ME

TRANSISTORS & ICs

DATABOOK

ISSUE 1

MICRO ELECTRONIC LTD.

ME

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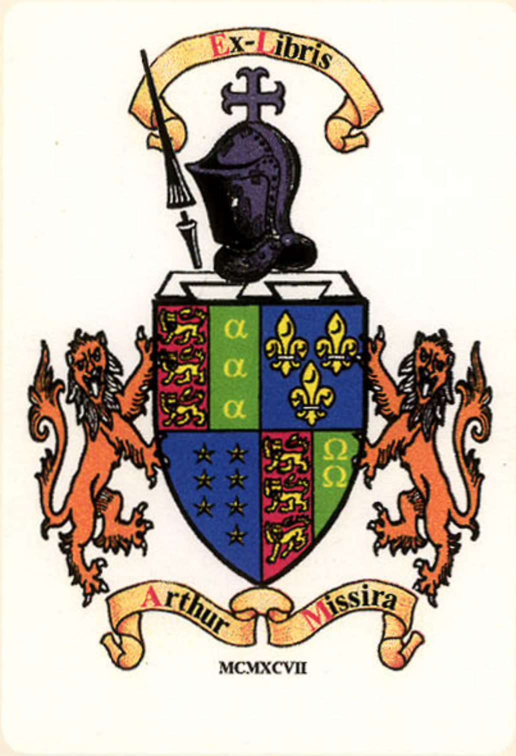
ISSUE 1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Since 1964 Micro Electronics Ltd. has been an independent manufacturer supplying more than 4000 types of solid-state devices. This databook contains the information of 560 master types only. Should you require a device not included, or a particular one designed to your own specifications, please contact M.E.L. regional sales offices and distributors.

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APPLICATIONS OF NON-REGISTERED TYPES

APPLICATIONS	REFERENCE DATA SHEETS	
MULTIBAND RADIO	KM types	
PORTABLE TV	CX types	
AUDIO AMPLIFIER		
Low Gain (20V)	KM901	*
High Gain (20V)	KM9014	*
Low Noise (25V)	LN9014	
Driver 0.1A/40V	CX904	*
0.5A/40V	CX906	*
1A/40V	CX908	*
1A/60V	CL855	*
1A/80V	MH8108	*
Output 0.5 ~1W	CL055	*
1.5 ~2W	CL155	*
3 ~5W	MH8100	*
7 ~15W	MH8700	*
18 ~25W	MH8500	
30W up	CX705A	

* Also suitable for medium speed switching and universal applications.

APPLICATIONS	REFERENCE DATA SHEETS
LOW VCE(sat) @ 1A	CL155
DARLINGTON AMPLIFIER	MPS-A13

APPLICATIONS	REFERENCE DATA SHEETS
GERMANIUM REPLACEMENT	MSB492
27 MHz LOW POWER	MPS8000 PN2222
PHOTO DETECTOR	
$I_L \approx 50\,\mu A$	MEL31
$I_L \approx 1mA$	FPT100
$I_L \approx 5mA$	MEL11
$I_L \approx 15mA$ up	CL138
Silicon Chip	S110
TRIGGERING & TIMING	
3-terminal type	MEU21
4-terminal type	MAS32
HIGH VOLTAGE	
0.1A (TO-92)	CX703
0.1A (TO-220)	MH7301
2A (TO-220)	CX701
5A (TO-220)	CX702
INTERGRATED CIRCUIT	
Digital Alarm Clock	MD8009
Precision Timer	ML555
Digit Driver	ML1060
Voltage Regulator	ML2005
V-F Converter	ML9400
BLINKING TOY KIT	D20.U20

NOTE : For Miniature Transistors, see BC146, BC200.
For N-Channel JFETs, see 2N3823.
For Rectifiers and LEDs, see individual catalogues.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES $I_C \approx 0.1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES $I_C \approx 0.5A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES $I_C \approx 1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES $I_C \approx 3A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES $I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
		USE → / V_{CEO}, H_{FE} (Note)										
BC107		TO-18				45B						
BC108	BC107	TO-18				20B						
BC109	BC107	TO-18			20B							
BC140		TO-39						40A				
BC141	BC140	TO-39						60Y				
BC146		MT-42 (Miniature)			20B							
BC160		TO-39						-40A				
BC161	BC160	TO-39						-60Y				
BC167	BC107	TO-92B				45B						
BC168	BC107	TO-92B				20B						
BC169	BC107	TO-92B			20B							
BC177		TO-18				-45B						
BC178	BC177	TO-18				-25B						
BC179	BC177	TO-18			-20B							
BC182		TO-92F					50A					
BC200		MT-42 (Miniature)			-20A							
BC204	BC177	TO-106				-45B						
BC205	BC177	TO-106				-20B						
BC206	BC177	TO-106			-20B							
BC207	BC107	TO-106				45B						
BC208	BC107	TO-106				25B						
BC209	BC107	TO-106			25B							
BC212	BC182	TO-92F					-50A					
BC237	BC107	TO-92F				45B						
BC238	BC107	TO-92F				20B						
BC239	BC107	TO-92F			20B							
BC257	BC177	TO-92B				-45B						
BC258	BC177	TO-92B				-25B						
BC259	BC177	TO-92B			-20B							
BC286		TO-39						60Y				
BC287	BC286	TO-39						-60Y				
BC300		TO-39						80Y				
BC301	BC300	TO-39						60Y				
BC302	BC300	TO-39						45A				
BC303		TO-39						-60Y				
BC304	BC303	TO-39						-45A				

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

VCEO, HFE (Note) / USE / CASE			RF-IF SMALL SIGNAL		GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES						HIGH VOLTAGE	
DEVICE TYPE	DATA SHEET	CASE	$f_T \approx 600MHz$	$f_T \approx 400MHz$	Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	$I_C \approx 0.1A$	
BC307	BC177	TO-92F				-45B						
BC308	BC177	TO-92F				-25B						
BC309	BC177	TO-92F			-20B							
BC317	BC107	TO-92A				45B						
BC318	BC107	TO-92A				30B						
BC319	BC107	TO-92A			20B							
BC320	BC177	TO-92A				-45B						
BC321	BC177	TO-92A				-30B						
BC322	BC177	TO-92A			-20B							
BC327		TO-92F						-45A				
BC328	BC327	TO-92F						-25A				
BC337		TO-92F						45A				
BC338	BC337	TO-92F						25A				
BC413		TO-92F			30B							
BC414	BC413	TO-92F			45B							
BC415	BC413	TO-92F			-35B							
BC416	BC413	TO-92F			-45B							
BC431		TO-92F						60Y				
BC432	BC431	TO-92F						-60Y				
BC440		TO-39						40A				
BC441	BC440	TO-39						60Y				
BC460	BC440	TO-39						-40A				
BC461	BC440	TO-39						-60Y				
BC527		TO-92A						-60Y				
BC528	BC527	TO-92A						-80Y				
BC537		TO-92A						60Y				
BC538	BC537	TO-92A						80Y				
BC546		TO-92F				65A						
BC547	BC546	TO-92F				45B						
BC548	BC546	TO-92F				30B						
BC549	BC546	TO-92F			30B							
BC550	BC546	TO-92F			45B							
BC556		TO-92F				-65A						
BC557	BC556	TO-92F				-45B						
BC558	BC556	TO-92F				-30B						
BC559	BC556	TO-92F			-30B							

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
BC560	BC556	TO-92F			-45B							
BC727		TO-92A						-40A				
BC728	BC727	TO-92A						-25A				
BC737		TO-92A						40A				
BC738	BC737	TO-92A						25A				
BD220		TO-220B							70X	(low speed)		
BD221	BD220	TO-220B							40X	(low speed)		
BD222	BD220	TO-220B							60X	(low speed)		
BD239		TO-220B							45Y			
BD239A	BD239	TO-220B							60Y			
BD239B	BD239	TO-220B							80X			
BD239C		TO-220B							100X			
BD240		TO-220B							-45Y			
BD240A	BD240	TO-220B							-60Y			
BD240B	BD240	TO-220B							-80X			
BD240C	BD239C	TO-220B							-100X			
BD241		TO-220B							45Y			
BD241A	BD241	TO-220B							60Y			
BD241B	BD241	TO-220B							80X			
BD241C	BD239C	TO-220B							100X			
BD242		TO-220B							-45Y			
BD242A	BD242	TO-220B							-60Y			
BD242B	BD242	TO-220B							-80X			
BD242C	BD239C	TO-220B							-100X			
BD533		TO-220B								45Y		
BD534		TO-220B								-45Y		
BD535	BD533	TO-220B								60Y		
BD536	BD534	TO-220B								-60Y		
BD537	BD533	TO-220B								80X		
BD538	BD534	TO-220B								-80X		
BD633		TO-220B							45Y			
BD634	BD633	TO-220B							-45Y			
BD635	BD633	TO-220B							60Y			

Header corner: V_{CEO}, H_{FE} (Note) / USE

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL		GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES						HIGH VOLTAGE	
VCEO, HFE (Note) / USE			$f_T \approx 600MHz$	$f_T \approx 400MHz$	Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	$I_C \approx 0.1A$	
BD636	BD633	TO-220B							-60Y			
BD637	BD633	TO-220B							80X			
BD638	BD633	TO-220B							-80X			
BF158		TO-106	12X									
BF159	BF158	TO-106	20X									
BF160	BF158	TO-106	12X									
BF244	2N3823	TO-92DA	N-JFET									
BF245	2N3823	TO-92DE	N-JFET									
BF254		TO-92E		20Y								
BF255	BF254	TO-92E		20X								
BF256	2N3823	TO-92DE	N-JFET									
BF257		TO-39									160Y	
BF258	BF257	TO-39									250Y	
BF259	BF257	TO-39									300X	
BF297		TO-92F									160Y	
BF298	BF297	TO-92F									250Y	
BF299	BF297	TO-92F									300X	
BF336		TO-39									180Y	
BF337	BF336	TO-39									200Y	
BF338	BF336	TO-39									225X	
BF368		TO-92A	15X									
BF369	BF368	TO-92A	20Y									
BF391		TO-92A									200Y	
BF392	BF391	TO-92A									250Y	
BF393	BF391	TO-92A									300X	
BF494		TO-92E		20Y								
BF495	BF494	TO-92E		20X								
CL055		TO-92A						-20A (low VCEK)				
CL066	CL055	TO-92A						20A (low VCEK)				
CL138		TO-106	Photo Darlington Transistor									

Note: (1) VCEO in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL: $f_T \approx 600MHz$	RF-IF SMALL SIGNAL: $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: Low Noise	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.5A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 3A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 7A$	HIGH VOLTAGE: $I_C \approx 0.1A$	
CL155		TO-92A						-25A	(low VCEK)			
CL166	CL155	TO-92A						25A	(low VCEK)			
CL855		TO-92A						-60Y				
CL866	CL855	TO-92A						60Y				
CX701		TO-220B							120X			
CX701A	CX701	TO-220B							150X			
CX702		TO-220B								80X		
CX702A	CX702	TO-220B								100X		
CX703		TO-92A									160Y	
CX703A	CX703	TO-92A									200Y	
CX703B	CX703	TO-92A									250X	
CX704		TO-220B							50Y			
CX705		TO-3								45X (low speed)		
CX705A	CX705	TO-3								60X (low speed)		
CX754	CX704	TO-220B							-50Y			
CX901		TO-92A				40X						
CX904		TO-92A				40B						
CX906		TO-92A					40A					
CX908		TO-92A						40A				
CX917		TO-92A		30X								
CX918		TO-92A	20X									
CX954	CX904	TO-92A				-40B						
CX956	CX906	TO-92A					-40A					
CX958	CX908	TO-92A						-40A				
D20.U20			Blinking Toy Kit									
D44C		TO-220B							30 ~ 80X			
D45C		TO-220B							-30 ~ -80X			

Note: (1) VCEO in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL: $f_T \approx 600MHz$	RF-IF SMALL SIGNAL: $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE: $I_C \approx 0.1A$	
EN930		TO-106			45B							
FPT100		TO-106	Photo Transistor									
FPT100A	FPT100	TO-106	Photo Transistor									
FPT100B	FPT100	TO-106	Photo Transistor									
KM901	KM PRODUCT LINE	TO-92A				20X						Ideal for FM/AM and radio control applications.
KM904		TO-92A					20A					
KM905		TO-92A					-20A					
KM917		TO-92A		20X								
KM918		TO-92A	12X									
KM928		TO-92A	20X									
KM934		TO-92A					30A					
KM935		TO-92A					-30A					
KM9014		TO-92A				20B						
KM9015		TO-92A				-20B						
LN9014		TO-92A			25B							
LN9015	LN9014	TO-92A			-25B							
MAS32		TO-72	Silicon Controlled Switch									
MAS39		TO-72	Silicon Controlled Switch									
MD8009			Digital Alarm Clock (I.C.)									
MEL11		TO-106	Photo Darlington Transistor									
MEL12	MEL11	TO-106	Photo Darlington Transistor									
MEL31		TO-106	Photo Transistor									

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL		GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES						HIGH VOLTAGE	
VCEO, HFE (Note) / USE			fT ≈ 600MHz	fT ≈ 400MHz	Low Noise	IC ≈ 0.1A	IC ≈ 0.5A	IC ≈ 1A	IC ≈ 3A	IC ≈ 7A	IC ≈ 0.1A	
MEL32	MEL31	TO-106	Photo Transistor									
MEU21		TO-106	Programmable Unijunction Transistor									
MEU22	MEU21	TO-106	Programmable Unijunction Transistor									
MH0810	MH8100	TO-220B							-30Y			
MH0816	MH8106	TO-220B						-60Y				
MH0818	MH8106	TO-220B						-80Y				
MH0850	MH8500	TO-220B								-60Y		
MH0870	MH8700	TO-220B							-50Y			
MH7301		TO-220B									160Y	
MH7302	MH7301	TO-220B									200Y	
MH7303	MH7301	TO-220B									250X	
MH8100		TO-220B							30Y			
MH8106		TO-220B						60Y				
MH8108		TO-220B						80Y				
MH8500		TO-220B								60Y		
MH8700		TO-220B							50Y			
ML555			Timer (I.C.)									
ML1060			Digit Driver (I.C.)									
ML2005			5-Volt Voltage Regulator (I.C.)									
ML9400			Voltage to Frequency Converter (I.C.)									
MPS2711	MPS6565	TO-92A				18X						
MPS2712	MPS6565	TO-92A				18A						
MPS2716	MPS6565	TO-92A				18A						
MPS2923	MPS6565	TO-92A				25Y						

Note: (1) VCEO in volts, positive value for NPN and negative value for PNP.
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DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
MPS2924	MPS6565	TO-92A				25A						
MPS2925	MPS6565	TO-92A				25B						
MPS3390	MPS6565	TO-92A				25C						
MPS3391	MPS6565	TO-92A				25B						
MPS3392	MPS6565	TO-92A				25A						
MPS3393	MPS6565	TO-92A				25Y						
MPS3394	MPS6565	TO-92A				25X						
MPS3395	MPS6565	TO-92A				25B						
MPS3396	MPS6565	TO-92A				25A						
MPS3397	MPS6565	TO-92A				25A						
MPS3398	MPS6565	TO-92A				25B						
MPS3638		TO-92A					-25Y					
MPS3638A	MPS3638	TO-92A					-25A					
MPS3702	2N3702	TO-92A					-25A					
MPS3703	2N3702	TO-92A					-30Y					
MPS3704	2N3702	TO-92A					30A					
MPS3705	2N3702	TO-92A					30Y					
MPS3706	2N3702	TO-92A					20A					
MPS3707	MPS6565	TO-92A				30B						
MPS3708	MPS6565	TO-92A				30B						
MPS3709	MPS6565	TO-92A				30Y						
MPS3710	MPS6565	TO-92A				30A						
MPS3711	MPS6565	TO-92A				30B						
MPS4354		TO-92A						-60Y				
MPS4355	MPS4354	TO-92A						-60A				
MPS4356	MPS4354	TO-92A						-80Y				
MPS5172	MPS6565	TO-92A				25B						
MPS6512	MPS6565	TO-92A				30X						
MPS6513	MPS6565	TO-92A				30Y						
MPS6530		TO-92A					40Y					
MPS6531	MPS6530	TO-92A					40A					
MPS6532	MPS6530	TO-92A					30Y					
MPS6533	MPS6530	TO-92A					-40Y					
MPS6534	MPS6530	TO-92A					-40A					
MPS6535	MPS6530	TO-92A					-30Y					
MPS6560		TO-92A						25A				

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

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MPS6561	MPS6560	TO-92A						20A				
MPS6562	MPS6560	TO-92A						-25A				
MPS6563	MPS6560	TO-92A						-20A				
MPS6565		TO-92A				45Y						
MPS6566	MPS6565	TO-92A				45A						
MPS6573	MPS6565	TO-92A				35B						
MPS6574	MPS6565	TO-92A				35A						
MPS6575	MPS6565	TO-92A				45B						
MPS6576	MPS6565	TO-92A				45A						
MPS8000		TO-92A						30A (27MHz)				
MPSA05		TO-92A						60Y				
MPSA06	MPSA05	TO-92A						80Y				
MPSA13		TO-92A	NPN Darlington									
MPSA14	MPSA13	TO-92A	NPN Darlington									
MPSA20		TO-92A				40A						
MPSA42		TO-92A									300X	
MPSA43	MPSA42	TO-92A									200Y	
MPSA55	MPSA05	TO-92A						-60Y				
MPSA56	MPSA05	TO-92A						-80Y				
MPSA65	MPSA13	TO-92A	PNP Darlington									
MPSA66	MPSA13	TO-92A	PNP Darlington									
MPSA70	MPSA20	TO-92A				-40A						
MPSD01		TO-92A									200Y	
MPSD05		TO-92A					25A					
MPSD55	MPSD05	TO-92A					-25A					
MPSL01		TO-92A									120Y	

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MSB492		TO-92A						-20A				
PN2222	2N2222	TO-92A					30A					
PN2222A	2N2222	TO-92A					40A					
PN2907	2N2907	TO-92A					-40A					
PN2907A	2N2907	TO-92A					-60A					
PN3563	2N3563	TO-92A	12Y									
PN3565	2N3565	TO-92A				25B						
PN3567	MPS4354	TO-92A						40Y				
PN3568	MPS4354	TO-92A						60Y				
PN3569	MPS4354	TO-92A						40A				
PN3641	MPS3638	TO-92A					30Y					
PN3642	MPS3638	TO-92A					45Y					
PN3643	MPS3638	TO-92A					30A					
PN3644	MPS3638	TO-92A					-45A					
PN3645	MPS3638	TO-92A					-60A					
PN5128	MPS3638	TO-92A					12A					
PN5130	2N3563	TO-92A	12X									
PN5132	2N3563	TO-92A		20X								
PN5138	2N3565	TO-92A				-30B						
PN5142	MPS3638	TO-92A					-20Y					
RN4918		TO-220B							-40X			
RN4919	RN4918	TO-220B							-60X			
RN4920	RN4918	TO-220B							-80X			
RN4921		TO-220B							40X			
RN4922	RN4921	TO-220B							60X			
RN4923	RN4921	TO-220B							80X			
			Photo Transistor Chip									

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
SE4010	EN930	TO-106			45B							
2N930		TO-18			45B							
2N2102		TO-39						65Y				
2N2222		TO-18					30A					
2N2222A	2N2222	TO-18					40A					
2N2586		TO-18			45B							
2N2711	MPS6565	TO-92B				18X						
2N2712	MPS6565	TO-92B				18A						
2N2716	MPS6565	TO-92B				18A						
2N2907		TO-18					-40A					
2N2907A	2N2907	TO-18					-60A					
2N2923	MPS6565	TO-92B				25Y						
2N2924	MPS6565	TO-92B				25A						
2N2925	MPS6565	TO-92B				25B						
2N3019		TO-39						80A				
2N3020	2N3019	TO-39						80Y				
2N3053		TO-39						40A				
2N3107		TO-39						60A				
2N3108	2N3107	TO-39						60Y				
2N3109	2N3107	TO-39						40A				
2N3110	2N3107	TO-39						40Y				
2N3390	MPS6565	TO-92B				25C						
2N3391	MPS6565	TO-92B				25B						
2N3392	MPS6565	TO-92B				25A						
2N3393	MPS6565	TO-92B				25Y						
2N3394	MPS6565	TO-92B				25X						
2N3395	MPS6565	TO-92B				25B						
2N3396	MPS6565	TO-92B				25A						
2N3397	MPS6565	TO-92B				25A						
2N3398	MPS6565	TO-92B				25B						
2N3402	2N3702	TO-92B					25A					
2N3403	2N3702	TO-92B					25B					
2N3404	2N3702	TO-92B					50A					

The header's corner cell reads: V_{CEO}, H_{FE} (Note) / USE / DEVICE TYPE / DATA SHEET / CASE.

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.

(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL: $f_T \approx 600MHz$	RF-IF SMALL SIGNAL: $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: Low Noise	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.5A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 3A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 7A$	HIGH VOLTAGE: $I_C \approx 0.1A$	
2N3405	2N3702	TO-92B					50B					
2N3414	2N3702	TO-92B					25A					
2N3415	2N3702	TO-92B					25B					
2N3416	2N3702	TO-92B					50A					
2N3417	2N3702	TO-92B					50B					
2N3548	2N930	TO-18			-45B							
2N3563		TO-106	12Y									
2N3565		TO-106				25B						
2N3691		TO-106				25Y						
2N3692	2N3691	TO-106				25A						
2N3693	2N3691	TO-106		45Y								
2N3694	2N3691	TO-106		45A								
2N3702		TO-92B					-25A					
2N3703	2N3702	TO-92B					-30Y					
2N3704	2N3702	TO-92B					30A					
2N3705	2N3702	TO-92B					30Y					
2N3706	2N3702	TO-92B					20A					
2N3707		TO-92B				30B						
2N3708	2N3707	TO-92B				30B						
2N3709	2N3707	TO-92B				30Y						
2N3710	2N3707	TO-92B				30A						
2N3711	2N3707	TO-92B				30B						
2N3819	2N3823	TO-92DA	N-JFET									
2N3823		TO-72	N-JFET									
2N3825		TO-92B	15X									
2N3827	2N3825	TO-92B		45A								
2N3843	2N3691	TO-92B				30 ($H_{FE} \approx 33$)						
2N3843A	2N3691	TO-92B				30 ($H_{FE} \approx 33$)						
2N3844	2N3691	TO-92B				30X						
2N3844A	2N3691	TO-92B				30X						
2N3845	2N3691	TO-92B				30Y						
2N3845A	2N3691	TO-92B				30Y						
2N3854	2N3691	TO-92B		18X								
2N3854A	2N3691	TO-92B		30X								
2N3855	2N3691	TO-92B		18Y								
2N3855A	2N3691	TO-92B		30Y								

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.

(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
2N3856	2N3691	TO-92B		18A								
2N3856A	2N3691	TO-92B		30A								
2N3858	2N3691	TO-92B				30Y						
2N3859	2N3691	TO-92B				30A						
2N3860	2N3691	TO-92B				30A						
2N3964	2N2586	TO-18			-45B							
2N4030		TO-39						-60Y				
2N4031	2N4030	TO-39						-80Y				
2N4032	2N4030	TO-39						-60A				
2N4033	2N4030	TO-39						-80A				
2N4036	2N2102	TO-39						-65Y				
2N4037	2N3053	TO-39						-40A				
2N4058	2N3707	TO-92B				-30B						
2N4059	2N3707	TO-92B				-30B						
2N4060	2N3707	TO-92B				-30Y						
2N4061	2N3707	TO-92B				-30A						
2N4062	2N3707	TO-92B				-30B						
2N4234		TO-39						-40Y				
2N4235	2N4234	TO-39						-60Y				
2N4237	2N4234	TO-39						40Y				
2N4238	2N4234	TO-39						60Y				
2N4248		TO-106			-40A							
2N4249	2N4248	TO-106			-60A							
2N4250	2N4248	TO-106			-40C							
2N4302	2N3823	TO-106	N-JFET									
2N4303	2N3823	TO-106	N-JFET									
2N4304	2N3823	TO-106	N-JFET									
2N4400		TO-92A					40Y					
2N4401	2N4400	TO-92A					40A					
2N4402		TO-92A					-40Y					
2N4403	2N4402	TO-92A					-40A					
2N4416	2N3823	TO-72	N-JFET									
2N4424	2N3702	TO-92B					40B					
2N4425	2N3702	TO-92B					40B					
2N4926		TO-39									200Y	
2N4927	2N4926	TO-39									250Y	

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
	V_{CEO}, H_{FE} (Note)	USE										
2N4964		TO-106				-40A						
2N4965	2N4964	TO-106				-40B						
2N4966	2N4964	TO-106				40A						
2N4967	2N4964	TO-106				40B						
2N4968	2N4964	TO-106				25A						
2N4994		TO-92F		45Y								
2N4995	2N4994	TO-92F		45A								
2N5086		TO-92A			-50B							
2N5087	2N5086	TO-92A			-50C							
2N5088	2N5086	TO-92A			30C							
2N5089	2N5086	TO-92A			25C							
2N5103	2N3823	TO-72	N-JFET									
2N5104	2N3823	TO-72	N-JFET									
2N5130	2N3563	TO-106	12X									
2N5132	2N3563	TO-106		20X								
2N5138	2N3565	TO-106				-30B						
2N5163	2N3823	TO-106	N-JFET									
2N5172	MPS6565	TO-92B				25B						
2N5209		TO-92A			50B							
2N5210	2N5209	TO-92A			50C							
2N5220	2N3702	TO-92A					15A					
2N5221	2N3702	TO-92A					-15A					
2N5225	2N3702	TO-92A					25A					
2N5226	2N3702	TO-92A					-25A					
2N5232	2N3691	TO-92B				50B						
2N5232A	2N3691	TO-92B				50B						
2N5245	2N3823	TO-92DE	N-JFET									
2N5246	2N3823	TO-92DE	N-JFET									
2N5247	2N3823	TO-92DE	N-JFET									
2N5248	2N3823	TO-92DA	N-JFET									
2N5294		TO-220B							70X (low speed)			
2N5296	2N5294	TO-220B							40X (low speed)			
2N5298	2N5294	TO-220B							60X (low speed)			
2N5354	2N3702	TO-92B					-25Y					
2N5355	2N3702	TO-92B					-25A					
2N5356	2N3702	TO-92B					-25B					

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL $f_T \approx 600MHz$	RF-IF SMALL SIGNAL $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	HIGH VOLTAGE $I_C \approx 0.1A$	
		USE / V_{CEO}, H_{FE} (Note)										
2N5365	2N3702	TO-92B					-40Y					
2N5366	2N3702	TO-92B					-40A					
2N5367	2N3702	TO-92B					-40B					
2N5368	2N5368	TO-92F					30Y					
2N5369	2N5368	TO-92F					30A					
2N5370	2N5368	TO-92F					30B					
2N5371		TO-92F					30A					
2N5372	2N5368	TO-92F					-30Y					
2N5373	2N5368	TO-92F					-30A					
2N5374	2N5368	TO-92F					-30B					
2N5375	2N5368	TO-92F					-30A					
2N5400		TO-92A									-120Y	
2N5401	2N5400	TO-92A									-150Y	
2N5418	2N3702	TO-92B					25Y					
2N5419	2N3702	TO-92B					25A					
2N5420	2N3702	TO-92B					25B					
2N5447		TO-92F					-25A					
2N5448	2N5447	TO-92F					-30Y					
2N5449	2N5447	TO-92F					30A					
2N5450	2N5447	TO-92F					30Y					
2N5451	2N3702	TO-92F					20A					
2N5457	2N3823	TO-92DD	N-JFET									
2N5458	2N3823	TO-92DD	N-JFET									
2N5459	2N3823	TO-92DD	N-JFET									
2N5484	2N3823	TO-92DD	N-JFET									
2N5485	2N3823	TO-92DD	N-JFET									
2N5486	2N3823	TO-92DD	N-JFET									
2N5490		TO-220B								40X (low speed)		
2N5492	2N5490	TO-220B								55X (low speed)		
2N5494	2N5490	TO-220B								40X (low speed)		
2N5496	2N5490	TO-220B								70X (low speed)		
2N5550	2N5400	TO-92A									140Y	
2N5551	2N5400	TO-92A									160A	
2N5556	2N3823	TO-72	N-JFET									
2N5557	2N3823	TO-72	N-JFET									
2N5558	2N3823	TO-72	N-JFET									

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. $X \approx 65$, $Y \approx 100$, $A \approx 165$, $B \approx 300$, $C \approx 500$.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL		GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES						HIGH VOLTAGE	
V_{CEO}, H_{FE} (Note)		USE	$f_T \approx 600MHz$	$f_T \approx 400MHz$	Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	$I_C \approx 0.1A$	
2N5668	2N3823	TO-92DD	N-JFET									
2N5669	2N3823	TO-92DD	N-JFET									
2N5670	2N3823	TO-92DD	N-JFET									
2N5810		TO-92F						25A				
2N5811	2N5810	TO-92F						-25A				
2N5812	2N5810	TO-92F						25B				
2N5813	2N5810	TO-92F						-25B				
2N5814	2N5810	TO-92F						40Y				
2N5815	2N5810	TO-92F						-40Y				
2N5816	2N5810	TO-92F						40A				
2N5817	2N5810	TO-92F						-40A				
2N5818	2N5810	TO-92F						40B				
2N5819	2N5810	TO-92F						-40B				
2N5820		TO-92F						60Y				
2N5821	2N5820	TO-92F						-60Y				
2N5822	2N5820	TO-92F						60A				
2N5823	2N5820	TO-92F						-60A				
2N5824		TO-92F				40Y						
2N5825	2N5824	TO-92F				40A						
2N5826	2N5824	TO-92F				40A						
2N5827	2N5824	TO-92F				40B						
2N5828	2N5824	TO-92F				40C						
2N6027		TO-92	Programmable Unijunction Transistor									
2N6028	2N6027	TO-92	Programmable Unijunction Transistor									
2N6107	2N6111	TO-220B								-70X		
2N6109	2N6111	TO-220B								-50Y		
2N6111		TO-220B								-30Y		
2N6121		TO-220B							45X			
2N6122	2N6121	TO-220B							60X			
2N6123	2N6121	TO-220B							80X			
2N6124		TO-220B							-45X			
2N6125	2N6124	TO-220B							-60X			
2N6126	2N6124	TO-220B							-80X			
2N6129		TO-220B								40X		
2N6130	2N6129	TO-220B								60X		
2N6131	2N6129	TO-220B								80X		

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL		GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES						HIGH VOLTAGE	
V_{CEO}, H_{FE} (Note) / USE			$f_T \approx 600MHz$	$f_T \approx 400MHz$	Low Noise	$I_C \approx 0.1A$	$I_C \approx 0.5A$	$I_C \approx 1A$	$I_C \approx 3A$	$I_C \approx 7A$	$I_C \approx 0.1A$	
2N6132		TO-220B								-40X		
2N6133	2N6132	TO-220B								-60X		
2N6134	2N6132	TO-220B								-80X		
2N6218		TO-92F									300X	
2N6219	2N6218	TO-92F									250X	
2N6220	2N6218	TO-92F									200Y	
2N6221	2N6218	TO-92F									150Y	
2N6288		TO-220B								30Y		
2N6290	2N6288	TO-220B								50Y		
2N6292	2N6288	TO-220B								70X		
2N6473		TO-220B								100X		
2N6474	2N6473	TO-220B								120X		
2N6475	2N6473	TO-220B								-100X		
2N6476	2N6473	TO-220B								-120X		
2SA473		TO-220B							-30A			
2SA489		TO-220B								-60X		
2SA490		TO-220B							-40Y			
2SA539		TO-92B					-45Y					
2SA564		TO-92B				-25B						
2SA564A		TO-92B				-45B						
2SA666		TO-92B			-25B							
2SA671		TO-220B							-50Y			
2SA719		TO-92B						-25A				
2SA720		TO-92B						-50A				
2SA730		TO-92B						-25A				
2SA731		TO-92B						-50A				
2SA816		TO-220B						-80Y				
2SA817		TO-92B						-80Y				
2SB512		TO-220B							-60X			
2SB512A	2SB512	TO-220B							-80X			

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. $X \approx 65$, $Y \approx 100$, $A \approx 165$, $B \approx 300$, $C \approx 500$.

DEVICE SELECTION GUIDE

DEVICE TYPE	DATA SHEET	CASE	RF-IF SMALL SIGNAL: $f_T \approx 600MHz$	RF-IF SMALL SIGNAL: $f_T \approx 400MHz$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: Low Noise	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 0.5A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 1A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 3A$	GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHES: $I_C \approx 7A$	HIGH VOLTAGE: $I_C \approx 0.1A$	
V_{CEO}, H_{FE} (Note) / USE												
2SB596	2SA489	TO-220B								-80X		
2SB604	2SA489	TO-220B								-70X		
2SC644	2SA666	TO-92B			25B							
2SC789		TO-220B								60X		
2SC790	2SA490	TO-220B							40Y			
2SC815	2SA539	TO-92B					45Y					
2SC828	2SA564	TO-92B				25B						
2SC828A	2SA564	TO-92B				45B						
2SC829		TO-92B		20Y								
2SC838		TO-92B		25Y								
2SC839	2SC838	TO-92B		25Y								
2SC922		TO-92B	20Y									
2SC1047	2SC922	TO-92B	20Y									
2SC1048		TO-39									200Y	
2SC1061	2SA671	TO-220B							50Y			
2SC1173	2SA473	TO-220B							30A			
2SC1317	2SA719	TO-92B						25A				
2SC1318	2SA719	TO-92B						50A				
2SC1346	2SA719	TO-92B						25A				
2SC1347	2SA719	TO-92B						50A				
2SC1626	2SA816	TO-220B						80Y				
2SC1627	2SA817	TO-92B						80Y				
2SD234		TO-220B							50X (low speed)			
2SD235	2SD234	TO-220B							40X (low speed)			
2SD365	2SB512	TO-220B							60X			
2SD365A	2SB512	TO-220B							80X			
2SD526	2SC789	TO-220B								80X		
2SD570	2SC789	TO-220B								70X		

Note: (1) V_{CEO} in volts, positive value for NPN and negative value for PNP.
(2) H_{FE} in X, Y, A, B, C categories. X≈65, Y≈100, A≈165, B≈300, C≈500.

BC107,8,9 BC167,8,9 BC207,8,9 BC237,8,9 BC317,8,9

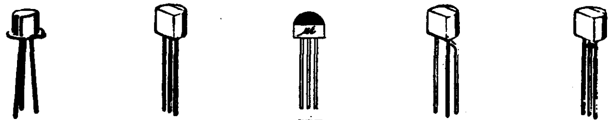
NPN SILICON AF SMALL SIGNAL TRANSISTORS

THE ABOVE TYPES ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS.

BC107, 8, 9 are complementary to BC177, 8, 9
BC167, 8, 9 are complementary to BC257, 8, 9
BC207, 8, 9 are complementary to BC204, 5, 6
BC237, 8, 9 are complementary to BC307, 8, 9
BC317, 8, 9 are complementary to BC320, 1, 2

CASE

TO-18	TO-92B	TO-106	TO-92F	TO-92A



CBE	ECB	CBE	CEB	EBC
BC107,8,9	BC167,8,9	BC207,8,9	BC237,8,9	BC317,8,9

ABSOLUTE MAXIMUM RATINGS

TYPE	V_{CBO} (V)	V_{CES} (V)	V_{CEO} (V)	V_{EBO} (V)	I_C(DC) (mA)	P_{tot} (mW) *	T_j, T_{stg}
BC107	50	50	45	6	100	300	
BC108	30	30	20	5	100	300	-55 to 175°C
BC109	30	30	20	5	100	300	
BC167	50	50	45	6	100	300	
BC168	30	30	20	5	100	300	-55 to 150°C
BC169	30	30	20	5	100	300	
BC207	50		45	5	100	300	
BC208	25		25	5	100	300	-55 to 125°C
BC209	25		25	5	100	300	
BC237	50	50	45	6	100	300	
BC238	30	30	20	5	100	300	-55 to 150°C
BC239	30	30	20	5	100	300	
BC317	50		45	6	150	310	
BC318	45		30	5	150	310	-55 to 150°C
BC319	30		20	5	150	310	

* Total Power Dissipation @ $T_A \leq 25°C$

BC107,8,9 BC167,8,9 BC207,8,9 BC237,8,9 BC317,8,9

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1			V	I_C=10µA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	Note 1			V	I_C=2mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	Note 1			V	I_E=1µA I_C=0
Collector Cutoff Current BC107, 108, 109 / BC167, 168, 169 / BC237, 238, 239 only	I_{CES}			15	nA	V_{CE}=V_{CES} V_{BE}=0
				4	µA	V_{CE}=V_{CES} V_{BE}=0 T_A=125°C
Collector Cutoff Current BC207 only	I_{CBO}			15	nA	V_{CB}=40V I_E=0
				15	µA	V_{CB}=40V I_E=0 T_A=65°C
BC208, 209 only	I_{CBO}			15	nA	V_{CB}=20V I_E=0
				15	µA	V_{CB}=20V I_E=0 T_A=65°C
BC317, 318, 319 only	I_{CBO}			30	nA	V_{CB}=20V I_E=0
				15	µA	V_{CB}=20V I_E=0 T_A=100°C
Collector-Emitter Saturation Voltage BC107, 108, 109 / BC167, 168, 169 / BC207, 208, 209 / BC237, 238, 239 only	$V_{CE(sat)}$*		0.07	0.25	V	I_C=10mA I_B=0.5mA
			0.22	0.6	V	I_C=100mA I_B=5mA
BC317, 318, 319 only	$V_{CE(sat)}$*		0.07	0.2	V	I_C=10mA I_B=0.5mA
			0.2	0.5	V	I_C=100mA I_B=5mA
Base-Emitter Saturation Voltage BC107, 108, 109 / BC167, 168, 169 / BC237, 238, 239 only	$V_{BE(sat)}$*		0.7	0.83	V	I_C=10mA I_B=0.5mA
			0.9	1.05	V	I_C=100mA I_B=5mA
Base-Emitter Voltage All types	V_{BE} *	0.55	0.63	0.7	V	I_C=2mA V_{CE}=5V
BC317, 318, 319 only			0.68	0.77	V	I_C=10mA V_{CE}=5V
Current Gain-Bandwidth Product BC107, 108, 109 / BC167, 168, 169 / BC237, 238, 239 only	f_T	150	250		MHz	I_C=10mA V_{CE}=5V
Collector-Base Capacitance BC107, 108, 109	C_{ob}		3.2	6.0	pF	V_{CB}=10V I_E=0 f=1MHz
BC167, 168, 169			2.7	4.5	pF	
BC207, 208, 209			2.7	6.0	pF	
BC237, 238, 239			2.7	4.5	pF	
BC317, 318, 319			2.7	4.0	pF	
Noise Figure BC107, 108	NF		2	10	dB	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=1kHz Δf=200Hz
BC167, 168			2	10	dB	
BC207, 208			2	10	dB	
BC237, 238			2	10	dB	
BC317, 318			2	6	dB	

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

Note 1 : equal to the value of absolute maximum ratings.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Noise Figure BC109, BC169, BC209, BC239, BC319 only	NF		1.5	4	dB	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=1kHz Δf=200Hz
			1.2	4	dB	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=30Hz-15KHz

D.C. CURRENT GAIN (H_{FE}) @ V_{CE}=5V T_A=25°C

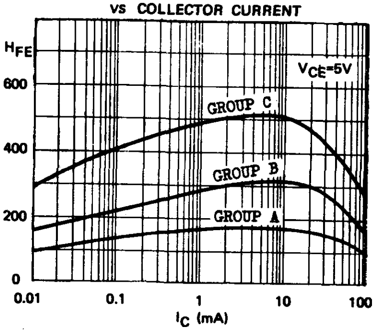
at I_C (Pulsed)	BC107, 167, 207, 237, 317 BC108, 168, 208, 238, 318			BC107, 167, 207, 237, 317 BC108, 168, 208, 238, 318 BC109, 169, 209, 239, 319			BC108, 168, 208, 238, 318 BC109, 169, 209, 239, 319		
	H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C		
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
0.01mA	40	90		40	170		100	290	
2mA	110	170	220	200	300	450	420	520	800
100mA		100			160			270	

h-PARAMETERS @ I_C=2mA V_{CE}=5V f=1kHz T_A=25°C (Note 2)

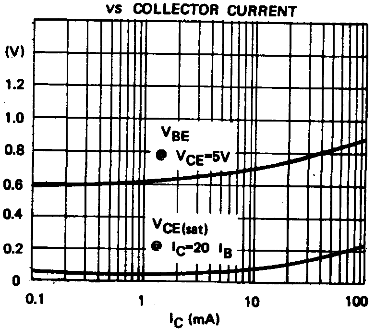
h - PARAMETER	SYMBOL	H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Impedance	h_{ie}	1.6	2.7	4.5	3.2	4.5	8.5	6	8.7	15	KΩ
Voltage Feedback Ratio	h_{re}		1.5			2			3		$x10^{-4}$
Small Signal Current Gain	h_{fe}	125	190	260	240	330	500	450	580	900	
Output Admittance	h_{oe}		18	30		30	60		60	110	μ℧

TYPICAL CHARACTERISTICS AT T_A=25°C (Pulse Test)

D.C. CURRENT GAIN
VS COLLECTOR CURRENT



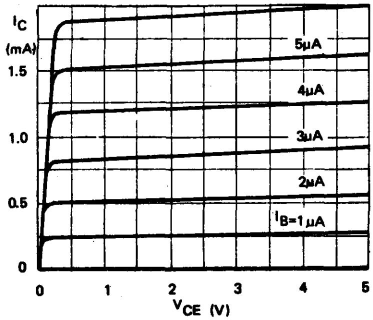
VBE AND VCE(sat)
VS COLLECTOR CURRENT



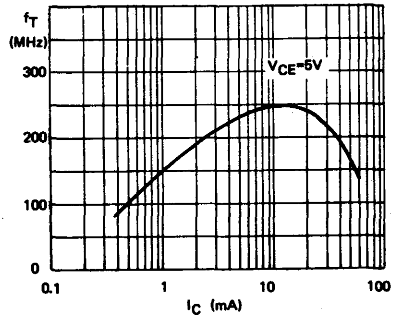
Note 2 : This table is not applicable to BC207,8,9.

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

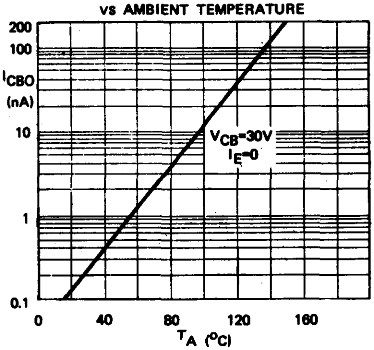
COMMON EMITTER OUTPUT CHARACTERISTICS



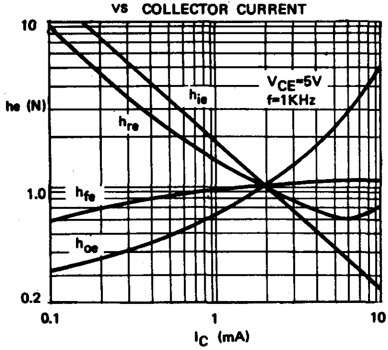
CURRENT GAIN – BANDWIDTH PRODUCT vs COLLECTOR CURRENT



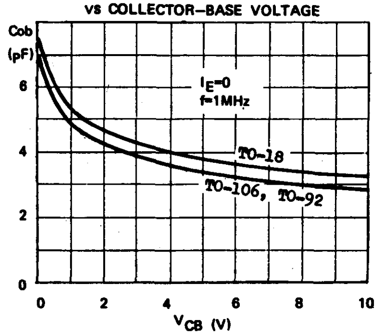
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



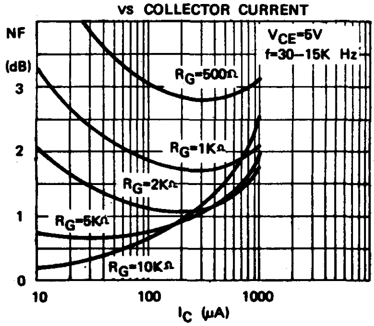
h–PARAMETERS (NORMALIZED) vs COLLECTOR CURRENT



COLLECTOR–BASE CAPACITANCE vs COLLECTOR–BASE VOLTAGE



BROAD BAND NOISE FIGURE vs COLLECTOR CURRENT



BC140 BC141

NPN SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE BC140, BC141 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THE BC140, BC141 ARE COMPLEMENTARY TO THE PNP TYPE BC160, BC161 RESPECTIVELY.

