Molded-Plastic Transistors and Thyristors
Detailed guidelines for handling and mounting plastic-packaged RCA power transistors and thyristors are given. Types of packages and suggested mounting hardware to accommodate various mounting arrangements are described. Recommendations are made for handling packages during the forming of leads. Various mounting arrangements, thermal considerations, and cleaning methods are described. This information is intended to supplement the data on electrical characteristics, safe operating area, and performance capabilities in the technical bulletin for each type of plastic-packaged transistor or thyristor.

AN-4509 . . . . 8 pages
Compact 5-Volt Power Supplies Using High-Voltage Power Transistors
The use of low-cost, industrial-type, high voltage power transistors and fast-recovery rectifiers to achieve size and weight reductions and efficiency improvements in 5-volt dc power supplies with output currents of 50 amperes or more are discussed. The supplies described, like those used in high-reliability aerospace applications, use switching rather than dissipating regulators to eliminate the need for a 60-Hz power transformer and heat sinks for the transsistors. A complete switching-regulator power supply is described in detail.

AN-4558 . . . . .12pages
A regulated constant-voltage power supply that uses integrated circuits and a rugged hometaxial-base transistor to attain high output-power capability is described. A 20-volt, 3-ampere supply that uses a single RCA-2N3055 pass transistor is described in detail; the discussion includes circuit descriptions, operating characteristics, component specifications, and suggestions for layout and construction. Thermal-fatigue effects and safe operating conditions for power transistors are considered. Guidance is provided for those who may want to develop a similar circuit.

AN-4573 . . . . 6 pages
Testing for Forward-Bias Second Breakdown in Power Transistors
The design of a non-destructive forward-bias second-breakdown test facility that determines the forward-bias second-breakdown safe-operating locus for power transistors is described. Detailed schematic diagrams of test circuits that can be used to test devices with collector-current ratings up to 2.5 amperes and sustaining collector-to-emitter voltage [V_{CEO}(sus)] ratings up to 300 volts, or with ratings to 5 amperes and 100 volts, are given.

AN4612 . . . . 4 pages
Thermal-Cycling Rating System for Silicon Power Transistors
The basic causes of thermal fatigue in silicon power transistors are analyzed, and a rating chart that makes it possible for a circuit designer to avoid such failures during the operating life of his equipment is described. Examples are provided on the use of this chart to determine the transistor operating conditions required to assure a desired thermal-cycling capability and to determine whether the thermal-cycling capability is adequate for the requirements of a given application.

AN-4673 . . . . 6 pages
A 750-Watt Three-Phase Frequency Converter
A frequency converter with an output frequency ranging from 380 Hz to 1250 Hz that delivers up to 750 watts of three-phase power at 120 or 208 volts rms is described. The circuit, useful in military equipment that uses three phase, 400-Hz power, and industrial plants and laboratories that require power at a variety of low frequencies, makes use of a three-phase bridge inverter supplied from a rectified line; the input can be single-phase or three-phase, 120 volts or 208 volts, at any frequency from 47 Hz to 1250 Hz. The RCA-2N5805 power transistor is used in the circuit.

AN-4783 . . . . 8 pages
Thermal-Cycling Ratings of Power Transistors
A testing program used to determine the capability of the design of an RCA-2N3055 power transistor to withstand thermal cycling over a wide range of operating conditions is described. A sufficient number of tests were performed to verify a rating chart that can be applied by an equipment designer to any practical operating condition. The discussion covers a brief description of thermal fatigue, a method of "scaling the environment" to determine the proper test conditions, specialized test equipment and techniques that assure that the proper stresses were applied to the transistor, and the test results and predicted-capability chart for the transistor.

AN-6145 . . . . 8 pages
A Test Set for Nondestructive Safe-Area Measurements Under High-Voltage, High-Current Conditions
The determination of the safe-operating area of power transistors at high volt/ampere products under pulsed and repetitive-pulsed conditions, nondestructively, is made possible by the test set described in this Note. System philosophy, design, construction, and operation are detailed.