CASE TO-39

C E B

ABSOLUTE MAXIMUM RATINGS

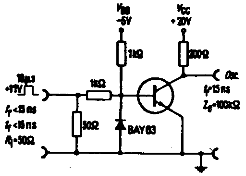
		BC140	BC141
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	80V	100V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	40V	60V
Emitter-Base Voltage	V_{EBO}	7V	7V
Collector Current	I_C	1A	
Total Power Dissipation (@ $T_C \leq 45^oC$)	P_{tot}	3.7W	
(@ $T_A \leq 45^oC$)		650mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 175°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

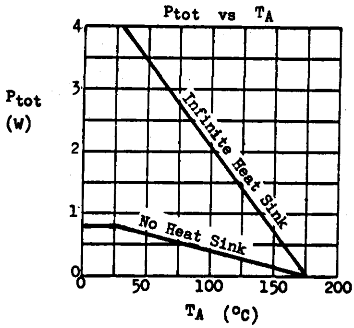
PARAMETER	SYMBOL	BC140 MIN	BC140 TYP	BC140 MAX	BC141 MIN	BC141 TYP	BC141 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CES}	80			100			V	I_C=0.1mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			60			V	I_C=50mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	7			7			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CES}			100			100	nA	V_{CES}=60V
				100			100	µA	V_{CES}=60V T_A=150°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*			1			1	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *			1.8			1.8	V	I_C=1A V_{CE}=1V
D.C. Current Gain	H_{FE} *	40		250	40		250		I_C=100mA V_{CE}=1V
Group 6		40		100	40		100		
Group 10		63		160	63		160		
Group 16		100		250	100		250		
H_{FE} Matched Pair Ratio	$\frac{H_{FE}\ 1}{H_{FE}\ 2}$ *			1.41			1.41		I_C=100mA V_{CE}=1V
Current Gain-Bandwidth Product	f_T	50	150		50	150		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		10	25		10	25	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib		80			80		pF	V_{EB}=0.5V I_C=0 f=1MHz
Turn-On Time	ton			250			250	nS	I_C=100mA I_{B1}=5mA
Turn-Off Time	toff			850			850	nS	I_C=100mA I_{B1}=-I_{B2}=5mA

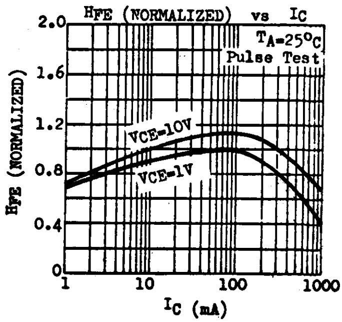
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

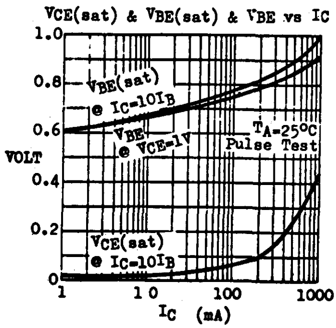
SWITCHING TIME TEST CIRCUIT (ton, toff)

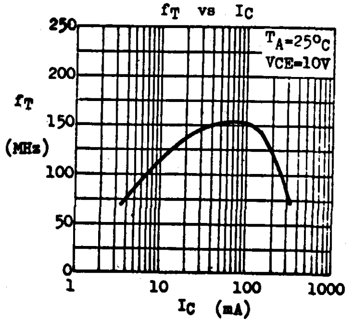


TYPICAL CHARACTERISTICS







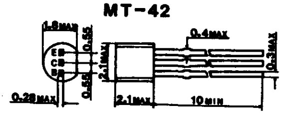


BC146

MINIATURE NPN AF LOW NOISE SILICON PLANAR EPITAXIAL TRANSISTOR

MECHANICAL OUTLINE

MT-42



ALL DIMENSIONS IN mm

GENERAL DESCRIPTION

The BC 146 is a NPN silicon planar epitaxial transistor in miniature plastic package designed for hearing aids, watches, paging systems and other equipment where small size is of paramount importance. The BC 146 is complementary to PNP BC 200.

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	20V
Collector-Emitter Voltage	V_{CEO}	20V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	50mA
Total Power Dissipation at $T_A \leqslant 45^oC$	P_{tot}	50mW
Junction Temperature	T_j	125^oC
Storage Temperature Range	T_{stg}	-65^oC to $+ 125^oC$

THERMAL RESISTANCE

Junction to Ambient	θ_{ja}	$1.6^oC/mW$

ELECTRICAL CHARACTERISTICS AT $T_A = 25^oC$

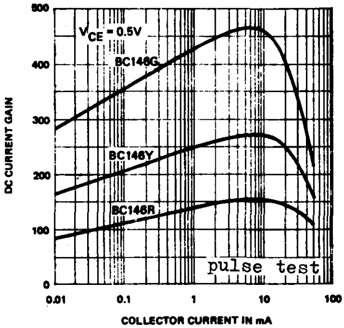
PARAMETER	SYMBOL	BC 146R MIN	BC 146R TYP	BC 146R MAX	BC 146Y MIN	BC 146Y TYP	BC 146Y MAX	BC 146G MIN	BC 146G TYP	BC 146G MAX	UNIT	TEST CONDITIONS
Collector-Base Cutoff Current	I_{CBO}			100			100			100	nA	V_{CB}=20V I_E=0
Collector-Emitter Knee Voltage	V_{CEK}		200			200			200		mV	I_C=2mA I_B=value for which I_C=2.2mA and V_{CE}=1V
Base-Emitter Voltage	V_{BE}		570			570			570		mV	V_{CE}=0.5V I_C=0.2mA
Base-Emitter Voltage	V_{BE}		630			630			630		mV	V_{CE}=1V I_C=2mA
DC Current Gain	H_{FE}	80	120	200	140	220	350	280	380	550		V_{CE}=0.5V I_C=0.2mA
DC Current Gain	H_{FE}	100			140			280				V_{CE}=1V I_C=2mA
Noise Figure	NF		1.5			1.5	4		1.5		dB	V_{CE}=5V I_C=0.2mA R_g=2KΩ f=30Hz–15KHz
Transition Frequency	f_T		80			110			150		MHz	V_{CE}=5V I_C=2mA
Collector Capacitance	C_{cb}		2.5			2.5			2.5		pF	V_{CB}=5V I_E=0 f=1MHz

TYPICAL h-PARAMETERS AT V_{CE}=0.5V, I_C=0.2mA, f=1KHz

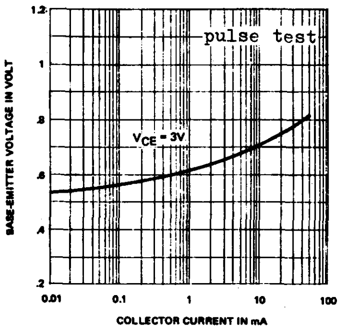
PARAMETER	SYMBOL	BC 146R	BC 146Y	BC146G	UNIT
Input Impedance	h_{ie}	20	30	45	KΩ
Reverse Voltage Transfer Ratio	h_{re}	15	25	40	$x10^{-4}$
Small Signal Current Gain	h_{fe}	130	240	400	
Output Admittance	h_{oe}	15	20	35	μυ

TYPICAL ELECTRICAL CHARACTERISTICS AT $T_A = 25^{\circ}C$

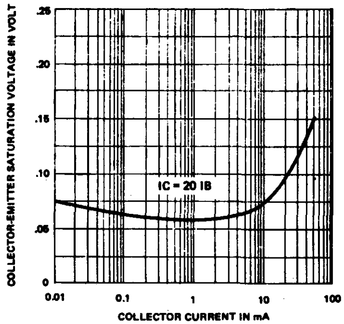
DC CURRENT GAIN VERSUS COLLECTOR CURRENT



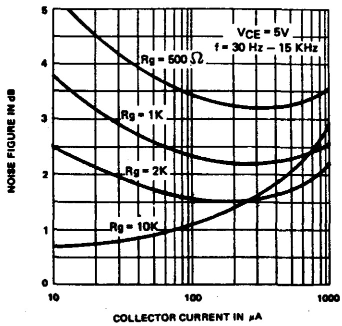
BASE-EMITTER VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



WIDE BAND NOISE FIGURE

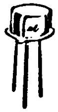


BC160 BC161

PNP SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE BC160, BC161 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THE BC160, BC161 ARE COMPLEMENTARY TO THE NPN TYPE BC140, BC141 RESPECTIVELY.

CASE TO-39



C E B

ABSOLUTE MAXIMUM RATINGS

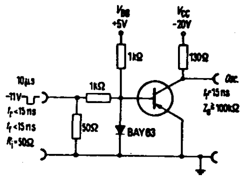
		BC160	BC161
Collector-Emitter Voltage (V_{BE}=0)	$-V_{CES}$	40V	60V
Collector-Emitter Voltage (I_B=0)	$-V_{CEO}$	40V	60V
Emitter-Base Voltage	$-V_{EBO}$	5V	5V
Collector Current	$-I_C$	1A	
Total Power Dissipation (@ $T_C \leq 45°C$)	P_{tot}	3.7W	
(@ $T_A \leq 45°C$)		650mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 175°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

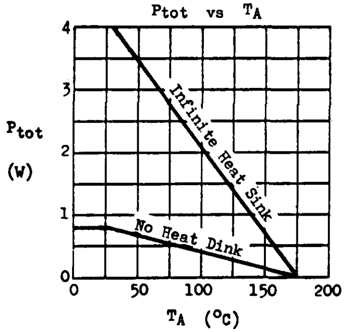
PARAMETER	SYMBOL	BC160 MIN	BC160 TYP	BC160 MAX	BC161 MIN	BC161 TYP	BC161 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-BV_{CES}$	40			60			V	$-I_C$=0.1mA V_{BE}=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	40			60			V	$-I_C$=50mA I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5			5			V	$-I_E$=0.1mA I_C=0
Collector Cutoff Current	$-I_{CES}$			100			100	nA	V_{CE}=V_{CES}
				100			100	µA	V_{CE}=V_{CES} T_A=150°C
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*			1			1	V	$-I_C$=1A $-I_B$=0.1A
Base-Emitter Voltage	$-V_{BE}$ *			1.7			1.7	V	$-I_C$=1A $-V_{CE}$=1V
D.C. Current Gain	H_{FE} *	40		250	40		250		$-I_C$=100mA $-V_{CE}$=1V
Group 6		40		100	40		100		
Group 10		63		160	63		160		
Group 16		100		250	100		250		
H_{FE} Matched Pair Ratio	$\frac{H_{FE}1}{H_{FE}2}$ *			1.41			1.41		$-I_C$=100mA $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T	50	140		50	140		MHz	$-I_C$=50mA $-V_{CE}$=10V
Collector-Base Capacitance	C_{ob}		18	30		18	30	pF	$-V_{CB}$=10V I_E=0 f=1MHz
Emitter-Base Capacitance	C_{ib}			180			180	pF	$-V_{EB}$=0.5V I_C=0 f=1MHz
Turn-On Time	t_{on}			500			500	nS	$-I_C$=100mA $-I_{B1}$=5mA
Turn-Off Time	t_{off}			650			650	nS	$-I_C$=100mA $-I_{B1}$=I_{B2}=5mA

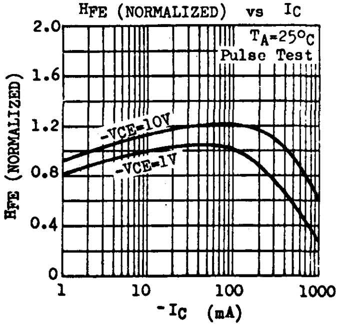
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

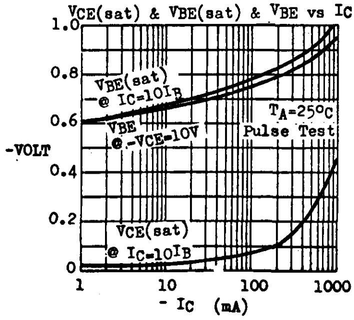
SWITCHING TIME TEST CIRCUIT (t_{on}, t_{off})

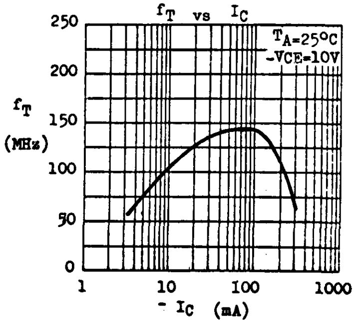


TYPICAL CHARACTERISTICS









BC177,8,9 BC204,5,6 BC257,8,9 BC307,8,9 BC320,1,2

PNP SILICON AF SMALL SIGNAL TRANSISTORS

THE ABOVE TYPES ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS.

BC177, 8, 9 are complementary to BC107, 8, 9
BC204, 5, 6 are complementary to BC207, 8, 9
BC257, 8, 9 are complementary to BC167, 8, 9
BC307, 8, 9 are complementary to BC237, 8, 9
BC320, 1, 2 are complementary to BC317, 8, 9

CASE	TO-18	TO-106	TO-92B	TO-92F	TO-92A
					
	CBE	CBE	ECB	CEB	EBC
	BC177,8,9	BC204,5,6	BC257,8,9	BC307,8,9	BC320,1,2

ABSOLUTE MAXIMUM RATINGS

TYPE	$-V_{CBO}$ (V)	$-V_{CES}$ (V)	$-V_{CEO}$ (V)	$-V_{EBO}$ (V)	$-I_C(DC)$ (mA)	P_{tot} * (mW)	T_j, T_{stg}
BC177	50	50	45	5	100	300	
BC178	30	30	25	5	100	300	-55 to 175°C
BC179	25	25	20	5	100	300	
BC204	50		45	5	100	300	
BC205	25		20	5	100	300	-55 to 125°C
BC206	25		20	5	100	300	
BC257	50	50	45	5	100	300	
BC258	30	30	25	5	100	300	-55 to 150°C
BC259	25	25	20	5	100	300	
BC307	50	50	45	5	100	300	
BC308	30	30	25	5	100	300	-55 to 150°C
BC309	25	25	20	5	100	300	
BC320	50		45	6	150	310	
BC321	45		30	5	150	310	-55 to 150°C
BC322	30		20	5	150	310	

* Total Power Dissipation @ $T_A \leq 25°C$

ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	Note 1			V	$-I_C=10\mu A$ $I_E=0$
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	Note 1			V	$-I_C=2mA$ $I_B=0$
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	Note 1			V	$-I_E=1\mu A$ $I_C=0$
Collector Cutoff Current BC177, 178, 179; BC257, 258, 259; BC307, 308, 309 only	$-I_{CES}$			15	nA	$V_{CE}=V_{CES}$ $V_{BE}=0$
				4	μA	$V_{CE}=V_{CES}$ $V_{BE}=0$ $T_A=125^oC$
Collector Cutoff Current BC204 only	$-I_{CBO}$			50	nA	$-V_{CB}=45V$ $I_E=0$
				3	μA	$-V_{CB}=45V$ $I_E=0$ $T_A=65^oC$
BC205, 206 only	$-I_{CBO}$			50	nA	$-V_{CB}=20V$ $I_E=0$
				3	μA	$-V_{CB}=20V$ $I_E=0$ $T_A=65^oC$
BC320, 321, 322 only	$-I_{CBO}$			30	nA	$-V_{CB}=20V$ $I_E=0$
				15	μA	$-V_{CB}=20V$ $I_E=0$ $T_A=100^oC$
Collector-Emitter Saturation Voltage All types	$-V_{CE}(sat)$*		0.1	0.3	V	$-I_C=10mA$ $-I_B=0.5mA$
			0.25		V	$-I_C=100mA$ $-I_B=5mA$
Collector-Emitter Knee Voltage BC177, 178, 179; BC307, 308, 309 only	$-V_{CEK}$		0.3	0.6	V	$-I_C=10mA$, I_B=value at which $-I_C=11mA$ $-V_{CE}=1V$
Base-Emitter Saturation Voltage All types	$-V_{BE}(sat)$*		0.72		V	$-I_C=10mA$ $-I_B=0.5mA$
			0.92		V	$-I_C=100mA$ $-I_B=5mA$
Base-Emitter Voltage All types	$-V_{BE}$ *	0.6	0.65	0.75	V	$-I_C=2mA$ $-V_{CE}=5V$
BC320, 321, 322 only	$-V_{BE}$ *		0.7	0.77	V	$-I_C=10mA$ $-V_{CE}=5V$
Current Gain-Bandwidth Product	f_T		180		MHz	$-I_C=10mA$ $-V_{CE}=5V$
Collector-Base Capacitance BC177, 178, 179	Cob		3.6	7	pF	$-V_{CB}=10V$ $I_E=0$ f=1MHz
BC204, 205, 206			3.2		pF	
BC257, 258, 259			3.2	6	pF	
BC307, 308, 309			3.2	6	pF	
BC320, 321, 322			3.2	4	pF	
Noise Figure BC177, 178	NF		2	10	dB	$-I_C=0.2mA$ $-V_{CE}=5V$ $R_G=2K\Omega$ f=1kHz $\Delta f=200Hz$
BC204, 205			2	10	dB	
BC257, 258			2	10	dB	
BC307, 308			2	10	dB	
BC320, 321			2	6	dB	

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

Note 1 : equal to the value of absolute maximum ratings.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Noise Figure BC179, BC206, BC259, BC309, BC322 only	NF		1.2	4	dB	$-I_C$=0.2mA $-V_{CE}$=5V R_G=2KΩ f=1KHz Δf=200Hz
			1.2	4	dB	$-I_C$=0.2mA $-V_{CE}$=5V R_G=2KΩ f=30Hz~15KHz

D.C. CURRENT GAIN (H_{FE}) @ $-V_{CE}$=5V T_A=25°C

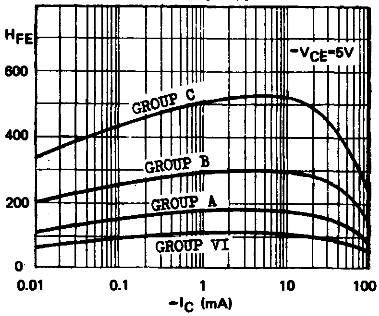
at $-I_C$ (Pulsed)	BC177,204,257,307,320 BC178,205,258,308,321			BC177,204,257,307,320 BC178,205,258,308,321			BC177,204,257,307,320 BC178,205,258,308,321 BC179,206,259,309,322			BC178,205,258,308,321 BC179,206,259,309,322		
	H_{FE} GROUP VI			H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C		
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
0.01mA		70			110			200			330	
2mA	70	110	140	110	170	220	200	300	450	420	520	800
100mA		60			80			140			240	

h - PARAMETERS @ $-I_C$=2mA $-V_{CE}$=5V f=1kHz T_A=25°C (Note 2)

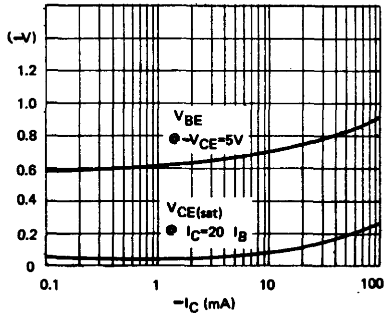
h - PARAMETER	SYMBOL	H_{FE} GROUP VI MIN TYP MAX	H_{FE} GROUP A MIN TYP MAX	H_{FE} GROUP B MIN TYP MAX	H_{FE} GROUP C MIN TYP MAX	UNIT
Input Impedance	h_{ie}	1.4	2.7	4.5	8.7	KΩ
Voltage Feedback Ratio	h_{re}	2.5	3	3.5	4	$x10^{-4}$
Small Signal Current Gain	h_{fe}	75 110 150	125 190 260	240 330 500	450 580 900	
Output Admittance	h_{oe}	20	25	35	60	u℧

TYPICAL CHARACTERISTICS AT T_A=25°C (Pulse Test)

D.C. CURRENT GAIN
VS COLLECTOR CURRENT



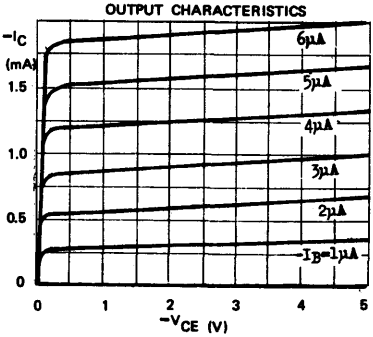
VBE AND VCE(sat)
VS COLLECTOR CURRENT



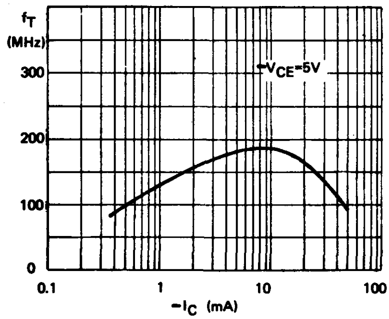
Note 2 : This table is not applicable to BC204,5,6.

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

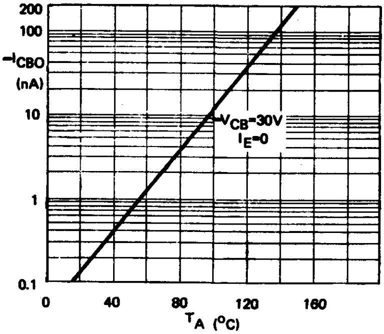
COMMON EMITTER OUTPUT CHARACTERISTICS



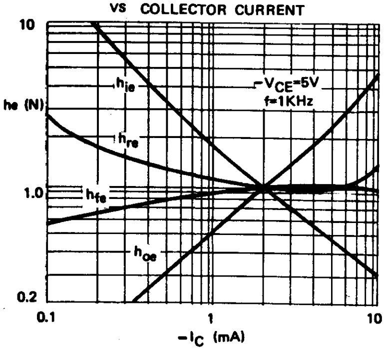
CURRENT GAIN – BANDWIDTH PRODUCT vs COLLECTOR CURRENT



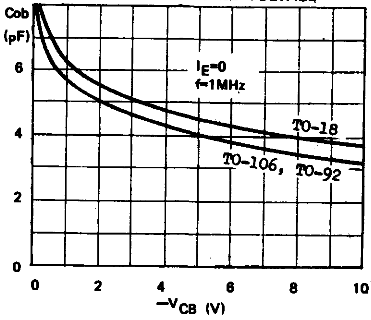
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



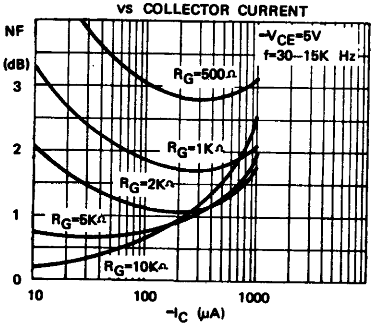
h–PARAMETERS (NORMALIZED) vs COLLECTOR CURRENT



COLLECTOR–BASE CAPACITANCE vs COLLECTOR–BASE VOLTAGE



BROAD BAND NOISE FIGURE vs COLLECTOR CURRENT



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BC182 BC212

COMPLEMENTARY
SILICON AF SMALL SIGNAL AMPLIFIERS & DRIVERS

THE BC182(NPN) AND BC212(PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIERS AND DRIVERS, AS WELL AS FOR LOW POWER UNIVERSAL APPLICATIONS. BOTH TYPES FEATURE GOOD LINEARITY OF DC CURRENT GAIN.

CASE TO-92F

CEB

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		BC182(NPN)	BC212(PNP)
Collector-Base Voltage	V_{CBO}	60V	60V
Collector-Emitter Voltage	V_{CEO}	50V	50V
Emitter-Base Voltage	V_{EBO}	6V	5V
Collector Current	I_C	200mA	
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	300mW derate 2.4mW/^oC above 25^oC	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^oC	

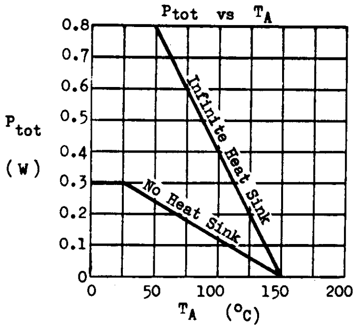
ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

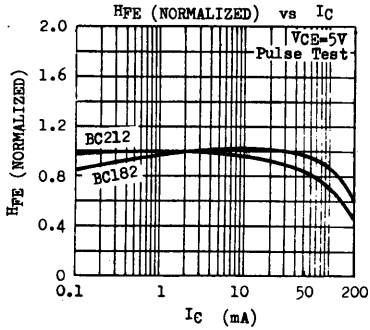
PARAMETER	SYMBOL	BC182(NPN) MIN	TYP	MAX	BC212(PNP) MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60			60			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	50			50			V	I_C=2mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6			5			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}			15				nA	V_{CB}=50V I_E=0
							15	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			15			15	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.05	0.25		0.05		V	I_C=10mA I_B=0.5mA
			0.12	0.6		0.14	0.6	V	I_C=100mA I_B=5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		0.85	1.2		0.85	1.1	V	I_C=100mA I_B=5mA
Base-Emitter Voltage	V_{BE} *	0.55	0.62	0.7	0.55	0.62	0.7	V	I_C=2mA V_{CE}=5V
D.C. Current Gain	h_{FE} *	40			40				I_C=10μA V_{CE}=5V
		120		460	60	220			I_C=2mA V_{CE}=5V
		80				110			I_C=100mA V_{CE}=5V
Small Signal Current Gain	h_{fe}								I_C=2mA V_{CE}=5V
Group A		125		260	100		300		f=1kHz
Group B		240		500	200		400		
Current Gain-Bandwidth Product	f_T	150	220		200	300		MHz	I_C=10mA V_{CE}=5V

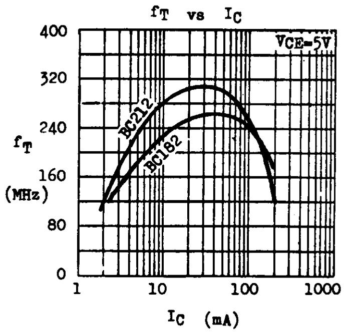
PARAMETER	SYMBOL	BC182(NPN) MIN	TYP	MAX	BC212(PNP) MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Capacitance	Cob		3.7	5		5		pF	V_{CB}=10V I_E=0 f=1MHz
Noise Figure	NF		2	10		1.5	10	dB	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=1kHz Δf=200Hz

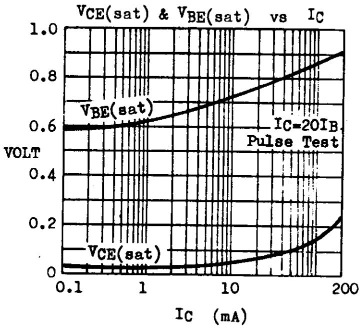
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)









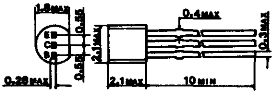
BC200

MINIATURE PNP AF LOW NOISE SILICON PLANAR EPITAXIAL TRANSISTOR

GENERAL DESCRIPTION

The BC 200 is a PNP silicon planar epitaxial transistor in miniature plastic package designed for hearing aids, watches, paging systems and other equipment where small size is of paramount importance. The BC 200 is complementary to NPN BC 146.

MECHANICAL OUTLINE
MT-42



ALL DIMENSIONS IN mm

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	$-V_{CBO}$	20V
Collector-Emitter Voltage	$-V_{CEO}$	20V
Emitter-Base Voltage	$-V_{EBO}$	5V
Collector Current	$-I_C$	50mA
Total Power Dissipation at $T_A \leq 45^oC$	P_{tot}	50mW
Junction Temperature	T_j	125°C
Storage Temperature Range	T_{stg}	–65°C to + 125°C

THERMAL RESISTANCE

Junction to Ambient	θ_{ja}	1.6°C/mW

ELECTRICAL CHARACTERISTICS AT $T_A = 25^oC$

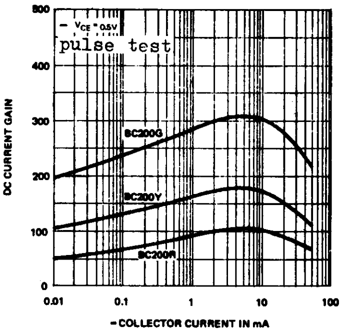
PARAMETER	SYMBOL	BC 200R			BC 200Y			BC 200G			UNIT	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
Collector Cutoff Current	$-I_{CBO}$			100			100			100	nA	$-V_{CB}=20V$ $I_E=0$
Collector Cutoff Current	$-I_{CBO}$			1			1			1	μA	$-V_{CB}=20V$ $I_E=0$ $T_j=125^oC$
Collector-Emitter Knee Voltage	$-V_{CEK}$		200			200			200		mV	$-I_C=2mA$ $-I_B$=value for which $-I_C=2.2mA$ and $-V_{CE}=1V$
Base-Emitter Voltage	$-V_{BE}$		580			580			580		mV	$-V_{CE}=0.5V$ $-I_C=0.2mA$
Base-Emitter Voltage	$-V_{BE}$		650			650			650		mV	$-V_{CE}=1V$ $-I_C=2mA$
D.C. Current Gain	H_{FE}	50	75	105	85	140	200	165	250	400		$-V_{CE}=0.5V$ $-I_C=0.2mA$
D.C. Current Gain	H_{FE}	60			100			175				$-V_{CE}=1V$ $-I_C=2mA$
Noise Figure	NF		1.5			1.5	4		1.5		dB	$-V_{CE}=5V$ $-I_C=0.2mA$ $R_s=2K\Omega$ f=30Hz to 15KHz
Transition Frequency	f_T		80			110			150		MHz	$-V_{CE}=5V$ $-I_C=2mA$
Collector Capacitance	C_{cb}		4.5			4.5			4.5		pF	$-V_{CB}=5V$ $I_E=0$ f=1MHz

TYPICAL h-PARAMETERS AT $-V_{CE} = 0.5V$, $-I_C=0.2mA$, $f = 1KHz$

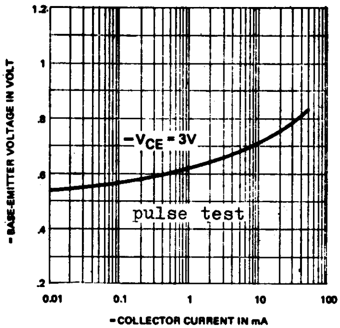
PARAMETER	SYMBOL	BC 200R	BC 200Y	BC 200G	UNIT
Input Impedance	h_{ie}	12	15	20	KΩ
Reverse Voltage Transfer Ratio	h_{re}	13	25	40	$\times 10^{-4}$
Small Signal Current Gain	h_{fe}	80	160	270	
Output Admittance	h_{oe}	13	18	33	μ℧

TYPICAL ELECTRICAL CHARACTERISTICS AT $T_A = 25^oC$

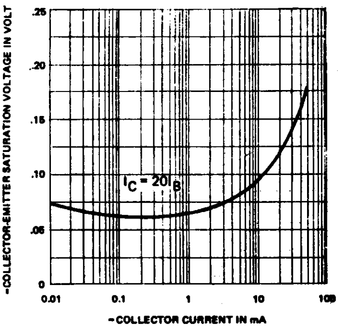
DC CURRENT GAIN VERSUS COLLECTOR CURRENT



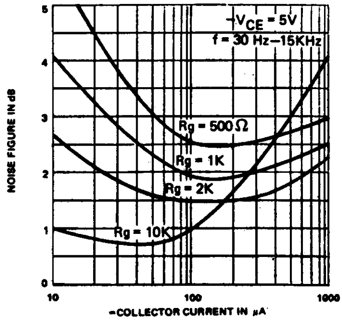
BASE-EMITTER VOLTAGE VERSUS COLLECTOR CURRENT



COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



WIDE BAND NOISE FIGURE



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BC286 BC287

COMPLEMENTARY

SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE BC286(NPN) AND BC287(PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE.

CASE TO-39

C E B

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

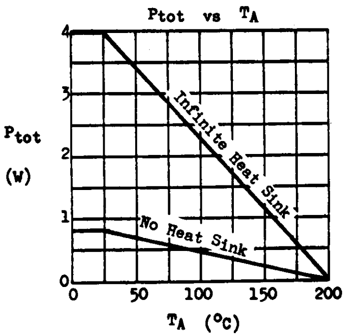
		BC286(NPN)	BC287(PNP)
Collector-Base Voltage	V_{CBO}	70V	60V
Collector-Emitter Voltage	V_{CEO}	60V	60V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	1A	
Total Power Dissipation (@ $T_C \leq 25°C$)	Ptot	4W	
(@ $T_A \leq 25°C$)		0.8W	
Operating Junction & Storage Temperature	T_j, Tstg	-55 to 200°C	

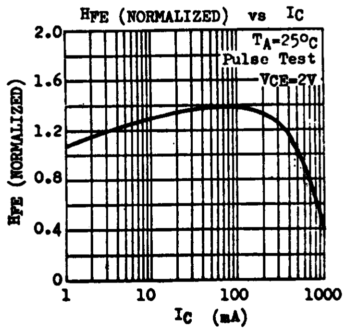
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

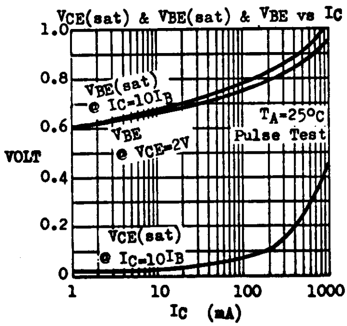
PARAMETER	SYMBOL	BC286(NPN) MIN	TYP	MAX	BC287(PNP) MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Pase Breakdown Voltage	BV_{CBO}	70						V	I_C=0.1mA I_E=0
					60			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60			60			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5						V	I_E=0.1mA I_C=0
					5			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}			20			50	nA	V_{CB}=30V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.4	1		0.45	1	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *		0.87			0.9		V	I_C=500mA V_{CE}=2V
D.C. Current Gain	H_{FE} *	20		180	20		200		I_C=500mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T		150			140		MHz	I_C=50mA V_{CE}=5V
Collector-Base Capacitance	Cob		11			18		pF	V_{CB}=10V I_E=0 f=1MHz

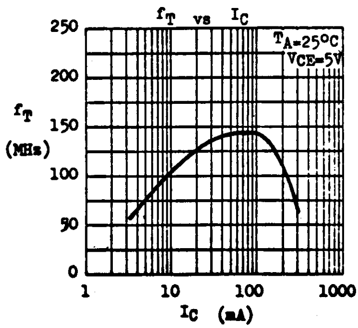
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS









BC300 BC301 BC302

NPN SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

CASE TO-39

C E B

THE BC300, BC301, BC302 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THEY ARE COMPLEMENTARY TO THE PNP TYPE BC303 AND BC304.

ABSOLUTE MAXIMUM RATINGS

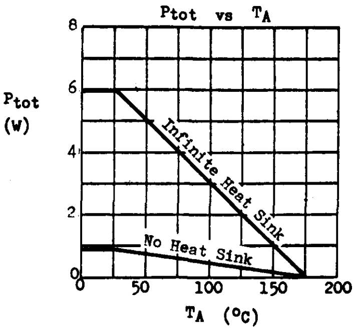
		BC300	BC301	BC302
Collector-Base Voltage	V_{CBO}	120V	90V	60V
Collector-Emitter Voltage	V_{CEO}	80V	60V	45V
Emitter-Base Voltage	V_{EBO}		7V	
Collector Current	I_C		1A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}		6W	
($T_A \leq 25^oC$)			850mW	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 175°C	

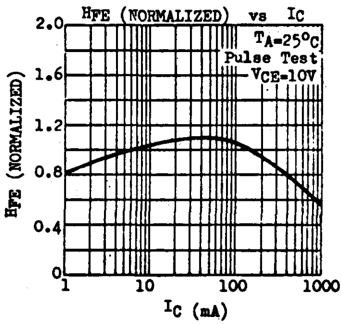
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

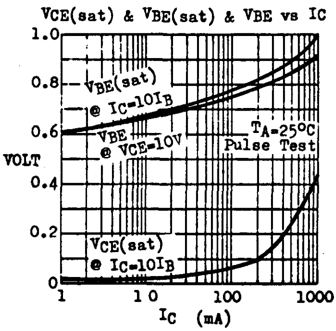
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDTIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=100mA I_B=0
BC300		80			V	
BC301		60			V	
BC302		45			V	
Collector-Emitter Breakdown Voltage	LV_{CEV} *					I_C=100mA V_{EB}=1.5V
BC300 only		120			V	
BC301 only		90			V	
Collector Cutoff Current	I_{CBO}			20	nA	V_{CB}=60V I_E=0
Emitter Cutoff Current	I_{EBO}			20	nA	V_{EB}=7V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.1	0.5	V	I_C=150mA I_B=15mA
Base-Emitter Voltage	V_{BE} *		0.78		V	I_C=150mA V_{CE}=10V
D.C. Current Gain	H_{FE} *	20				I_C=0.1mA V_{CE}=10V
		40		240		I_C=150mA V_{CE}=10V
		20				I_C=500mA V_{CE}=10V
D.C. Current Gain Group 4	H_{FE} *	40		80		I_C=150mA V_{CE}=10V
Group 5		70		140		
Group 6		120		240		
Current Gain-Bandwidth Product	f_T		120		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		10		pF	V_{CB}=10V I_E=0 f=1MHz

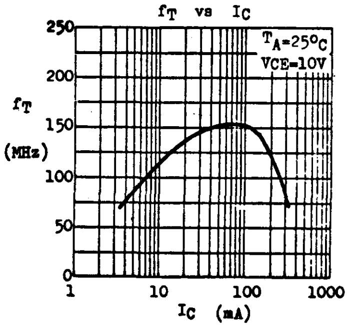
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS









BC303 BC304

PNP SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

CASE TO-39

THE BC303, BC304 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR AF DRIVERS & OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THEY ARE COMPLEMENTARY TO THE NPN TYPE BC300, BC301, BC302.

ABSOLUTE MAXIMUM RATINGS

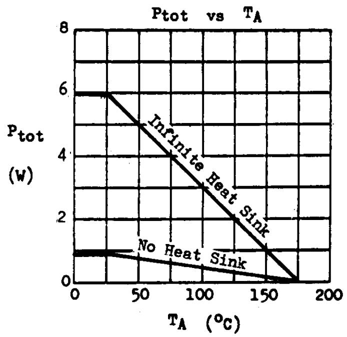
		BC303	BC304
Collector-Base Voltage	$-V_{CBO}$	85V	60V
Collector-Emitter Voltage	$-V_{CEO}$	60V	45V
Emitter-Base Voltage	$-V_{EBO}$	7V	7V
Collector Current	$-I_C$	1A	
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	6W	
($T_A \leq 25°C$)		850mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 175°C	

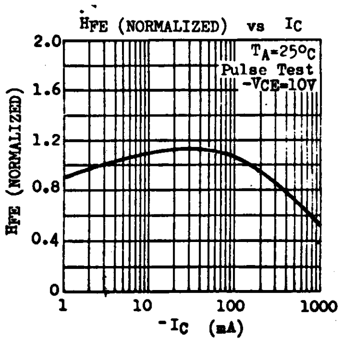
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

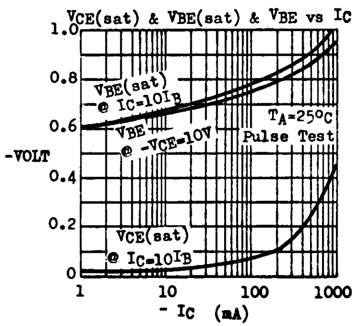
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=100mA I_B=0
BC303		60			V	
BC304		45			V	
Collector-Emitter Breakdown Voltage BC303 only	$-LV_{CEV}$	85			V	$-I_C$=100mA $-V_{EB}$=1.5V
Collector Cutoff Current	$-I_{CBO}$			20	nA	$-V_{CB}$=60V I_E=0
Emitter Cutoff Current	$-I_{EBO}$			20	nA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*		0.1	0.65	V	$-I_C$=150mA $-I_B$=15mA
Base-Emitter Voltage	$-V_{BE}$ *		0.78		V	$-I_C$=150mA $-V_{CE}$=10V
D.C. Current Gain	H_{FE} *	20				$-I_C$=0.1mA $-V_{CE}$=10V
		40		240		$-I_C$=150mA $-V_{CE}$=10V
		20				$-I_C$=500mA $-V_{CE}$=10V
D.C. Current Gain Group 4	H_{FE} *	40		80		$-I_C$=150mA $-V_{CE}$=10V
Group 5		70		140		
Group 6		120		240		
Current Gain-Bandwidth Product	f_T		100		MHz	$-I_C$=10mA $-V_{CE}$=10V
Collector-Base Capacitance	Cob		17		pF	$-V_{CB}$=10V I_E=0 f=1MHz

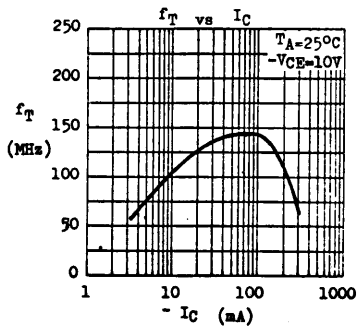
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS









BC327 BC328

PNP SILICON AF MEDIUM POWER TRANSISTORS

THE BC327, BC328 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC327, BC328 ARE COMPLEMENTARY TO THE NPN TYPE BC337, BC338 RESPECTIVELY.

CASE TO-92F

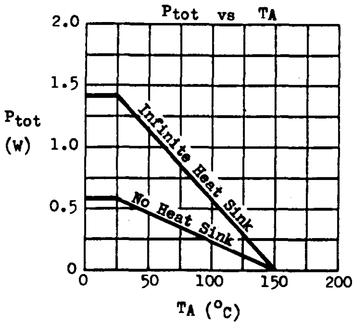
CEB

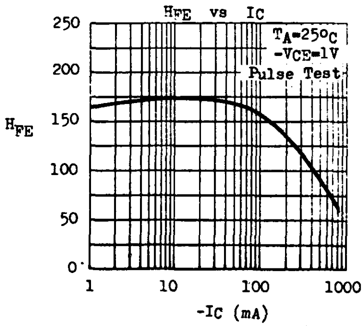
ABSOLUTE MAXIMUM RATINGS

		BC327	BC328
Collector-Emitter Voltage (V_{BE}=0)	$-V_{CES}$	50V	30V
Collector-Emitter Voltage (I_B=0)	$-V_{CEO}$	45V	25V
Emitter-Base Voltage	$-V_{EBO}$	5V	
Collector Current	$-I_C$	0.8A	
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$	1.5A	
Total Power Dissipation (@ $T_C \leq 25^oC$)	Ptot	1.4W	
(@ $T_A \leq 25^oC$)		625mW	
Operating Junction & Storage Temperature	Tj, Tstg	-55 to 150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	90°C/W	max.
Junction to Ambient	θ_{ja}	200°C/W	max.

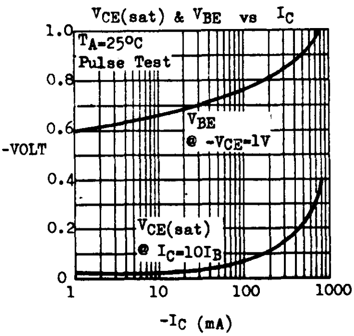


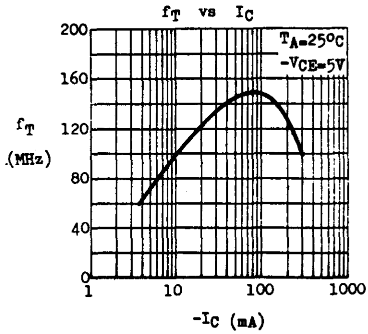


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	BC327 MIN	BC327 TYP	BC327 MAX	BC328 MIN	BC328 TYP	BC328 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-BV_{CES}$	50			30			V	$-I_C$=0.1mA V_{BE}=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	45			25			V	$-I_C$=10mA I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5			5			V	$-I_E$=0.1mA I_C=0
Collector Cutoff Current	$-I_{CES}$			100				nA	$-V_{CES}$=45V
							100	nA	$-V_{CES}$=25V
				10				μA	$-V_{CES}$=45V T_A=125°C
							10	μA	$-V_{CES}$=25V T_A=125°C
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*			0.7			0.7	V	$-I_C$=500mA $-I_B$=50mA
Base-Emitter Voltage	$-V_{BE}$ *			1.2			1.2	V	$-I_C$=300mA $-V_{CE}$=1V
D.C. Current Gain	H_{FE} *	100		630	100		630		$-I_C$=100mA $-V_{CE}$=1V
Group 16		100		250	100		250		
Group 25		160		400	160		400		
Group 40		250		630	250		630		
All Groups		40			40				$-I_C$=300mA $-V_{CE}$=1V
H_{FE} Matched Pair Ratio	$\frac{H_{FE}\,1}{H_{FE}\,2}$ *			1.41			1.41		$-I_C$=100mA $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T		100			100		MHz	$-I_C$=10mA $-V_{CE}$=5V
Collector-Base Capacitance	Cob		14			14		pF	$-V_{CB}$=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BC337 BC338

NPN SILICON AF MEDIUM POWER TRANSISTORS

THE BC337, BC338 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC337, BC338 ARE COMPLEMENTARY TO THE PNP TYPE BC327, BC328 RESPECTIVELY.

CASE TO-92F

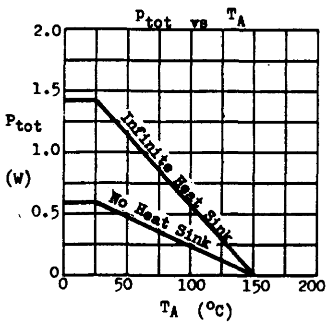
CEB

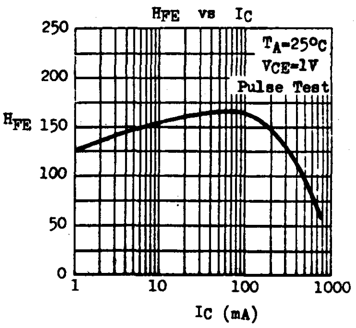
ABSOLUTE MAXIMUM RATINGS

		BC337	BC338
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	50V	30V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	45V	25V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	0.8A	
Collector Peak Current (t < 10mS)	I_{CM}	1.5A	
Total Power Dissipation (@ T_C < 25°C)	P_{tot}	1.4W	
(@ T_A < 25°C)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE

Junction to Case	Θ_{jc}	90°C/W	max.
Junction to Ambient	Θ_{ja}	200°C/W	max.

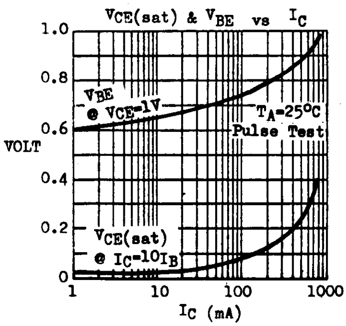


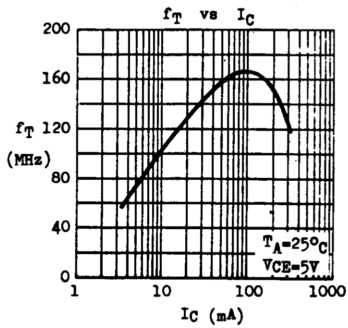


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	BC337 MIN	BC337 TYP	BC337 MAX	BC338 MIN	BC338 TYP	BC338 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CES}	50			30			V	I_C=0.1mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	45			25			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			5			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CES}			100				nA	V_{CES}=45V
							100	nA	V_{CES}=25V
				10				µA	V_{CES}=45V T_A=125°C
							10	µA	V_{CES}=25V T_A=125°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*			0.7			0.7	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *			1.2			1.2	V	I_C=300mA V_{CE}=1V
D.C. Current Gain	H_{FE} *	100		630	100		630		I_C=100mA V_{CE}=1V
Group 16		100		250	100		250		
Group 25		160		400	160		400		
Group 40		250		630	250		630		
All Groups		40			40				I_C=300mA V_{CE}=1V
H_{FE} Matched Pair Ratio	$\frac{H_{FE}\,1}{H_{FE}\,2}$ *			1.41			1.41		I_C=100mA V_{CE}=1V
Current Gain-Bandwidth Product	f_T		100			100		MHz	I_C=10mA V_{CE}=5V
Collector-Base Capacitance	Cob		10			10		pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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BC413 BC414 BC415 BC416

COMPLEMENTARY
SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

CASE TO-92F

CEB

THE BC413, BC414, BC415, BC416 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF LOW NOISE PREAMPLIFIER APPLICATIONS. THE BC413, BC414 ARE NPN AND ARE COMPLEMENTARY TO THE PNP BC415, BC416 RESPECTIVELY.

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

		BC413 (NPN)	BC414 (NPN)	BC415 (PNP)	BC416 (PNP)
Collector-Base Voltage	V_{CBO}	45V	50V	45V	50V
Collector-Emitter Voltage	V_{CEO}	30V	45V	35V	45V
Emitter-Base Voltage	V_{EBO}	5V			
Collector Current	I_C	100mA			
Total Power Dissipation @ $T_A \leq 25^oC$	P_{tot}	300mW derate 2.4mW/°C above 25°C			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C			

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=10µA I_E=0
BC413		45			V	
BC414		50			V	
BC415		45			V	
BC416		50			V	
Collector-Emitter Breakdown Voltage	LV_{CEO}					I_C=10mA (Pulsed) I_B=0
BC413		30			V	
BC414		45			V	
BC415		35			V	
BC416		45			V	
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=10µA I_C=0
Collector Cutoff Current	I_{CBO}			15	nA	V_{CB}=30V I_E=0
				5	µA	V_{CB}=30V I_E=0 T_A=150°C
Emitter Cutoff Current	I_{EBO}			15	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.08	0.25	V	I_C=10mA I_B=0.5mA
			0.25	0.6	V	I_C=100mA I_B=5mA (Pulsed)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Knee Voltage	V_{CEK}		0.3	0.6	V	I_C=10mA, I_B=value at which I_C=11mA V_{CE}=1V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		0.92		V	I_C=100mA I_B=5mA(Pulsed)
Base-Emitter Voltage	V_{BE}	0.55	0.64	0.75	V	I_C=2mA V_{CE}=5V
			0.57		V	I_C=0.1mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T		200		MHz	I_C=10mA V_{CE}=5V
Collector-Base Capacitance	Cob					V_{CB}=10V I_E=0 f=1MHz
BC413, BC414			2.7		pF	
BC415, BC416			3.2		pF	
Noise Figure	NF					I_C=0.2mA V_{CE}=5V R_G=2KΩ f=30Hz-15KHz
BC413, BC414			1.2	2.5	dB	
BC415, BC416			1.2	2.0	dB	
Flicker Noise Voltage Referred to Base	$\bar{E}n$					I_C=0.2mA V_{CE}=5V R_G=2KΩ f=10Hz-50Hz
BC413, BC414				0.135	μV	
BC415, BC416				0.11	μV	

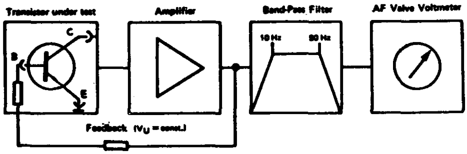
D.C. CURRENT GAIN (H_{FE}) AT V_{CE}=5V T_A=25°C

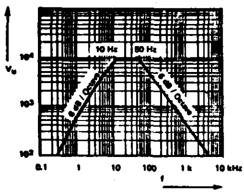
@ I_C	BC415, BC416 H_{FE} GROUP A			BC413, BC414, BC415, BC416 H_{FE} GROUP B			BC413, BC414, BC415, BC416 H_{FE} GROUP C		
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
0.01mA	40	100		100	170		100	290	
2mA	120	170	220	180	300	460	380	520	800
100mA		100			160			270	

h - PARAMETERS AT I_C=2mA V_{CE}=5V f=1kHz T_A=25°C

h - PARAMETER	SYMBOL	H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Impedance	h_{ie}	1.6	2.7	4.5	3.2	4.5	8.5	6	8.7	15	KΩ
Voltage Feedback Ratio	h_{re}		1.5			2			3		$x10^{-4}$
Small Signal Current Gain	h_{fe}	125	190	260	240	330	500	450	580	900	
Output Admittance	h_{oe}		18	30		30	60		60	110	μ℧

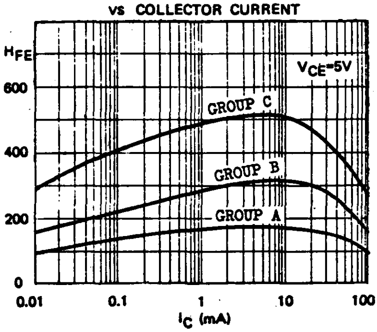
FLICKER NOISE MEASUREMENT



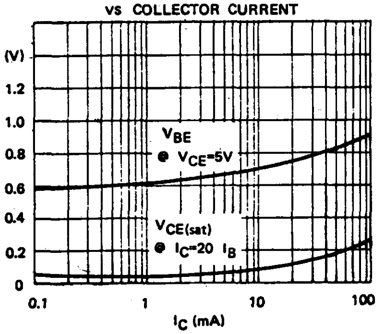


TYPICAL CHARACTERISTICS AT T_A=25°C (Pulse Test)

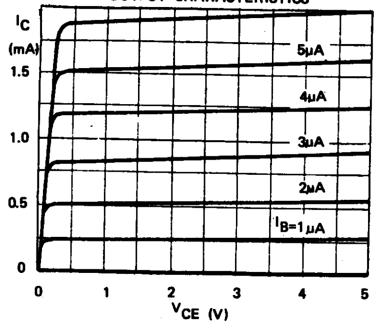
D.C. CURRENT GAIN
vs COLLECTOR CURRENT

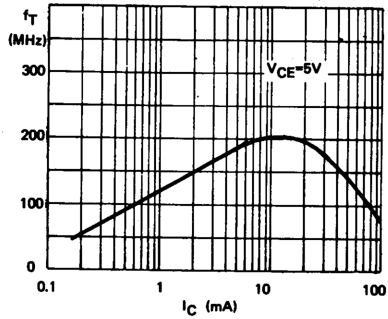


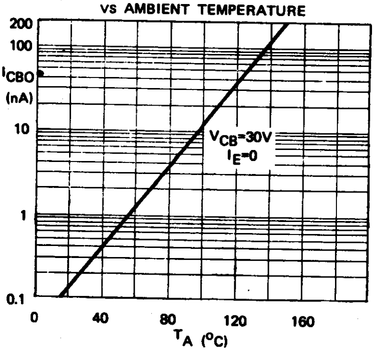
V_{BE} AND $V_{CE(sat)}$
vs COLLECTOR CURRENT

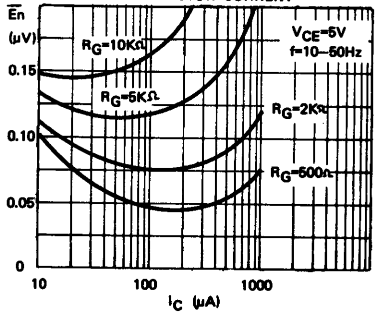


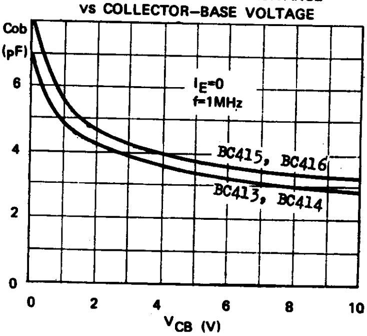
TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

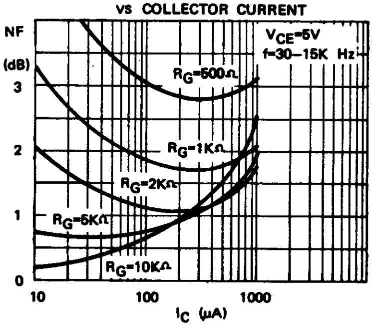












BC431 BC432

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

THE BC431 (NPN) AND BC432 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS.

CASE TO-92F

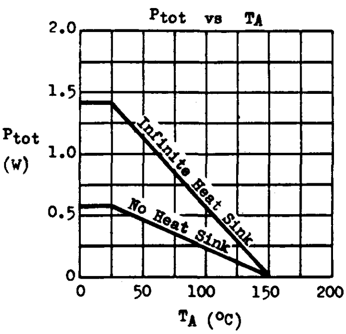
CEB

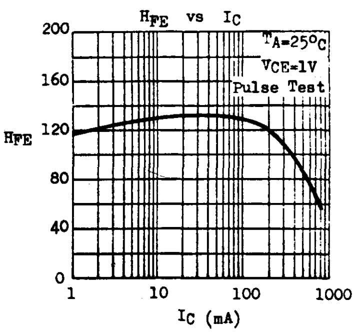
ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	70V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	60V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	0.8A
Collector Peak Current ($t \leq 10mS$)	I_{CM}	1.5A
Total Power Dissipation (@ $T_C \leq 25^oC$)	Ptot	1.4W
(@ $T_A \leq 25^oC$)		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

THERMAL RESISTANCE

Junction to Case	θ_{jc}	90°C/W max.
Junction to Ambient	θ_{ja}	200°C/W max.

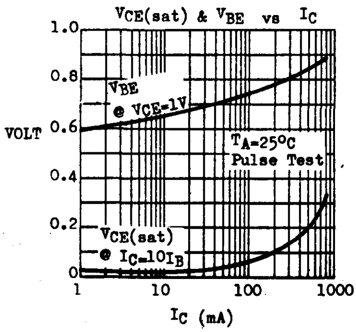


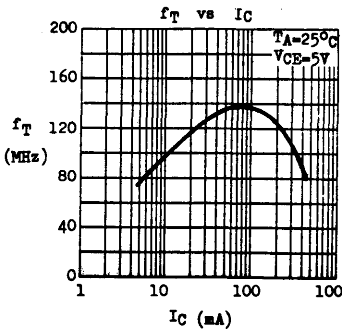


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CES}	70			V	I_C=0.1mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_C=0.1mA I_C=0
Collector Cutoff Current	I_{CES}			100 10	nA µA	V_{CES}=60V V_{CES}=60V T_A=125°C
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*			0.7	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *			1.2	V	I_C=300mA V_{CE}=1V
D.C. Current Gain	H_{FE} *	63		250		I_C=100mA V_{CE}=1V
Group 10		63		160		
Group 16		100		250		
All Groups		40				I_C=300mA V_{CE}=1V
H_{FE} Matched Pair Ratio	$\frac{H_{FE}1}{H_{FE}2}$ *			1.41		I_C=100mA V_CE=1V
Current Gain-Bandwidth Product	f_T		100		MHz	I_C=10mA V_{CE}=5V
Collector-Base Capacitance BC431 BC432	Cob		12 17		pF pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BC440 BC441 BC460 BC461

COMPLEMENTARY
SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

CASE TO-39

THE BC440, BC441, BC460, BC461 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THE BC440, BC441 ARE NPN AND ARE COMPLEMENTARY TO THE PNP BC460, BC461 RESPECTIVELY.

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

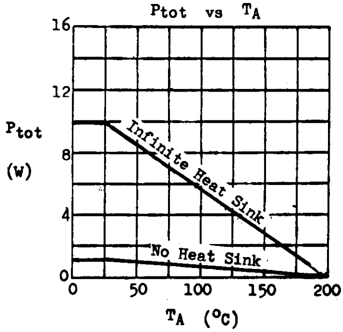
		BC440(NPN) BC460(PNP)	BC441(NPN) BC461(PNP)
Collector-Emitter Voltage ($R_{BE} \leq 100\,\Omega$)	V_{CER}	50V	75V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	40V	60V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	1A	
Collector Peak Current	I_{CM}	2A	
Total Power Dissipation ($T_C \leq 25°C$, $V_{CE} \leq 10V$)	P_{tot}	10W	
($T_A \leq 25°C$)		1W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 200°C	

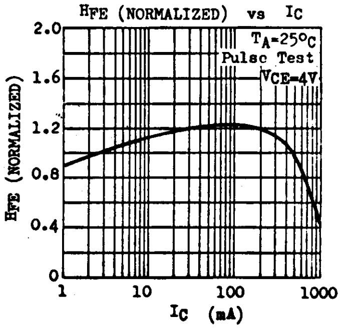
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

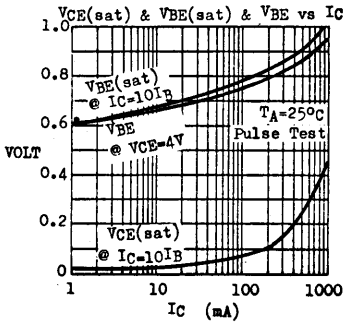
PARAMETER	SYMBOL	BC440 BC460 MIN	BC440 BC460 MAX	BC441 BC461 MIN	BC441 BC461 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40.		60		V	I_C=100mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5		5		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		100		100	nA	V_{CB}=40V I_E=0
Collector Cutoff Current	I_{CER}		10			μA	V_{CE}=50V R_{BE}=100Ω
					10	μA	V_{CE}=70V R_{BE}=100Ω
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1		1	V	I_C=1A I_B=0.1A
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.5		1.5	V	I_C=1A I_B=0.1A
D.C. Current Gain	H_{FE} *	40	250	40	250	V	I_C=500mA V_{CE}=4V
Group 4		40	70	40	70		
Group 5		60	130	60	130		
Group 6		115	250	115	250		
		20					I_C=1A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	50		50		MHz	I_C=50mA V_{CE}=4V
Collector-Base Capacitance	Cob		25		25	pF	V_{CB}=10V I_E=0 f=1MHz

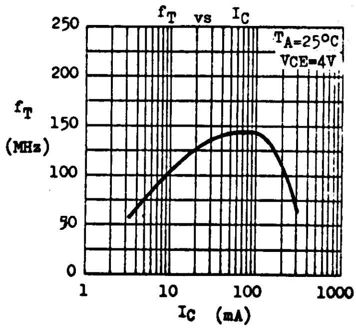
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS









BC527 BC528

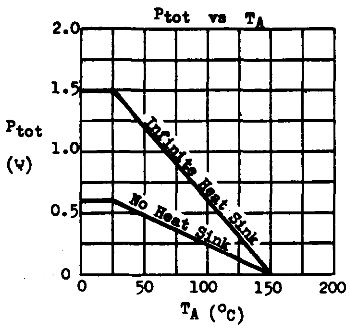
PNP SILICON AF MEDIUM POWER TRANSISTORS

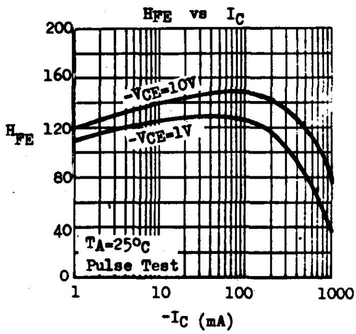
THE BC527, BC528 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC527, BC528 ARE COMPLEMENTARY TO THE NPN TYPE BC537, BC538 RESPECTIVELY.

CASE TO-92A

ABSOLUTE MAXIMUM RATINGS		BC527	BC528
Collector-Base Voltage	$-V_{CBO}$	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	60V	80V
Emitter-Base Voltage	$-V_{EBO}$	6V	
Collector Current	$-I_C$	1A	
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$	1.5A	
Total Power Dissipation (@ $T_C < 25°C$)	P_{tot}	1.5W	
(@ $T_A < 25°C$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE		
Junction to Case	θ_{jc}	83°C/W max.
Junction to Ambient	θ_{ja}	200°C/W max.

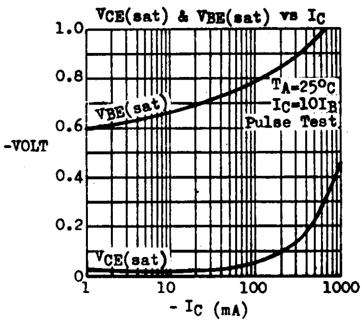


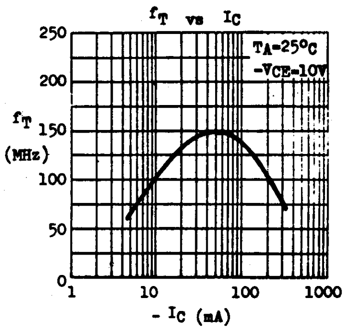


ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

PARAMETER	SYMBOL	BC527 MIN	BC527 MAX	BC528 MIN	BC528 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	60		80		V	$-I_C=0.1mA$ $I_E=0$
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	60		80		V	$-I_C=10mA$ $I_B=0$
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	6		6		V	$-I_E=0.01mA$ $I_C=0$
Collector Cutoff Current	$-I_{CBO}$		100			nA	$-V_{CB}=40V$ $I_E=0$
					100	nA	$-V_{CB}=60V$ $I_E=0$
Emitter Cutoff Current	$-I_{EBO}$		100		100	nA	$-V_{EB}=4V$ $I_C=0$
Collector-Emitter Saturation Voltage	$-V_{CE}(sat)$*		0.7		0.7	V	$-I_C=500mA$ $-I_B=50mA$
			1.2		1.5	V	$-I_C=1A$ $-I_B=0.1A$
Base-Emitter Saturation Voltage	$-V_{BE}(sat)$*		1.3		1.3	V	$-I_C=150mA$ $-I_B=15mA$
D.C. Current Gain	H_{FE} *	40	400	40	400		$-I_C=100mA$ $-V_{CE}=1V$
Group 6		40	100	40	100		
Group 10		63	160	63	160		
Group 16		100	250	100	250		
Group 25		160	400	160	400		
All Groups	H_{FE} *	50		50			$-I_C=10mA$ $-V_{CE}=10V$
		50		50			$-I_C=150mA$ $-V_{CE}=10V$
		50		50			$-I_C=500mA$ $-V_{CE}=10V$
		15		15			$-I_C=1A$ $-V_{CE}=10V$
Current Gain-Bandwidth Product	f_T	100		100		MHz	$-I_C=50mA$ $-V_{CE}=10V$
Collector-Base Capacitance	Cob		15		15	pF	$-V_{CB}=10V$ $I_E=0$ f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





1.78.0810B

BC537 BC538

NPN SILICON AF MEDIUM POWER TRANSISTORS

THE BC537, BC538 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC537, BC538 ARE COMPLEMENTARY TO THE PNP TYPE BC527, BC528 RESPECTIVELY.

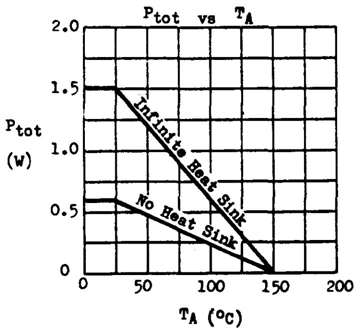
CASE TO-92A

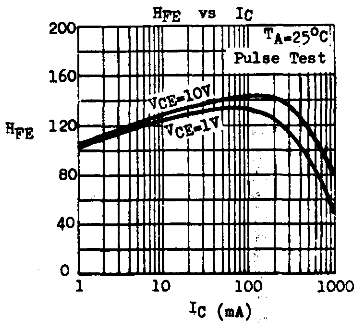
ABSOLUTE MAXIMUM RATINGS

		BC537	BC538
Collector-Base Voltage	V_{CBO}	60V	80V
Collector-Emitter Voltage	V_{CEO}	60V	80V
Emitter-Base Voltage	V_{EBO}	6V	
Collector Current	I_C	1A	
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}	1.5A	
Total Power Dissipation (@ $T_C \leqslant 25^oC$)	P_{tot}	1.5W	
(@ $T_A \leqslant 25^oC$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	83°C/W	max.
Junction to Ambient	θ_{ja}	200°C/W	max.

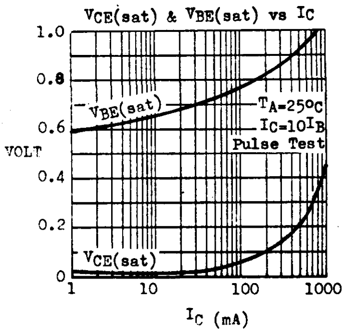


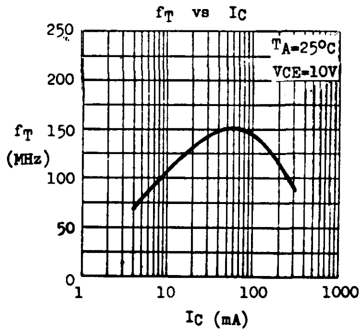


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	BC537 MIN	BC537 MAX	BC538 MIN	BC538 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60		80		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60		80		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		6		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		100			nA	V_{CB}=40V I_E=0
					100	nA	V_{CB}=60V I_E=0
Emitter Cutoff Current	I_{EBO}		100		100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.7		0.7	V	I_C=500mA I_B=50mA
			1.2		1.5	V	I_C=1A I_B=0.1A
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.3		1.3	V	I_C=150mA I_B=15mA
D.C. Current Gain	H_{FE} *	40	400	40	400		I_C=100mA V_{CE}=1V
Group 6		40	100	40	100		
Group 10		63	160	63	160		
Group 16		100	250	100	250		
Group 25		160	400	160	400		
All Groups	H_{FE} *	50		50			I_C=10mA V_{CE}=10V
		50		50			I_C=150mA V_{CE}=10V
		50		50			I_C=500mA V_{CE}=10V
		15		15			I_C=1A V_{CE}=10V
Current Gain-Bandwidth Product	f_T	100		100		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		15		15	pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





1.78.8100B

BC546 through BC550

NPN SILICON AF SMALL SIGNAL TRANSISTORS

THE BC546 THROUGH BC550 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS. THEY ARE COMPLEMENTARY TO BC556 THROUGH BC560.

THE BC549, BC550 ARE CHARACTERIZED BY LOW NOISE FIGURE.

CASE TO-92F

CEB

ABSOLUTE MAXIMUM RATINGS

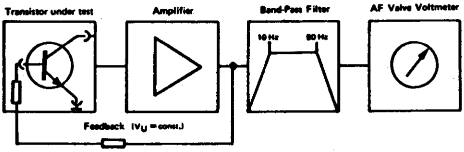
		BC546	BC547	BC548	BC549	BC550
Collector-Base Voltage	V_{CBO}	80V	50V	30V	30V	50V
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	80V	50V	30V	30V	50V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	65V	45V	30V	30V	45V
Emitter-Base Voltage	V_{EBO}	6V	6V	5V	5V	5V
Collector Current	I_C			100mA		
Collector Peak Current	I_{CM}			200mA		
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}			500mW derate 4mW/^oC above 25^oC		
Operating Junction & Storage Temperature	T_j, T_{stg}			-55 to 150^oC		

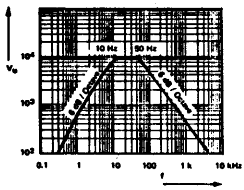
ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					$I_C=10\mu A$ $I_E=0$
BC546		80			V	
BC547		50			V	
BC548		30			V	
BC549		30			V	
BC550		50			V	
Collector-Emitter Breakdown Voltage	BV_{CES}					$I_C=10\mu A$ $V_{BE}=0$
BC546		80			V	
BC547		50			V	
BC548		30			V	
BC549		30			V	
BC550		50			V	
Collector-Emitter Breakdown Voltage	LV_{CEO}					I_C=2mA(Pulsed) $I_B=0$
BC546		65			V	
BC547		45			V	
BC548		30			V	
BC549		30			V	
BC550		45			V	

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Emitter-Base Breakdown Voltage	BV_{EBO}					I_E=1μA I_C=0
BC546,547		6			V	
BC548,549,550		5			V	
Collector Cutoff Current	I_{CBO}			15	nA	V_{CB}=30V I_E=0
				5	μA	V_{CB}=30V I_E=0 T_A=150°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.07	0.25	V	I_C=10mA I_B=0.5mA
			0.22	0.6	V	I_C=100mA I_B=5mA(Pulsed)
Collector-Emitter Knee Voltage	V_{CEK}		0.3	0.6	V	I_C=10mA, I_B=value at which I_C=11mA V_{CE}=1V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		0.7		V	I_C=10mA I_B=0.5mA
			0.9		V	I_C=100mA I_B=5mA(Pulsed)
Base-Emitter Voltage	V_{BE}	0.58	0.63	0.7	V	I_C=2mA V_{CE}=5V
			0.68	0.77	V	I_C=10mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T		250		MHz	I_C=10mA V_{CE}=5V
Collector-Base Capacitance	Cob		2.7	4.5	pF	V_{CB}=10V I_E=0 f=1MHz
Noise Figure	NF					I_C=0.2mA V_{CE}=5V R_G=2KΩ f=1kHz Δf=200Hz
BC546,547,548			2	10	dB	
BC549,550			1.4	4	dB	
Noise Figure	NF					I_C=0.2mA V_{CE}=5V R_G=2KΩ f=30Hz-15kHz
BC549 only			1.2	4	dB	
BC550 only			1.2	3	dB	
Flicker Noise Voltage Referred to Base BC549,550 only	$\overline{En}$			0.135	μV	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=10Hz-50Hz

FLICKER NOISE MEASUREMENT





D.C. CURRENT GAIN (H_{FE}) AT V_{CE}=5V T_A=25°C

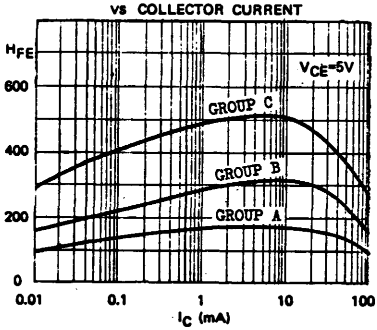
@ I_C	BC546, BC547 BC548			BC546, BC547 BC548 BC549, BC550			BC548 BC549, BC550		
	H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C		
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
0.01mA		90			170			290	
2mA	110	170	220	200	300	450	420	520	800
100mA		100			160			270	

h - PARAMETERS AT I_C=2mA V_{CE}=5V f=1kHz T_A=25°C

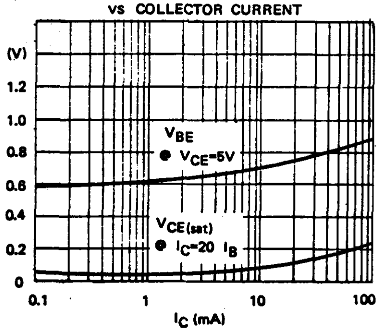
h - PARAMETER	SYMBOL	H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Impedance	h_{ie}	1.6	2.7	4.5	3.2	4.5	8.5	6	8.7	15	KΩ
Voltage Feedback Ratio	h_{re}		1.5			2			3		$\times 10^{-4}$
Small Signal Current Gain	h_{fe}	125	190	260	240	330	500	450	580	900	
Output Admittance	h_{oe}		18	30		30	60		60	110	μ℧

TYPICAL CHARACTERISTICS AT T_A=25°C (Pulse Test)

D.C. CURRENT GAIN vs COLLECTOR CURRENT

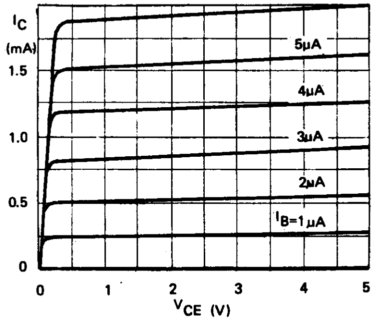


VBE AND VCE(sat) vs COLLECTOR CURRENT

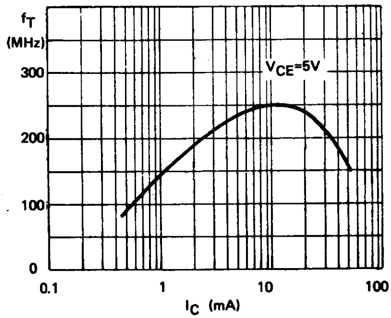


TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

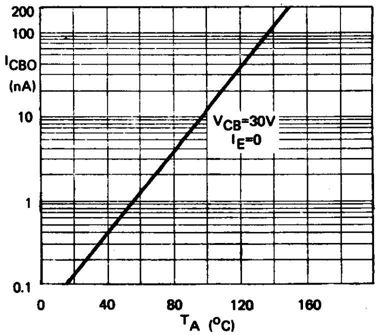
COMMON EMITTER
OUTPUT CHARACTERISTICS



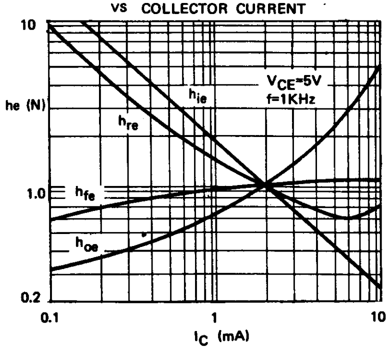
CURRENT GAIN – BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



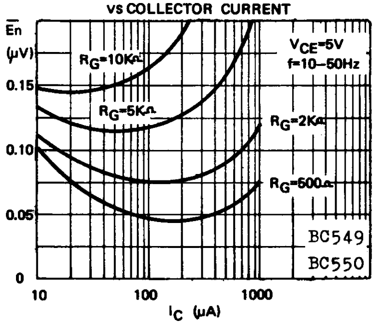
COLLECTOR CUTOFF CURRENT
vs AMBIENT TEMPERATURE



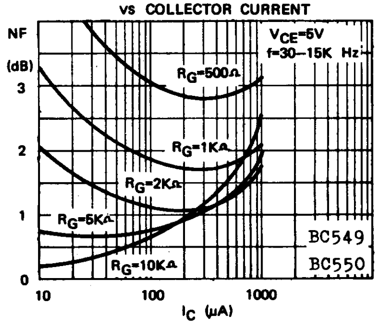
h–PARAMETERS (NORMALIZED)
vs COLLECTOR CURRENT



EQUIVALENT NOISE VOLTAGE AT BASE
vs COLLECTOR CURRENT



BROAD BAND NOISE FIGURE
vs COLLECTOR CURRENT



BC556 through BC560

PNP SILICON AF SMALL SIGNAL TRANSISTORS

THE BC556 THROUGH BC560 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS. THEY ARE COMPLEMENTARY TO BC546 THROUGH BC550.

THE BC559, BC560 ARE CHARACTERIZED BY LOW NOISE FIGURE.

CASE TO-92F

ABSOLUTE MAXIMUM RATINGS		BC556	BC557	BC558	BC559	BC560
Collector-Base Voltage	$-V_{CBO}$	80V	50V	30V	30V	50V
Collector-Emitter Voltage (V_{BE}=0)	$-V_{CES}$	80V	50V	30V	30V	50V
Collector-Emitter Voltage (I_B=0)	$-V_{CEO}$	65V	45V	30V	30V	45V
Emitter-Base Voltage	$-V_{EBO}$			5V		
Collector Current	$-I_C$			100mA		
Collector Peak Current	$-I_{CM}$			200mA		
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}			500mW derate 4mW/^oC above 25^oC		
Operating Junction & Storage T perature	T_j, T_{stg}			-55 to 150^oC		

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$					$-I_C$=10μA I_E=0
BC556		80			V	
BC557		50			V	
BC558		30			V	
BC559		30			V	
BC560		50			V	
Collector-Emitter Breakdown Voltage	$-BV_{CES}$					$-I_C$=10μA V_{BE}=0
BC556		80			V	
BC557		50			V	
BC558		30			V	
BC559		30			V	
BC560		50			V	
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$					$-I_C$=2mA(Pulsed) I_B=0
BC556		65			V	
BC557		45			V	
BC558		30			V	
BC559		30			V	
BC560		45			V	

D.C. CURRENT GAIN (H_{FE}) AT $-V_{CE}=5V$ $T_A=25^oC$

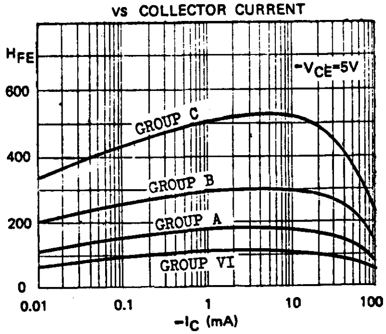
@ $-I_C$	BC556, BC557 BC558			BC556, BC557 BC558 BC559, BC560			BC556, BC557 BC558 BC559, BC560			BC558 BC559, BC560		
	H_{FE} GROUP VI			H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C		
	MIN	TYP	MIN	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
0.01mA		70			110			200			330	
2mA	70	110	140	110	170	220	200	300	450	420	520	800
100mA		60			80			140			240	

h - PARAMETERS AT $-I_C=2mA$ $-V_{CE}=5V$ f=1KHz $T_A=25^oC$

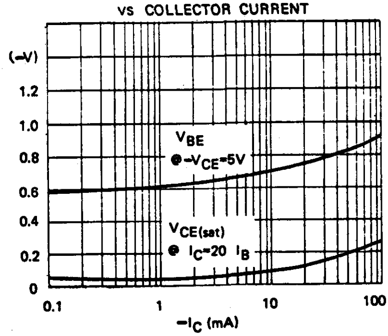
h - PARAMETER	SYMBOL	H_{FE} GROUP VI			H_{FE} GROUP A			H_{FE} GROUP B			H_{FE} GROUP C			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Impedance	h_{ie}		1.4			2.7			4.5			8.7		KΩ
Voltage Feedback Ratio	h_{re}		2.5			3			3.5			4		$x10^{-4}$
Small Signal Current Gain	h_{fe}	75	110	150	125	190	260	240	330	500	450	580	900	
Output Admittance	h_{oe}		20			25			35			60		μ℧

TYPICAL CHARACTERISTICS AT $T_A=25^oC$ (Pulse Test)

D.C. CURRENT GAIN
vs COLLECTOR CURRENT

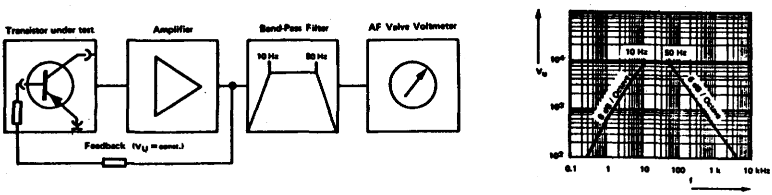


VBE AND VCE(sat)
vs COLLECTOR CURRENT



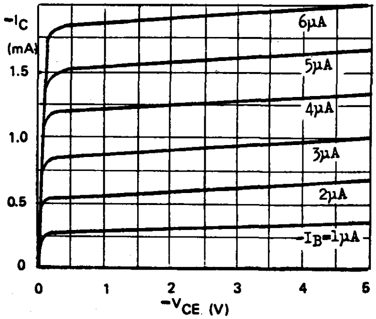
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5			V	$-I_E=1\mu A$ $I_C=0$
Collector Cutoff Current	$-I_{CBO}$			15	nA	$-V_{CB}=30V$ $I_E=0$
				5	µA	$-V_{CB}=30V$ $I_E=0$ $T_A=150^oC$
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$		0.1	0.3	V	$-I_C=10mA$ $-I_B=0.5mA$
			0.25	0.65	V	$-I_C=100mA$ $-I_B=5mA$(Pulsed)
Collector-Emitter Knee Voltage	$-V_{CEK}$		0.3	0.6	V	$-I_C=10mA$, I_B=value at which $-I_C=11mA$ $-V_{CE}=1V$
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$		0.72		V	$-I_C=10mA$ $-I_B=0.5mA$
			0.92		V	$-I_C=100mA$ $-I_B=5mA$(Pulsed)
Base-Emitter Voltage	$-V_{BE}$	0.6	0.65	0.75	V	$-I_C=2mA$ $-V_{CE}=5V$
			0.7	0.82	V	$-I_C=10mA$ $-V_{CE}=5V$
Current Gain-Bandwidth Product	f_T		180		MHz	$-I_C=10mA$ $-V_{CE}=5V$
Collector-Base Capacitance	Cob		3.2		pF	$-V_{CB}=10V$ $I_E=0$ $f=1MHz$
Noise Figure BC556,557,558	NF		2	10	dB	$-I_C=0.2mA$ $-V_{CE}=5V$ $R_G=2K\Omega$ $f=1kHz$ $\Delta f=200Hz$
Noise Figure BC559,560			1.2	4	dB	
Noise Figure BC559 only	NF		1.2	4	dB	$-I_C=0.2mA$ $-V_{CE}=5V$ $R_G=2K\Omega$ $f=30Hz-15KHz$
Noise Figure BC560 only			1.2	2	dB	
Flicker Noise Voltage Referred to Base BC559,560 only	En			0.11	µV	$-I_C=0.2mA$ $-V_{CE}=5V$ $R_G=2K\Omega$ $f=10-50Hz$

FLICKER NOISE MEASUREMENT

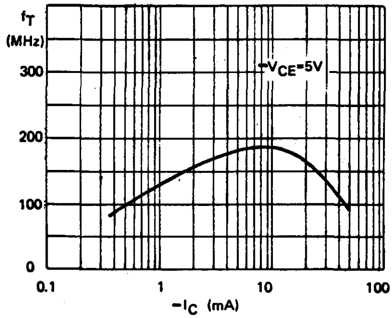


TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

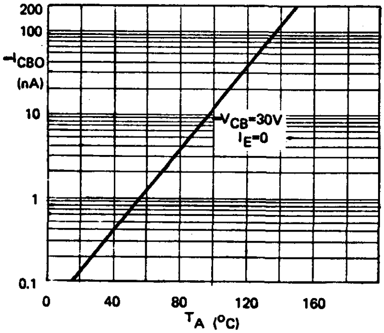
COMMON EMITTER
OUTPUT CHARACTERISTICS



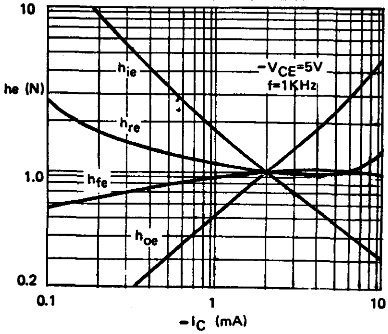
CURRENT GAIN – BANDWIDTH PRODUCT
VS COLLECTOR CURRENT



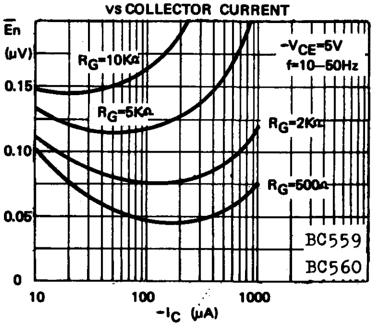
COLLECTOR CUTOFF CURRENT
VS AMBIENT TEMPERATURE



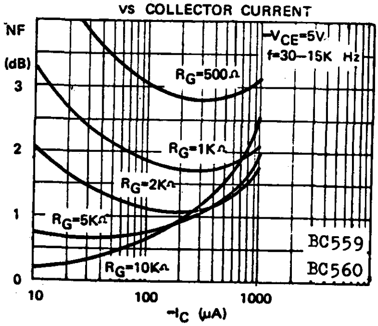
h–PARAMETERS (NORMALIZED)
VS COLLECTOR CURRENT



EQUIVALENT NOISE VOLTAGE AT BASE
VS COLLECTOR CURRENT



BROAD BAND NOISE FIGURE
VS COLLECTOR CURRENT



BC727 BC728

PNP SILICON AF MEDIUM POWER TRANSISTORS

THE BC727, BC728 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC727, BC728 ARE COM-COMPLEMENTARY TO THE NPN TYPE BC737, BC738 RESPECTIVELY.

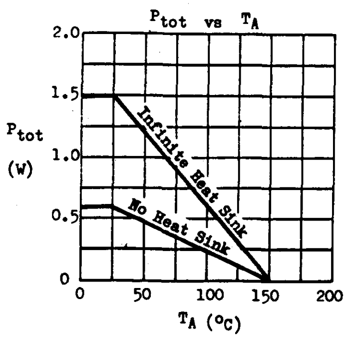
CASE TO-92A

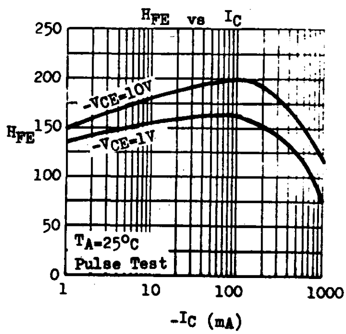
ABSOLUTE MAXIMUM RATINGS

		BC727	BC728
Collector-Base Voltage	$-V_{CBO}$	50V	30V
Collector-Emitter Voltage	$-V_{CEO}$	40V	25V
Emitter-Base Voltage	$-V_{EBO}$	5V	
Collector Current	$-I_C$	1.5A	
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$	2.5A	
Total Power Dissipation (@ $T_C \leq 25^oC$)	P_{tot}	1.5W	
(@ $T_A \leq 25^oC$)		625mW	
Operating Junction & Stoarage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	83°C/W	max.
Junction to Ambient	θ_{ja}	200°C/W	max.