AN-6163 . . . . 12 pages
Quantitative Measurement of Thermal-Cycling Capability of Silicon Power Transistors
This Note discusses the methods used to test the thermal-cycling capability of power transistors. A brief description of thermal fatigue, application requirements, and rating charts is given. A detailed discussion of the practical design and construction of thermal-cycling racks is also included along with actual test conditions for various power transistor types. Acceleration factors, failure indicators, failure mechanisms, and real-time control of thermal-cycling capability of factory products are discussed. Some information is also given on hermetic versus plastic-package thermal-cycling reliability.

AN-6195 . . . . 8 pages
A Switching Regulator Using An RCA p-n-p Power Darlington Transistor
A 20-kHz switching regulator that employs an RCA8350B, a p-n-p Darlington transistor, and that operates from a 28-volt supply is described. The regulator has a regulated output between 4 and 16 volts dc and features overload protection that limits the current to about 11 amperes. The regulator does not operate at a fixed clock frequency, but is free-running.

AN-6215 . . . . 6 pages
Interpretation of Voltage Ratings for Transistors
The basic voltage-breakdown mechanisms of power transistors and the relationship of these mechanisms to external circuits are described—transistor voltage breakdown is a function of both individual device characteristics and associated circuits. The mechanisms described are used to explain the various types of voltage ratings used by transistor manufacturers.

AN-6249 . . . . 6 pages
Real-Time Controls of Silicon Power-Transistor Reliability
This Note compares the traditional, classical approach to the reliability-assurance testing of power transistors with a newer classification of testing: Real-Time Control, RTC. The classical approach is commonly referred to as Group B, and involves a series of mechanical, environmental, and life stress tests. RTC involves a continuous, systematic evaluation and control in "real time" of basic, potential failure mechanisms. It is an important supplement to a total program of reliability assurance.

AN-6272 . . . . 6 pages
Characteristics of RCA Monolithic Power Darlingtons
The design and application of RCA monolithic power Darlington transistors is described. The Darlington circuit has been in use for some time in applications where high beta is needed, but has only recently been available as a monolithic device. The RCA Power Darlington series 2N6385 consists of n-p-n circuits that can be driven directly from an integrated circuit and that operate at currents up to 10 amperes and voltages ranging from 40 to 80 volts.

Application Note Abstracts

AN-6281 . . . . 6 pages
Accurate Measurement of Sustaining Voltage of Power Transistors – A Pulsed-Breakdown Test Set

Several techniques for the measurement of the primary (sustaining) breakdown voltage of power transistors are in common use today. The characteristics and limitations of these test methods frequently make rapid and accurate sustaining-voltage readings on power transistors difficult or impossible. The test set described in this Note fills the need for accurate, laboratory-type, sustaining-voltage measuring equipment, although circuitry used in the test set design may be adapted to high-speed testing equipment as well. A complete parts list and calibration sequence are given.

AN-6297 . . . . 2 pages
Biasing Circuit for the Output Stage of a Power Amplifier – The V_{BE} Multiplier

A biasing circuit, the V_{BE} multiplier, for the output stage of a power amplifier is described. The V_{BE} multiplier provides proper bias for the output transistors of the amplifier under all operating conditions.

AN-6320 . . . . 8 pages
Radiation-Hardness Capability of RCA Silicon Power Transistors

The types of radiation damage that might be experienced by a power device and the tests used to determine the design most effective in preventing these types of damage are described.

AN-6330 . . . . 12 pages
A Safe-Area Rating System for Power Inverters Handling Capacitive and Inductive Loads

Although transistor power inverters have classically been evaluated with resistive loads, the reliability of practical inverters often depends on inductive and capacitive loads and associated starting transient considerations. This Note describes a safe-area rating system for transistors and relates this system to self-excited single-transformer, self-excited double transformer, and driven inverters operating into resistive, capacitive, and inductive loads under both steady-state and starting conditions.