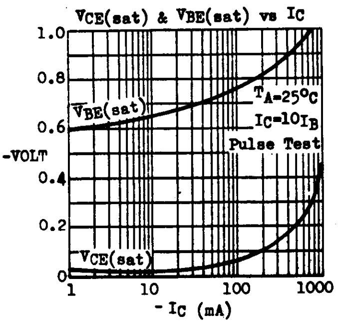


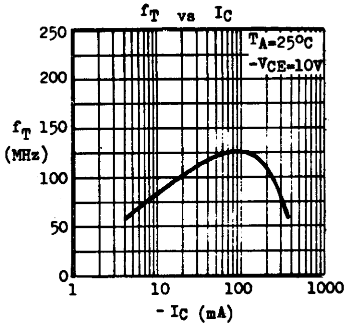


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	BC727 MIN	BC727 TYP	BC727 MAX	BC728 MIN	BC728 TYP	BC728 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	50			30			V	$-I_C$=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	40			25			V	$-I_C$=10mA I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5			5			V	$-I_E$=0.1mA I_C=0
Collector Cutoff Current	$-I_{CBO}$			100				nA	$-V_{CB}$=40V I_E=0
							100	nA	$-V_{CB}$=25V I_E=0
Emitter Cutoff Current	$-I_{EBO}$			100			100	nA	$-V_{EB}$=4V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*			0.7			0.7	V	$-I_C$=500mA $-I_B$=50mA
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$*			1.2			1.2	V	$-I_C$=500mA $-I_B$=50mA
				1.3			1.3	V	$-I_C$=1A $-I_B$=0.1A
D.C. Current Gain	H_{FE} *	63		630	63		630		$-I_C$=100mA $-V_{CE}$=1V
Group 10		63		160	63		160		
Group 16		100		250	100		250		
Group 25		160		400	160		400		
Group 40		250		630	250		630		
All Groups	H_{FE} *	63			63				$-I_C$=500mA $-V_{CE}$=1V
		15			30				$-I_C$=1A $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T	40	120		40	120		MHz	$-I_C$=50mA $-V_{CE}$=10V
Collector-Base Capacitance	Cob		17	20		17	20	pF	$-V_{CB}$=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BC737 BC738

NPN SILICON AF MEDIUM POWER TRANSISTORS

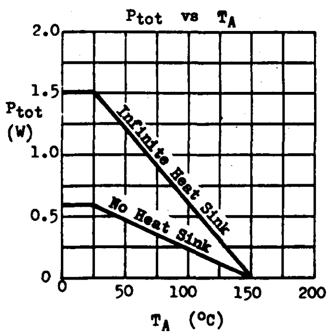
THE BC737, BC738 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVER AND OUTPUT STAGES, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE BC737, BC738 ARE COMPLEMENTARY TO THE PNP TYPE BC727, BC728 RESPECTIVELY.

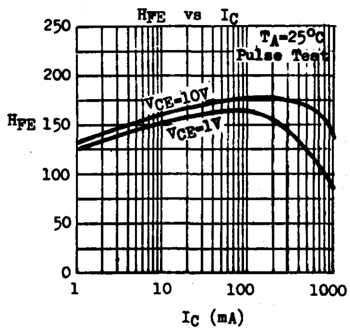
CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS		BC737	BC738
Collector-Base Voltage	V_{CBO}	50V	30V
Collector-Emitter Voltage	V_{CEO}	40V	25V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	1.5A	
Collector Peak Current ($t \leq 10mS$)	I_{CM}	2.5A	
Total Power Dissipation (@ $T_C \leq 25°C$)	P_{tot}	1.5W	
(@ $T_A \leq 25°C$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE		
Junction to Case	θ_{jc}	83°C/W max.
Junction to Ambient	θ_{ja}	200°C/W max.

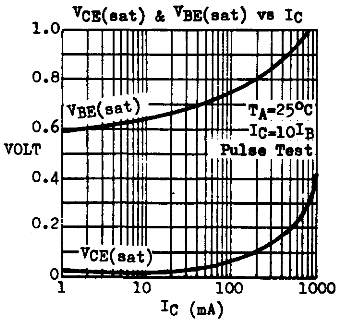


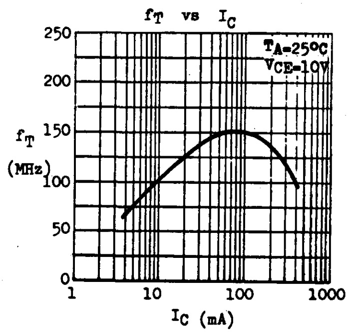


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted

PARAMETER	SYMBOL	BC737 MIN	BC737 TYP	BC737 MAX	BC738 MIN	BC738 TYP	BC738 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50			30			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			25			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			5			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}			100				nA	V_{CB}=40V I_E=0
							100	nA	V_{CB}=25V I_E=0
Emitter Cutoff Current	I_{EBO}			100			100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	V_{CE}(sat)*			0.7			0.7	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	V_{BE}(sat)*			1.2			1.2	V	I_C=500mA I_B=50mA
				1.3			1.3	V	I_C=1A I_B=0.1A
D.C. Current Gain	H_{FE} *	63		630	63		630		I_C=100mA V_{CE}=1V
Group 10		63		160	63		160		
Group 16		100		250	100		250		
Group 25		160		400	160		400		
Group 40		250		630	250		630		
All Groups	H_{FE} *	63			63				I_C=500mA V_{CE}=1V
		15			30				I_C=1A V_{CE}=1V
Current Gain-Bandwidth Product	f_T	40	150		40	150		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		12	20		12	20	pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BD220 BD221 BD222

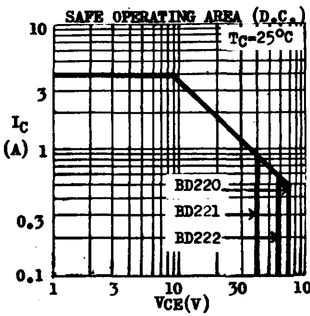
NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS

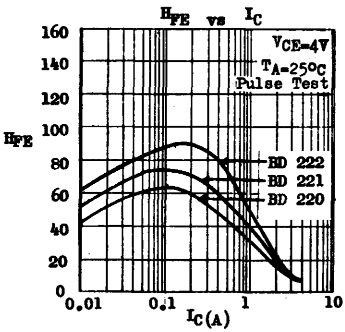
THE BD 220, BD 221 AND BD 222 ARE NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS DESIGNED FOR LOW SPEED SWITCHING AND AUDIO AMPLIFIER APPLICATIONS. THEY FEATURE LARGE SAFE OPERATING AREA.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		BD 220	BD 221	BD 222
Collector-Base Voltage	V_{CBO}	80V	60V	80V
Collector-Emitter Voltage	V_{CEO}	70V	40V	60V
Emitter-Base Voltage	V_{EBO}	7V	5V	5V
Collector Current	I_C		4A	
Base Current	I_B		2A	
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}		36W	
@ $T_A \leq 25^oC$			1.8W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	3.5°C/W	max.
Junction to Ambient	Θ_{ja}	70°C/W	max.





ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherise noted)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage		LV_{CEO} *					I_C=0.1A I_B=0
	BD 220		70			V	
	BD 221		40			V	
	BD 222		60			V	
Collector-Emitter Breakdown Voltage		LV_{CER} *					I_C=0.1A R_{BE}=100Ω
	BD 220		75			V	
	BD 221		50			V	
	BD 222		70			V	
Collector-Emitter Breakdown Voltage		LV_{CEV} *					I_C=0.1A V_{EB}=1.5V
	BD 220/222		80			V	
	BD 221		60			V	
Collector Cutoff Current	BD 220/222	I_{CER}			0.5	mA	V_{CE}=50V R_{BE}=100Ω
Collector Cutoff Current	BD 220/222	I_{CER}			2	mA	V_{CE}=50V R_{BE}=100Ω T_C=150°C
Collector Cutoff Current	BD 220/222	I_{CEV}			0.5	mA	V_{CE}=65V V_{EB}=1.5V
	BD 221				2	mA	V_{CE}=35V V_{EB}=1.5V
Collector Cutoff Current	BD 220/222	I_{CEV}			3	mA	V_{CE}=65V V_{EB}=1.5V
	BD 221				5	mA	V_{CE}=35V V_{EB}=1.5V T_C=150°C
Emitter Cutoff Current	BD 220	I_{EBO}			1	mA	V_{EB}=7V I_C=0
	BD 221/222				1	mA	V_{EB}=5V I_C=0
Base-Emitter Voltage	BD 220	V_{BE} *		0.70	1.1	V	I_C=0.5A V_{CE}=4V
	BD 221			0.80	1.3	V	I_C= 1 A V_{CE}=4V
	BD 222			0.90	1.5	V	I_C=1.5A V_{CE}=4V
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$ *					
	BD 220			0.15	1	V	I_C=0.5A I_B=0.05A
	BD 221			0.20	1	V	I_C= 1 A I_B=0.1 A
	BD 222			0.30	1	V	I_C=1.5A I_B=0.15A
D.C. Current Gain	BD 220	H_{FE} *	30		120		I_C=0.5A V_{CE}=4V
	BD 221		30		120		I_C= 1 A V_{CE}=4V
	BD 222		20		80		I_C=1.5A V_{CE}=4V
Current Gain-Bandwidth product		f_T	0.8			MHz	I_C=0.2A V_{CE}=4V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

12.77.MA

BD239 BD239A BD239B

NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

THE BD 239, BD 239A AND BD 239B ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD 239, BD 239A AND BD 239B ARE COMPLEMENTARY TO BD 240, BD 240A AND BD 240B RESPECTIVELY.

CASE TO-220B

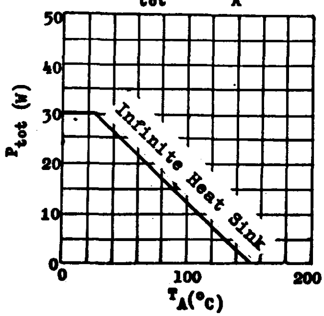
ABSOLUTE MAXIMUM RATINGS

		BD 239	BD 239A	BD 239B
Collector-Emitter Voltage with R_{BE}=100Ω	V_{CER}	55V	70V	90V
with base open	V_{CEO}	45V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		2A	
Base Current	I_B		1A	
Total Power Dissipation (T_C<25°C)	P_{tot}		30W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	Tstg		-55 to +150°C	

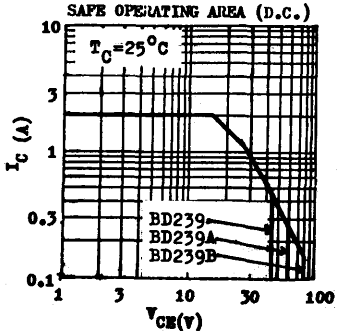
THERMAL RESISTANCE

Junction to Case	θ_{jc}	4.17°C/W	max.

P_{tot} vs T_A



SAFE OPERATING AREA (D.C.)

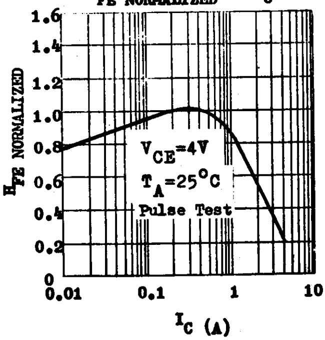


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

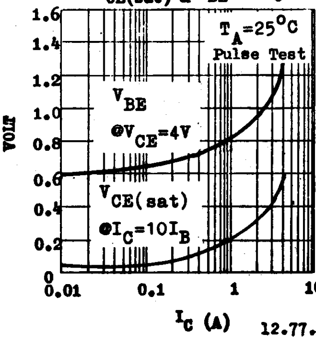
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage : with external base-emitter resistance	LV_{CER} *				I_C=30mA R_{BE}=100 Ω
BD 239		55		V	
BD 239A		70		V	
BD 239B		90		V	
with base open	LV_{CEO} *				I_C=30mA I_B=0
BD 239		45		V	
BD 239A		60		V	
BD 239B		80		V	
Collector Cutoff Current	I_{CEO}				
BD 239, BD 239A			0.3	mA	V_{CE}=30V I_B=0
BD 239B			0.3	mA	V_{CE}=60V I_B=0
Collector Cutoff Current	I_{CES}				
BD 239			0.2	mA	V_{CE}=45V V_{BE}=0
BD 239A			0.2	mA	V_{CE}=60V V_{BE}=0
BD 239B			0.2	mA	V_{CE}=80V V_{BE}=0
Emitter Cutoff Current	I_{EBO}		1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.7	V	I_C=1A I_B=0.2A
Base-Emitter Voltage	V_{BE} *		1.3	V	I_C=1A V_{CE}=4V
D.C. Current Gain	H_{FE} *	40			I_C=0.2A V_{CE}=4V
		15			I_C=1A V_{CE}=4V
Current Gain-Bandwidth Product	f_T	3		MHz	I_C=0.2A V_{CE}=10V

* Pulse Test : Pulse Width = 0.3mS, Duty Cycle = 1%

H_{FE} NORMALIZED vs I_C



$V_{CE(sat)}$ & V_{BE} vs I_C



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BD239C through BD242C

COMPLEMENTARY

SILICON EPITAXIAL BASE AF POWER TRANSISTORS

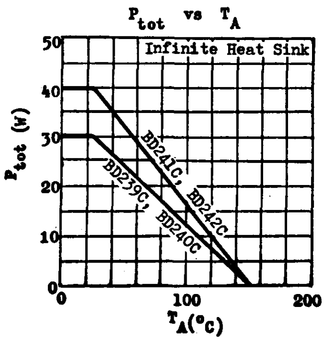
THE BD239C THROUGH BD242C ARE COMPLEMENTARY SILICON EPITAXIAL BASE AF POWER TRANSISTORS. THEY FEATURE 100V MINIMUM COLLECTOR TO EMITTER BREAKDOWN VOLTAGE. THE BD239C, BD241C ARE NPN. THE BD240C, BD242C ARE PNP.

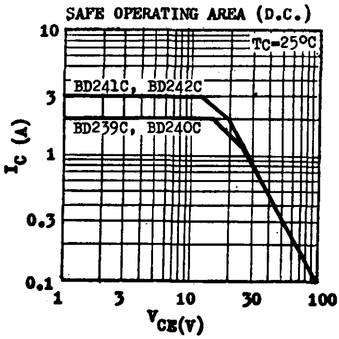
CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.		BD239C(NPN) BD240C(PNP)	BD241C(NPN) BD242C(PNP)
Collector-Emitter Voltage (R_{BE}=100Ω)	V_{CER}	115V	115V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	100V	100V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	2A	3A
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	30W	40W
($T_A \leq 25°C$)		2W	2W
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	4.17°C/W max.	3.12°C/W max.
Junction to Ambient	Θ_{ja}	62.5°C/W max.	62.5°C/W max.

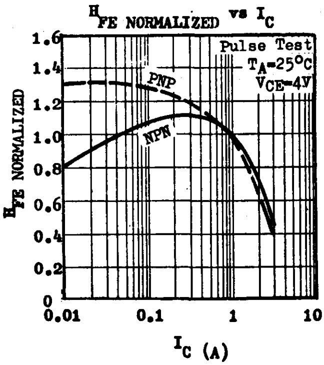


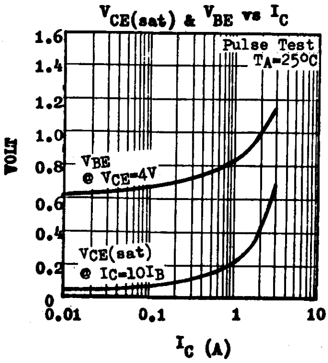


ELECTRICAL CHARACTERISTICS (T_A=25°C)

PARAMETER	SYMBOL	BD239C BD240C MIN	BD239C BD240C MAX	BD241C BD242C MIN	BD241C BD242C MAX	UNIT	TEST CONDTIONS
Collector-Emitter Breakdown Voltage	LV_{CER} *	115		115		V	I_C=30mA R_{BE}=100Ω
Collector-Emitter Breakdown Voltage	LV_{CEO} *	100		100		V	I_C=30mA I_B=0
Collector Cutoff Current	I_{CEO}		0.3		0.3	mA	V_{CE}=60V I_B=0
Collector Cutoff Current	I_{CES}		0.2		0.2	mA	V_{CE}=100V V_{BE}=0
Emitter Cutoff Current	I_{EBO}		1		1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.7			V	I_C=1A I_B=0.2A
					1.2	V	I_C=3A I_B=0.6A
Base-Emitter Voltage	V_{BE} *		1.3			V	I_C=1A V_{CE}=4V
					1.8	V	I_C=3A V_{CE}=4V
D.C. Current Gain	H_{FE} *	40					I_C=0.2A V_{CE}=4V
		15		25			I_C=1A V_{CE}=4V
				10			I_C=3A V_{CE}=4V
Small Signal Current Gain	h_{fe}			20			I_C=0.5A V_{CE}=10V f=1kHz
Current Gain-Bandwidth Product	f_T	3				MHz	I_C=0.2A V_{CE}=10V
				3		MHz	I_C=0.5A V_{CE}=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BD240 BD240A BD240B

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

THE BD 240, BD 240A AND BD 240B ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD 240, BD 240A AND BD 240B ARE COMPLEMENTARY TO BD 239, BD 239A AND BD 239B RESPECTIVELY.

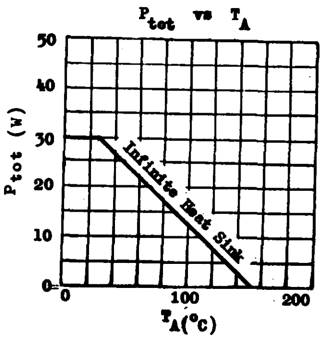
CASE TO-220B

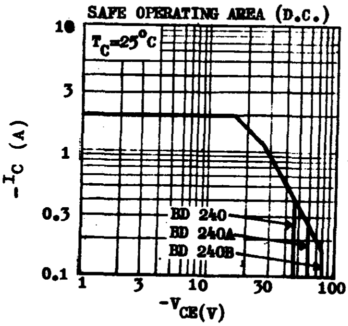
ABSOLUTE MAXIMUM RATINGS

		BD 240	BD 240A	BD 240B
Collector-Emitter Voltage				
with R_{BE}=100Ω	$-V_{CER}$	55V	70V	90V
with base open	$-V_{CEO}$	45V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		2A	
Base Current	$-I_B$		1A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}		30W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	4.17°C/W	max.

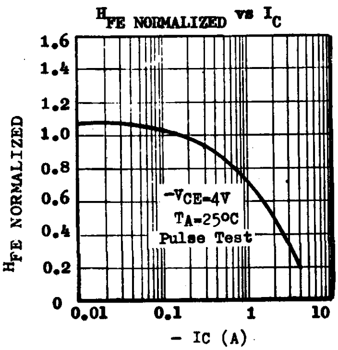


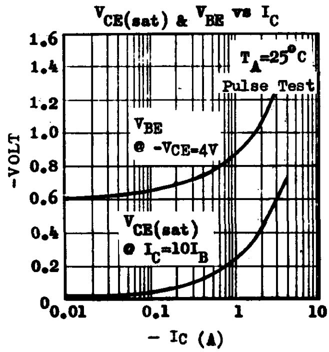


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER		SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage With external base-emitter resistance		$-LV_{CER}$ *				$-I_C$=30mA R_{BE}=100Ω
	BD 240		55		V	
	BD 240A		70		V	
	BD 240B		90		V	
With base open	BD 240	$-LV_{CEO}$ *	45		V	$-I_C$=30mA I_B=0
	BD 240A		60		V	
	BD 240B		80		V	
Collector Cutoff Current		$-I_{CEO}$				
	BD 240, BD 240A			0.3	mA	$-V_{CE}$=30V I_B=0
	BD 240B			0.3	mA	$-V_{CE}$=60V I_B=0
Collector Cutoff Current	BD 240	$-I_{CES}$		0.2	mA	$-V_{CE}$=45V V_{BE}=0
	BD 240A			0.2	mA	$-V_{CE}$=60V V_{BE}=0
	BD 240B			0.2	mA	$-V_{CE}$=80V V_{BE}=0
Emitter Cutoff Current		$-I_{EBO}$		1	mA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage		$-V_{CE(sat)}$ *		0.7	V	$-I_C$=1A $-I_B$=0.2A
Base-Emitter Voltage		$-V_{BE}$ *		1.3	V	$-I_C$=1A $-V_{CE}$=4V
D.C. Current Gain		H_{FE} *	40			$-I_C$=0.2A $-V_{CE}$=4V
			15			$-I_C$=1A $-V_{CE}$=4V
Current Gain-Bandwidth Product		f_T	3		MHz	$-I_C$=0.2A $-V_{CE}$=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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BD241 BD241A BD241B

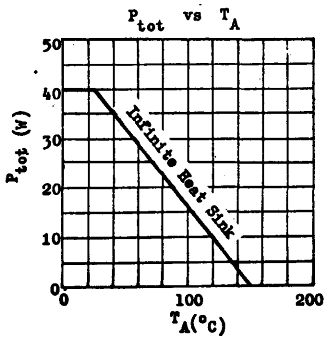
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

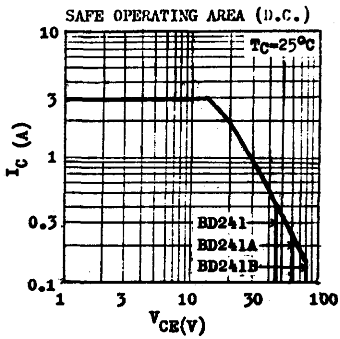
THE BD 241, BD 241A AND BD 241B ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD 241, BD 241A AND BD 241B ARE COMPLEMENTARY TO BD 242, BD 242A AND BD 242B RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		BD241	BD241A	BD241B
Collector-Emitter Voltage (R_{BE}=100Ω)	V_{CER}	55V	70V	90V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	45V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		3A	
Base Current	I_B		1A	
Total Power Dissipation @ $T_C \leq 25^oC$	Ptot		40W	
@ $T_A \leq 25^oC$			2W	
Junction and Storage Temperature	T_j, T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	3.12°C/W	max.
Junction to Ambient	θ_{ja}	62.5°C/W	max.

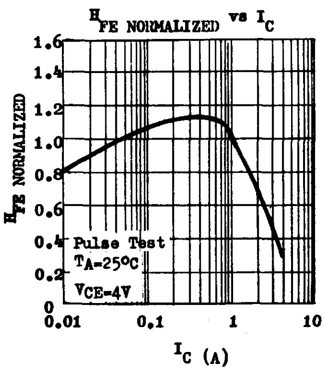


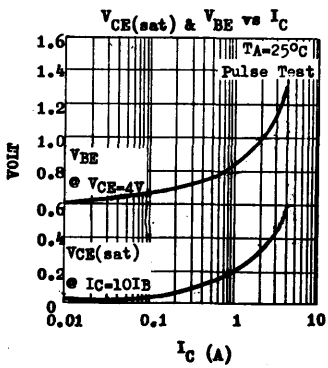


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *				I_C=30mA I_B=0
BD241		45		V	
BD241A		60		V	
BD241B		80		V	
Collector Cutoff Current	I_{CEO}				
BD241, BD241A			0.3	mA	V_{CE}=30V I_B=0
BD241B			0.3	mA	V_{CE}=60V I_B=0
Collector Cutoff Current BD241	I_{CES}		0.2	mA	V_{CE}=45V V_{BE}=0
BD241A			0.2	mA	V_{CE}=60V V_{BE}=0
BD241B			0.2	mA	V_{CE}=80V V_{BE}=0
Emitter Cutoff Current	I_{EBO}		1	mA	V_{EB}=5V I_C=0
Base-Emitter Voltage	V_{BE} *		1.8	V	I_C=3A V_{CE}=4V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1.2	V	I_C=3A I_B=0.6A
D.C. Current Gain	H_{FE} *	25			I_C=1A V_{CE}=4V
		10			I_C=3A V_{CE}=4V
Small Signal Current Gain	h_{fe}	20			I_C=0.5A V_{CE}=10V f=1kHz
Current Gain-Bandwidth Product	f_T	3		MHz	I_C=0.5A V_{CE}=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%



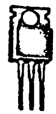


BD242 BD242A BD242B

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

THE BD 242, BD 242A AND BD 242B ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT SATAGES IN AUDIO AMPLIFIERS. THE BD 242, BD 242A AND BD 242B ARE COMPLEMENTARY TO BD 241, BD 241A AND BD 241B RESPECTIVELY.

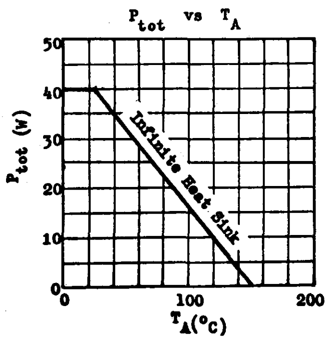
CASE TO-220B

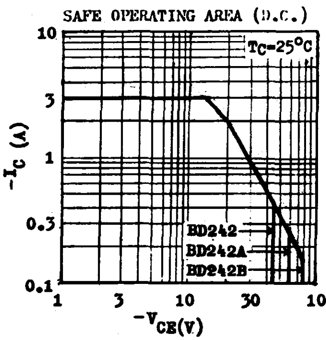


BCE

ABSOLUTE MAXIMUM RATINGS		BD242	BD242A	BD242B
Collector-Emitter Voltage (R_{BE}=100Ω)	$-V_{CER}$	55V	70V	90V
Collector-Emitter Voltage (I_B=0)	$-V_{CEO}$	45V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		3A	
Base Current	$-I_B$		1A	
Total Power Dissipation @ $T_C \leq 25°C$	P_{tot}		40W	
@ $T_A \leq 25°C$			2W	
Junction and Storage Temperature	T_j, T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	3.12°C/W	max.
Junction to Ambient	θ_{ja}	62.5°C/W	max.

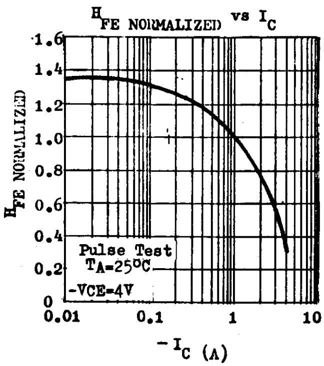


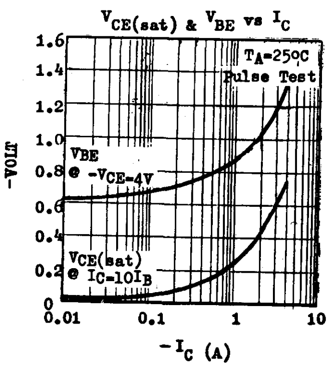


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER		SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage		$-LV_{CEO}$*				$-I_C$=30mA I_B=0
	BD242		45		V	
	BD242A		60		V	
	BD242B		80		V	
Collector Cutoff Current		$-I_{CEO}$				
	BD242, BD242A			0.3	mA	$-V_{CE}$=30V I_B=0
	BD242B			0.3	mA	$-V_{CE}$=60V I_B=0
Collector Cutoff Current	BD242	$-I_{CES}$		0.2	mA	$-V_{CE}$=45V V_{BE}=0
	BD242A			0.2	mA	$-V_{CE}$=60V V_{BE}=0
	BD242B			0.2	mA	$-V_{CE}$=80V V_{BE}=0
Emitter Cutoff Current		$-I_{EBO}$		1	mA	$-V_{EB}$=5V I_C=0
Base-Emitter Voltage		$-V_{BE}$ *		1.8	V	$-I_C$=3A $-V_{CE}$=4V
Collector-Emitter Saturation Voltage		$-V_{CE(sat)}$*		1.2	V	$-I_C$=3A $-I_B$=0.6A
D.C. Current Gain		H_{FE} *	25			$-I_C$=1A $-V_{CE}$=4V
			10			$-I_C$=3A $-V_{CE}$=4V
Small Signal Current Gain		hfe	20			$-I_C$=0.5A $-V_{CE}$=10V f=1kHz
Current Gain-Bandwidth Product		f_T	3		MHz	$-I_C$=0.5A $-V_{CE}$=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%.





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BD533 BD535 BD537

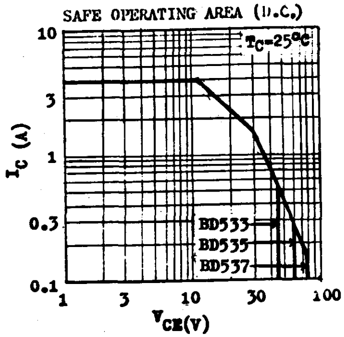
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

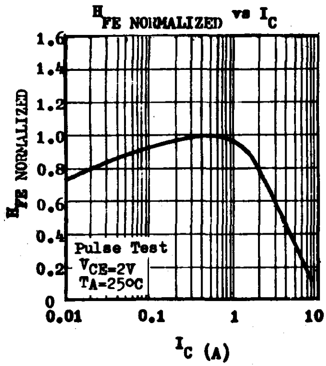
THE BD 533, BD 535 AND BD 537 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD 533, BD 535 AND BD 537 ARE COMPLEMENTARY TO BD 534, BD 536 AND BD 538 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		BD 533	BD 535	BD 537
Collector-Base Voltage	V_{CBO}	45V	60V	80V
Collector-Emitter Voltage	V_{CEO}	45V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		4A	
Collector Peak Current ($t \leq 10mS$)	I_{CM}		8A	
Base Current	I_B		1A	
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}		50W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	2.5°C/W	max.
Junction to Ambient	Θ_{ja}	70°C/W	max.





ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
BD 533		45			V	
BD 535		60			V	
BD 537		80			V	
Collector-Emitter Breakdown Voltage	LV_{CEO}*					I_C=100mA I_B=0
BD 533		45			V	
BD 535		60			V	
BD 537		80			V	
Emitter-Base Breakdown Voltage	BV_{EBO}					I_E=0.1mA I_C=0
BD 533, BD 535, BD 537		5			V	
Collector Cutoff Current	I_{CBO}					
BD 533				100	µA	V_{CB}=45V I_E=0
BD 535				100	µA	V_{CB}=60V I_E=0
BD 537				100	µA	V_{CB}=80V I_E=0
Collector Cutoff Current	I_{CES}					V_{CE}=45V V_{BE}=0
BD 533, BD 535, BD 537				100	µA	
Emitter Cutoff Current	I_{EBO}			100	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.27	0.8	V	I_C=2A I_B=0.2A
			0.8		V	I_C=6A I_B=0.6A
Base-Emitter Voltage	V_{BE} *		0.92	1.5	V	I_C=2A V_{CE}=2V
D.C. Current Gain	H_{FE} *					
BD 533		20				I_C=10mA V_{CE}=5V
BD 535		20				
BD 537		15				
BD 533		25				I_C=2A V_{CE}=2V
BD 535		25				
BD 537		15				
All types		40				I_C=500mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	3			MHz	I_C=250mA V_{CE}=1V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

BD534 BD536 BD538

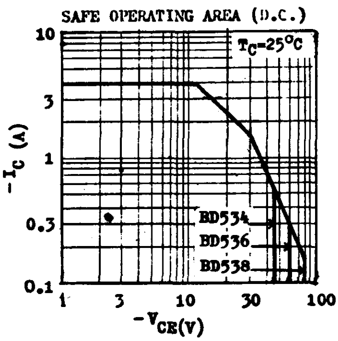
PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

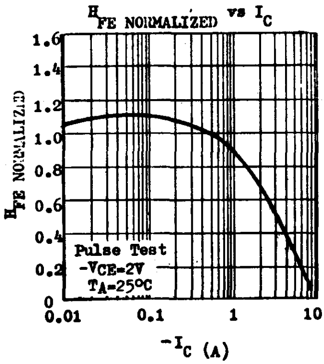
THE BD 534, BD 536 AND BD 538 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD 534, BD 536 AND BD 538 ARE COMPLEMENTARY TO BD 533, BD 535 AND BD 537 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		BD 534	BD 536	BD 538
Collector-Base Voltage	$-V_{CBO}$	45V	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	45V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		4A	
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$		8A	
Base Current	$-I_B$		1A	
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}		50W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	2.5°C/W	max.
Junction to Ambient	Θ_{ja}	70°C/W	max.





ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage		$-BV_{CBO}$					$-I_C$=0.1mA I_E=0
	BD 534		45			V	
	BD 536		60			V	
	BD 538		80			V	
Collector-Emitter Breakdown Voltage		$-LV_{CEO}$ *					$-I_C$=100mA I_B=0
	BD 534		45			V	
	BD 536		60			V	
	BD 538		80			V	
Emitter-Base Breakdown Voltage	BD 534, BD 536, BD 538	$-BV_{EBO}$	5			V	$-I_E$=0.1mA I_C=0
Collector Cutoff Current		$-I_{CBO}$					
	BD 534				100	µA	$-V_{CB}$=45V I_E=0
	BD 536				100	µA	$-V_{CB}$=60V I_E=0
	BD 538				100	µA	$-V_{CB}$=80V I_E=0
Collector Cutoff Current		$-I_{CES}$					
	BD 534				100	µA	$-V_{CE}$=45V V_{BE}=0
	BD 536				100	µA	
	BD 538				100	µA	
Emitter Cutoff Current		$-I_{EBO}$			100	µA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage		$-V_{CE(sat)}$ *		0.3	0.8	V	$-I_C$=2A $-I_B$=0.2A
				0.8		V	$-I_C$=6A $-I_B$=0.6A
Base-Emitter Voltage		$-V_{BE}$ *		0.95	1.5	V	$-I_C$=2A $-V_{CE}$=2V
D.C. Current Gain	BD 534	H_{FE} *	20				$-I_C$=10mA $-V_{CE}$=5V
	BD 536		20				
	BD 538		15				
	BD 534		25				$-I_C$=2A $-V_{CE}$=2V
	BD 536		25				
	BD 538		15				
	All types		40				$-I_C$=500mA $-V_{CE}$=2V
Current Gain-Bandwidth Product		f_T	3			MHz	$-I_C$=250mA $-V_{CE}$=1V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

BD633 through BD638

COMPLEMENTARY
SILICON EPITAXIAL BASE AF POWER TRANSISTORS

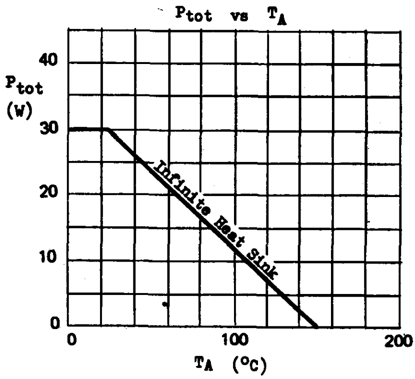
THE BD633 THROUGH BD638 ARE SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE BD633, BD635, BD637 ARE NPN AND ARE COMPLEMENTARY TO THE PNP TYPE BD634, BD636, BD638.

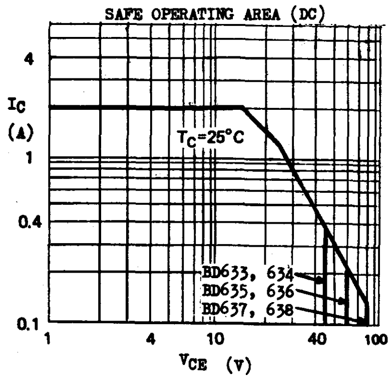
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative		BD633(NPN) BD634(PNP)	BD635(NPN) BD636(PNP)	BD637(NPN) BD638(PNP)
Collector-Base Voltage	V_{CBO}	45V	60V	100V
Collector-Emitter Voltage	V_{CEO}	45V	60V	80V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V
Collector Current	I_C	2A	2A	2A
Collector Peak Current	I_{CM}	5A	5A	5A
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}		30W	
($T_A \leq 25°C$)			2W	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	4.17°C/W max.
Junction to Ambient	θ_{ja}	62.5°C/W max

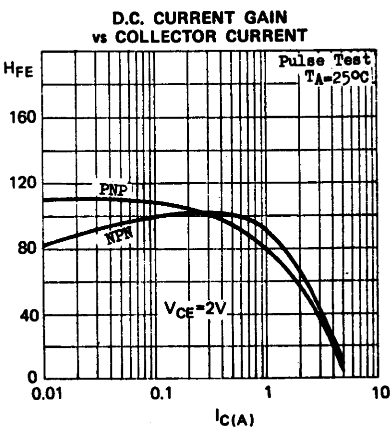


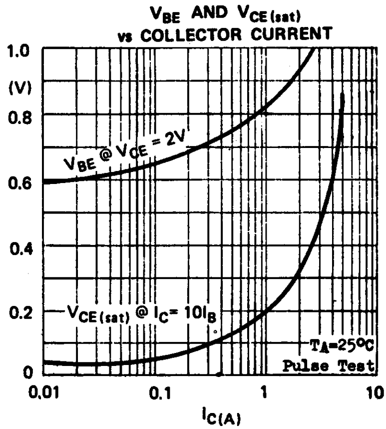


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}				I_C=0.1mA I_E=0
BD633, 634		45		V	
BD635, 636		60		V	
BD637, 638		100		V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *				I_C=30mA I_B=0
BD633, 634		45		V	
BD635, 636		60		V	
BD637, 638		80		V	
Emitter-Base Breakdown Voltage	BV_{EBO}	5		V	I_E=1mA I_C=0
Collector Cutoff Current	I_{CES}				
BD633, 634			0.2	mA	V_{CE}=45V V_{BE}=0
BD635, 636			0.2	mA	V_{CE}=60V V_{BE}=0
BD637, 638			0.2	mA	V_{CE}=100V V_{BE}=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.6	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *		1.3	V	I_C=1A V_{CE}=2V
D.C. Current Gain	H_{FE} *	40			I_C=25mA V_{CE}=2V
		25			I_C=1A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	3		MHz	I_C=0.2A V_{CE}=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BF158 BF159 BF160

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE BF158, BF159, BF160 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF SMALL SIGNAL APPLICATIONS SUCH AS RF-IF AMPLIFIERS IN FM RECEIVERS AND THIRD VIDEO IF AMPLIFIERS IN TV RECEIVERS.

CASE TO-106

CBE

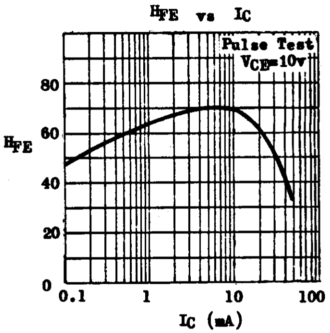
ABSOLUTE MAXIMUM RATINGS

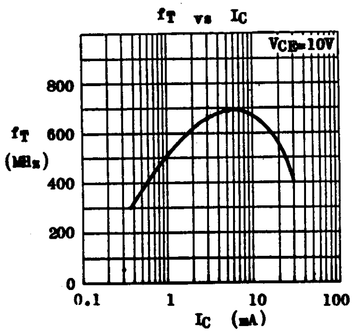
		BF158	BF159	BF160
Collector-Base Voltage	V_{CBO}	30V	40V	30V
Collector-Emitter Voltage	V_{CEO}	12V	20V	12V
Emitter-Base Voltage	V_{EBO}	2V	2V	2V
Collector Current	I_C		50mA	
Total Power Dissipation ($T_A < 25°C$)	P_{tot}		200mW derate 2mW/°C above 25°C	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 125°C	

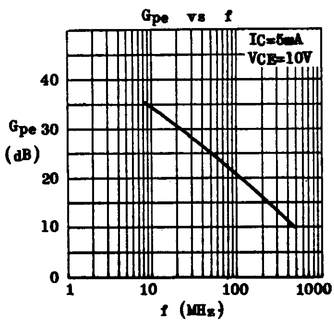
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

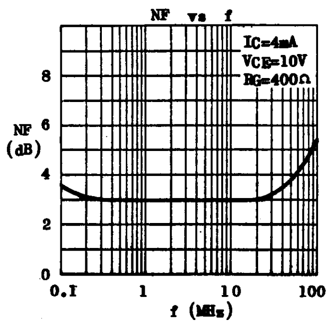
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage BF158, BF160 BF159	BV_{CBO}	 30 40			 V V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage BF158, BF160 BF159	LV_{CEO}	 12 20			 V V	I_C=3mA (pulsed) I_B=0
Emitter-Base Breakdown Voltage All types	BV_{EBO}	 2			 V	I_E=0.1mA I_C=0
Collector Cutoff Current All types	I_{CBO}			100 5	nA µA	V_{CB}=15V I_E=0 V_{CB}=15V I_E=0 T_A=65°C
Collector-Emitter Saturation Voltage All types	$V_{CE(sat)}$		0.1	0.5	V	I_C=10mA I_B=1mA
D.C. Current Gain BF158, BF159 BF160	h_{FE}	20 20	70 70			I_C=4mA V_{CB}=10V I_C=3mA V_{CB}=10V
Current Gain-Bandwidth Product BF158, BF159 BF160	f_T	 400	 700 600		 MHz MHz	I_C=5mA V_{CE}=10V I_C=3mA V_{CB}=10V
Feedback Capacitance BF158, BF159 BF160	C_{re}		0.8 0.8	1.2 1.2	pF pF	I_C=5mA V_{CB}=10V f=1MHz I_C=3mA V_{CB}=10V f=1MHz
Power Gain BF158, BF159 BF160	G_{pe}	22 28	26 32		dB dB	I_C=5mA V_{CB}=10V f=40MHz I_C=3mA V_{CB}=8V f=10.7MHz
Output Conductance BF158 only	g_{oe}		0.2	0.3	mU	I_C=5mA V_{CB}=10V f=40MHz
Noise Figure All types	NF		3.5		dB	I_C=4mA V_{CB}=10V R_G=400Ω f=40MHz

TYPICAL CHARACTERISTICS AT T_A=25°C









BF254 BF255

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE BF254, BF255 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS. THE BF254 IS INTENDED FOR USE IN AM/FM IF AMPLIFIERS AND FOR INPUT STAGES IN THE SHORT, MEDIUM ABD LONG WAVE BANDS. THE BF255 IS INTENDED FOR USE IN PRE-STAGES AND CONVERTER STAGES IN THE VHF BAND.

CASE TO-92E

CBE

ABSOLUTE MAXIMUM RATINGS

		BF254	BF255
Collector-Base Voltage	V_{CBO}	30V	30V
Collector-Emitter Voltage	V_{CEO}	20V	20V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	30mA	
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	300mW derate 3mW/^{o}C above 25^{o}C	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125^{o}C	

ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

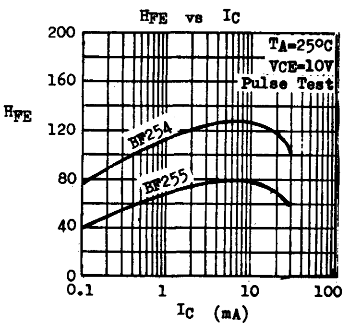
PARAMETER	SYMBOL	BF254 MIN	BF254 TYP	BF254 MAX	BF255 MIN	BF255 TYP	BF255 MAX	UNIT	TEST CONDITIONS
Emitter-Base Breakdown Voltage	BV_{EBO}	5			5			V	I_E=10μA I_C=0
Collector Cutoff Current	I_{CBO}			0.1			0.1	μA	V_{CB}=30V I_E=0
Collector Cutoff Current	I_{CEO}			1			1	μA	V_{CE}=20V I_B=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.1			0.1		V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}		0.67	0.74		0.67	0.74	V	I_C=1mA V_{CE}=10V
D.C. Current Gain	H_{FE}	67	115	220	36	67	125		I_C=1mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T		260			200		MHz	I_C=1mA V_{CE}=10V
Feedback Time Constant	$C_c r_{bb'}$		25	40		20	35	pS	I_C=1mA V_{CE}=5V f=31.8MHz
Feedback Capacitance	C_{re}		0.85			0.85		pF	I_C=1mA V_{CE}=10V f=450KHz
Noise Figure	NF		4			4		dB	I_C=1mA V_{CE}=10V R_G=100Ω f=100MHz

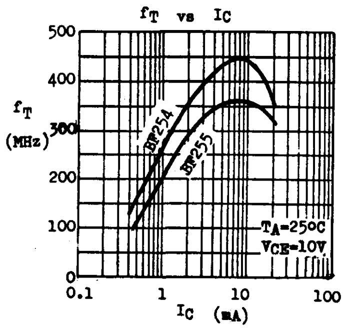
BF254 TYPICAL y-PARAMETERS AT T_A=25°C I_C=1mA V_{CE}=10V

f=450kHz	g_{11}=0.33m℧	$\|y_{12}\|$=2.8μ℧	$\|y_{21}\|$=36m℧	g_{22}=6μ℧
Common Emitter	b_{11}=0.065m℧	$-\theta_{12}$=90°	$-\theta_{21}$=0°	b_{22}=4.5μ℧
	C_{11}=23pF			C_{22}=1.6pF
f=10.7MHz	g_{11}=0.45m℧	$\|y_{12}\|$=65μ℧	$\|y_{21}\|$=36m℧	g_{22}=8.5μ℧
Common Emitter	b_{11}=1.5m℧	$-\theta_{12}$=90°	$-\theta_{21}$=10°	b_{22}=0.11m℧
	C_{11}=22pF			C_{22}=1.6pF
f=100MHz	g_{11}=36m℧	$\|y_{12}\|$=420μ℧	$\|y_{21}\|$=33m℧	g_{22}=22μ℧
Common Base	$-b_{11}$=3m℧	$-\theta_{12}$=88°	$-\theta_{21}$=146°	b_{22}=1.1m℧
	$-C_{11}$=4.8pF			C_{22}=1.75pF

BF255 TYPICAL y-PARAMETERS AT T_A=25°C I_C=1mA V_{CE}=10V

f=450kHz	g_{11}=0.5m℧	$\|y_{12}\|$=2.6μ℧	$\|y_{21}\|$=36m℧	g_{22}=2.7μ℧
Common Emitter	b_{11}=0.1m℧	$-\theta_{12}$=90°	$-\theta_{21}$=0°	b_{22}=4.5μ℧
	C_{11}=32pF			C_{22}=1.6pF
f=10.7MHz	g_{11}=0.6m℧	$\|y_{12}\|$=60μ℧	$\|y_{21}\|$=36m℧	g_{22}=4.5μ℧
Common Emitter	b_{11}=2m℧	$-\theta_{12}$=90°	$-\theta_{21}$=10°	b_{22}=0.11m℧
	C_{11}=30pF			C_{22}=1.6pF
f=100MHz	g_{11}=38m℧	$\|y_{12}\|$=410μ℧	$\|y_{21}\|$=34m℧	g_{22}=12μ℧
Common Base	$-b_{11}$=1m℧	$-\theta_{12}$=85°	$-\theta_{21}$=140°	b_{22}=1.1m℧
	$-C_{11}$=1.6pF			C_{22}=1.75pF





BF257 BF258 BF259

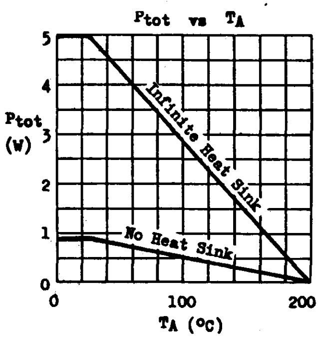
NPN HIGH VOLTAGE VIDEO AMPLIFIERS

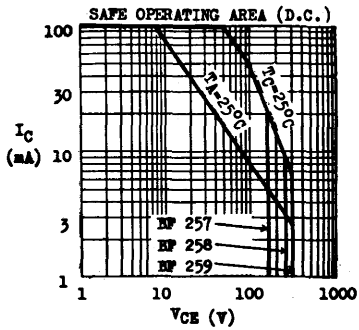
THE BF257, BF258, BF259 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR HIGH VOLTAGE VIDEO OUTPUT STAGES IN BLACK-AND-WHITE AND COLOUR TV-RECEIVERS.

CASE TO-39

ABSOLUTE MAXIMUM RATINGS		BF257	BF258	BF259
Collector-Base Voltage	V_{CBO}	160V	250V	300V
Collector-Emitter Voltage	V_{CEO}	160V	250V	300V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		100mA	
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}		5W	
@ $T_A \leq 25^oC$			800mW	
Operating Junction & Storage Temperature	T_j, T_{stg}		-65 to 200°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	35°C/W	max.
Junction to Ambient	θ_{ja}	220°C/W	max.

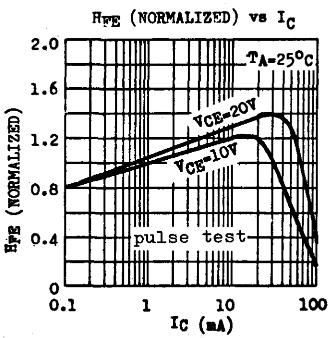


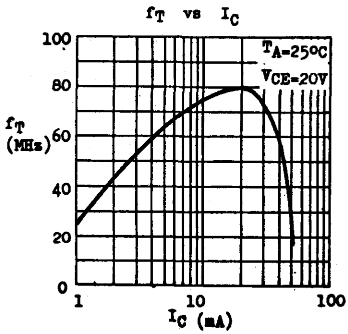


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	BF257 MIN	BF257 MAX	BF258 MIN	BF258 MAX	BF259 MIN	BF259 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	160		250		300		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	160		250		300		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5		5		5		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		50					nA	V_{CB}=100V I_E=0
					50			nA	V_{CB}=200V I_E=0
							50	nA	V_{CB}=250V I_E=0
Emitter Cutoff Current	I_{EBO}		50		50		50	nA	V_{EB}=3V I_C=0
D.C. Current Gain	H_{FE} *	25		25		25			I_C=30mA V_{CE}=10V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1		1		1	V	I_C=30mA I_B=6mA
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	I_C=15mA V_{CE}=20V
Collector-Base Capacitance	Ccb		5		5		5	pF	V_{CB}=30V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





BF297 BF298 BF299

NPN HIGH VOLTAGE VIDEO AMPLIFIERS

THE BF297, BF298, BF299 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR HIGH VOLTAGE VIDEO AMPLIFIERS IN TELEVISION RECEIVERS. THEY FEATURE GOOD FREQUENCY CHARACTERISTICS.

CASE TO-92F

CEB

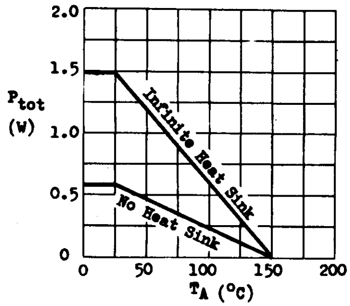
ABSOLUTE MAXIMUM RATINGS		BF297	BF298	BF299
Collector-Base Voltage	V_{CBO}	160V	250V	300V
Collector-Emitter Voltage	V_{CBO}	160V	250V	300V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		100mA	
Total Power Dissipation ● $T_C \leq 25^oC$	P_{tot}		1.5W	
● $T_A \leq 25^oC$			625mW	
Operating Junction & Storage Temperature	T_j & Tstg		-55 to 150°C	

ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

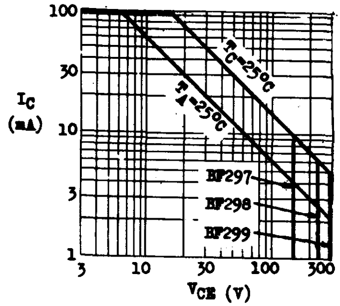
PARAMETER	SYMBOL	BF297 MIN	BF297 MAX	BF298 MIN	BF298 MAX	BF299 MIN	BF299 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	160		250		300		V	$I_C=0.1mA$ $I_E=0$
Collector-Emitter Breakdown Voltage	LV_{CEO}	160		250		300		V	$I_C=10mA$ $I_B=0$
Emitter-Base Voltage	BV_{EBO}	5		5		5		V	$I_E=0.1mA$ $I_C=0$
Collector Cutoff Current	I_{CBO}		50					nA	$V_{CB}=100V$ $I_E=0$
					50			nA	$V_{CB}=200V$ $I_E=0$
							50	nA	$V_{CB}=250V$ $I_E=0$
Emitter Cutoff Current	I_{EBO}		50		50		50	nA	$V_{EB}=3V$ $I_C=0$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1		1		1	V	$I_C=30mA$ $I_B=3mA$
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		0.85		0.85		0.85	V	$I_C=30mA$ $I_B=3mA$
D.C. Current Gain	H_{FE}	10		10		10			$I_C=5mA$ $V_{CE}=10V$
		30	150	30	150	30	150		$I_C=30mA$ $V_{CE}=10V$
		10		10		10			$I_C=100mA$ $V_{CE}=10V$
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	$I_C=30mA$ $V_{CE}=10V$
Collector-Base Capacitance	Cob		5		5		5	pF	$V_{CB}=30V$ $I_E=0$ f=1MHz

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

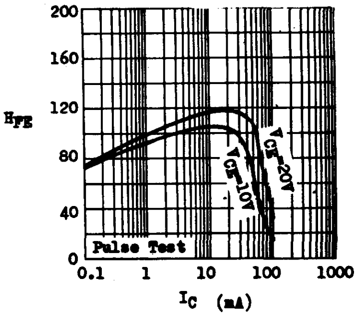
P_{tot} vs T_A



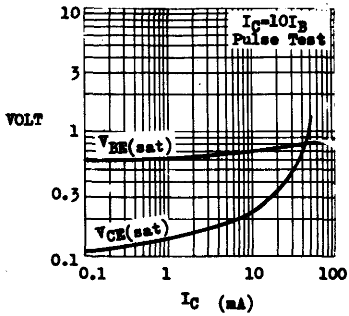
SAFE OPERATING AREA (D.C.)



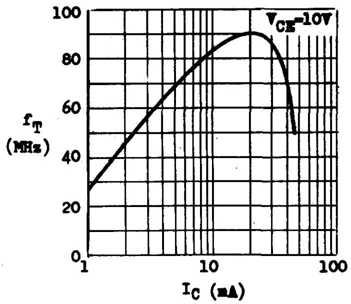
H_{FE} vs I_C



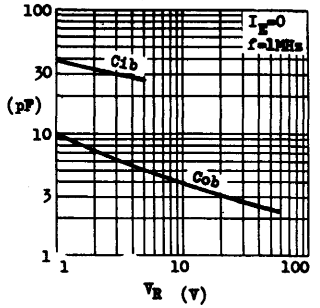
$V_{BE(sat)}$ & $V_{CE(sat)}$ vs I_C



f_T vs I_C



C_{ib} & C_{ob} vs V_R



BF336 BF337 BF338

NPN HIGH VOLTAGE VIDEO AMPLIFIERS

THE BF336, BF337, BF338 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR R-G-B AND COLOUR DIFFERENCE OUTPUT CIRCUITS OF COLOUR TELEVISION RECEIVERS. THEY FEATURE HIGH BREAKDOWN VOLTAGE AND GOOD FREQUENCY CHARACTERISTICS.

CASE TO-39

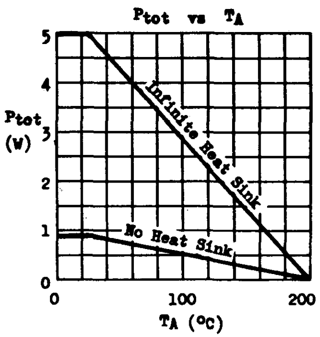
C E B

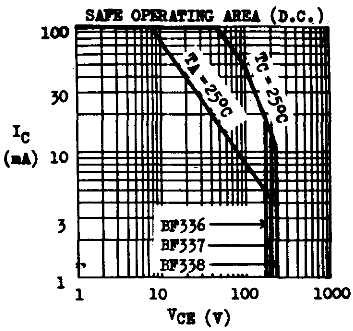
ABSOLUTE MAXIMUM RATINGS

		BF336	BF337	BF338
Collector-Emitter Voltage(R_{BE} =1kΩ)	V_{CER}	185V	250V	300V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	180V	200V	225V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		100mA	
Total Power Dissipation @ $T_C \leq 25°C$	P_{tot}		5W	
@ $T_A \leq 25°C$			800mW	
Operating Junction & Storage Temperature	T_j & T_{stg}		-65 to 200°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	35°C/W	max.
Junction to Ambient	θ_{ja}	220°C/W	max.



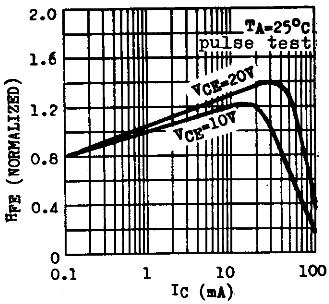


ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

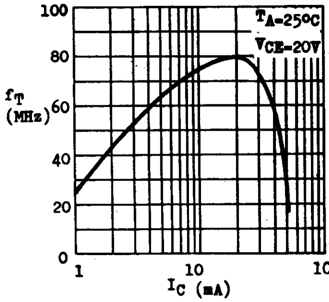
PARAMETER	SYMBOL	BF336 MIN	BF336 MAX	BF337 MIN	BF337 MAX	BF338 MIN	BF338 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	185		250		300		V	$I_C=0.1mA$ $I_E=0$
Collector-Emitter Breakdown Voltage	LV_{CER}*	185		250		300		V	$I_C=1mA$ $R_{BE}=1k\Omega$ $T_j\leq150^oC$
Collector-Emitter Breakdown Voltage	LV_{CEO}*	180		200		225		V	$I_C=4mA$ $I_B=0$
Emitter-Base Breakdown Voltage	BV_{EBO}	5		5		5		V	$I_E=0.1mA$ $I_C=0$
Collector Cutoff Current	I_{CER}		100					µA	$V_{CE}=150V$ $R_{BE}=1k\Omega$
					100			µA	$V_{CE}=200V$ $R_{BE}=1k\Omega$
							100	µA	$V_{CE}=250V$ $R_{BE}=1k\Omega$
Base-Emitter Voltage	V_{BE} *		1.2		1.2		1.2	V	$I_C=30mA$ $V_{CE}=10V$
D.C. Current Gain	H_{FE} *	20		20		20			$I_C=30mA$ $V_{CE}=10V$
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	$I_C=30mA$ $V_{CE}=20V$
Feedback Capacitance	Cre		3.5		3.5		3.5	pF	$I_C=10mA$ $V_{CE}=20V$ f=0.5MHz
Feedback Time Constant	Ccrbb'		100		100		100	pS	$I_E=30mA$ $V_{CB}=20V$ f=10MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

H_{FE} (NORMALIZED) vs I_C



f_T vs I_C



BF368 BF369

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE BF368, BF369 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR HF-IF SMALL SIGNAL AMPLIFIER AND OSCILLATOR APPLICATIONS.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS

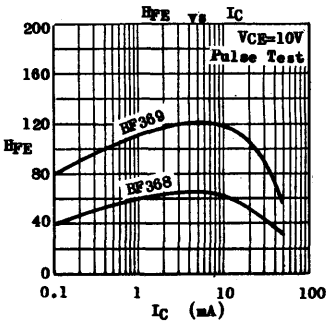
		BF368	BF369
Collector-Base Voltage	VCBO	25V	30V
Collector-Emitter Voltage	VCEO	15V	20V
Emitter-Base Voltage	VEBO	4V	4V
Collector Current	I_C	50mA	
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	310mW derate 2.81mW/°C above 25°C	
Operating Junction & Storage Temperature	Tj, Tstg	-55 to 135°C	

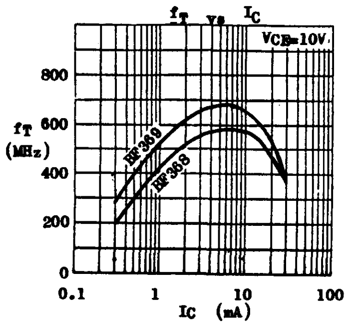
ELECTRICAL CHARACTERISTICS (T_A=25°C)

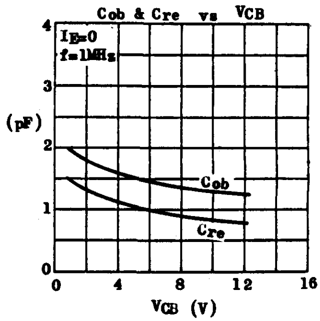
PARAMETER	SYMBOL	BF368 MIN	BF368 TYP	BF368 MAX	BF369 MIN	BF369 TYP	BF369 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BVCBO	25			30			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LVCEO*	15			20			V	I_C=3mA I_B=0
Emitter-Base Breakdown Voltage	BVEBO	4			4			V	I_E=0.01mA I_C=0
Collector Cutoff Current	ICBO			100			100	nA	V_{CB}=15V I_E=0
Collector-Emitter Saturation Voltage	VCE(sat)		0.12	0.4		0.1	0.4	V	I_C=10mA I_B=1mA
Base-Emitter Saturation Voltage	VBE(sat)		0.84	1.0		0.84	1.0	V	I_C=10mA I_B=1mA
D.C. Current Gain	h_{FE}	35	60	125	70	110	220		I_C=1mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	250	400		400	520		MHz	I_C=1mA V_{CE}=10V
Output Capacitance	Cob		1.3	1.7		1.3	1.7	pF	V_{CB}=10V I_E=0 f=1MHz
Collector-Base Time Constant	Ccrbb'		20			25		pS	I_C=1mA V_{CE}=5V f=31.8MHz

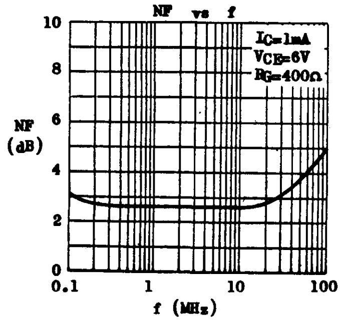
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS AT T_A=25°C

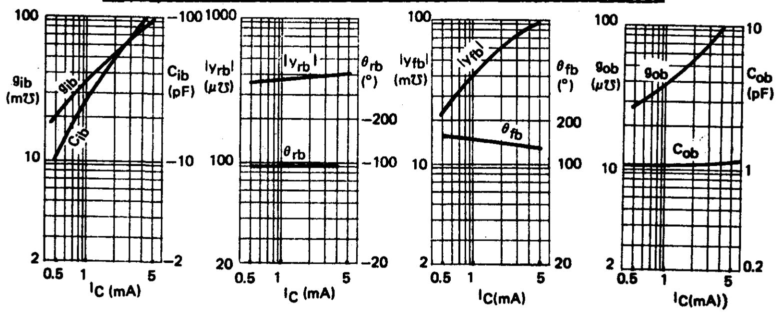








TYPICAL COMMON BASE y-PARAMETERS AT f=100MHz VCB=5V T_A=25°C



3.78.3100B

BF391 BF392 BF393

NPN HIGH VOLTAGE VIDEO AMPLIFIERS

THE BF391, BF392, BF393 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR HIGH VOLTAGE VIDEO AMPLIFIERS IN TELEVISION RECEIVERS. THEY FEATURE 200V MINIMUM COLLECTOR-EMITTER BREAKDOWN VOLTAGE AND GOOD FREQUENCY CHARACTERISTICS.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS

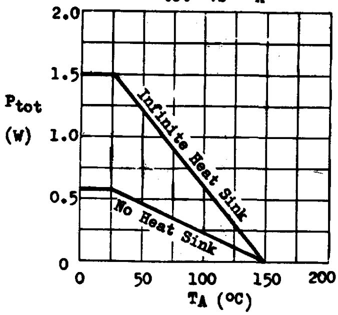
		BF391	BF392	BF393
Collector-Base Voltage	V_{CBO}	200V	250V	300V
Collector-Emitter Voltage	V_{CEO}	200V	250V	300V
Emitter-Base Voltage	V_{EBO}	6V	8V	8V
Collector Current	I_{CM}		500mA	
Total Power Dissipation ● $T_C \leq 25^oC$	P_{tot}		1.5W	
● $T_A \leq 25^oC$			625mW	
Operating Junction & Storage Temperature	T_j & T_{stg}		-55 to 150°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

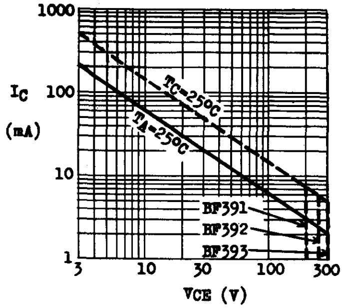
PARAMETER	SYMBOL	BF391 MIN	BF391 MAX	BF392 MIN	BF392 MAX	BF393 MIN	BF393 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	200		250		300		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	200		250		300		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		8		8		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		0.1					µA	V_{CB}=160V I_E=0
					0.1		0.1	µA	V_{CB}=200V I_E=0
Emitter Cutoff Current	I_{EBO}		0.1					µA	V_{EB}=4V I_C=0
					0.1		0.1	µA	V_{EB}=6V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		2		2		2	V	I_C=20mA I_B=2mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$		2		2		2	V	I_C=20mA I_B=2mA
D.C. Current Gain	H_{FE}	25		25		25			I_C=1mA V_{CE}=10V
		40		40		40			I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	I_C=10mA V_{CE}=20V
Feedback Capacitance	C_{re}		2		2		2	pF	V_{CB}=60V I_E=0 f=1MHz

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

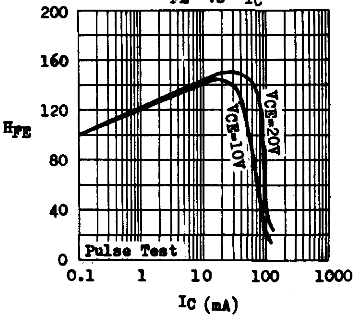
P_{tot} vs T_A



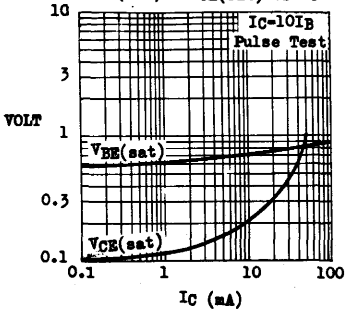
SAFE OPERATING AREA (D.C.)



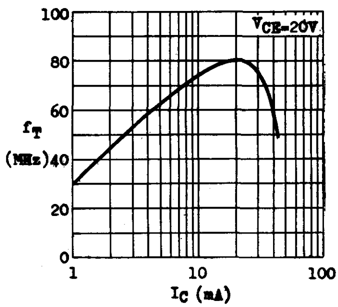
H_{FE} vs I_C

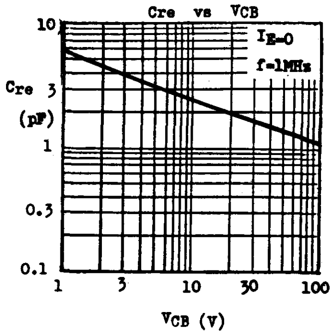


$V_{BE}(sat)$ & $V_{CE}(sat)$ vs I_C



f_T vs I_C





BF494 BF495

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE BF494, BF495 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF SMALL SIGNAL APPLICATIONS UP TO 100MHz.

CASE TO-92E

CBE

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BF494	BF495
Collector-Base Voltage	V_{CBO}	30V	30V
Collector-Emitter Voltage	V_{CEO}	20V	20V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	30mA	
Total Power Dissipation ($T_A \leq 75^oC$)	P_{tot}	300mW derate 4mW/°C above 75°C	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

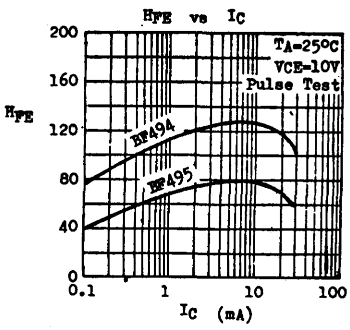
PARAMETER	SYMBOL	BF494 MIN	BF494 TYP	BF494 MAX	BF495 MIN	BF495 TYP	BF495 MAX	UNIT	TEST CONDITIONS
Emitter-Base Breakdown Voltage	BV_{EBO}	5			5			V	I_E=10µA I_C=0
Collector Cutoff Current	I_{CBO}			0.1			0.1	µA	V_{CB}=30V I_E=0
Collector Cutoff Current	I_{CEO}			1			1	µA	V_{CE}=20V I_B=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.1			0.1		V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}	.65	.68	.74	.65	.68	.74	V	I_C=1mA V_{CE}=10V
D.C. Current Gain	H_{FE}	67	115	220	36	67	125		I_C=1mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T		260			200		MHz	I_C=1mA V_{CE}=10V
Feedback Capacitance	Cre		.85			.85		pF	I_C=1mA V_{CE}=10V f=450KHz
Noise Figure	NF		4			4		dB	I_C=1mA V_{CE}=10V R_G=100Ω f=100MHz
Mixing Noise Figure	NF_c		2					dB	I_C=1mA V_{CE}=10V R_G=830Ω f=1MHz
	NF_c					2.5		dB	I_C=1mA V_{CE}=10V R_G=670Ω f=1MHz

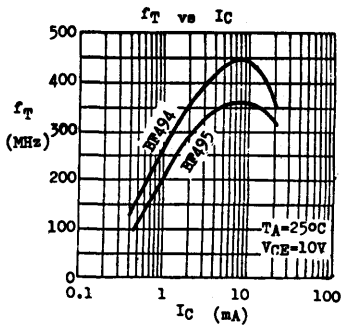
BF494 TYPICAL y-PARAMETERS AT T_A=25°C I_C=1mA V_{CE}=10V

f=450kHz Common Emitter	g_{11}=0.33m℧ b_{11}=0.065m℧ C_{11}=23pF	$\lvert y_{12}\rvert$=2.8μ℧ $-\theta_{12}$=90°	$\lvert y_{21}\rvert$=36m℧ $-\theta_{21}$=0°	g_{22}=6μ℧ b_{22}=4.5μ℧ C_{22}=1.6pF
f=10.7MHz Common Emitter	g_{11}=0.45m℧ b_{11}=1.5m℧ C_{11}=22pF	$\lvert y_{12}\rvert$=65μ℧ $-\theta_{12}$=90°	$\lvert y_{21}\rvert$=36m℧ $-\theta_{21}$=10°	g_{22}=8.5μ℧ b_{22}=0.11m℧ C_{22}=1.6pF
f=100MHz Common Base	g_{11}=36m℧ $-b_{11}$=3m℧ $-C_{11}$=4.8pF	$\lvert y_{12}\rvert$=420μ℧ $-\theta_{12}$=88°	$\lvert y_{21}\rvert$=33m℧ $-\theta_{21}$=146°	g_{22}=22μ℧ b_{22}=1.1m℧ C_{22}=1.75pF

BF495 TYPICAL y-PARAMETERS AT T_A=25°C I_C=1mA V_{CE}=10V

f=450kHz Common Emitter	g_{11}=0.5m℧ b_{11}=0.1m℧ C_{11}=32pF	$\lvert y_{12}\rvert$=2.6μ℧ $-\theta_{12}$=90°	$\lvert y_{21}\rvert$=36m℧ $-\theta_{21}$=0°	g_{22}=2.7μ℧ b_{22}=4.5μ℧ C_{22}=1.6pF
f=10.7MHz Common Emitter	g_{11}=0.6m℧ b_{11}=2m℧ C_{11}=30pF	$\lvert y_{12}\rvert$=60μ℧ $-\theta_{12}$=90°	$\lvert y_{21}\rvert$=36m℧ $-\theta_{21}$=10°	g_{22}=4.5μ℧ b_{22}=0.11m℧ C_{22}=1.6pF
f=100MHz Common Base	g_{11}=38m℧ $-b_{11}$=1m℧ $-C_{11}$=1.6pF	$\lvert y_{12}\rvert$=410μ℧ $-\theta_{12}$=85°	$\lvert y_{21}\rvert$=34m℧ $-\theta_{21}$=140°	g_{22}=12μ℧ b_{22}=1.1m℧ C_{22}=1.75pF





2.78.3300A

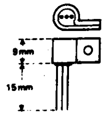
CL055 CL066

COMPLEMENTARY SILICON PLANAR LOW VCEK TRANSISTORS

THE CL055 (PNP) AND CL066 (NPN) ARE SILICON PLANAR EPITAXIAL COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR 1-WATT AUDIO AMPLIFIER OUTPUT AND SWITCHING APPLICATIONS. THEY FEATURE LOW COLLECTOR-EMITTER KNEE VOLTAGE AND GOOD LINEARITY OF D.C. CURRENT GAIN.

CASE TO-92A

X-67 Heat Sink



ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	25V
Collector-Emitter Voltage	V_{CEO}	20V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	1A
Collector Peak Current ($t \leqslant 50mS$)	I_{CM}	1.5A
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	1.5W
With X-67 Heat Sink @ $T_A \leq 25^oC$		800mW
Without Heat Sink @ $T_A \leq 25^oC$		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	25			V	I_C=100μA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	20			V	I_C=10mA I_B=0
Collector-Emitter Cutoff Current	I_{CES}			0.5	μA	V_{CE}=20V V_{BE}=0
Emitter-Base Cutoff Current	I_{EBO}			1.0	μA	V_{EB}=5V I_C=0
Collector-Emitter Knee Voltage	V_{CEK}		0.25	0.5	V	I_C=0.2A I_B=value at which I_C=0.22A V_{CE}=1V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.21	0.4	V	I_C=0.5A I_B=0.05A
Base-Emitter Voltage	V_{BE} *		0.87	1.2	V	I_C=0.5A V_{CE}=1V
D.C. Current Gain (Note)	H_{FE} 1 *	50	160	360		I_C=0.1A V_{CE}=1V
	H_{FE} 2 *	20	80			I_C=1A V_{CE}=2V
Current Gain-Bandwidth Product	f_T		120		MHz	I_C=50mA V_{CE}=10V

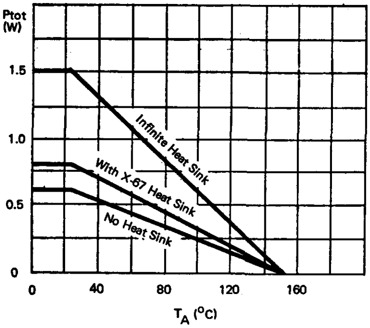
Note : $H_{FE\,1}$ is classified as follows. Group A : 50-100 Group B : 80-160
Group C : 120-240 Group D : 180-360

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

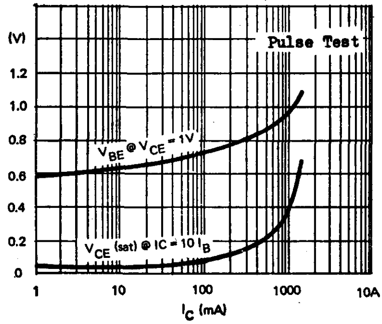
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)

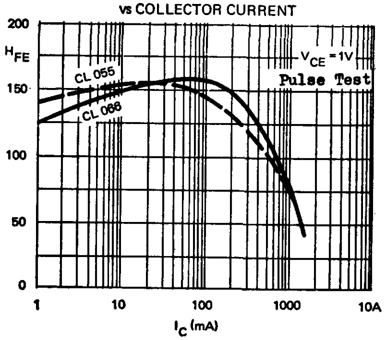
TOTAL POWER DISSIPATION
vs AMBIENT TEMPERATURE



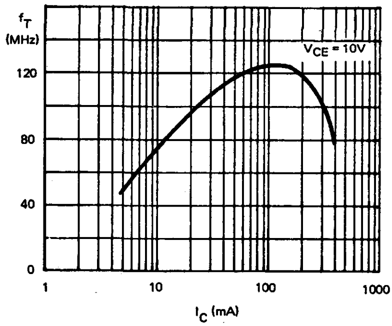
VBE AND VCE (sat)
vs COLLECTOR CURRENT



D.C. CURRENT GAIN
vs COLLECTOR CURRENT



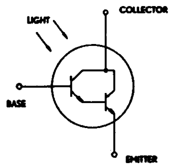
CURRENT GAIN – BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



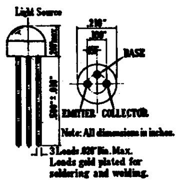
CL138

NPN SILICON PHOTO DARLINGTON TRANSISTOR

THE CL138 IS AN NPN SILICON PHOTO DARLINGTON TRANSISTOR FOR USE IN PHOTO DETECTOR CIRCUITS IN WHICH VERY SENSITIVE LIGHT CURRENT IS REQUIRED. THE DEVICE IS SUPPLIED IN SELECTED LIGHT CURRENT GROUPS.



CASE TO-106



Note : The base terminal may be isolated from the internal silicon chip upon request.

ABSOLUTE MAXIMUM RATINGS

Collector-Emitter Voltage	V_{CEO}	18V
Emitter-Collector Voltage	V_{ECO}	5V
Collector Current	I_C	100mA
Total Power Dissipation @ $T_A \leq 25°C$	P_{tot}	300mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 100°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

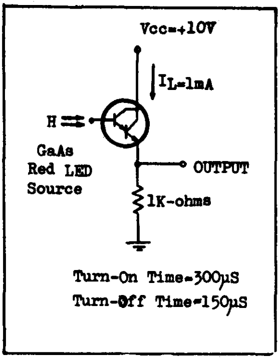
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}*	18	35		V	I_C=10mA (Pulsed) I_B=0
Emitter-Collector Breakdown Voltage	BV_{ECO}*	5	8.5		V	I_E=0.1mA I_B=0
Collector Cutoff Current (=Dark Current)	I_{CEO} *			1	µA	V_{CE}=5V I_B=0
Light Current	I_L **	15		80	mA	V_{CE}=3V H=2mW/cm^2
Group A		15	25	40	mA	V_{CE}=3V H=2mW/cm^2
Group B		30	50	80	mA	V_{CE}=3V H=2mW/cm^2

* Tested in complete darkness.

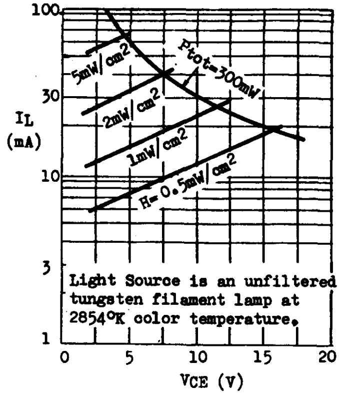
** The light current is the collector to emitter current measured at specified irradiance (H). The radiation source is an unfiltered tungsten filament lamp at 2874°K color temperature.

TYPICAL CHARACTERISTICS AT T_A=25°C

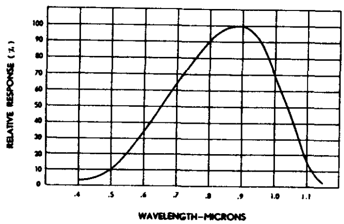
SWITCHING TIME



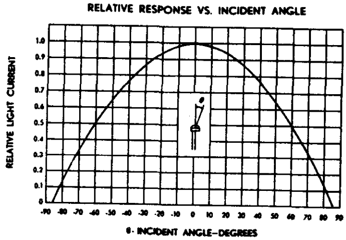
LIGHT CURRENT
vs COLLECTOR-EMITTER VOLTAGE



SPECTRAL RESPONSE



RELATIVE RESPONSE VS. INCIDENT ANGLE



CL155 CL166

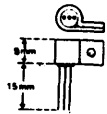
COMPLEMENTARY SILICON PLANAR LOW VCEK TRANSISTORS

THE CL155 (PNP) AND CL166 (NPN) ARE SILICON PLANAR EPITAXIAL COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR 2-WATT AUDIO AMPLIFIER OUTPUT AND SWITCHING APPLICATIONS. THEY FEATURE LOW COLLECTOR-EMITTER KNEE VOLTAGE AND GOOD LINEARITY OF D.C. CURRENT GAIN.

TO-92A

EBC

X - 67 HEAT SINK



ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	30V
Collector-Emitter Voltage	V_{CEO}	25V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	1.5A
Collector Peak Current ($t \leqslant 50mS$)	I_{CM}	2.2A
Total Power Dissipation @ $T_C \leq 25^oC$	Ptot	1.5W
With X-67 Heat Sink @ $T_A \leq 25^oC$		800mW
Without Heat Sink @ $T_A \leq 25^oC$		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30			V	I_C=100µA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	25			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CES}			0.5	µA	V_{CE}=20V V_{BE}=0
Emitter Cutoff Current	I_{EBO}			1.0	µA	V_{EB}=5V I_C=0
Collector-Emitter Knee Voltage	V_{CEK}		0.2	0.4	V	I_C=0.2A I_B=value at which I_C=0.22A V_{CE}=1V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.25	0.45	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *		0.82	1.2	V	I_C=0.5A V_{CE}=1V
D.C. Current Gain (Note)	H_{FE} 1 *	50	160	360		I_C=0.1A V_{CE}=1V
	H_{FE} 2 *	30	110			I_C=1A V_{CE}=2V
Current Gain-Bandwidth Product	f_T		120		MHz	I_C=50mA V_{CE}=10V

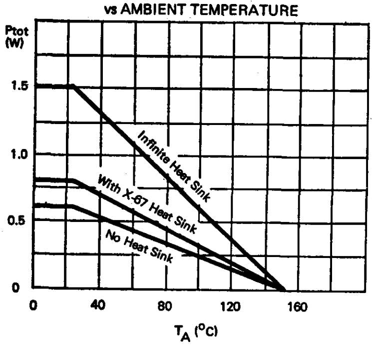
Note : H_{FE} 1 is classified as follows. Group A : 50-100 Group B : 80-160 Group C : 120-240 Group D : 180-360

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

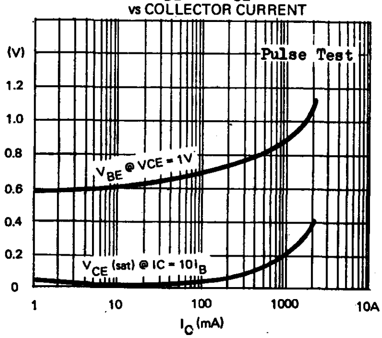
TYPICAL CHARACTERISTICS

($T_A = 25^oC$ UNLESS OTHERWISE NOTED)

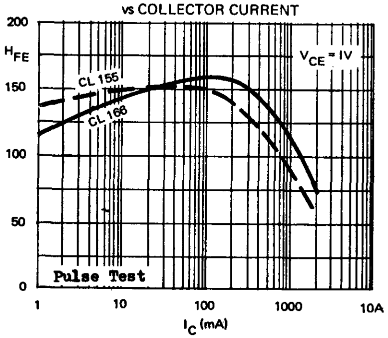
TOTAL POWER DISSIPATION vs AMBIENT TEMPERATURE



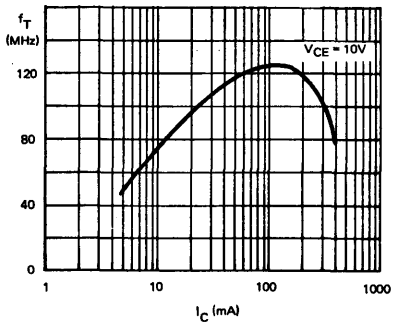
V_{BE} AND V_{CE} (sat) vs COLLECTOR CURRENT



D.C. CURRENT GAIN vs COLLECTOR CURRENT

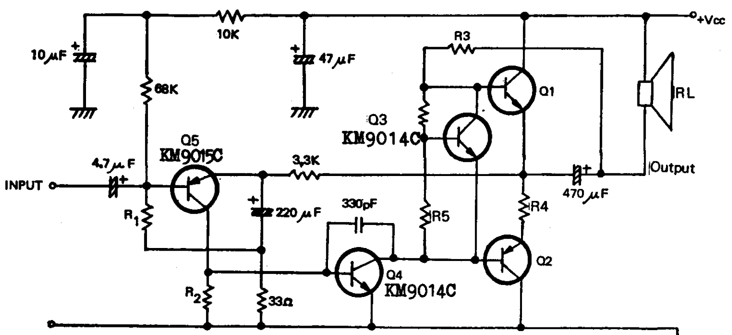


CURRENT GAIN – BANDWIDTH PRODUCT vs COLLECTOR CURRENT



APPLICATION NOTE (MEAP 168)

LOW VOLTAGE OTL AUDIO AMPLIFIER (RL=4~8Ω)



All resistances are in ohms. Quiescent current is very stable when Q3 is placed close to Q2.

CIRCUIT DETAILS	SUPPLY VOLTAGE (RL=8 ohms)					SUPPLY VOLTAGE (RL=4ohms)			
	12V	9V	7.5V	6V	4.5V	9V	7.5V	6V	4.5V
R1	56K	47K	39K	33K	27K	56K	39K	33K	27K
R2	2.2K	2.2K	2.2K	2.4K	3K	2.7K	2.4K	2.4K	3K
R3	390	390	330	220	120	270	270	220	120
R4	1	1	0	0	0	1	0	0	0
R5	560	470	470	470	470	510	510	470	470
Q1,HFE group C or D	CL166	CL066	CL066	CL066	CL066	CL166	CL166	CL066	CL066
Q2,HFE group C or D	CL155	CL055	CL055	CL055	CL055	CL155	CL155	CL055	CL055
10% THD Output	* 2W	1.1W	0.75W	0.5W	0.23W	*1.9W	*1.5W	0.9W	0.4W
Input Impedance	55K	55K	53K	50K	47K	53K	50K	47K	45K
Input Sensitivity	43mV	34mV	27mV	23mV	16mV	35mV	28mV	24mV	16mV
THD @ 0.5W Output	0.5%	0.6%	1%	10%	—	0.5%	0.7%	1%	—
Frequency Response	42Hz to 38KHz, -3dB					70Hz to 38KHz, -3dB			
Current Drain @ no signal	14mA	13mA	13mA	13mA	13mA	16mA	15mA	14mA	14mA
Current Drain @ 10% THD output	230mA	170mA	140mA	120mA	72mA	290mA	255mA	210mA	145mA

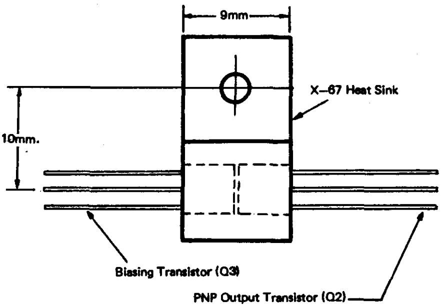
* Output transistors mounted to X-67 heat sink.

USING X–67 HEAT SINK TO ITS FULL ADVANTAGES

The X–67 heat sink is specially designed for the low V_{CEK} transistors to perform two functions.

1. Permits 2-Watts continuous output power in the amplifier circuit shown in last page.

2. Provides excellent stability of quiescent current when the biasing transistor (Q3) shares common heat sink with the PNP output transistor (Q2). The arrangement is shown in the following diagram.



CL855 CL866

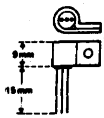
COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

THE CL855 (PNP) AND CL866 (NPN) ARE SILICON PLANAR EPITAXIAL TRANSISTORS OF COMPLEMENTARY CHARACTERISTICS. THEY ARE DESIGNED FOR USE IN AF LARGE SIGNAL AMPLIFIERS AND MEDIUM SPEED SWITCHING UP TO 1.5A PEAK CURRENT.