AN-6400 . . . . 16 pages
Operating Conditions Experienced by Transistors in TV Horizontal-Deflection Circuits

This Note is a compilation of equations used to calculate the operating conditions experienced by the output transistor in various types of deflection circuits, circuits that provide horizontal (line) deflection of the electron beam in TV picture tubes employing magnetic deflection yokes. The circuits treated include direct-drive circuits and those in which taps and auxiliary windings on the flyback transformer are employed to provide impedance transformation and yoke voltage reduction. Derivations of the various equations, the simplified as well as the rigorous forms, are provided in Appendixes. Relationships for calculating the "worst case" voltage conditions are given. Operating conditions as measured in experimental circuits are compared with those calculated by means of the equations provided in this Note.

AN-6432 . . . . 8 pages
2-Kilowatt Stepped Sine-Wave Inverter

Recent advances in high-power semiconductor technology, complemented by the capabilities of existing digital integrated circuits, have made possible the economical design of a stepped sine-wave inverter in the multikilowatt range. This Note describes the use of the 2N5578 power transistor in a 2-kilowatt, 60-Hz, stepped sine-wave inverter.

AN-6423 . . . . 8 pages
Thirty-Watt (RMS) True Complementary – Symmetry Audio Amplifier Using BDX33 and BDX34 Darlington Transistors

Monolithic-silicon Darlington transistors designed for low- and medium-frequency power applications are especially suitable for audio-output applications. This Note describes the design and performance of an audio amplifier that incorporates such devices.

AN-6425 . . . . 8 pages
Automatic Analyzer for Determining Safe Operating Area of Power Transistors

The safe operating area is one of the most important ratings of a power transistor, yet only a few methods exist to evaluate it. The method presented in this Note allows description of the safe operating area for both dc and pulse operation without subjecting the transistor to breakdown. Both n-p-n and p-n-p transistors in hermetic or plastic packages can be evaluated, and the complete safe-area curve can be automatically described in a short time.

AN-6605 . . . . 16 pages
Application of RCA Power Devices in Off-Line, High-Frequency Inverter/Converter Circuits

The current trend in power inverter/converter design is to use high-frequency switching techniques and direct operation off the available utility lines (i.e., 110 or 220 volts). The use of higher operating frequencies reduce the magnetic materials required and the size of the filter capacitors. This Note discusses the use of RCA power transistors and SCR's in selected high-frequency inverter/converter applications.

AN-6624 . . . . .16 pages
Voltage Limitations of Power Transistors

This Note summarizes the primary factors that determine the voltage limitations of power transistors used in common-emitter circuits with typical base-to-emitter circuit terminations. The material presented defines terms and the various operating regions of the transistor as shown in typical volt-ampere characteristics, develops the analytic relations defining operation in each of the regions, and relates each of the operating regions to the physical actions taking place within the transistor structure.

AN-6741 . . . . 8 pages
RCA 15-Ampere SwitchMax Power Transistors in a 340-Watt 20kHz Flyback Converter

This Note describes the use of the RCA 2N6676, a 15-ampere SwitchMax power transistor, as a driven pulse-width-modulated flyback-converter stage, the final power-output stage, in a 20-kHZ off-line power converter that provides 340 watts of output power. Adjunct circuitry, such as the driver stage, reverse-bias amplifier, and overvoltage and overcurrent protection circuits, are also discussed.

RF/Microwave Power Transistors

AN-3749 . . . . 6 pages
40-Watt Peak-Envelope-Power Transistor Amplifier for AM Transmitters in the Aircraft Band (118 to 136 MHz)

A broadband amplifier for use in AM transmitters operating in the aircraft communication band (118 to 136 MHz) is described. The uncomplicated design of the unit leaves ample room for adaptation to specific needs. The amplifier is capable of delivering peak envelope power of 40 watts at a modulation of 95 per cent with a collector voltage of 12.5 volts dc. Unmodulated drive of 5 milliwatts is required at the input. The overall efficiency of the amplifier is 48 to 53 per cent and the envelope distortion is less than 5 per cent for an amplitude modulation of 95 per cent.

AN-6683 . . . . 6 pages
6- and 12-Volt 4-W Transmitters for Class D Citizens Band Radio-Telephony Using the RCA-2N6670

This Note acquaints the reader with basic principles of amplitude modulation (AM), circuit and transistor design and performance considerations, and introduces the RCA-2N6670, a reliable rf output transistor for 6-V or 12.5-V CB transmitter applications.

Power Hybrid Circuits

AN-4483 . . . . 6 pages
General Application Considerations for the RCA-HC2000H Hybrid Linear Power Amplifier

This Note briefly describes the RCA HC-2000H hybrid linear amplifier and discusses such operating considerations as dc and ac power dissipation, efficiency as a function of frequency, protection against excessive load variations and reactive loads, and heat-sink requirements.

AN-4782. . . . . 6 pages
General Application Considerations for the RCA-HC2000H Power Hybrid Operational Amplifier

The RCA-HC2000H is a power hybrid operational amplifier that can deliver 100 watts rms to a 4-ohm load at a maximum peak current of 7 amperes. It operates from a maximum power-supply voltage of 75 volts (single ended) or ±37.5 volts (split). The low-profile package is light in weight and can be used with either printed-circuit-board connections or commercially available 0.110-inch quick-disconnect push-on terminals. This Note briefly describes the HC2000H and discusses some general application considerations for this amplifier.

Application Note Abstracts

Thyristors (SCR's and Triacs)

AN-3551 . . . . 6 pages
Circuit Factor Charts for RCA Thyristor Applications
In the design of circuits using thyristors, it is often necessary to determine the specific values of peak, average, and rms current flowing through the device. This Note contains charts that show several current ratios as functions of conduction and firing angles for some SCR and triac circuits. Examples are given of the use of these charts in the design of half-wave, full-wave ac, full-wave dc, and three-phase half-wave circuits using RCA thyristors. Current and voltage waveforms for the various circuits are included, as are curves of per-cent ripple in load current and voltage.

AN-3659 . . . . 6 pages
Application of RCA Silicon Rectifiers to Capacitive Loads
This Note describes a simplified rating system that allows designers to calculate the characteristics of capacitive-load rectifier circuits quickly and accurately. The effect of the addition of a series limiting resistance to such circuits and the importance of the ratio of the limiting resistance to capacitive reactance are described; curves of rectifier current ratios are presented as functions of the effective ratio. Typical design examples are given, and output-ripple considerations are discussed.

AN-3697 . . . . 8 pages
Triac Power-Control Applications
This Note describes triac operating characteristics and provides guidance in the use of triacs in specific applications: incandescent lamp controls, light-activated controls, motor controls, heat controls, and a proportional integral-cycle control.

AN-3778 . . . . 6 pages
Light Dimmers Using Triacs
A simple, inexpensive light-dimmer circuit that contains a diac, triac, and RC charge-control network is described. The use of the diac to trigger the triac in light-dimming circuits is explained. The basic light-control circuit is introduced and its operation described. In addition, the components added to improve circuit performance are discussed. Three complete circuits and parts lists are shown for 120-volt, 60-Hz operation and 240-volt, 50/60-Hz operation. Mechanical details involved in building the circuits are discussed, and a trouble-shooting chart is included.

AN-3822 . . . . 6 pages
Thermal Considerations in Mounting of RCA Thyristors
Three simple rules to aid the designer in determining heat-sink specifications for a given application are provided. Power dissipation and heat-sink area, the mounting of thyristors on heat-sinks, typical heat-sink configurations, and chassis-mounted heat-sinks are discussed.

AN-3886 . . . . 6 pages
AC Voltage Regulators Using Thyristors
This Note describes a basic ac-voltage regulating technique using thyristors that prevents ac rms or dc voltage from fluctuating more than ±3 percent in spite of wide variations in input line voltage. Load voltage can also be held within ±3 percent of a desired value despite variations in load impedance through the use of a voltage-feedback technique. The voltage regulator described can be used in photocopying machines, light dimmers, dc power supplies, and motor controllers (to maintain fixed speed under fixed load conditions).