CASE TO-92A

EBC

X-67 HEAT SINK



ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	70V
Collector-Emitter Voltage	V_{CEO}	60V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	1A
Collector Peak Current ($t \leq 50mS$)	I_{CM}	1.5A
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	1.5W
With X-67 Heat Sink @ $T_A \leq 25^oC$		800mW
No Heat Sink @ $T_A \leq 25^oC$		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

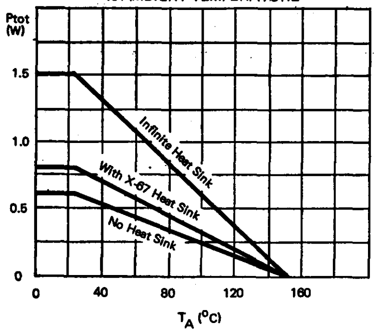
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	70			V	I_C=100μA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CES}			0.5	μA	V_{CE}=50V V_{BE}=0
Emitter Cutoff Current	I_{EBO}			1	μA	V_{EB}=5V I_C=0
Collector-Emitter Knee Voltage	V_{CEK}		0.45		V	I_C=0.2A, I_B=value at which I_C=0.22A V_{CE}=1V
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.23	0.5	V	I_C=0.5A I_B=0.05A
Base-Emitter Voltage	V_{BE} *		0.85	1.2	V	I_C=0.5A V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1*	50	120	240		I_C=0.1A V_{CE}=2V
	H_{FE} 2*	20	55			I_C=1A V_{CE}=4V
Current Gain-Bandwidth Product	f_T	50	150		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		15	25	pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

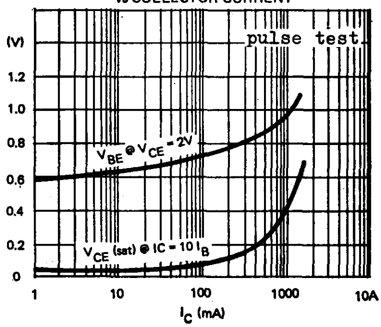
Note : H_{FE} 1 is classified as follows. Group A : 50-100 Group B : 80-160 Group C : 120-240

TYPICAL CHARACTERISTICS (T_A = 25°C UNLESS OTHERWISE SPECIFIED)

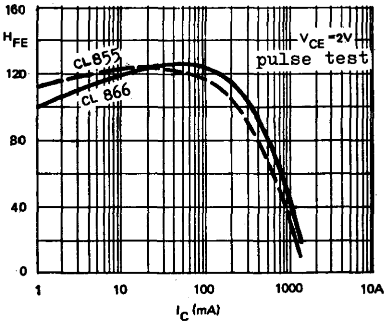
TOTAL POWER DISSIPATION vs AMBIENT TEMPERATURE



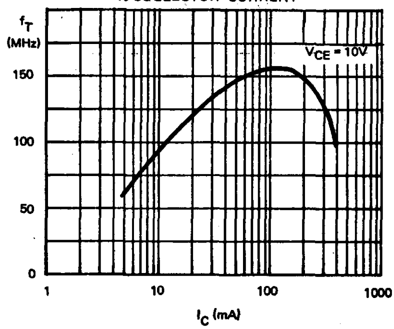
VBE AND VCE (sat) vs COLLECTOR CURRENT



D.C. CURRENT GAIN vs COLLECTOR CURRENT

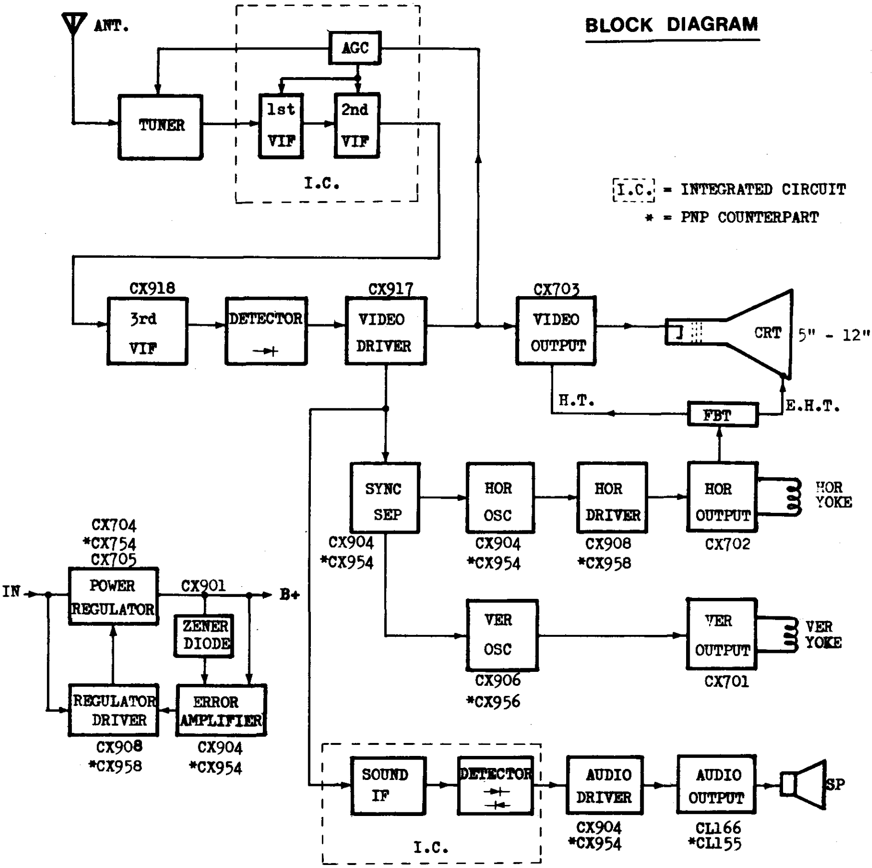


CURRENT GAIN – BANDWIDTH PRODUCT vs COLLECTOR CURRENT



CX PRODUCT LINE

DISCRETE SILICON TRANSISTORS
FOR PORTABLE B & W TV RECEIVERS



CX PRODUCT LINE — DEVICE SPECIFICATIONS (T_A=25°C unless otherwise noted)

APPLICATIONS	TYPE NPN	TYPE PNP	CASE	MAX RATINGS I_C (mA)	MAX RATINGS V_{CEO} (V)	MAX RATINGS P_{tot} (mW)	ELECTRICAL CHARACTERISTICS I_{CBO} @ V_{CB} (µA) (V) max	$V_{CE(sat)}$ @ I_C / I_B (V) (mA)/(mA) max	H_{FE} @ I_C/V_{CE} (mA)/(V) min-max	f_T @ I_C/V_{CE} (MHz)(mA)/(V) min	Cob @ V_{CB} (pF) (V) max
VER. OUTPUT	CX701 CX701A	-	TO-220B	2A	120 150	(25W)	10 @ 100	1 @ 1A/0.1A	30-120 @ 0.5A/5	-	-
HOR. OUTPUT	CX702 CX702A	-	TO-220B	5A	(160) (200)	(40W)	(100 @ 100)	2 @ 4A/0.8A	15-70 @ 4A/5	-	-
VIDEO OUTPUT	CX703 CX703A CX703B	-	TO-92A	100	160 200 250	625	0.1 @ 120 0.1 @ 150 0.1 @ 150	1.5 @ 20/2	40-200 @ 10/10	50 @ 10/20	3* @ 30
POWER REGULATOR	CX704	CX754	TO-220B	4A	50	(30W)	(1 @ 30)	1 @ 2A/0.2A	40-240 @ 1A/2	3 @ 0.2A/5	-
	CX705 CX705A	-	TO-3	7A	45 60	(75W)	(200 @ 30)	1.2 @ 3A/0.3A	20-70 @ 3A/4	0.5 @ 0.5A/10	-
GENERAL PURPOSE	CX901	-	TO-92A	100	40	300	0.1 @ 30	0.4 @ 50/5	40-150 @ 1/5	80 @ 1/5	3.5 @ 10
HOR. OSC SYNC. SEPARATOR AUDIO DRIVER ERROR AMPLIFIER	CX904	CX954	TO-92A	100	40	300	0.1 @ 30	0.4 @ 50/5	80-540 @ 5/5	80 @ 10/10	5 @ 10
VER. OSC	CX906	CX956	TO-92A	500	40	500	0.1 @ 30	0.5 @ 250/25	50-360 @ 50/1	80 @ 50/10	8 @ 10
HOR. DRIVER REGULATOR DRIVER	CX908	CX958	TO-92A	1A	40	625	0.1 @ 30	0.5 @ 500/50	80-360 @ 100/1	60 @ 50/10	18 @ 10
VIDEO DRIVER	CX917	-	TO-92A	50	30	250	0.1 @ 20	0.4 @ 20/2	40-150 @ 5/10	200 @ 5/10	2* @ 10
3rd VIDEO IF	CX918	-	TO-92A	50	20	250	0.1 @ 20	0.4 @ 20/2	40-150 @ 7/10	400 @ 7/10	1.5* @ 10
AUDIO OUTPUT	See CL155 . CL166 data sheet.										

( ) : I_{CEX} @ V_{CE}
( ) : P_{tot} @ T_C=25°C
( ) : V_{CES}

*C_{re}

CX701 CX701A

NPN SILICON TRANSISTORS
FOR TV VERTICAL OUTPUT APPLICATIONS

THE CX701 AND CX701A ARE NPN SILICON POWER TRANSISTORS RECOMMENDED FOR THE VERTICAL OUTPUT STAGES OF 5" — 12" B & W TELEVISION RECEIVERS.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS

		CX701	CX701A
Collector-Base Voltage	V_{CBO}	150V	180V
Collector-Emitter Voltage	V_{CEO}	120V	150V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	2A	
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}	4A	
Total Power Dissipation ($T_C \leqslant 25°C$)	P_{tot}	25W	
($T_A \leqslant 25°C$)		1.5W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

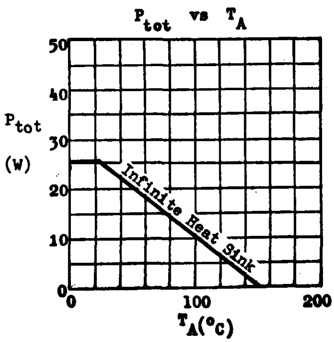
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

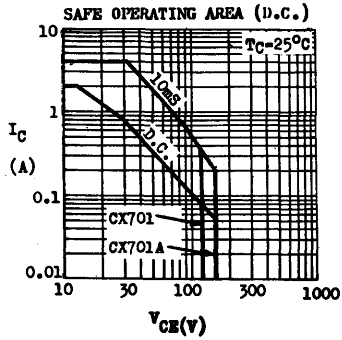
PARAMETER	SYMBOL	CX701 MIN	CX701 MAX	CX701A MIN	CX701A MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *	120		150		V	I_C=100mA I_B=0
Collector Cutoff Current	I_{CBO}		10		10	μA	V_{CB}=100V I_E=0
Emitter Cutoff Current	I_{EBO}		10		10	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1		1	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *	0.6	0.85	0.6	0.85	V	I_C=0.2A V_{CE}=5V
D.C. Current Gain	H_{FE} *	30	120	30	120		I_C=0.5A V_{CE}=5V

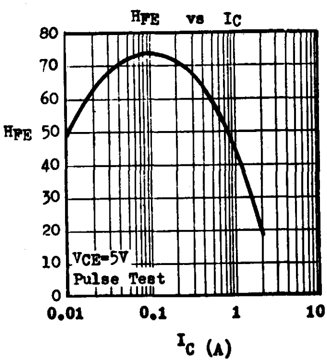
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

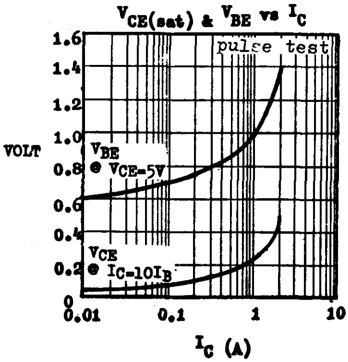
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









CX702 CX702A

NPN SILICON TRANSISTORS
FOR TV HORIZONTAL OUTPUT APPLICATIONS

CASE TO-220B

BCE

THE CX702, CX702A ARE NPN SILICON POWER TRANSISTORS RECOMMENDED FOR THE HORIZONTAL OUTPUT STAGES OF 5" — 12" B & W TELEVISION RECEIVERS.

ABSOLUTE MAXIMUM RATINGS

		CX702	CX702A
Collector-Base Voltage	V_{CBO}	160V	200V
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	160V	200V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	80V	100V
Emitter-Base Voltage	V_{EBO}	8V	
Collector Current	I_C	5A	
Collector Peak Current (t ≤10mS)	I_{CM}	8A	
Total Power Dissipation (T_C ≤ 25°C)	Ptot	40W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

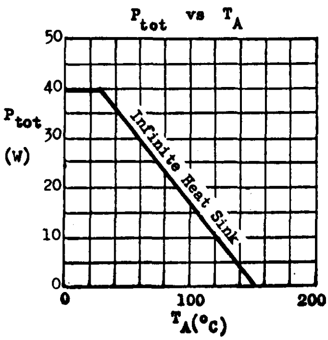
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

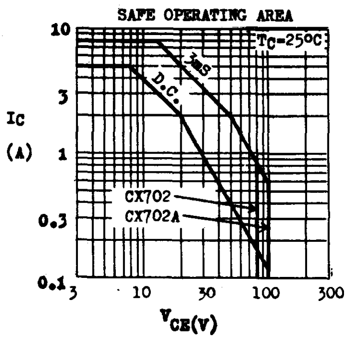
PARAMETER	SYMBOL	CX702 MIN	CX702 MAX	CX702A MIN	CX702A MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CES} *	160		200		V	I_C=100mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	80		100		V	I_C=100mA I_B=0
Collector Cutoff Current	I_{CES}		100		100	µA	V_{CE}=100V V_{BE}=0
Emitter Cutoff Current	I_{EBO}		10		10	µA	V_{EB}=8V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		2		2	V	I_C=4A I_B=0.8A
Base-Emitter Voltage	V_{BE} *		2		2	V	I_C=4A V_{CE}=5V
D.C. Current Gain	H_{FE} *	15	70	15	70		I_C=4A V_{CE}=5V
Fall Time	t_f		1		1	µS	I_C=4A I_{B1}=0.8A -V_{BB}=5V R_B=5Ω

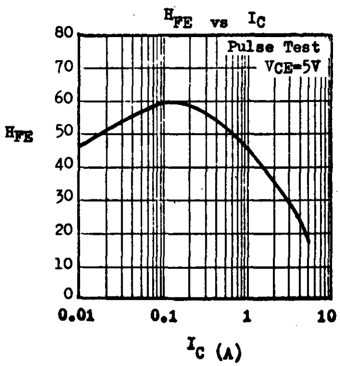
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

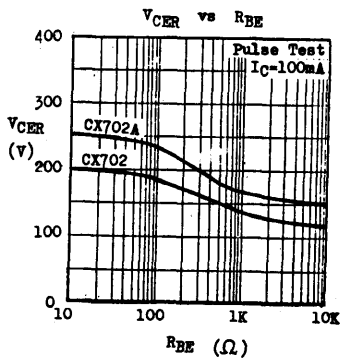
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









CX703 CX703A CX703B

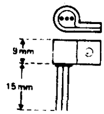
NPN SILICON VIDEO AMPLIFIERS & HIGH VOLTAGE SWITCHES

THE CX703, CX703A, CX703B ARE NPN SILICON PLANAR TRANSISTORS RECOMMENDED FOR TV VIDEO OUTPUT STAGES AND HIGH VOLTAGE SWITCHES UP TO 100mA COLLECTOR CURRENT. THEY ARE SUPPLIED IN TO-92A PLASTIC CASE WITH OPTIONAL X-67 HEAT SINK.

TO-92A

EBC

X - 67 HEAT SINK



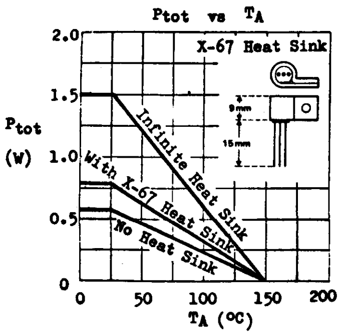
ABSOLUTE MAXIMUM RATINGS

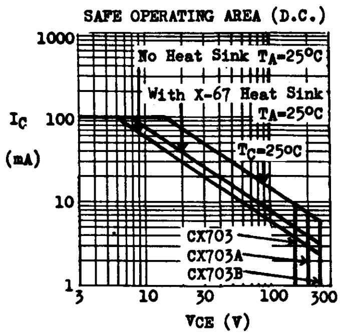
		CX703	CX703A	CX703B
Collector-Base Voltage	V_{CBO}	160V	200V	250V
Collector-Emitter Voltage	V_{CEO}	160V	200V	250V
Emitter-Base Voltage	V_{EBO}		6V	
Collector Current	I_C		100mA	
Total Power Dissipation @ $T_C \leqslant 25°C$	P_{tot}		1.5W	
With X-67 Heat Sink, $T_A \leqslant 25°C$			800mW	
No Heat Sink, $T_A \leqslant 25°C$			625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 150°C	

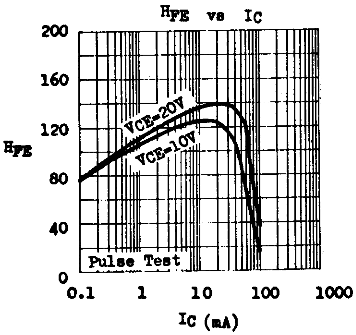
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

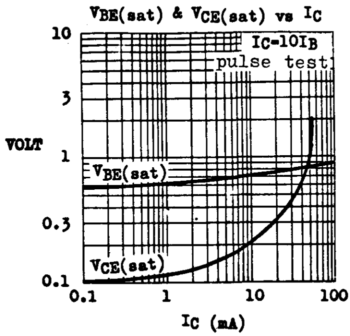
PARAMETER	SYMBOL	CX703 MIN	CX703 MAX	CX703A MIN	CX703A MAX	CX703B MIN	CX703B MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	160		200		250		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	160		200		250		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		6		6		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		0.1		0.1		0.1	µA µA	V_{CB}=120V I_E=0 V_{CB}=150V I_E=0
Emitter Cutoff Current	I_{EBO}		0.1		0.1		0.1	µA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1.5		1.5		1.5	V	I_C=20mA I_B=2mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$		1.2		1.2		1.2	V	I_C=20mA I_B=2mA
D.C. Current Gain	H_{FE}	40	200	40	200	40	200		I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	I_C=10mA V_{CE}=20V
Feedback Capacitance	Cre		3		3		3	pF	V_{CB}=30V I_E=0 f=1MHz

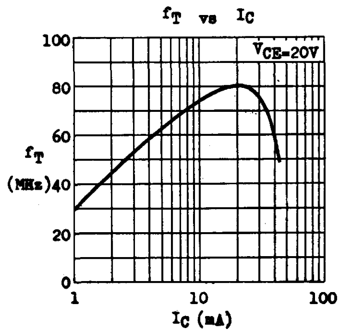
TYPICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

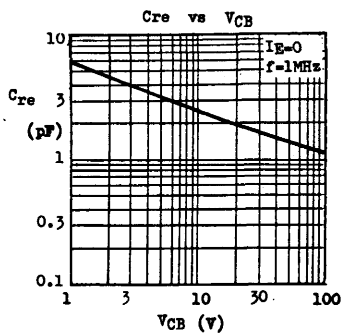












CX704 CX754

COMPLEMENTARY SILICON EPIBASE AF POWER TRANSISTORS

THE CX704 (NPN) AND CX754 (PNP) ARE COMPLEMENTARY SILICON EPIBASE TRANSISTORS RECOMMENDED FOR MEDIUM POWER APPLICATIONS SUCH AS

* POWER REGULATOR IN PORTABLE TV
* 10 W OTL AUDIO AMPLIFIER
* MEDIUM SPEED SWITCH UP TO 4 A

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Emitter Voltage (R_{BE}=100Ω)	V_{CER}	60V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	50V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	4A
Collector Peak Current (t ≤10mS)	I_{CM}	7A
Total Power Dissipation (T_C ≤25°C)	P_{tot}	30W
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

THERMAL RESISTANCE

Junction to Case	θ_{jc}	4.17°C/W max.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

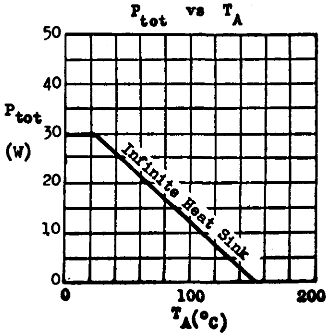
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CER} *	60			V	I_C=100mA R_{BE}=100Ω
Collector-Emitter Breakdown Voltage	LV_{CEO} *	50			V	I_C=100mA I_B=0
Collector Cutoff Current	I_{CER}			1	μA	V_{CE}=30V R_{BE}=100Ω
Emitter Cutoff Current	I_{EBO}			1	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.35	1	V	I_C=2A I_B=0.2A
Base-Emitter Voltage	V_{BE} *		1	1.5	V	I_C=2A V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1 *	40	100	240		I_C=1A V_{CE}=2V
	H_{FE} 2 *	30	90			I_C=10mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	3			MHz	I_C=0.2A V_{CE}=5V

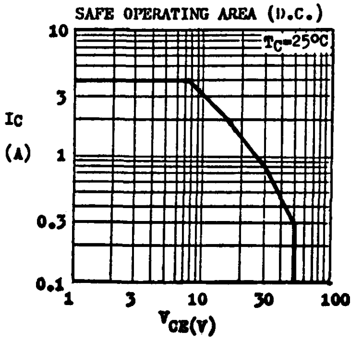
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

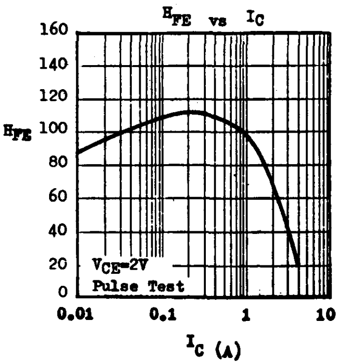
Note : H_{FE} 1 is classified as follows. Group A : 40-80 Group B : 70-140 Group C : 120-240

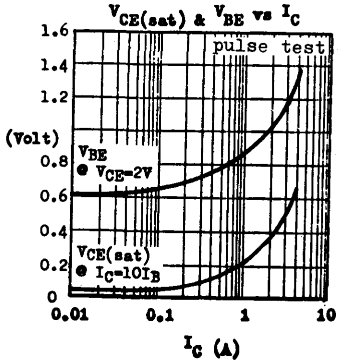
TYPICAL CHARACTERISTICS

($T_A = 25°C$ unless otherwise noted)







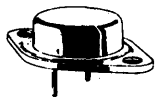


CX705 CX705A

NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS

THE CX705 AND CX705A ARE NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS RECOMMENDED FOR POWER REGULATORS, AUDIO AMPLIFIERS AND LOW SPEED SWITCHES REQUIRING VERY LARGE SAFE OPERATING AREA.

CASE TO-3



ABSOLUTE MAXIMUM RATINGS

		CX705	CX705A
Collector-Emitter Voltage (R_{BE}=100Ω)	V_{CER}	55V	70V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	45V	60V
Emitter-Base Voltage	V_{EBO}	7V	
Collector Current	I_C	7A	
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	75W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 175°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	2°C/W max.

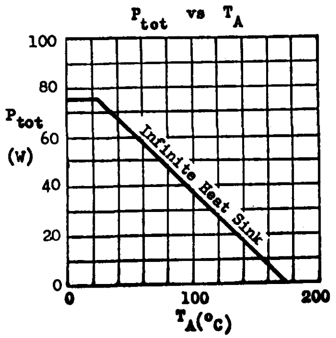
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

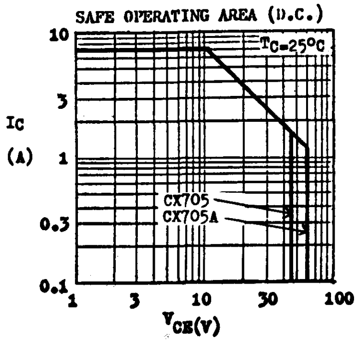
PARAMETER	SYMBOL	CX705 MIN	CX705 MAX	CX705A MIN	CX705A MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CER} *	55		70		V	I_C=0.2A R_{BE}=100Ω
Collector-Emitter Breakdown Voltage	LV_{CEO} *	45		60		V	I_C=0.2A I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	7		7		V	I_E=5mA I_C=0
Collector Cutoff Current	I_{CEO}		1		1	mA	V_{CE}=30V I_B=0
Collector Cutoff Current	I_{CER}		0.2		0.2	mA	V_{CE}=30V R_{BE}=100Ω
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1.2		1.2	V	I_C=3A I_B=0.3A
Base-Emitter Voltage	V_{BE} *		1.8		1.8	V	I_C=3A I_B=0.3A
D.C. Current Gain	H_{FE} *	20 5	70	20 5	70		I_C=3A V_{CE}=4V I_C=7A V_{CE}=4V
Current Gain-Bandwidth Product	f_T	0.5		0.5		MHz	I_C=0.5A V_{CE}=10V

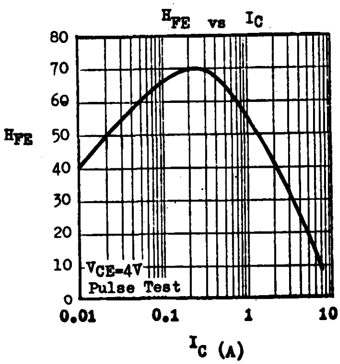
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

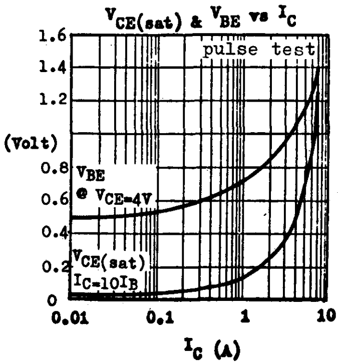
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted).







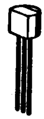


CX901

NPN SILICON GENERAL PURPOSE AMPLIFIER AND ZENER DIODE

THE CX901 IS NPN SILICON PLANAR EPITAXIAL TRANSISTOR FOR GENERAL PURPOSE SMALL SIGNAL APPLICATIONS FROM D.C. TO FREQUENCIES BEYOND 10MHz. ITS EMITTER-BASE JUNCTION CAN ALSO BE USED AS A 7-VOLT ZENER DIODE.

CASE TO-92A



EBC

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	45V
Collector-Emitter Voltage	V_{CEO}	40V
Collector Current	I_C	100mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	300mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

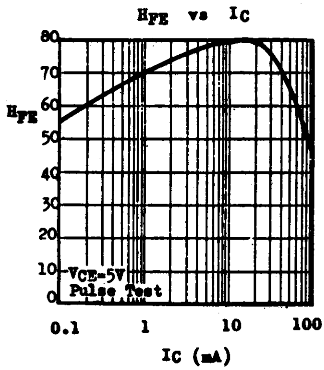
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

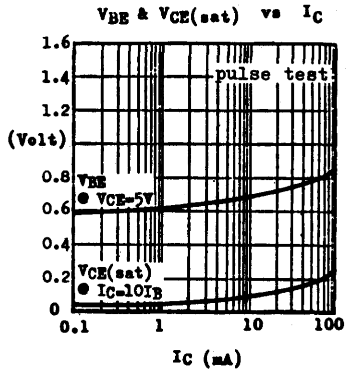
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	40			V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6.7	7.2	7.7	V	I_E=5mA I_C=0
			7.4		V	I_E=25mA I_C=0 *
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.15	0.4	V	I_C=50mA I_B=5mA
Base-Emitter Voltage	V_{BE}		0.62	0.8	V	I_C=1mA V_{CE}=5V
D.C. Current Gain	H_{FE}	40	70	150		I_C=1mA V_{CE}=5V
		30	55			I_C=0.1mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T	80	140		MHz	I_C=1mA V_{CE}=5V
Collector-Base Capacitance	Cob		2.7	3.5	pF	V_{CB}=10V I_E=0 f=1MHz
Collector-Base Time Constant	Corbb'		60	150	pS	I_C=1mA V_{CE}=5V f=31.8MHz

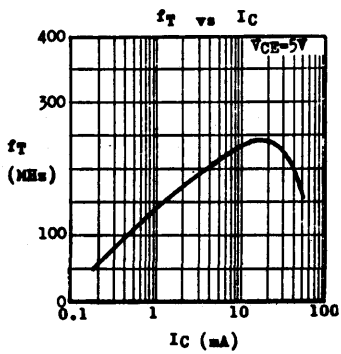
* Maximum operating emitter current is 30mA when the emitter-base junction is used as a zener diode (collector open).

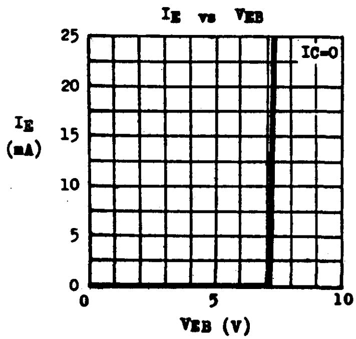
TYPICAL CHARACTERISTICS

($T_A=25°C$ unless otherwise noted)









CX904 CX954

COMPLEMENTARY SILICON GENERAL PURPOSE AF AMPLIFIERS

THE CX904 (NPN) AND CX954 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR TV SMALL SIGNAL PROCESSING CIRCUITS SUCH AS

CASE TO-92A

EBC

* SYNC. SEPARATOR
* HORIZONTAL OSCILLATOR
* ERROR AMPLIFIER
* AUDIO DRIVER

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	45V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	100mA
Total Power Dissipation ($T_A \leq 25°C$)	Ptot	300mW
Operating Junction & Storage Temperature	Tj, Tstg	-55 to 150°C

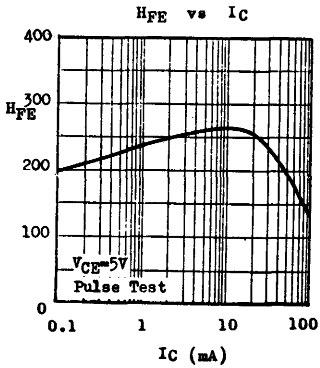
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

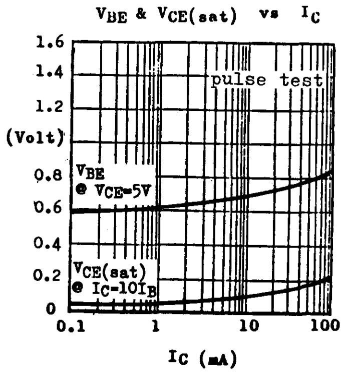
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	40			V	I_C=1mA I_B=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.14	0.4	V	I_C=50mA I_B=5mA
Base-Emitter Voltage	V_{BE}		0.65	0.8	V	I_C=5mA V_{CE}=5V
D.C. Current Gain (Note)	H_{FE} 1 H_{FE} 2	80 50	260 200	540		I_C=5mA V_{CE}=5V I_C=0.1mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T	80	200		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		3	5	pF	V_{CB}=10V I_E=0 f=1MHz
Noise Figure	NF		2		dB	I_C=0.1mA V_{CE}=5V R_G=10KΩ f=30Hz - 15KHz

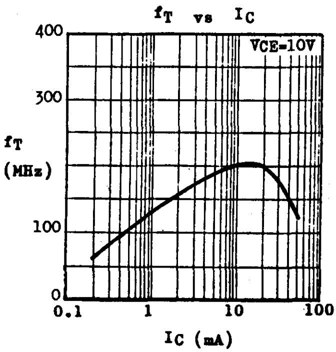
Note : H_{FE} 1 is classified as follows. Group B : 80-160 Group C : 120-240
Group D : 180-360 Group E : 270-540

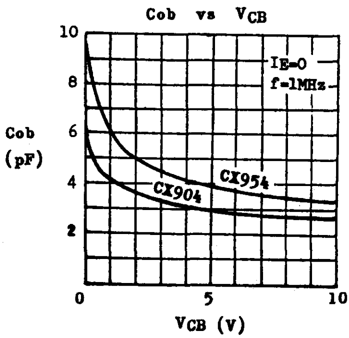
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









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CX906 CX956

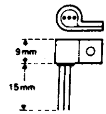
COMPLEMENTARY

SILICON AF MEDIUM POWER AMPLIFIERS & DRIVERS

CASE TO-92A

EBC

X-67 Heat Sink



THE CX906 (NPN) AND CX956 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR MEDIUM POWER APPLICATIONS SUCH AS

* TV VERTICAL OSCILLATOR
* POWER REGULATOR DRIVER
* MEDIUM SPEED SWITCH UP TO 500mA
* OTL AF AMPLIFIER UP TO 500mW

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	45V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	500mA
Total Power Dissipation @ $T_C \leqslant 25^oC$	P_{tot}	1.2W
With X-67 Heat Sink @ $T_A \leqslant 25^oC$		700mW
No Heat Sink @ $T_A \leqslant 25^oC$		500mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^{o}C

ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

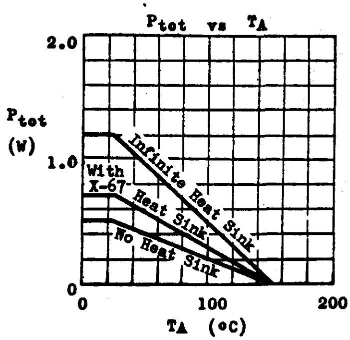
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			V	I_C=10mA I_B=0
Collector-Cutoff Current	I_{CBO}			100	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.25	0.5	V	I_C=250mA I_B=25mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		0.94	1.2	V	I_C=250mA I_B=25mA
D.C. Current Gain (Note)	H_{FE} 1 * H_{FE} 2 *	50 30	160 100	360		I_C=50mA V_{CE}=1V I_C=250mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	80	200		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance CX906 CX956	Cob		4 5	8 8	pF pF	V_{CB}=10V I_E=0 f=1MHz

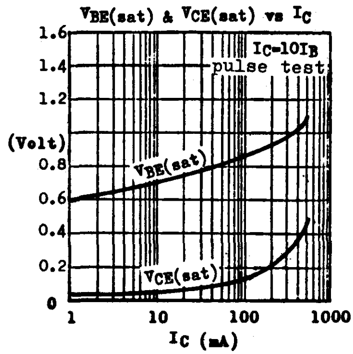
Note : H_{FE} 1 is classified as follows. Group A : 50-100 Group B : 80-160 Group C : 120-240 Group D : 180-360

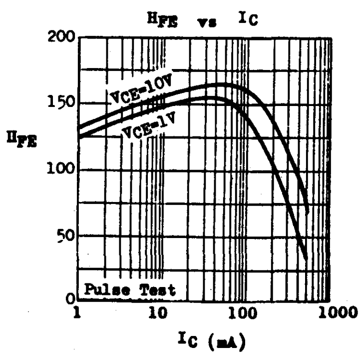
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

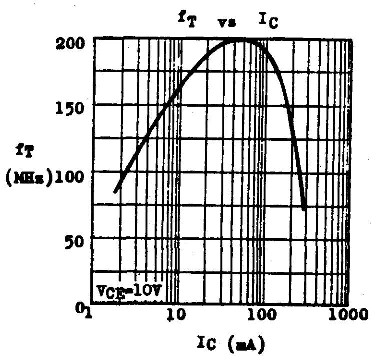
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









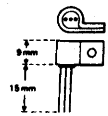
CX908 CX958

COMPLEMENTARY
SILICON AF MEDIUM POWER AMPLIFIERS & DRIVERS

CASE TO-92A

EBC

X-67 Heat Sink



THE CX908 (NPN) AND CX958 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS RECOMMENDED FOR MEDIUM POWER APPLICATIONS SUCH AS

- **TV HORIZONTAL DRIVER**
- **POWER REGULATOR DRIVER**
- **MEDIUM SPEED SWITCH UP TO 1A**
- **OTL AF AMPLIFIER UP TO 1W**

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	45V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	1A
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	1.5W
With X-67 Heat Sink @ $T_A \leq 25^oC$		800mW
No Heat Sink @ $T_A \leq 25^oC$		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^{o}C

ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

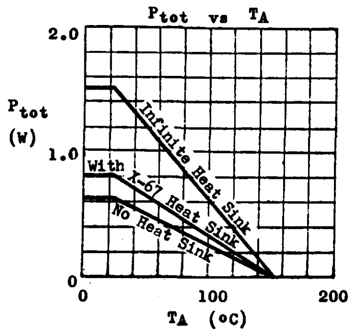
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	V_{CE}(sat)*		0.25	0.5	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	V_{BE}(sat)*		0.92	1.2	V	I_C=500mA I_B=50mA
D.C. Current Gain (Note)	H_{FE} 1 * H_{FE} 2 *	80 40	170 110	360		I_C=100mA V_{CE}=1V I_C=500mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	60	150		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob					V_{CB}=10V I_E=0
CX908			9	18	pF	f=1MHz
CX958			14	18	pF	

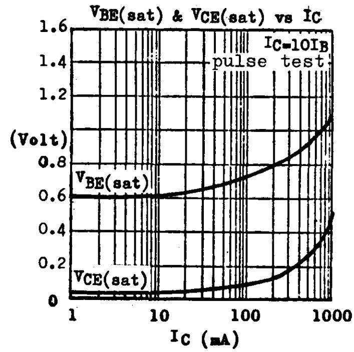
Note : H_{FE} 1 is classified as follows. Group B : 80-160 Group C : 120-240
Group D : 180-360

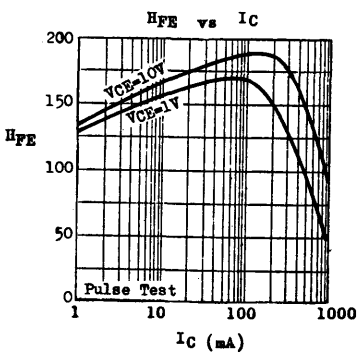
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

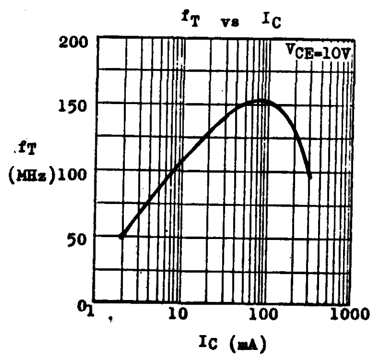
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









CX917

NPN SILICON HIGH FREQUENCY AMPLIFIER

CASE TO-92A

EBC

THE CX917 IS NPN SILICON PLANAR EPITAXIAL TRANSISTOR RECOMMENDED FOR SMALL SIGNAL HIGH FREQUENCY APPLICATIONS SUCH AS

* TV VIDEO DRIVER
* FM IF STAGE
* RF & CONVERTER STAGES UP TO SW BAND

ABSOLUTE MAXIMUM RATINGS

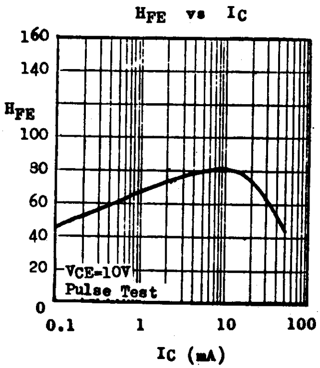
Collector-Base Voltage	V_{CBO}	40V
Collector-Emitter Voltage	V_{CEO}	30V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	50mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	250mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

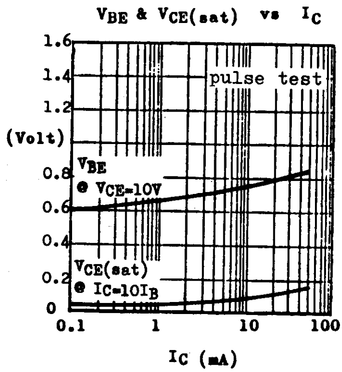
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

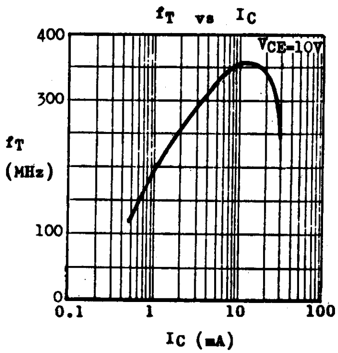
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	40			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	30			V	I_C=1mA I_B=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.1	0.4	V	I_C=20mA I_B=2mA
Base-Emitter Voltage	V_{BE}		0.7	0.85	V	I_C=5mA V_{CE}=10V
D.C. Current Gain	H_{FE}	40	80	150		I_C=5mA V_{CE}=10V
		30	60			I_C=0.5mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	200	330		MHz	I_C=5mA V_{CE}=10V
Feedback Capacitance	Cre		0.95	2	pF	V_{CB}=10V I_E=0 f=1MHz
Collector-Base Time Constant	Ccrbb'		23	45	pS	I_C=1mA V_{CE}=5V f=31.8MHz

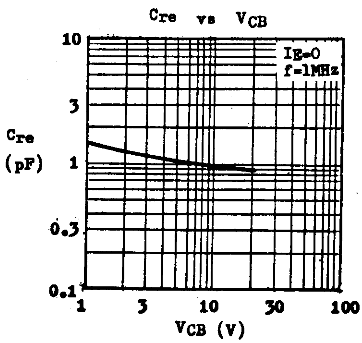
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)





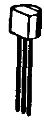




CX918

NPN SILICON VHF AMPLIFIER

CASE TO-92A



EBC

THE CX918 IS NPN SILICON PLANAR EPITAXIAL TRANSISTOR RECOMMENDED FOR SMALL SIGNAL VHF APPLICATIONS SUCH AS

* TV THIRD VIDEO IF STAGE
* FM RF & CONVERTER STAGES
* VHF OSCILLATOR

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	30V
Collector-Emitter Voltage	V_{CEO}	20V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	50mA
Total Power Dissipation ($T_A \leqslant 25^oC$)	Ptot	250mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

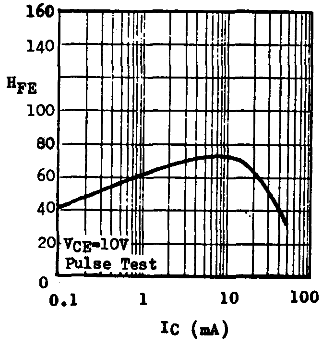
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	20			V	I_C=1mA I_B=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.2	0.4	V	I_C=20mA I_B=2mA
Base-Emitter Voltage	V_{BE}		0.76	0.85	V	I_C=7mA V_{CE}=10V
D. C. Current Gain	H_{FE}	40	70	150		I_C=7mA V_{CE}=10V
		30	55			I_C=0.5mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	400	620		MHz	I_C=7mA V_{CE}=10V
Feedback Capacitance	C_{re}		0.8	1.5	pF	V_{CB}=10V I_E=0 f=1MHz
Collector-Base Time Constant	Ccrbb'		20	35	pS	I_C=1mA V_{CE}=5V f=31.8MHz
A.C. Power Gain	Gpe		28		dB	I_C=7mA V_{CE}=10V f=45MHz

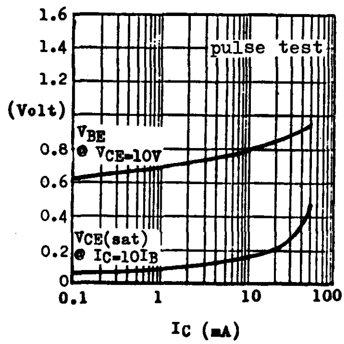
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)

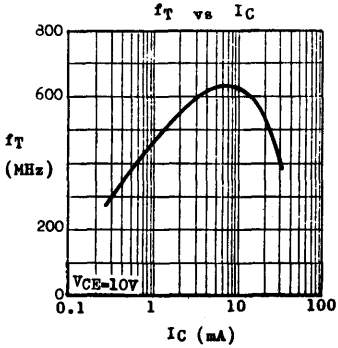
H_{FE} vs I_C



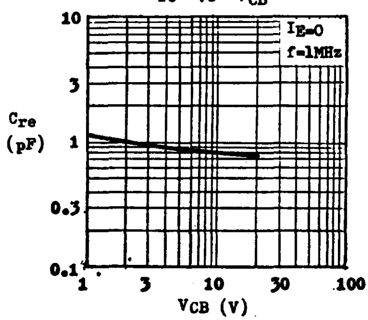
V_{BE} & $V_{CE(sat)}$ vs I_C



f_T vs I_C



C_{re} vs V_{CB}



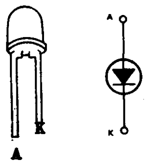
1.78.3100B

D20 U20

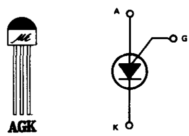
SEMICONDUCTOR KIT FOR BLINKING TOY APPLICATIONS

The D20 · U20 is a two-component semiconductor kit designed for blinking toy applications. It consists of a red LED lamp (D20) and a programmable unijunction transistor (U20). When they are connected with few resistors, a capacitor and a battery, the LED lamp will blink at 2 to 3 cycles per second.

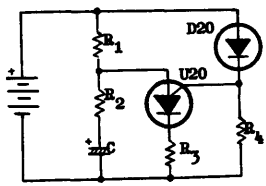
D20 RED L.E.D. LAMP



U20 PROGRAMMABLE UNIJUNCTION TRANSISTOR



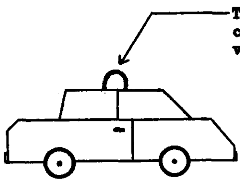
REFERENCE CIRCUIT



BATTERY (Volts)	R_1 (ohms)	R_2 (ohms)	R_3 (ohms)	R_4 (ohms)	C (µF/V)
12	6.8K	330	220	100K	22/10
9	6.8K	330	100	100K	22/10
6	6.8K	330	68	100K	33/6
4.5	6.8K	330	0	100K	33/6
3	6.8K	330	0	100K	47/3

Blinking frequency≈2 cycles per second. Average current consumption is less than 8mA. R_1 and C can be changed to adjust ON-OFF Time of L.E.D. lamp.

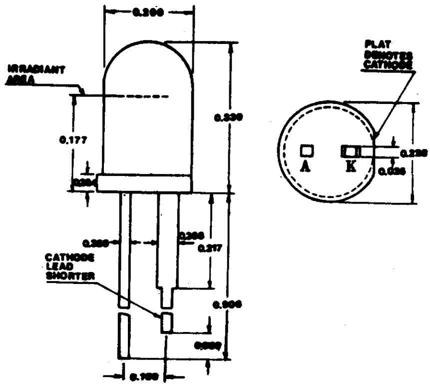
TYPICAL APPLICATION



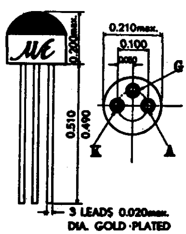
The complete circuit is wired by printed circuit board with lamp exposed at top of vehicle only.

PHYSICAL DIMENSIONS IN INCHES

D20 RED L.E.D. LAMP



U20 PROGRAMMABLE UNIJUNCTION TRANSISTOR



D44C

NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

THE D44C IS A SERIES OF NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR MEDIUM SPEED SWITCHING AND AMPLIFIER APPLICATIONS. ITS HIGH CURRENT GAIN-BANDWIDTH PRODUCT (f_T=30MHz TYP @ 0.2A I_C) PERMITS AMPLIFIERS OPERATING AT FREQUENCIES ABOVE 1MHz.

THE D44C IS COMPLEMENTARY TO D45C.

CASE TO-220B

All dimensions in inches

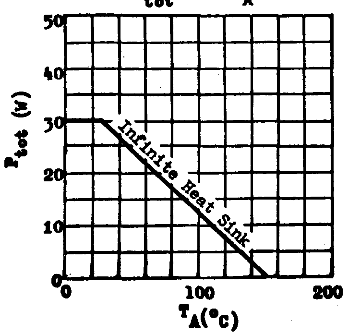
ABSOLUTE MAXIMUM RATINGS

		D44C1 D44C2 D44C3	D44C4 D44C5 D44C6	D44C7 D44C8 D44C9	D44C10 D44C11 D44C12
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	40V	55V	70V	90V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	30V	45V	60V	80V
Emitter-Base Voltage	V_{EBO}	5V			
Collector Current	I_C	4A			
Collector Peak Current ($t \leq 10mS$)	I_{CM}	6A			
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	30W			
@ $T_A \leq 25^oC$		1.67W			
Junction Temperature	T_j	150°C			
Storage Temperature Range	T_{stg}	-55 to +150°C			

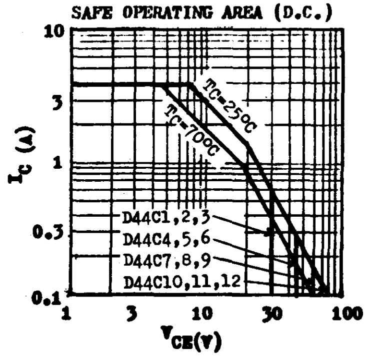
THERMAL RESISTANCE

Junction to Case	Θ_{jc}	4.17°C/W	max.
Junction to Ambient	Θ_{ja}	75°C/W	max.