AN-4124 . . . . 8 pages
Handling and Mounting of RCA Molded-Plastic Transistors and Thyristors
Detailed guidelines for handling and mounting plastic-packaged RCA power transistors and thyristors are given. Types of packages and suggested mounting hardware to accommodate various mounting arrangements are described. Recommendations are made for handling packages during the forming of leads. Various mounting arrangements, thermal considerations, and cleaning methods are described. This information is intended to supplement the data on electrical characteristics, safe operating area, and performance capabilities in the technical bulletin for each type of plastic-packaged transistor or thyristor.

AN-4242 . . . . 16 pages
A Review of Thyristor Characteristics and Applications
This Note describes the operation, ratings, characteristics and typical applications of thyristors. The basic operation of a thyristor is explained by use of a two-transistor anology. The significance of voltage and temperature ratings is pointed out. Thyristor gate characteristics, switching behavior, and triggering techniques are described. Use of thyristors in typical power-control applications is discussed.

AN-4537 . . . . 8 pages
Thyristor Control of Incandescent Traffic-Signal Lamps
This Note discusses the use of thyristors in the control of traffic signals. The thyristor most applicable to this application is the triac, which can carry the electrical power required for incandescent traffic-light bulbs, yet can be gated by the low-power signals from electronic control timers or monitoring computers. In addition, the triac is able to handle the large transient currents that result from cold filament turn-on (inrush) and filament rupture (flash-over). Triac operation, stresses on triacs in operation with incandescent lamps, and a number of triac circuits for control of incandescent lamps in traffic signal applications are discussed.

AN-4745 . . . . 6 pages
Analysis and Design of Snubber Networks for dv/dt Suppression in Thyristor Circuits
When a triac is used to control an inductive load, voltages with high rates of change (dv/dt) can be generated that can cause a non-gated turn-on of the triac. The result is a loss of control of power to the load. The simplest method of suppressing this dv/dt stress is to place a series RC network across the main terminals of the triac. The design of this network, commonly called a snubber network, must take into account the peak voltage that can be allowed in the circuit and the maximum dv/dt stress that the device can withstand. This Note analyzes the RC network design and contains graphs that allow a designer to select a snubber to fit a given application.

AN-6054 . . . . 6 pages
Triac Power Controls for Three-Phase Systems
The growing demand for solid-state switching of ac power in heating controls and other industrial applications has resulted in the increasing use of triac circuits in the control of three-phase power. This Note explains a basic approach to the design of triac control circuits for use in the switching of three-phase power. The basic design rules employed in this approach are outlined, an integrated-circuit zero-voltage switch specifically intended for use in triac triggering is briefly described, and the necessity for, and methods of isolation of, the dc logic circuitry in power controls for three-phase systems are pointed out. Recommended configurations are then shown for power-control circuits intended for use with both inductive and resistive balanced three-phase loads, and the specific design requirements for each type of loading condition are discussed.

AN-6096. . . . . 8 pages
Solid-State Approaches to Cooking-Range Control
As a result of decreasing semiconductor costs, advanced system-cost analysis by appliance manufacturers, and increased consumer consciousness, various solid-state range-control designs can be applied in today's applicance market. This Note presents various solid-state design approaches available to the range-control designer.

AN-6141 . . . . 6 pages
Power Switching Using Solid-State Relays
Solid-state relays make use of a semiconductor device for control of ac or dc power. Since, in most ac applications, the semiconductor element chosen for power control is the triac, this Note describes the triac as a power-switching element. Advantages and disadvantages of the active element over the electro-mechanical relay are discussed in general terms. Basic parameters, such as surge in-rush capability, transient-voltage ratings, suppression network, turn-off consideration and the different modes of triac gating are also discussed. AC power control is covered by various circuit designs for ON/OFF control, zero-voltage switching, and line-voltage isolation.

ICAN-6182 . . . . 28 pages
Features and Applications of RCA Integrated-Circuit Zero - Voltage Switches (CA3058, CA3059 and CA3079
RCA-CA3058, CA3059 and CA3079 zero-voltage switches are monolithic integrated cir-

Application Note Abstracts

cuits designed primarily for use as trigger circuits for thyristors in ac power-control and power-switching applications. These integrated-circuit switches operate from ac input voltages of 24, 120, 208 to 230, or 277 volts at 50, 60, or 400 Hz. Zero-voltage switches trigger the thyristors at zero-voltage points in the supply-voltage cycle. Consequently, transient load-current surges and radio-frequency interferance are substantially reduced. Zero-voltage switches also reduce the rate of change of on-state current (di/dt) in the thyristor being triggered and can be adapted for use in a variety of control functions by use of an internal differential comparator to detect the difference between two externally developed voltages.

AN-6286 . . . . 8 pages
Latching, Gate-Trigger Circuits Using Thyristors for Machine Control Applications
This Note describes a variety of approaches to the development of a solid-state, latching gate drive for the control of ac loads; the solid-state device used is the thyristor. The solid-state circuits described have fewer undesirable characteristics than electro-mechanical devices and are smaller and lighter.

AN-6288 . . . . 2 pages
Thyristors in Capacitive Discharge (CD) Ignition Systems
This Note describes the requirements of small-engine ignition systems (those deriving electrical energy from a flywheel alternator system), automotive or battery-powered systems, and the ac line-operated igniters. The merits of both capacitive and inductive systems are compared. Both systems are described in terms of performance and limitations. Practical circuits are shown.

AN-6438 . . . . 24 pages
Surge Capability of SCR's, Triacs, and Rectifiers
This Note provides the designer with an easy way to derive, from the published sinusoidal capability of any semiconductor, its triangular surge capability for stress durations between 0.5 and 20 milliseconds, and thereby helps him select the most suitable fuse to protect the semiconductor of interest.

AN-6452 . . . . 16 pages
A New Practical Fuse-Thyristor Coordination Method
This Note describes the possibilities of protecting a semiconductor by fusing—when and how a fuse can be used and how much protection is afforded. Cases for which fuse protection is not possible, or for which only partial protection is feasible are also discussed. Fuse selection methods are described.

AN-6456 . . . . 12 pages
Characteristics and Applications of RCA Fast-Switching ASCR's
Silicon controlled rectifiers (SCR's) used in applications such as inverters, choppers, and radar pulse modulators at switching frequencies up to 30 kHz require high di/dt and dv/dt capabilities and very short turn-on and turn-off times. This Note explains SCR characteristics required for fast-switching applications, describes a new type of fast-switching SCR, the asymmetrical silicon controlled rectifier (ASCR), and discusses the application of this new type of SCR in induction cooking ranges.

AN-6605 . . . . 16 pages
Application of RCA Power Devices in Off-Line, High-Frequency Inverter/Converter Circuits
The current trend in power inverter/converter design is to use high-frequency switching techniques and direct operation off the available utility lines (i.e., 110 or 220 volts). The use of higher operating frequencies reduce the magnetic materials required and the size of the filter capacitors. This Note discusses the use of RCA power transistors and SCR's in selected high-frequency inverter/converter applications.

AN-6628 . . . . 8 pages
Design and Application of High-Power Ultrasonic Converters Using ASCR's
Asymmetrical SCR's with maximum turn-off times of 4 microseconds make possible high-power ultrasonic converters operating at 10 kilowatts at a very competitive price. This Note describes the ASCR structure, explains the basic design principles of an ASCR converter, and discusses the application of this converter to electronic arc-welding equipment and industrial power supplies.