P_{tot} vs T_A



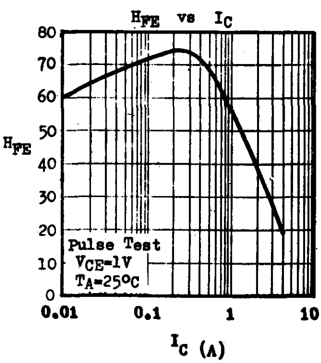
SAFE OPERATING AREA (D.C.)

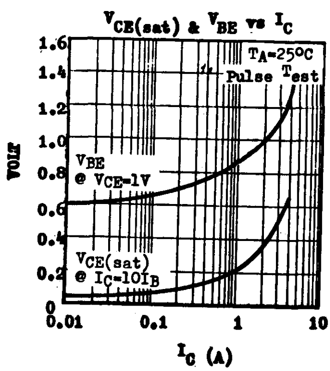


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=100mA I_B=0
D44C1, 2, 3		30			V	
D44C4, 5, 6		45			V	
D44C7, 8, 9		60			V	
D44C10, 11, 12		80			V	
Collector Cutoff Current	I_{CES}			10	µA	V_{CE}=Rated V_{CES}, V_{BE}=0
Emitter Cutoff Current	I_{EBO}			100	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*					
D44C2, 3, 5, 6, 8, 9, 11, 12				0.5	V	I_C=1A I_B=0.05A
D44C1, 4, 7, 10				0.5	V	I_C=1A I_B=0.1A
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*			1.3	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE} *		0.82		V	I_C=1A V_{CE}=1V
D.C. Current Gain						
D44C2, 3, 5, 6, 8, 9, 11, 12	H_{FE} 1 *	40		120		I_C=0.2A V_{CE}=1V
D44C1, 4, 7, 10		25				
D44C2, 5, 8, 11	H_{FE} 2 *	20				I_C=1A V_{CE}=1V
D44C1, 4, 7, 10		10				
D44C3, 6, 9, 12	H_{FE} 3 *	20				I_C=2A V_{CE}=1V
Current Gain-Bandwidth Product	f_T		30		MHz	I_C=0.2A V_{CE}=5V
Collector-Base Capacitance	Cob		40	100	pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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D45C

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

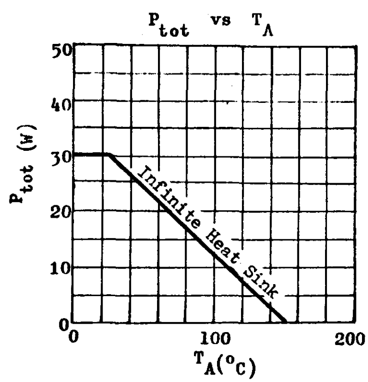
THE D45C IS A SERIES OF PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR MEDIUM SPEED SWITCHING AND AMPLIFIER APPLICATIONS. ITS HIGH CURRENT GAIN-BANDWIDTH PRODUCT (f_T=30MHz TYP @ 0.2A I_C) PERMITS AMPLIFIERS OPERATING AT FREQUENCIES ABOVE 1MHz.
THE D45C IS COMPLEMENTARY TO D44C.

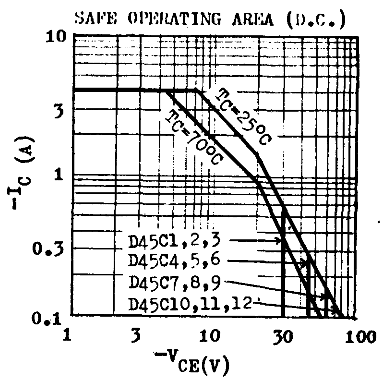
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		D45C1 D45C2 D45C3	D45C4 D45C5 D45C6	D45C7 D45C8 D45C9	D45C10 D45C11 D45C12
Collector-Emitter Voltage (V_{BE}=0)	$-V_{CES}$	40V	55V	70V	90V
Collector-Emitter Voltage (I_B=0)	$-V_{CEO}$	30V	45V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$	5V			
Collector Current	$-I_C$	4A			
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$	6A			
Total Power Dissipation @ $T_C \leq 25^oC$	Ptot	30W			
@ $T_A \leq 25^oC$		1.67W			
Junction Temperature	T_j	150°C			
Storage Temperature Range	Tstg	-55 to +150°C			

THERMAL RESISTANCE

Junction to Case	Θ_{jc}	4.17°C/W	max.
Junction to Ambient	Θ_{ja}	75°C/W	max.

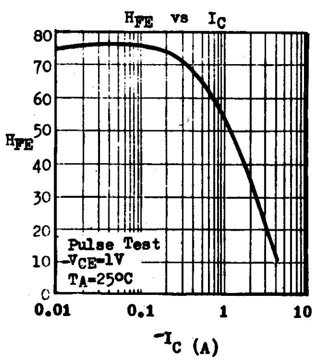


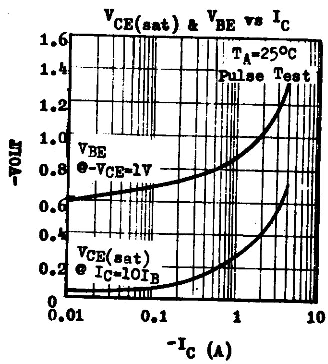


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=100mA I_B=0
D45C1, 2, 3		30			V	
D45C4, 5, 6		45			V	
D45C7, 8, 9		60			V	
D45C10, 11, 12		80			V	
Collector Cutoff Current	$-I_{CES}$			10	µA	V_{CE}=Rated V_{CES},V_{BE}=0
Emitter Cutoff Current	$-I_{EBO}$			100	µA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$ *					
D45C2, 3, 5, 6, 8, 9, 11, 12				0.5	V	$-I_C$=1A $-I_B$=0.05A
D45C1, 4, 7, 10				0.5	V	$-I_C$=1A $-I_B$=0.1A
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$ *			1.3	V	$-I_C$=1A $-I_B$=0.1A
Base-Emitter Voltage	$-V_{BE}$ *		0.85		V	$-I_C$=1A $-V_{CE}$=1V
D.C. Current						
D45C2, 3, 5, 6, 8, 9, 11, 12	H_{FE} 1 *	40		120		$-I_C$=0.2A $-V_{CE}$=1V
D45C1, 4, 7, 10		25				
D45C2, 5, 8, 11	H_{FE} 2 *	20				$-I_C$=1A $-V_{CE}$=1V
D45C1, 4, 7, 10		10				
D45C3, 6, 9, 12	H_{FE} 3 *	20				$-I_C$=2A $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T		30		MHz	$-I_C$=0.2A $-V_{CE}$=5V
Collector-Base Capacitance	Cob		75	125	pF	$-V_{CB}$=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





EN930 SE4010

NPN SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE EN930, SE4010 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF LOW NOISE PREAMPLIFIER APPLICATIONS.

CASE TO-106

CBE

ABSOLUTE MAXIMUM RATINGS		EN930	SE4010
Collector-Base Voltage	V_{CBO}	45V	30V
Collector-Emitter Voltage	V_{CEO}	45V	25V
Emitter-Base Voltage	V_{EBO}	5V	6V
Collector Current	I_C	50mA	50mA
Total Power Dissipation ($T_A \leqslant 25°C$)	P_{tot}	200mW derate 2mW/°C above 25°C	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C	

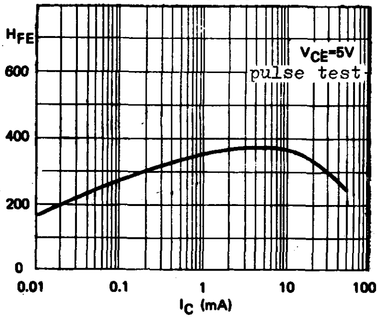
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	EN930 MIN	EN930 MAX	SE4010 MIN	SE4010 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45		30		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	45		25		V	I_C=10mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5		6		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CES}		50 10			nA μA	V_{CE}=45V V_{BE}=0 V_{CB}=45V V_{BE}=0 T_A=100°C
Collector Cutoff Current	I_{CBO}				200 3	nA μA	V_{CB}=5V I_E=0 V_{CB}=5V I_E=0 T_A=65°C
Emitter Cutoff Current	I_{EBO}		50			nA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1		0.35	V V	I_C=10mA I_B=0.5mA I_C=1mA I_B=0.1mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.6	1			V	I_C=10mA I_B=0.5mA
D.C. Current Gain	h_{FE}	100 150	300 600	200	1000		I_C=10μA V_{CE}=5V I_C=500μA V_{CE}=5V I_C=10mA V_{CE}=5V I_C=1mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	30		60	300	MHz MHz	I_C=0.5mA V_{CE}=5V I_C=1mA V_{CE}=5V
Collector-Base Capacitance	C_{ob}		8		4	pF	V_{CB}=5V I_E=0 f=1MHz

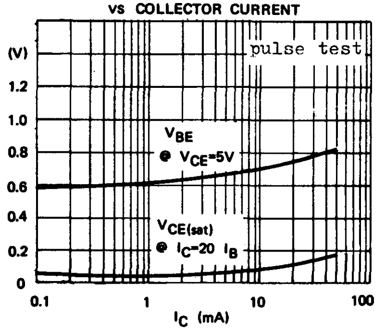
PARAMETER	SYMBOL	EN930 MIN	EN930 MAX	SE4010 MIN	SE4010 MAX	UNIT	TEST CONDITIONS
Noise Figure	NF		3			dB	I_C=10µA V_{CE}=5V R_G=10KΩ f=10Hz-10KHz
					3	dB	I_C=30µA V_{CE}=5V R_G=10KΩ f=1KHz
Small Signal Current Gain	h_{fe}	150	600				I_C=1mA V_{CE}=5V f=1KHz

TYPICAL CHARACTERISTICS AT T_A=25°C

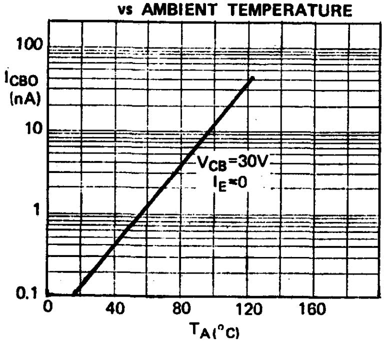
D.C. CURRENT GAIN vs COLLECTOR CURRENT



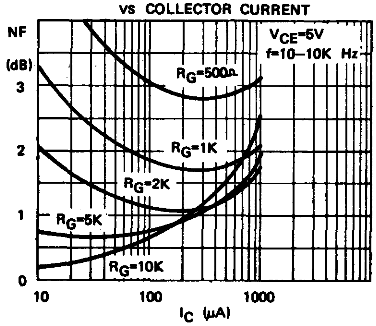
VBE AND VCE(sat) vs COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



BROAD BAND NOISE FIGURE vs COLLECTOR CURRENT



FPT100 FPT100A FPT100B

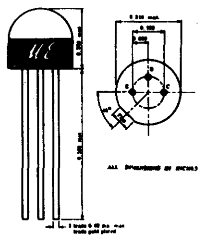
NPN SILICON PHOTO TRANSISTORS

GENERAL DESCRIPTION

The FPT 100, FPT 100 A & FPT 100 B are three terminal NPN silicon planar phototransistors. It features high illumination sensitivity, fast response time and low dark current. Besides, the availability of base lead also allows the circuit designer to optimise their design. It is intended for punched cards and paper tape reader, intrusion alarm sensor, position detector and optical tachometer.

MECHANICAL OUTLINE

TO-106



ABSOLUTE MAXIMUM RATINGS

Continuous Power Dissipation @ T_A = 25°C, Pmax (note 1 & 2)	100mW
Continuous Power Dissipation @ T_C = 25°C, Pmax (note 1 & 2)	200mW
Continuous Collector Current, I_C max	25mA
Collector-Base Voltage, V_{CBO} (note 5)	50V
Collector-Emitter Sustaining Voltage, V_{CEO} (note 3 & 5)	30V
Operating Junction Temperature Range, Tj	-55 to +85°C
Storage Temperature Range, Tstg	-55 to +100°C
Relative Humidity at Temperature	98% at 65°C

ELECTRICAL CHARACTERISTICS: (@ T_A = 25°C unless otherwise specified)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50	120		V	I_C = 100µA (note 5)
Collector-Emitter Sustaining Voltage	$V_{CEO\,(sus)}$	30	50		V	I_C = 1mA (pulsed) (note 5)
Emitter-Collector Breakdown Voltage	BV_{ECO}		7		V	I_{EC} = 100µA (note 5)
Collector Dark Current	I_{CBO}		0.25	25	nA	V_{CB} = 10V (note 5)
Collector Dark Current	I_{CBO}		0.025	0.5	µA	V_{CB} = 10V T_A = 65°C (note 5)
Collector Dark Current	I_{CEO}		2	100	nA	V_{CE} = 5V (note 5)
Responsivity (Tungsten)	R_{CBO}	0.6	1.6		µA/mW/cm²	V_{CB} = 10V (notes 3 & 8)
Responsivity (Ga As)	R_{CBO}	1.8	4.8		µA/mW/cm²	V_{CB} = 10V (notes 4 & 8)
Photo Current (Tungsten)	$I_{CE\,(L)}$					
FPT 100		0.2	1.4		mA	V_{CE} = 5V H=5mW/cm²
FPT 100A		1		3	mA	(notes 3 & 7)
FPT 100B		1.3		2.6	mA	
Photo Current (Ga As)	$I_{CE\,(L)}$	0.6	4.2		mA	V_{CE} = 5V H=5mW/cm² (notes 4 & 7)
Light Current Rise Time	t_r		2.8		µsec	(note 6)
Light Current Fall Time	t_f		2.8		µsec	(note 6)
Collector-Emitter Saturation Voltage	$V_{CE\,(sat)}$		0.16	0.3	V	I_C = 500µA H=20mW/cm²

Note 1: These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Note 2: These ratings give a maximum junction temperature of +85°C and junction to case thermal resistance of +300°C/W (derating factor of 3.33 mW/°C) and a junction to Ambient thermal resistance of +600 °C/W (derating factor of 1.67 mW/°C)

Note 3: Measured at noted irradiance as emitted from a tungsten filament lamp at a colour temperature of 2854°K

Note 4: These are values obtained at noted irradiance as emitted from a GaAs source at 0.9µ.

Note 5: Measured with radiation flux intensity of less than 0.1µW/cm² over the spectrum from 100 to 1500 nm.

Note 6: Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test Conditions are: I_{CE} = 4mA, V_{CE} = 5V, R_L = 100 ohm, GaAs source.

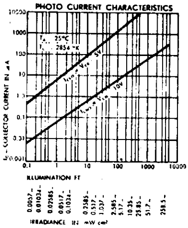
Note 7: No electrical connection to base lead.

Note 8: No electrical connection to emitter lead.

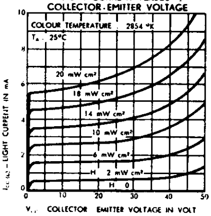
TYPICAL ELECTRICAL CHARACTERISTICS

FPT 100 • FPT 100A • FPT 100B

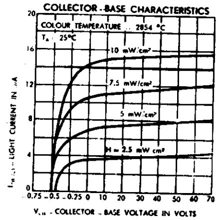
PHOTO CURRENT CHARACTERISTICS



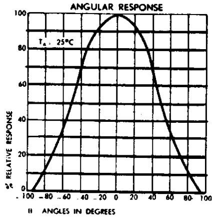
LIGHT CURRENT VERSUS COLLECTOR-EMITTER VOLTAGE



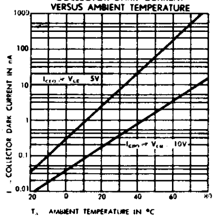
COLLECTOR-BASE CHARACTERISTICS



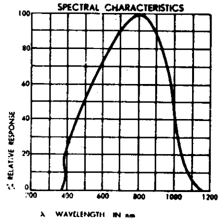
ANGULAR RESPONSE



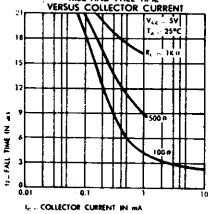
COLLECTOR DARK CURRENT VERSUS AMBIENT TEMPERATURE



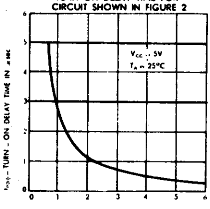
SPECTRAL CHARACTERISTICS



RISE AND FALL TIME VERSUS COLLECTOR CURRENT



TURN ON DELAY TIME FOR CIRCUIT SHOWN IN FIGURE 2



TURN OFF DELAY TIME FOR CIRCUIT SHOWN IN FIGURE 2

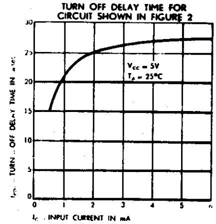


FIGURE 1. SWITCHING CIRCUIT FOR RISE AND FALL TIME.

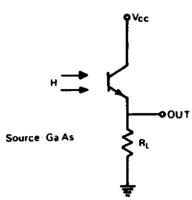
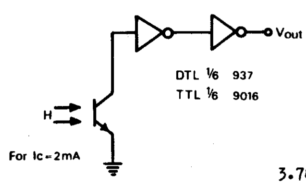


FIGURE 2. CIRCUIT FOR TURN ON AND TURN OFF DATA

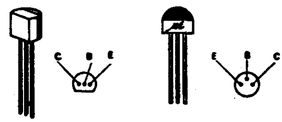


KM PRODUCT LINE
SILICON TRANSISTORS
FOR AM-FM AND RADIO CONTROL APPLICATIONS

The KM PRODUCT LINE are silicon planer epitaxial transistors for AM-FM receiver and radio control applications. They are supplied in TO-92A case. TO-106 case is also available for the small signal types.

CASE

TO-92A TO-106



DEVICE TYPE	CASE	CHARACTERISTICS
KM928 : NPN UHF/VHF Type KM918 : NPN FM-RF Type KM917 : NPN AM/FM-IF Type KM901 : NPN General Purpose AM Type	TO-92A or TO-106	f_T = 560MHz Ccrbb' ≈ 8 pS f_T = 450MHz Ccrbb' = 18 pS f_T = 210MHz Ccrbb' = 23 pS f_T = 140MHz Ccrbb' = 60 pS
KM9014 : NPN General Purpose High Gain Type KM9015 : PNP General Purpose High Gain Type	TO-92A or TO-106	H_{FE} = 60 to 1000 @ I_C = 1mA
KM904 : NPN Audio Output Type KM905 : PNP Audio Output Type	TO-92A only	$V_{CE(sat)}$ = 0.6V max @ I_C = 150mA I_B = 15mA
KM934 : NPN Servo Control Type KM935 : PNP Servo Control Type	TO-92A only	$V_{CE(sat)}$ = 0.6V max @ I_C = 150mA I_B = 3mA

H_{FE} GROUPINGS

(* Preferred H_{FE} Group)

GROUP	A	B	C	D	E	F	G	H	I	@ I_C/V_{CE}
KM 928	40–80*	60–120								1mA/5V
KM 918 KM 917 KM 901				29–44	40–59*	54–80*	72–108	97–146		1mA/5V
KM9014 KM9015	60–150	100–300*	200–600*	400–1000						1mA/5V
KM 904 KM 905				64–91	78–112	96–135*	118–166*	144–202*	176–246	50mA/1V
KM 934 KM 935		80–160	120–240*	180–360*						50mA/1V

DEVICE SPECIFICATIONS (T_A = 25°C unless otherwise specified)

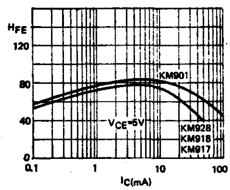
TYPE	MAXIMUM RATINGS I_C (mA)	V_{CBO} (V)	V_{CEO} (V)	V_{EBO} (V)	P_d (mW)	ELECTRICAL CHARACTERISTICS H_{FE}	I_{CBO} (nA) max	@ V_{CB} (V)	V_{BE} (V) typ-max	@ I_C/V_{CE} (mA)/(V)	$V_{CE(sat)}$ (V) typ-max	@ I_C/I_B (mA)/(mA)	f_T (MHz) typ-min	@ I_C/V_{CE} (mA)/(V)	Cob @ V_{CB}=10V I_E=0 (pF) typ-max	Crbb' note 1 (pSec) typ-max	NF (dB) typ
KM928 (NPN)	50	25	20	3	250	See H_{FE} GROUPINGS in front page	50	18	0.72-0.85	1/5	0.14-	10/1	800-550	5/5	0.9-1.3	8-20	2, note 2
KM918 (NPN)	50	20	12	3	250		50	18	0.72-0.85	1/5	0.14-0.5	10/1	450-250	1/5	1.3-1.7	18-35	
KM917 (NPN)	50	25	20	3	250		50	18	0.67-0.85	1/5	0.08-0.5	10/1	210-150	1/5	1.9-2.5	23-50	
KM901 (NPN)	100	25	20	5	300		50	18	0.63-0.85	1/5	0.08-0.5	10/1	140-80	1/5	2.7-3.5	60-160	
KM9014 (NPN)	100	25	20	5	300		50	18	0.63-0.85	1/5	0.07-0.5	10/1	140-50	1/5	2.7-6	150-	2, note 3
KM9015 (PNP)	100	25	20	5	300		50	18	0.64-0.85	1/5	0.07-0.5	10/1	120-50	1/5	3.5-6		2, note 3
KM904 (NPN)	500	25	20	5	500		100	18	0.72-	60/1	0.14-0.6	150/15	200-	10/5	4.8-		
KM905 (PNP)	500	25	20	5	500		100	18	0.72-	60/1	0.14-0.6	150/15	120-	10/5	9-		
KM934 (NPN)	500	35	30	5	500		100	25	0.72-	80/1	0.2-0.6	150/3	180-	10/5	4-		
KM935 (PNP)	500	35	30	5	500		100	25	0.72-	80/1	0.2-0.6	150/3	160-	10/5	5-		

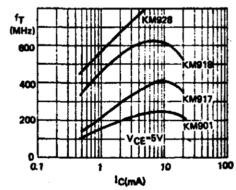
note 1 : Crbb' @ I_C = 1mA V_{CE} = 5V f = 31.8MHz
note 2 : NF @ I_C = 2mA V_{CE} = 5V R_G = 100Ω f = 200MHz
note 3 : NF @ I_C = 0.1mA V_{CE} = 5V R_G = 10kΩ f = 30Hz to 15KHz

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

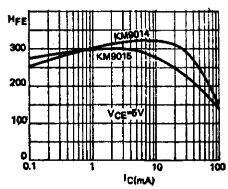
TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise specified)

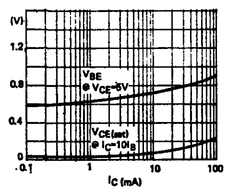
KM928 • KM918 • KM917 • KM901



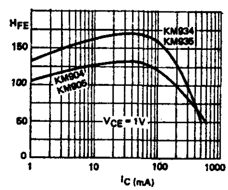


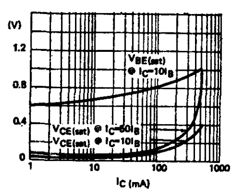
KM9014 • KM9015





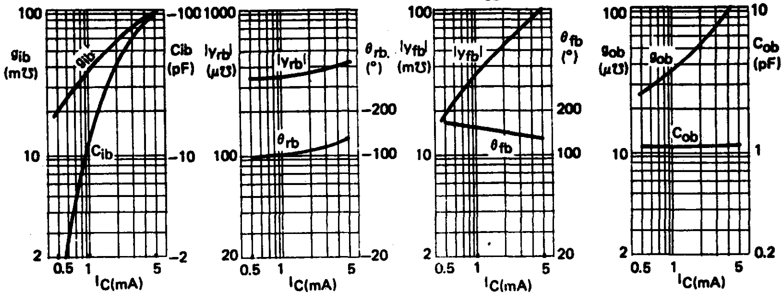
KM904 • KM905 • KM934 • KM935



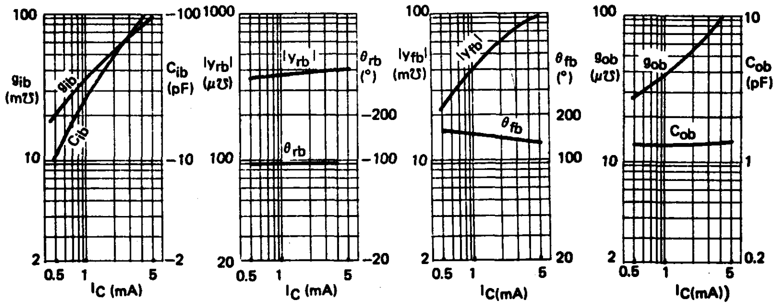


TYPICAL y – PARAMETERS AT T_A=25°C

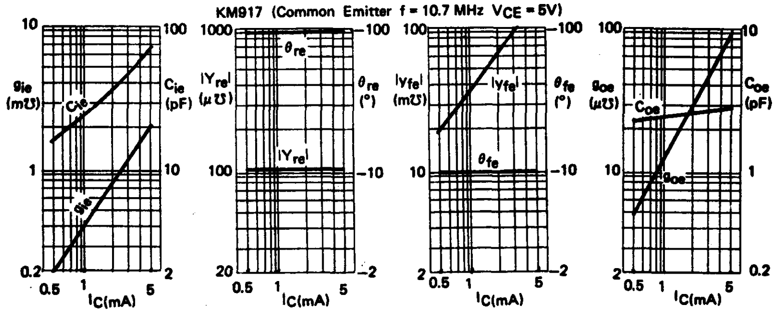
KM928 (Common Base f=100MHz V_{CB}=5V)



KM918 (Common Base f = 100MHz V_{CB} = 5V)

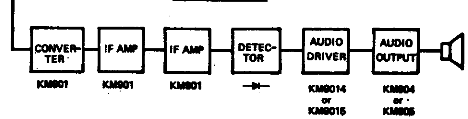


KM917 (Common Emitter f = 10.7 MHz V_{CE} = 5V)



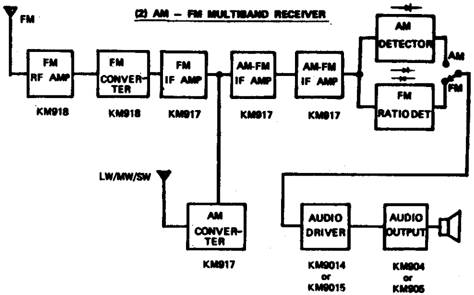
APPLICATIONS GUIDE

(1) AM RECEIVER



Note : KM917 is recommended for AM converter stage up to Short-Wave (SW) Band.

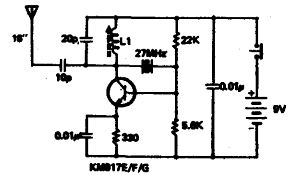
(2) AM – FM MULTIBAND RECEIVER



Note : KM928 is recommended for FM RF and converter stages up to Police Band (144 – 174 MHz).

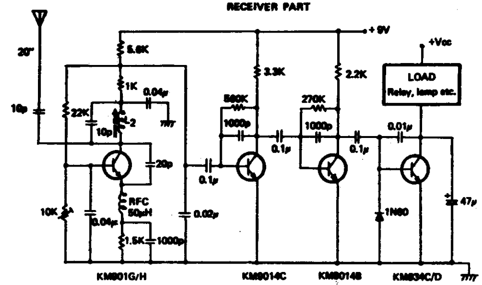
(3) A 27MHz SUPER REGENERATIVE RADIO CONTROL CIRCUIT

TRANSMITTER PART



L_1 : 9 turns SWG 27 wound on 6mmd adjustable ferrite core.

RECEIVER PART



L_2: 11 turns KM901G/H SWG 27 wound on 6mmd adjustable ferrite core. Control Range ≈ 300ft.

LN9014 LN9015

COMPLEMENTARY
LOW NOISE TRANSISTORS FOR AUDIO PREAMPLIFIERS

The LN 9014 (NPN), LN 9015 (PNP) are complementary silicon passivated planar epitaxial transistors fabricated by low noise technology. They feature high current gain, low noise figure (0.7dB typical at 30Hz – 15KHz) and are best suitable for audio preamplifier applications.

CASE
TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS: For p-n-p devices, voltage and current values are negative

Collector-Base Voltage	V_{CBO}	30V
Collector-Emitter Voltage	V_{CEO}	25V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	100mA
Total Power Dissipation (T_A=25°C)	P_d	300mW
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	–55 to +150°C

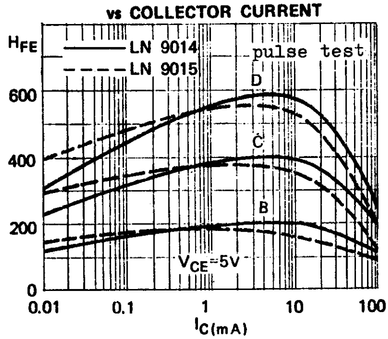
ELECTRICAL CHARACTERISTICS (T_A=25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}	25	50		V	I_C = 10mA I_B = 0
Collector Cutoff Current	I_{CBO}			50	nA	V_{CB}= 30V I_E = 0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}= 5V I_C = 0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.08	0.25	V	I_C = 10mA I_B = 1mA
Base-Emitter Voltage	V_{BE}	0.55	0.62	0.75	V	I_C = 1mA V_{CE} = 5V
D.C. Current Gain	$H_{FE\,1}$	100		1000		I_C = 1mA V_{CE} = 5V
	$H_{FE\,2}$	50				I_C = 10μA V_{CE} = 5V
Current Gain-Bandwidth Product	f_T		120		MHz	I_C = 1mA V_{CE} = 5V
Collector-Base Capacitance, NPN/PNP	Cob		2.4/3.5		pF	V_{CB} = 10V I_E = 0 f = 1MHz
Noise Figure (30Hz – 15 KHz)	NF		0.7	3	dB	I_C = 0.1mA V_{CE} = 5V R_G = 10 K ohms
Output Noise Voltage (RIAA equalized)	Vo(N)		300		μV	See Low Noise Preamplifier Circuit

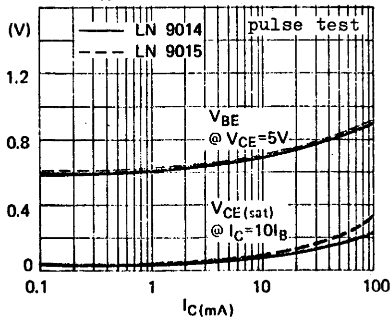
$H_{FE\,1}$ is classified as follows. GROUP B : 100–300 GROUP C : 200–600 GROUP D : 400–1000

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

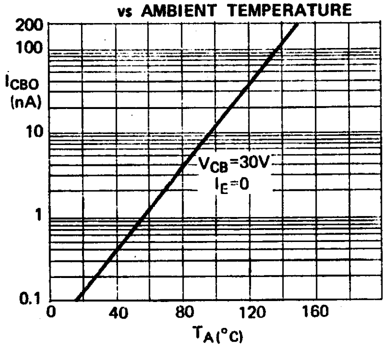
D.C. CURRENT GAIN vs COLLECTOR CURRENT



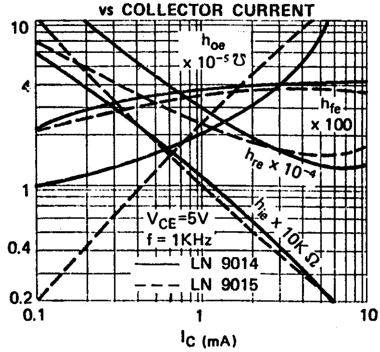
VBE AND VCE(sat) vs COLLECTOR CURRENT



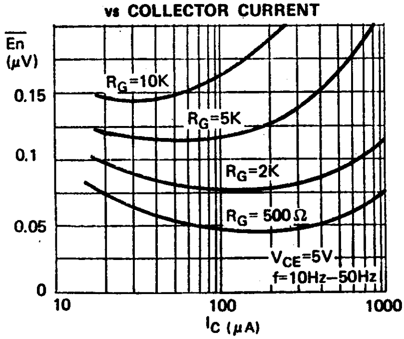
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



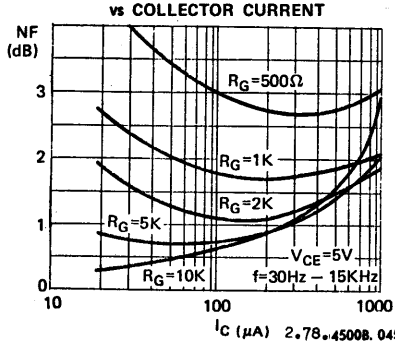
h –PARAMETER vs COLLECTOR CURRENT



EQUIVALENT NOISE VOLTAGE AT BASE vs COLLECTOR CURRENT

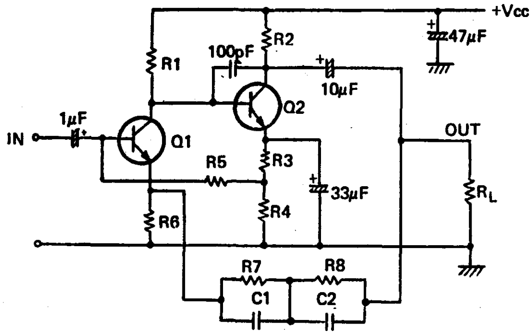


BROAD-BAND NOISE FIGURE vs COLLECTOR CURRENT



2.78.4500B. 0450B.

LOW NOISE PREAMPLIFIER CIRCUIT



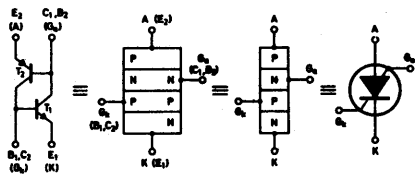
APPLICATION / CIRCUIT DETAILS	FOR MAGNETIC CARTRIDGE	FOR CASSETTE TAPE RECORDER
Vcc	+22 V	+5 V
R_L	47 K ohms	10 K ohms
R1	180 K ohms	22 K ohms
R2	12 K ohms	3.9 K ohms
R3	2.7 K ohms	zero
R4	820 ohms	2.2 K ohms
R5	220 K ohms	220 K ohms
R6	390 ohms	560 ohms
R7	330 K ohms	68 K ohms
R8	27 K ohms	4.7 K ohms
C1	0.01 µF	0.022 µF
C2	0.003 µF	zero
Q1	LN 9014C or D	LN 9014C or D
Q2	LN 9014B or C	LN 9014B or C
Frequency Response	RIAA equalized	equalized at 4.75cm/sec.
Input Impedance	200 K ohms	200 K ohms
Max Undistorted Output	4 V rms	0.5 V rms
Voltage Gain	39dB @ 1KHz	30dB @ 400Hz
Total Harmonic Distortion	better than 0.1% @ 1KHz	better than 0.2% @ 400Hz
Output Noise Voltage	300µV @ R_G = 24K ohms	100µV @ R_G=100 ohms

Note: Reverse polarity of supply voltage and capacitors for PNP transistors LN 9015.

MAS32

PNPN SILICON CONTROLLED SWITCH

The MAS 32 is a Planar PNPN Silicon Controlled Switch offering outstanding circuit design flexibility by providing leads to all four semiconductor regions. It is intended for time base circuits and other television applications, also suitable as trigger device for thyristors and as driver for numberical indicator tubes.

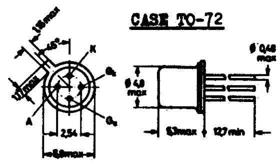


ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−65°C to +150°C
Operating Junction Temperature	150°C
Power Dissipation 25°C ambient	250mW

	NPN	PNP	UNIT
VCBO	70	−70	V
VCEO		−70	V
VEBO	5	−70	V
IE max.	−100	100	mA
IC max. (DC)	50		mA

CASE TO-72



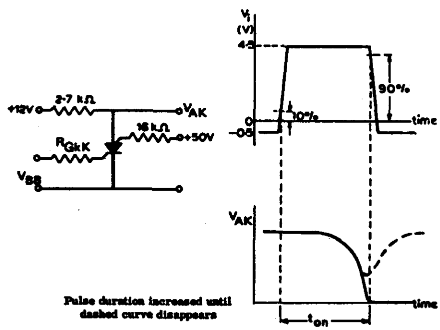
Dimension in mm.
Ga connected to case

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Individual NPN Transistor		MIN.	TYP.	MAX.	UNIT
VCE(sat)	Collector Emitter Saturation Voltage IC = 10mA, IB = 1.0mA			500	mV
VBE(sat)	Base Emitter Saturation Voltage IC = 10mA, IB = 1.0mA			900	mV
hFE	D.C. Current Gain IC = 10mA, VCE = 2V	50			
C_{tc}	Collector capacitance IE = I_e = 0, VCB = 20V			5	pf
C_{te}	Emitter Capacitance IC = Ic = 0, VEB = 1V			30	pf
ICER	Collector Cutoff Current VCE = 70V, RBE = 10kohm			100	nA
IEBO	Emitter Cut Off Current IC = 0, VEB = 5V			1	µA

ELECTRICAL CHARACTERISTICS (T_A=25°C)

Individual PNP Transistor		MIN.	TYP.	MAX.	UNIT
ICEO	Collector Emitter Cut Off Current IB = 0, VCE =-70V			-1	µA
IEBO	Emitter Base Cut off Current IC = 0, VEB =-70V			-10	µA
hFE	D.C. Current Gain IE = 1mA, VCB = 0	0.25		2.5	
Combined Device : –					
VAK	Forward Voltage (RGkK = 10 kΩ)				
	IA = 50mA, IGa = 0			1.4	V
	IA = 1mA, IGa = 10mA			1.2	V
	IA = 50mA, IGa = 0, Tj = -55°C			1.9	V
I_H	Holding Current IGa = 10mA, V_{BB} = 2.0V, RGkK = 10 Ω	0.1		1.0	mA
t_{on}	Turn on Time when switch from : – –VGkK = 0.5V to +VGkK = 4.5V				
	RGkK = 1 kΩ			0.25	µS
	RGkK = 10 kΩ			1.5	µS



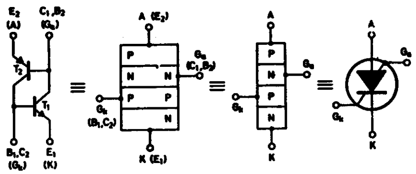
APPLICATION NOTE NO. MEAP 154 IS AVAILABLE

2.78.S210

MAS39

PNPN SILICON CONTROLLED SWITCH

The MAS 39 is a Planar PNPN Silicon Controlled Switch offering outstanding circuit design flexibility by providing leads to all four semiconductor regions. It is intended for time base circuits and other television applications, also suitable as trigger device for thyristors. The anode gate is connected to case.

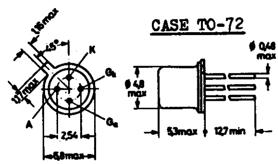


ABSOLUTE MAXIMUM RATINGS

Storage Temperature		–65°C to +150°C	
Operating Junction Temperature		150°C	
Power Dissipation 25°C ambient		250mW	

	NPN	PNP	UNIT
VCBO	50	–50	V
VCEO		–50	V
VEBO	4	–50	V
IE max.	–100	100	mA
IC max. (DC)	50		mA

CASE TO-72



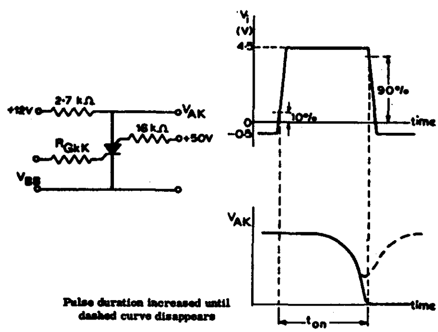
Dimension in mm.
Ga connected to case

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Individual NPN transistor		MIN.	TYP.	MAX.	UNITS
VCE(sat)	Collector Emitter Saturation Voltage IC = 10mA, IB = 1.0mA			800	mV
VBE(sat)	Base Emitter Saturation Voltage IC = 10mA, IB = 1.0mA			1.0	V
hFE	D.C. Current Gain IC = 10mA, VCE = 2V	30			
C_{tc}	Collector capacitance IE = I_e = 0, VCB = 20V			5	pf
C_{te}	Emitter Capacitance IC = Ic = 0, VEB = 1V			30	pf
ICER	Collector Cutoff Current VCE = 30V, RBE = 10k ohm			100	nA
IEBO	Emitter Cur Off Current IC = 0, VEB = 4V			10	μA

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Individual PNP Transistor		MIN.	TYP.	MAX.	UNIT
ICEO	Collector Emitter Cut Off Current IB = 0, VCE = −50V			−10	µA
IEBO	Emitter Base Cut Off Current IC = 0, VEB = −50V			−10	µA
hFE	D.C. Current Gain IE = 1mA, VCB = 0	0.25		2.5	
Combined Device : –					
VAK	Forward Voltage (RG_KK=10 kΩ) IA = 50mA, IGa = 0 IA = 1mA, IGa = 10mA			 1.4 1.2	 V V
I_H	Holding Current IGa = 10mA, V_{BB} = 2.0V, RGkK = 10 kΩ	0.1		1.0	mA
t_{on}	Turn on Time when switch from : – −VGkK = 0.5V to +VGkK = 4.5V RGkK = 1 kΩ RGkK = 10 kΩ			 0.25 1.5	 µS µS



Pulse duration increased until dashed curve disappears

APPLICATION NOTE NO. MEAP 154 IS AVAILABLE

MD8009

DIGITAL ALARM CLOCK

GENERAL DESCRIPTION

The MD8009 is a 40-lead DIP monolithic digital alarm clock utilizing MOS P-channel low-threshold enhancement mode and ion-implanted integrated circuit technology. The timekeeping function operates from line frequency (50 or 60Hz). Four display modes (time, seconds, alarm and sleep) are provided to optimize circuit utility. The circuit interfaces directly with seven-segment displays and provides either a 12-hour or 24-hour format. Outputs consist of display drives, sleep (e.g. timed radio turn-off) and alarm enable. Power failure indication is provided to inform the user that incorrect time is being displayed. Setting the time cancels this indication.

FEATURES

* 50 or 60Hz inputs
* Unregulated power supply
* Direct LED/LCD/Tube drive
* 12 or 24 hour display format
* AM/PM outputs } 12-hour format
* Leading zero blanking } 12-hour format
* Power failure indication
* Presettable 59-min sleep timer
* Fast & slow set controls
* Blanking/brightness control capability
* Same pin connections as AMI-S1998, MM5316 & MM5387AA.

FIGURE 1. BLOCK DIAGRAM

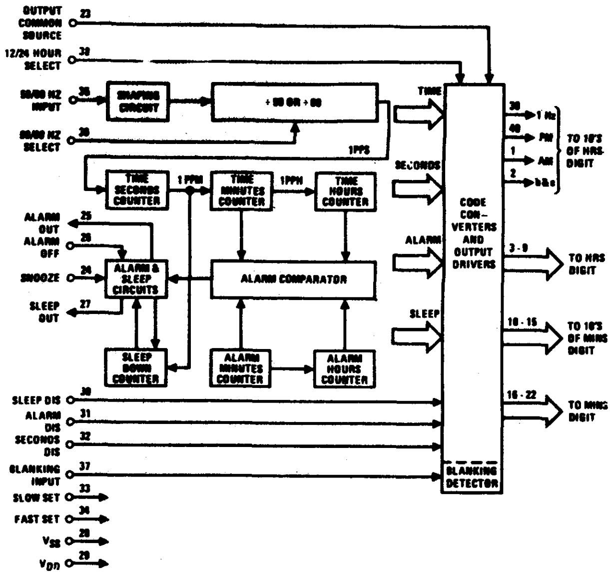
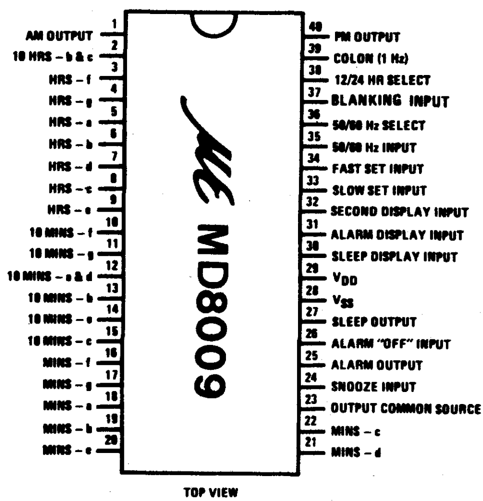


FIGURE 2. CONNECTION DIAGRAM

Dual-In-Line Package



ABSOLUTE MAXIMUM RATINGS

Voltage at Any Pin	V_{SS} + 0.3V to V_{SS} −30V
Operating Temperature Range	0°C to + 70°C
Storge Temperature Range	−55°C to +150°C

ELECTRICAL CHARACTERISTICS

TA=0° to 70°C, V_{SS}=15 to 28V, V_{DD}=0 unless otherwise noted)

	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
	Power Supply Voltage (V_{SS})	8		28	V	Counter operating
	Power Supply Current		1.8 2	4 5	mA mA	V_{SS}= 8V, no output loads V_{SS}=28V, no output loads
	Power Failure Detect Voltage	8	11	15	V	AM or PM flashing
	50/60Hz Input: Frequency Logical High Level Logical Low Level	 DC V_{SS}-1 V_{DD}	 50 or 60	 10K V_{SS} V_{DD}+1	 Hz V V	
	All Other Input Voltages: Logical High Level Logical Low Level	 V_{SS}-2 V_{DD}		 V_{SS} V_{DD}+2	 V V	Internal depletion Load to V_{DD}
Output Currents	1 Hz Output: Logical High Level Logical Low Level	 1.5		 1	 mA μA	 V_{OH}=V_{SS}−2V V_{OL}=V_{DD}
Output Currents	10's of Hours (b&c) and 10's of Minutes (a&d) : Logical High Level Logical Low Level	 2		 1	 mA μA	 V_{OH}=V_{SS}−2V V_{OL}= V_{DD}
Output Currents	Alarm and Sleep Outputs: Logical High Level Logical Low Level	 3.5		 10	 mA μA	 V_{OH}=V_{SS}−2V V_{OL}=V_{DD}+0.6V
Output Currents	All Other Display Outputs: Logical High Level Logical Low Level	 5	 15	 1	 mA μA	 V_{OH}=V_{SS}−2V V_{OL}=V_{DD}

FUNCTIONAL DESCRIPTION

A block diagram of the MD8009 digital alarm clock is shown in ***Figure 1.*** The various display modes provided by this clock are listed in Table I. The functions of the setting controls are listed in Table II. ***Figure 2*** is a connection diagram. The following discussions are based on ***Figure 1.***

50 or 60 Hz Input (pin 35): A shaping circuit is provided to square the 50 or 60 Hz input. This circuit allows use of a filtered sinewave input. The circuit is a Schmitt Trigger that is designed to provide about 6V of hysteresis. A simple RC filter, such as shown in ***Figure. 5,*** should be used to remove possible line-voltage transients that could either cause the clock to gain time or damage the device. The shaper output drives a counter chain which performs the timekeeping function.