AN-6671 . . . . 16 pages
Characteristics and Turn-off Circuit Considerations for RCA GTO Silicon Controlled Rectifiers (G4000)
This Note describes the RCA G4000 family of gate turn-off devices designed primarily for automotive and dc switching applications. The description consists of a qualitative discussion of device switching, physical structure, and general applications. Turn-off circuit designs are also discussed. Ratings and characteristics are covered in the appendix.

RCA Sales Offices

Argentina …… RCA SAIC, Calle Paroi SSIAN 3930, Buenos Aires …… 70-4171
Belgium …… RCA s.a., Rue De LaFusee 100, 1130 Brussel Bruxelles …… 02/7208980
Brazil …… RCA Electronica Ltda., Av. Ipiranga 1097 CP30443, Sao Paulo …… 36-6951
Canada …… RCA Ltd., 4515 Manhattan Rd. S.E., Calgary, Alberta T2G 4B3 …… (403)243-6051
RCA Ltd., 21001 No. Service Rd., Trans-Canada Highway, Ste. Anne de Bellevue, Quebec H9X 3L3 …… (514)457-9000
RCA Ltd., 1 Vulcan Street, Rexdale, Ontario M9W 1L3 …… (416)247-5491
France …… RCA s.a., 32 rue Fessart, 92100 Boulogne …… 603 8787
Germany …… RCA GmbH, Justus-von-Liebig-Ring 10, 2085 Quickborn b, Hamburg …… 04106/2001
RCA GmbH, Linprunstrasse 23, 8000 Munchen 2 …… 089/52 79/28
RCA GmbH, Zeppelinstrasse 35, D-7302 Ostfildern 4 …… 0711/454001/4
Iran …… RCA (Iran) Ltd., 160 Boulevard Elizabeth II, PO Box 12/1359, Tehran …… 651900/657410
Italy …… RCA spA, Divisioni Semiconduttori, Piazza S. Marco 1, 20121 Milano …… 637 048/051
Japan …… c/oRCA Purchasing Co., N.V. Fugi Bldg., 7-4 Kasumigaseki, 3-Chome, Chiyoda-ku, Tokyo …… 581-3211
Mexico …… RCA S.A. de C.V., Avenida Cuitalhuac 2519, Mexico 16, D.F. …… (905)527-6020
Spain …… RCA S.A., Dr Fleming 43, Madrid 16 …… 250 6955
Sweden …… RCA International Ltd., Box 3047, Hagalundsgaten 8, S-17103, Solna 3 …… 08 83 42 25
Taiwan …… RCA, 103 Nanking E. Rd., Sect. 2, 2nd Floor, Taipei …… 571-9171
UK …… RCA Ltd., Solid State-Europe, Sunbury-on-Thames, Middlesex TW17 7HW …… 093 27 85511

U.S.

Alabama …… RCA, Holiday Office Center, Suite 41, 3322 So. Memorial Parkway, Huntsville, AL 35801 …… (205)881-4100
Arizona …… RCA, 4227 N. Brown Ave., Suite 4, Scottsdale, AZ 85251 …… (602)947-7235
California …… RCA, 6363 Sunset Blvd., Hollywood, CA 90028 …… (213)468-4156
RCA, 4546 El Camino Real, Los Altos, CA 94022 …… (415)948-8996
RCA, 8333 Clairemont Mesa Blvd., Suite 105, San Diego, CA 92111 …… (714)279-0420
RCA, 17731 Irvine Blvd., Suite 104, Magnolia Plaza, Tustin, CA 92680 …… (714)832-5302
Colorado …… RCA, 2785 N. Speer Blvd., Room 346, Denver, CO 80211 …… (303)433-8841
Florida …… RCA, PO Box 12247, Lake Park, FL 33403 …… (305)626-6350
RCA, 1850 Lee Road, Suite 135, Winter Park, FL 32789 …… (305)647-7100
Illinois …… RCA, 2700 River Road, Des Plaines, IL 60018 …… (312)391-4380
Indiana …… RCA, Parkwest Office Plaza, 3811 Illinois Rd., Suite 4000, Fort Wayne, IN 46804 …… (219)432-1589
RCA, 2511 E. 46th St., Suite Q-1, Atkinson Square, Indianapolis, IN 46205 …… (317)546-4001
Massachusetts …… RCA, 109 Highland Avenue, Needham Heights, MA 02194 …… (617)444-7200
Michigan …… RCA, 30400 Telegraph Rd., Suite 440, Birmingham, MI 48010 …… (313)644-1151
Minnesota …… RCA, 6750 France Ave. S., Suite 122, Minneapolis, MN 55435 …… (612)929-0676
Kansas …… RCA, 5750 W. 95th St. Suite 111, Overland Park, KS 66207 …… (913)642-7656
New Jersey …… RCA, 1998 Springdale Rd., Cherry Hill, NJ 08003 …… (609)424-3650
RCA, 67 Walnut Ave., Clark, NJ 07066 …… (201)574-3550
New York …… RCA, 160 Perinton Hill Office Park, Fairport, NY 14450 …… (716)223-5240
RCA, One Huntington Quadrangle, Suite 2C14, Huntington Station, LI, NY 11746 …… (516)293-0180
Ohio …… RCA, 29525 Chagrin Blvd., Pepper Pike, OH 44122 …… (216)831-0030
Texas …… RCA Center, 8700 Stemmons Freeway, Dallas, TX 75247 …… (214)638-6434
Virginia …… RCA, 1901 N. Moore St., Arlington, VA 22209 …… (703)558-4161

RCA Manufacturers' Representatives

Arizona …… C. T. Carlberg Associates, 4236 North Brown Ave., Scottsdale, AZ 85251 …… (602)277-2808
California …… Bestronics (San Diego Area), 7827 Convoy Court, Suite 407, San Diego, CA 92111 …… (714)278-2150
Colorado …… Waugaman Associates, Inc., 4800 Van Gordon, Wheatridge, CO 80033 …… (303)423-1020
Delaware …… Thomas Associates, Inc., (see New Jersey)
Florida …… G. F. Bohman Associates, 5104 No. Orange Blossom Trail, Suite 115, Rosemont Bldg., Orlando, FL 32804 …… (305)295-5760
G. F. Bohman Associates, 15800 SW 84th Court Miami, FL 33157 …… (305)564-3081
G. F. Bohman Associates, PO Box 600, Clearwater, FL 33517 …… (813)442-5606
Idaho …… Western Technical Sales, Inc., (No. of Boise, see Washington)
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Illinois …… Kebco, 75 Worthington Drive, Maryland Heights, MO 63043 …… (314)576-4110/4111
Iowa …… Lorenz Sales, Inc., Suite 302, Executive Plaza, Cedar Rapids, IA 52402 …… (319)393-6912
Kansas …… Kebco, PO Box 4805, Overland Park, KS 66204 …… (913)649-2168
Louisiana …… Jackson Arnold Company, (see Texas)
Michigan …… Nicon Associates, 3835 W. Eight Mile Rd., Detroit, MI 48221 …… (313)341-7688
Minnesota …… Comstrand, Inc., 2852 Anthony Lane South, Minneapolis, MN 55114 …… (612)788-9234
Missouri …… Kebco,, 75 Worthington Drive, Maryland MO 63043 …… (314)576-4110/4111
Montana …… R^2 Marketing, (see Utah)
Nebraska …… Lorenz Sales, Inc., (see Iowa)
Nevada …… C. T. Carlberg Associates (Clark Co., see Arizona)
New Jersey …… Thomas Associates, Inc., (So. N.J.), 12 South Blackhorse Pike, Bellmawr, NJ 08031 …… (215)627-6615 (609)933-2600
New Mexico …… C. T. Carlberg Associates, PO Box 3177, Station D, Albuquerque, NM 87110 …… (505)265-1579
New York …… L-Mar Associates, Inc., (Upstate NY), 98 Elwell Ave., Binghamton, NY 13901 …… (607)723-1513

RCA Manufacturers' Representatives

New York ...... L-Mar Associates, Inc.,
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