50 or 60 Hz Select Input (pin 36): A programmable prescale counter divides the input line frequency by either 50 or 60 to obtain a 1 Hz time base. This counter is programmed to divide by 60 simply by leaving pin 36 unconnected; pull-down to V_{DD} is provided by an internal depletion device. Operation at 50 Hz is programmed by connecting pin 36 to V_{SS}.

Display Mode Select Inputs (pins 30–32): In the absence of any of these three inputs, the display drivers present time-of-day information to the appropriate display digits. Internal pull-down depletion devices allow use of simple SPST switches to select the display mode. If more than one mode is selected, the priorities are as noted in Table I. Alternate display modes are selected by applying V_{SS} to the appropriate pin. As shown in ***Figure 1*** the code converters receive time, seconds, alarm and sleep information from appropriate points in the clock circuitry. The display mode select inputs control the gating of the desired data to the code converter inputs and ultimately (via output drivers) to the display digits.

Time Setting Inputs (pins 33 and 34): Both fast and slow setting inputs are provided. These inputs are applied either singly or in combination to obtain the control functions listed in Table II. Again, internal pull-down depletion devices are provided; application of V_{SS} to these pins effects the control functions. Note that the control functions proper are dependent on the selected display mode. For example, a hold-time control function is obtained by selecting seconds display and actuating the slow set input. As another example, the clock time may be reset to 12:00:00 AM, in the 12-hour format (00:00:00 in the 24-hour format) by selecting seconds display and actuating both slow and fast set inputs.

Blanking Control Input (pin 37): Connecting this Schmitt Trigger input to V_{DD} places all display drivers in a non-conducting, high-impedance state, thereby inhibiting the display. Conversely, V_{SS} applied to this input enables the display.

Output Common Source Connection (pin 23): All display output drivers are open-drain devices with all sources common to pin 23, V_{SS} or a display brightness control voltage should be permanently connected to this pin. ***(Figure 5).***

12 or 24-Hour Select Input (pin 38): By leaving this pin unconnected, the outputs for the most-significant display digit (10's of hours) are programmed to provide a 12-hour display format. An internal depletion pull down device is again provided. Connecting this pin to V_{SS} programs the 24-hour display format. Segment connections for 10's of hours in 24-hour mode are shown in ***Figure 3b.***

Power Fail Indication: If the power to the integrated circuit drops indicating a momentary ac power failure and possible loss of clock, the power fail latch is set. The power failure indication consists of a flashing of the AM or PM indicator at a 1 Hz rate. A fast or slow set input resets an internal power failure latch and returns the display to normal. In the 24-hour format, the power failure indication consists of flashing segments "c" and "f" for times less than 10 hours, and of a flashing segment "c" for times equal to or greater than 10 hours but less than 20 hours; and a flashing segment "g" for times equal to or greater than 20 hours.

Alarm Operation and Output (pin 25): The alarm comparator ***(Figure 1)*** senses coincidence between the alarm counters (the alarm setting) and the time counters (real time). The comparator output is used to set a latch in the alarm and sleep circuits. The latch output enables the alarm output driver that is used to control the external alarm sound generator. The alarm latch remains set for 59 minutes, during which the alarm will therefore sound if the latch output is not temporarily inhibited by another latch set by the snooze alarm input (pin 24) or reset by the alarm "OFF" input (pin 26). If power fail occurs and power comes back up, the alarm output will be in high impedance state.

Snooze Alarm Input (pin 24): Momentarily connecting pin 24 to V_{SS} inhibits the alarm output for between 8 and 9 minutes, after which the alarm will again be sounded. This input is pulled-down to V_{DD} by an internal depletion device. The snooze alarm feature may be repeatedly used during the 59 minutes in which the alarm latch remains set.

alarm "OFF" Input (pin 26): Momentarily connecting pin 26 to V_{SS} resets the alarm latch and thereby silences the alarm. This input is also returned to V_{DD} by an internal depletion device. The momentary alarm "OFF" input also readies the alarm latch for the next comparator output, and the alarm will automatically sound again in 24 hours (or at a new alarm setting). If it is desired to silence the alarm for a day or more, the alarm "OFF" input should remain at V_{SS}.

Sleep Timer and Output (pin 27): The sleep output at pin 27 can be used to turn off a radio after a desired time interval of up to 59 minutes. The time interval is chosen by selecting the sleep display mode (Table I) and setting the desired time interval (Table II). This automatically results in a current-source output via pin 27, which can be used to turn on a radio (or other appliance). When the sleep counter, which counts downwards, reaches 00 minutes, a latch is reset and the sleep output current drive is removed, thereby turning off the radio. The turn off may also be manually controlled (at any time in the countdown) by a momentary V_{SS} connection to the snooze input (pin 24).

TABLE I. MD8009 DISPLAY MODES

*SELECTED DISPLAY MODE	DIGIT NO. 1	DIGIT NO. 2	DIGIT NO. 3	DIGIT NO. 4
Time Display	10's of Hours & AM/PM	Hours	10's of Minutes	Minutes
Seconds Display	Blanked	Minutes	10's of Seconds	Seconds
Alarm Display	10's of Hours & AM/PM	Hours	10's of Minutes	Minutes
Sleep Display	Blanked	Blanked	10's of Minutes	Minutes

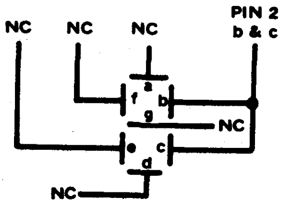
* If more than one display mode input is applied, the display priorities are in the order of Sleep (overrides all others), Alarm, Seconds, Time (no other mode selected).

TABLE II. MD8009 SETTING CONTROL FUNCTIONS

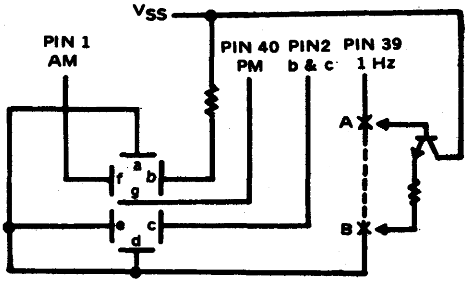
SELECTED DISPLAY MODE	CONTROL INPUT	CONTROL FUNCTION
*Time	Slow	Minutes Advance at 2 Hz Rate
	Fast	Minutes Advance at 60 Hz Rate
	Both	Minutes Advance at 60 Hz Rate
Alarm	Slow	Alarm Minutes Advance at 2 Hz Rate
	Fast	Alarm Minutes Advance at 60 Hz Rate
	Both	Alarm Resets to 12:00 AM (Midnight) (12-Hour Format)
	Both	Alarm Resets to 00:00 (24-Hour Format)
Seconds	Slow	Input to Entire Time Counter is Inhibited (Hold)
	Fast	Seconds and 10's of Seconds Reset to Zero Without a Carry to Minutes
	Both	Time Resets to 12:00:00 AM (Midnight) (12-Hour Format)
	Both	Time Resets to 00:00:00 (24-Hour Format)
Sleep	Slow	Subtracts Count at 2 Hz
	Fast	Subtracts Count at 60 Hz
	Both	Subtracts Count at 60 Hz

*When setting time sleep minutes will decrement at rate of time counter, until the sleep counter reaches 00 minutes (sleep counter will not recycle).

FIGURE 3. WIRING TEN'S OF HOUR DIGIT



(a) 12-hour display format



(b) 24-hour display format. An optional NPN can be inserted between A & B to increase the output current of pin 39.

FIGURE 4. PHYSICAL DIMENSIONS IN INCHES

40-lead dural-in-line package

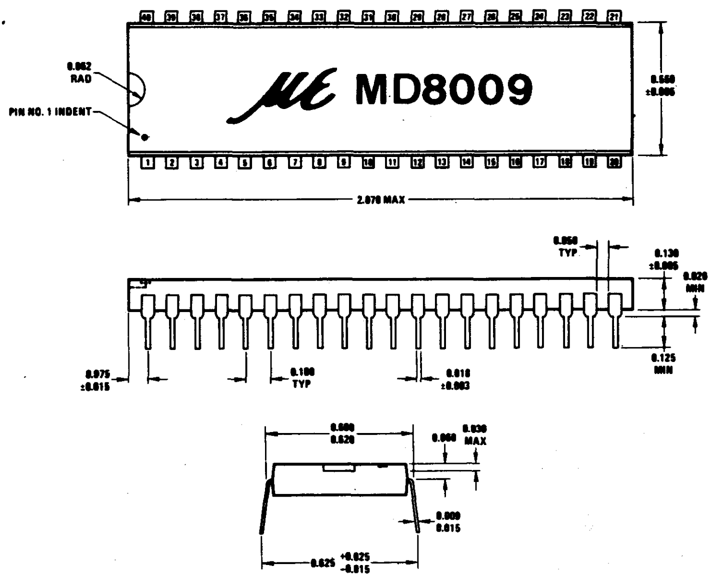
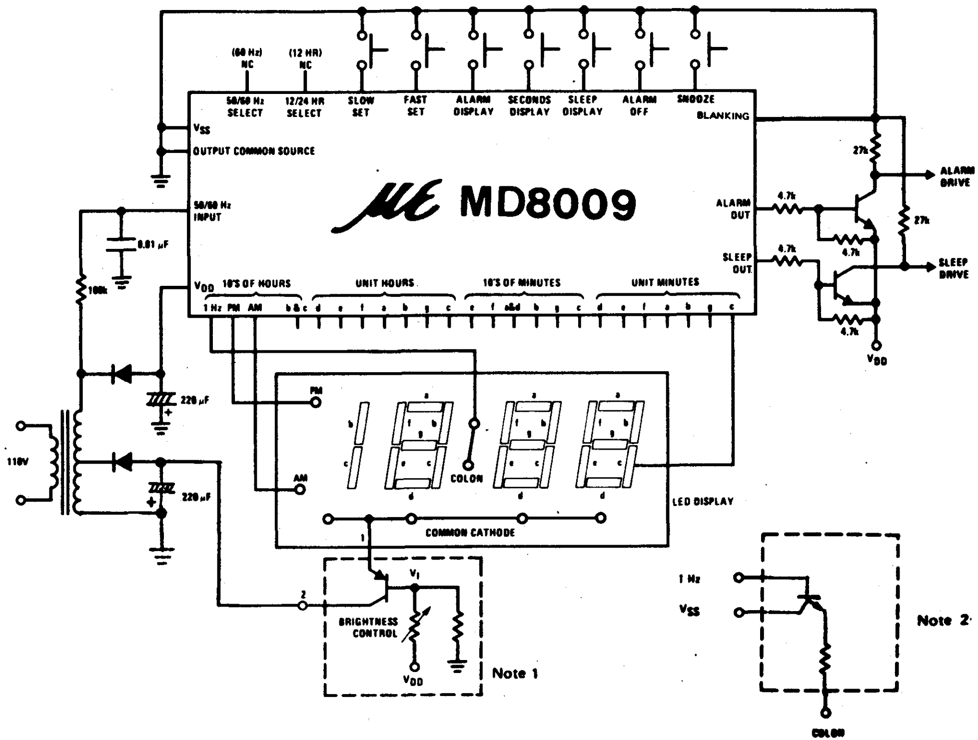


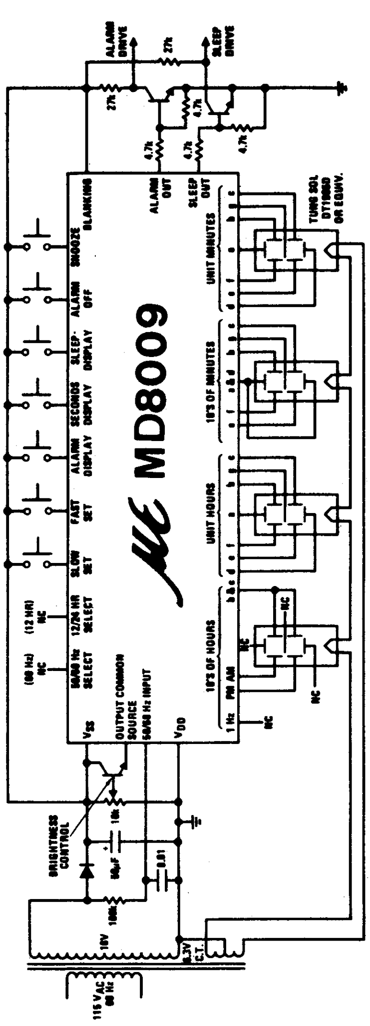
FIGURE 5. TYPICAL APPLICATION: A 12-HR DISPLAY MODE LED ALARM CLOCK



Note 1 :: If brightness control is not required, the emitter-collector terminals (1-2) of the PNP transistor can be disconnected and replaced by a current limiting resistor.

Note 2 :: An NPN transistor can be connected as shown to intensify the colon brightness, if necessary.

FIGURE 6. TYPICAL APPLICATION: A FLUORENSCENT TUBE DISPLAY ALARM CLOCK

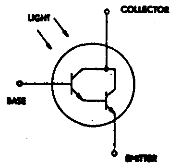


5.78.R2381

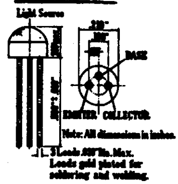
MEL11 MEL12

NPN SILICON PHOTO DARLINGTON TRANSISTORS

THE MEL11, MEL12 ARE NPN SILICON PHOTO DARLINGTON TRANSISTORS FOR USE IN SENSITIVE PHOTO DETECTOR CIRCUITS. THEY ARE SUPPLIED IN SELECTED LIGHT CURRENT GROUPS.



CASE TO-106



ABSOLUTE MAXIMUM RATINGS

		MEL11	MEL12
Collector-Emitter Voltage	V_{CEO}	30V	25V
Emitter-Collector Voltage	V_{ECO}	5V	5V
Collector Current	I_C	100mA	100mA
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	300mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 100°C	

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

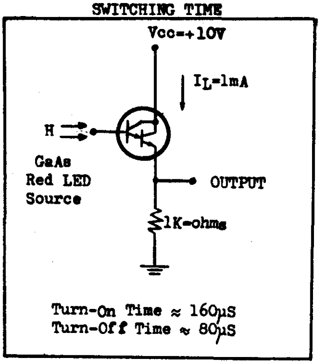
PARAMETER		SYMBOL	MEL11 MIN	MEL11 TYP	MEL11 MAX	MEL12 MIN	MEL12 TYP	MEL12 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage		LV_{CEO} *	30	50		25	40		V	I_C=10mA (Pulsed) I_B=0
Emitter-Collector Breakdown Voltage		BV_{ECO} *	5	8.5		5	8.5		V	I_E=0.1mA I_B=0
Collector Cutoff Current (Dark Current)		I_{CEO} *			0.2			0.5	µA	V_{CE}=5V I_B=0
Light Current.	Group A	I_L **	0.5	1	2				mA	V_{CE}=3V H=2mW/cm^2
	Group B		1	2	4	1	2	4	mA	V_{CE}=3V H=2mW/cm^2
	Group C		3	5	10	3	5	10	mA	V_{CE}=3V H=2mW/cm^2
	Group D					7	12	20	mA	V_{CE}=3V H=2mW/cm^2

* Tested in complete darkness.

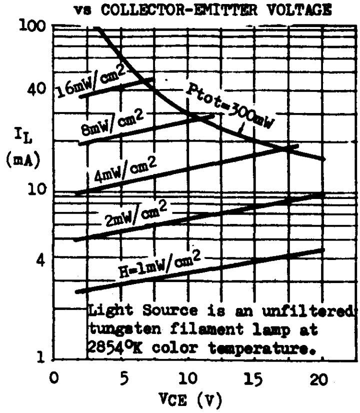
** The light current is the collector to emitter current measured at specified irradiance (H). The radiation source is an unfiltered tungsten filament lamp at 2874°K color temperature.

TYPICAL CHARACTERISTICS AT T_A=25°C

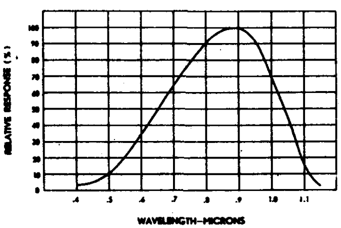
SWITCHING TIME



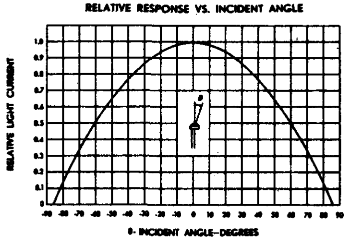
LIGHT CURRENT
vs COLLECTOR-EMITTER VOLTAGE



SPECTRAL RESPONSE



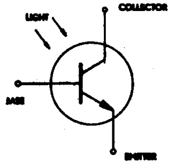
RELATIVE RESPONSE VS. INCIDENT ANGLE



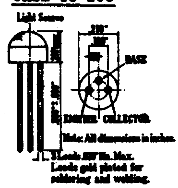
MEL31 MEL32

NPN SILICON PHOTO TRANSISTORS

THE MEL31, MEL32 ARE NPN SILICON PHOTO TRANSISTORS FOR USE IN PHOTO COUPLING CIRCUITS REQUIRING FAST RESPONSE TIME AND LOW DARK CURRENT.



CASE TO-106



ABSOLUTE MAXIMUM RATINGS

		MEL31	MEL32
Collector-Base Voltage	V_{CBO}	40V	40V
Collector-Emitter Voltage	V_{CEO}	30V	30V
Emitter-Base Voltage	V_{EBO}	6V	6V
Collector Current	I_C	50mA	50mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	200mW derate 2.67mW/^oC above 25^oC	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 100^oC	

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

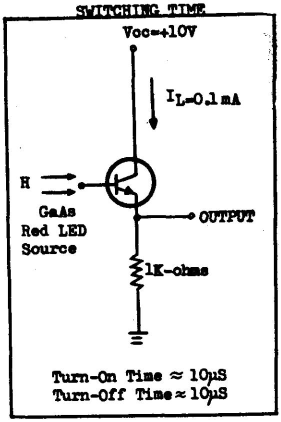
PARAMETER	SYMBOL	MEL31 MIN	MEL31 TYP	MEL31 MAX	MEL32 MIN	MEL32 TYP	MEL32 MAX	UNIT	TEST CONDTIONS
Collector-Base Breakdown Voltage	BV_{CBO} *	40			40			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	30			30			V	I_C=10mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO} *	6			6			V	I_E=0.1mA I_C=0
Collector Cutoff Current (=Dark Current)	I_{CEO} *		2	50		3	50	nA	V_{CE}=5V I_B=0
			30			50		nA	V_{CE}=5V I_B=0 T_A=65^oC
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*			0.35			0.35	V	I_C=500μA I_B=25μA
D.C. Current Gain	H_{FE} *	160			280				V_{CE}=5V I_B=1μA
Light Current	I_L **	10	25		30	50		μA	V_{CE}=5V H=2mW/cm^2

* Tested in complete darkness.

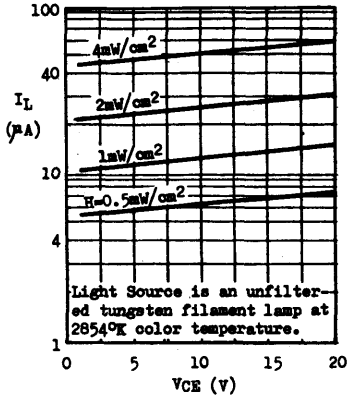
** I_L is the collector to emitter current measured at specified irradiance (H) with the base terminal open circuit. The light source is an unfiltered tungsten filament lamp at 2854^oK color temperature.

TYPICAL CHARACTERISTICS AT T_A=25°C

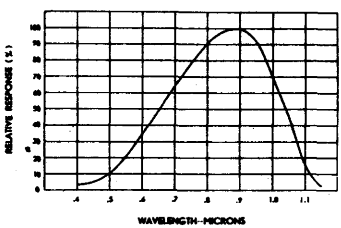
SWITCHING TIME



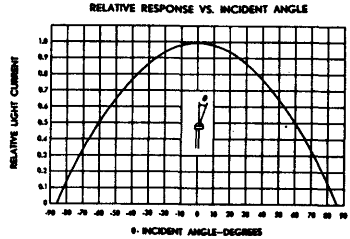
LIGHT CURRENT vs COLLECTOR-EMITTER VOLTAGE



SPECTRAL RESPONSE



RELATIVE RESPONSE VS. INCIDENT ANGLE



MEU21 MEU22

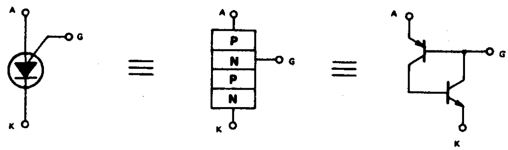
PROGRAMMABLE UNIJUNCTION TRANSISTORS

The Micro Electronics Programmable Unijunction Transistor (PUT) is a three-terminal planar passivated PNPN device in TO-106 package. The terminals are designated as anode, gate and cathode.

The Micro Electronics PUT offers outstanding circuit design flexibility. External resistors can be selected to meet designers' needs in programming the unijunction characteristics such as η, R_{BB}, I_P and I_V.

The MEU 22 is designed for long interval timers and other applications requiring low peak point current. The MEU 21 is designed for general use where the low peak point current of the MEU 22 is not essential.

For further information, refer to Application Notes Nos. 143, 144 and 158.



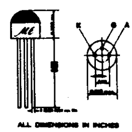
FEATURES

- PROGRAMMABLE η; R_{BB}; I_P; I_V
- LOW LEAKAGE CURRENT
- LOW PEAK POINT CURRENT
- LOW FORWARD VOLTAGE
- HIGH PULSE OUTPUT VOLTAGE
- LOW COST

APPLICATIONS

- OSCILLATORS AND TIMERS
- TRIGGER DEVICES
- LATCHING SWITCHES
- PULSE SHAPING CIRCUITS
- SENSING CIRCUITS
- ELECTRICALLY SIMILAR TO 2N6027 & 2N6028

PACKAGE



ABSOLUTE MAXIMUM RATINGS

Voltage		
Gate-Cathode Forward Voltage	+40	V
Gate-Cathode Reverse Voltage	−5	V
Gate-Anode Reverse Voltage	+40	V
Anode-Cathode Voltage	±40	V
Current		
DC Forward Anode Current*	150	mA
Peak Forward Anode Current, Repetitive (100 μsec pulse width, 1% duty cycle)	1	A
(20 μsec pulse width, 1% duty cycle)	2	A
Current		
Peak Forward Anode Current, Non-repetitive (10 μsec pulse)	5	A
DC Gate Current	±20	mA
Capacitive Discharge Energy†	250	μJ
Power		
Total Average Power*	300	mW
Temperature		
Operating Ambient* Temperature Range	−50°C to +100°C	

*Derate currents and powers 1%/°C above 25°C

†$E = \frac{1}{2} CV^2$ capacitor discharge energy with no current limiting

ELECTRICAL CHARACTERISTICS AT T_A = 25°C (unless otherwise specified)

CHARACTERISTICS	SYMBOL	FIG. NO.	MEU 21 Min.	MEU 21 Max.	MEU 22 Min.	MEU 22 Max.	UNITS	TEST CONDITIONS
Peak Point Current	I_P	1		2		.15	μA	V_S = 10 Volts R_G = 1 MΩ
				5		1.0	μA	V_S = 10 Volts R_G = 10 KΩ
Offset Voltage	V_T	1	.2	1.6	.2	.6	Volts	V_S = 10 Volts R_G = 1 MΩ
			.2	.6	.2	.6	Volts	V_S = 10 Volts R_G = 10 KΩ
Valley Current	I_V	1		50		25	μA	V_S = 10 Volts R_G = 1 MΩ
			70		25		μA	V_S = 10 Volts R_G = 10 KΩ
Gate-Anode Leakage Current	I_{GAO}	2		10		10	nA	V_S = 40 Volts, T_A = 25°C
				100		100	nA	T_A = 75°C
Gate - Cathode Leakage Current	I_{GKS}	3		100		100	nA	V_S = 40 Volts, V_A = 0
Forward Voltage	V_F	1		1.5		1.5	Volts	I_F = 50 mA
Pulse Output Voltage	V_O	4	6		6		Volts	
Pulse Voltage Rate of Rise	t_r	4		80		80	nsec.	

Note: MEU21 is electrically similar to 2N6027.
MEU22 is electrically similar to 2N6028.

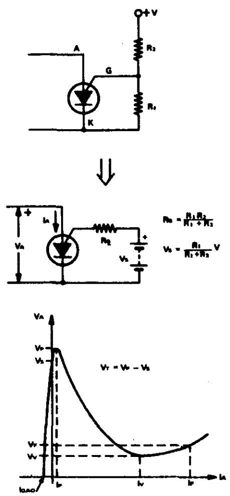


Figure 1

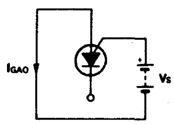


Figure 2

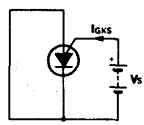


Figure 3

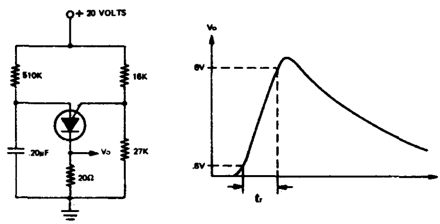
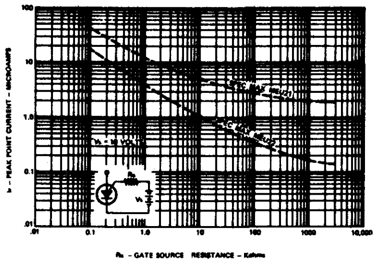
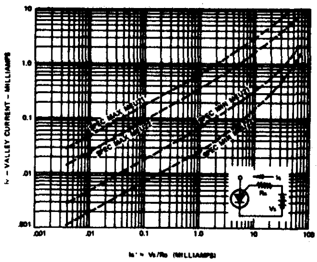


Figure 4

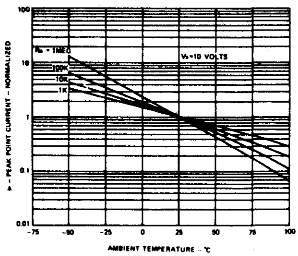
TYPICAL CHARACTERISTICS AT $T_A = 25°C$ (unless otherwise specified)



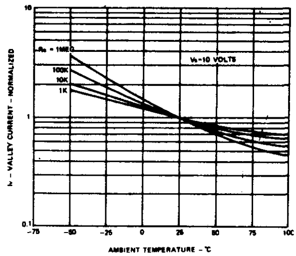
I_P VS GATE SOURCE RESISTANCE



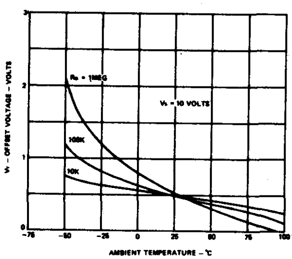
I_V VS "ON STATE" GATE CURRENT



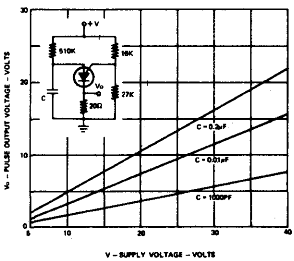
I_P VS TEMPERATURE AND R_G



I_V VS TEMPERATURE AND R_G



V_T VS TEMPERATURE AND R_G



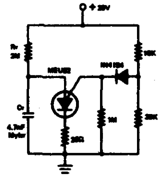
PULSE OUTPUT VOLTAGE

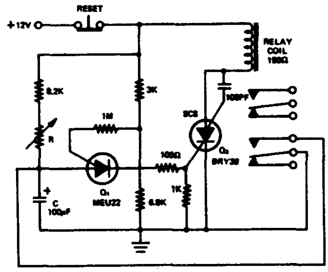
APPLICATIONS

Precision Relaxation Oscillator

The use of the diode 1N4154 and 1 meg resistor at the gate gives low peak point current, therefore reducing the shunting effect of the PUT on C_T during the charging period. The diode also temperature compensates V_{AG} which drifts at about −2.5mV per °C.

The circuit oscillates at 100Hz which is kept within 1% from −30°C to 75°C.



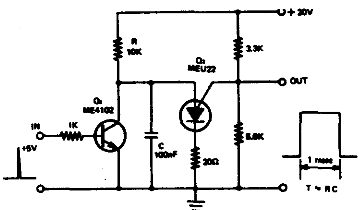


Ten-minute Time Delay Relay

The PUT uses high gate source resistance (1M-ohms) and draws negligible current from the RC network during the delay time. When the SCS is triggered by the PUT, the relay is energized. C is short-circuited by a pair of relay contacts. This condition ensures that accurate timing is repeatable because C is always charged from zero volt after the circuit is reset. Time delay is approximately 10 minutes at R = 4.7 M-ohms.

Monostable Multivibrator

The PUT is normally ON. A positive pulse at the input turns Q_1 on, C is discharged rapidly through the saturation resistance of the collector-emitter junction. The PUT becomes OFF. At the removal of the input pulse, Q_1 is cut off. C is charged through R towards +20V. When the peak point voltage is reached, Q_2 fires and returns to the latching state again due to the holding current through R.

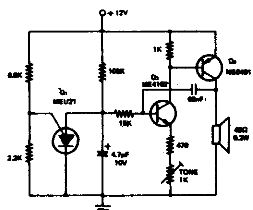


Warble Alarm Circuit

This alarm can be easily heard in noisy background. Q_2 and Q_3 forms a tone generator in which the fundamental frequency is modulated by the sawtooth output of Q_1.

Tone frequency ≈ (500-800)Hz

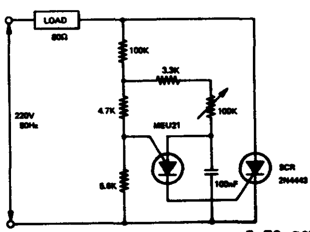
Sawtooth frequency ≈ 2.5Hz



SCR Phase Control

The conduction angle of the SCR is controlled by the PUT oscillator which is synchronized from the a.c. line. This ensures that the SCR is triggered at the same point on the a.c. cycle each time.

The conduction angle of the SCR can be varied from 30° to 160° by using the 100 k-ohm variable resistor.



3.78.S210

MH7301 MH7302 MH7303

NPN HIGH VOLTAGE
HIGH FREQUENCY MEDIUM POWER TRANSISTORS

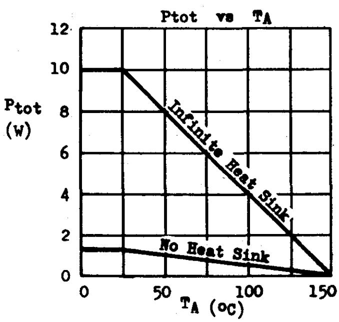
THE MH7301, MH7302, MH7303 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR HIGH VOLTAGE AND HIGH FREQUENCY MEDIUM POWER APPLICATIONS. THEY ARE CAPACABLE TO DISSIPATE 1.25 WATT WITHOUT ANY HEATSINK AT 25°C FREE AIR.

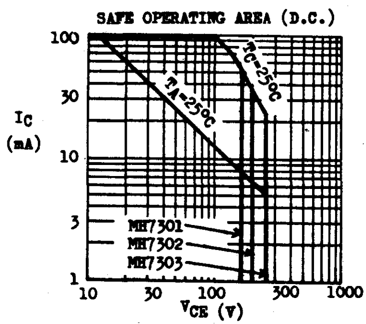
CASE TO-220B

* FOR TV VIDEO OUTPUT STAGE
* FOR HIGH VOLTAGE CLASS A AUDIO AMPLIFIER
* FOR HIGH VOLTAGE SWITCH UP TO 100mA / 250V

ABSOLUTE MAXIMUM RATINGS		MH7301	MH7302	MH7303
Collector-Base Voltage	V_{CBO}	160V	200V	250V
Collector-Emitter Voltage	V_{CEO}	160V	200V	250V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		100mA	
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}		500mA	
Total Power Dissipation ($T_C \leqslant 25°C$)	P_{tot}		10W	
($T_A \leqslant 25°C$)			1.25W	
Operating Junction & Storage Temperature	T_j & T_{stg}		-55 to 150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	12.5°C/W	max.
Junction to Ambient	Θ_{ja}	100°C/W	max.



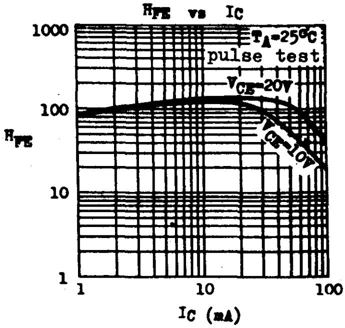


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

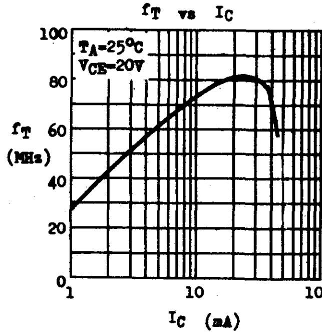
PARAMETER	SYMBOL	MH7301 MIN	MH7301 MAX	MH7302 MIN	MH7302 MAX	MH7303 MIN	MH7303 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	160		200		250		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	160		200		250		V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CBO}		0.5		0.1		0.1	μA	V_{CB}=150V I_E=0
Collector Cutoff Current	I_{CEO}		20		5			μA	V_{CE}=150V I_B=0
							5	μA	V_{CE}=200V I_B=0
Emitter Cutoff Current	I_{EBO}		0.1		0.1		0.1	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		1.5		1.5		1.5	V	I_C=30mA I_B=3mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.5		1.5		1.5	V	I_C=30mA I_B=3mA
D.C. Current Gain	H_{FE} *	40		40		40			I_C=30mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	50		50		50		MHz	I_C=30mA V_{CE}=20V
Collector-Base Capacitance	Cob		5		5		5	pF	V_{CB}=30V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

H_{FE} vs I_C



f_T vs I_C



MH8100 MH0810

COMPLEMENTARY EPITAXIAL TRANSISTORS FOR 3-5W AF OUTPUT

The MH8100 (NPN), MH0810 (PNP) are complementary silicon planar epitaxial transistors designed for the output stages of 3–5 watt audio amplifiers. They are also suitable for switches up to 3A collector current.

CASE
TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS: For p-n-p devices voltage and current values are negative.

Collector-Emitter Voltage (V_{BE} = 0)	V_{CES}	35V
Collector-Emitter Voltage (Base Open)	V_{CEO}	30V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	3A
Collector Peak Current (t ≤ 10mS)	I_{CM}	5A
Total Power Dissipation (T_C ≤ 25°C)	P_{tot}	12W
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	−55 to +150°C

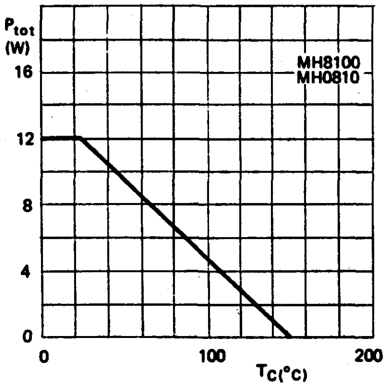
ELECTRICAL CHARACTERISTICS (T_A=25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}	30			V	I_C =50mA I_B =0
Collector Cutoff Current	I_{CES}			1	μA	V_{CE}=35V V_{BE}=0
Emitter Cutoff Current	I_{EBO}			1	μA	V_{EB}=5V I_C =0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$			0.8	V	I_C =2A I_B =0.2A
Base-Emitter Voltage	V_{BE}			1	V	I_C =0.5A V_{CE}=2V
D.C. Current Gain	*$H_{FE\,1}$	40		240		I_C =0.5A V_{CE}=2V
	$H_{FE\,2}$	30				I_C =0.01A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	30	100		MHz	I_C =0.2A V_{CE}=4V

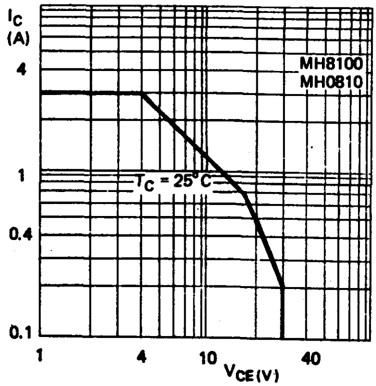
*$H_{FE\,1}$ is classified as follows. Group A : 40–80 Group B : 70–140
Group C : 120–240

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

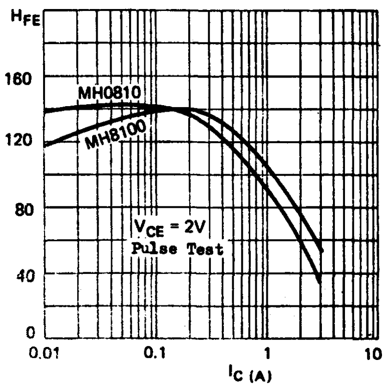
RATED POWER vs CASE TEMPERATURE



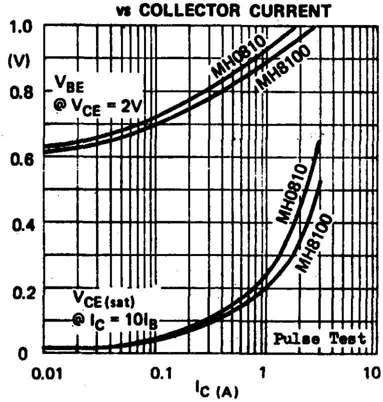
SAFE OPERATING AREA (D.C.)



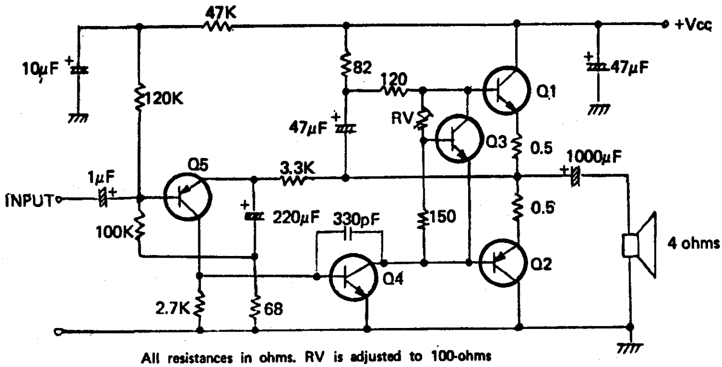
D.C. CURRENT GAIN vs COLLECTOR CURRENT



V_{BE} AND $V_{CE(sat)}$ vs COLLECTOR CURRENT



APPLICATION 1: 3W OTL AUDIO AMPLIFIER



All resistances in ohms. RV is adjusted to 100-ohms at which quiescent collector current of Q_1 = 5mA.

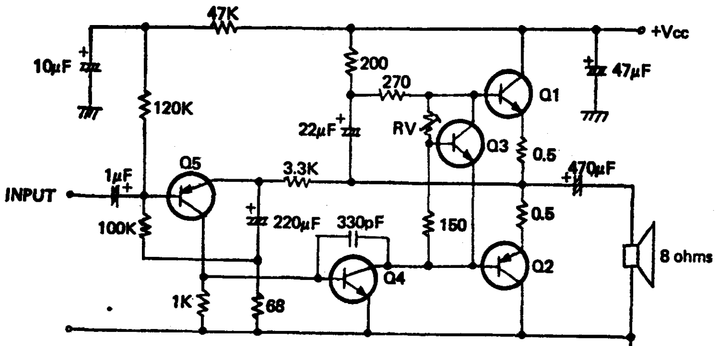
TRANSISTORS

Q_1	:	MH8100, H_{FE} GROUP B to C, mounted on heat sink.
Q_2	:	MH0810, H_{FE} GROUP B to C, mounted on heat sink.
Q_3	:	BC238, H_{FE} GROUP B.
Q_4	:	BC338, any H_{FE} GROUP.
Q_5	:	BC308, H_{FE} GROUP B to C.

CIRCUIT PERFORMANCE

Supply Voltage	:	13.2V (16V @ no signal)
Max Undistorted Output	:	3W @ 1KHz
Input Sensitivity	:	84mV @ 3W output
Input Impedance	:	90K ohms @ 1KHz
Frequency Response	:	37Hz to 55KHz, −3dB
Total Harmonic Distortion	:	less than 1% @ 2W output, 1KHz
Current Drain	:	42mA @ no signal 440mA @ 3W output

APPLICATION 2: 5W OTL AUDIO AMPLIFIER



All resistances in ohms. RV is adjusted to 100-ohms at which quiescent collector current of Q_1 = 5mA.

TRANSISTORS

Q_1	:	MH8100, H_F GROUP B to C, mounted on heat sink.
Q_2	:	MH0810, H_{FE} GROUP B to C, mounted on heat sink.
Q_3	:	BC238, H_{FE} GROUP B.
Q_4	:	BC338, any H_{FE} GROUP.
Q_5	:	BC308, H_{FE} GROUP B to C.

CIRCUIT PERFORMANCE

Supply Voltage	:	22V (25V @ no signal)
Max Undistorted Output	:	5.5W @ 1KHz
Input Sensitivity	:	140mV @ 5W
Input Impedance	:	105K ohms @ 1KHz
Frequency Response	:	33Hz to 65KHz, –3dB
Total Harmonic Distortion	:	less than 2% @ 5W output, 1KHz
Current Drain	:	32mA @ no signal 390mA @ 5W output

MH8106 MH8108 MH0816 MH0818

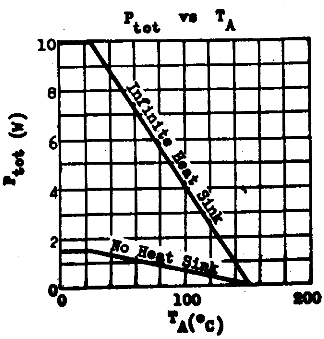
NPN PNP SILICON PLANAR EPITAXIAL POWER TRANSISTORS

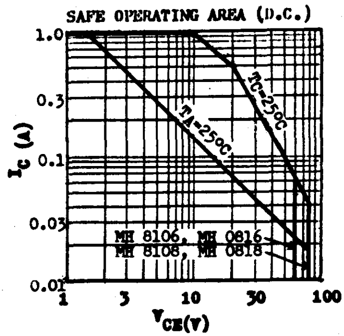
THE MH 8106, MH 8108 (NPN) AND MH 0816, MH 0818 (PNP) ARE SILICON PLANAR EPITAXIAL TRANSISTORS OF COMPLEMENTARY CHARACTERISTICS. THEY ARE SUITABLE FOR THE DRIVER STAGES OF 30-50WATT AUDIO AMPLIFIERS AND MEDIUM SPEED SWITCHES UP TO 1A COLLECTOR CURRENT.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

		MH 8106 (NPN) MH 0816 (PNP)	MH 8108 (NPN) MH 0818 (PNP)
Collector-Base Voltage	V_{CBO}	70V	90V
Collector-Emitter Voltage	V_{CEO}	60V	80V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	1A	
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}	2A	
Total Power Dissipation @ $T_C \leqslant 25°C$	P_{tot}	10W	
@ $T_A \leqslant 25°C$		1.5W	
Junction Temperature	T_j	150°C	
Storage Temperature Range	T_{stg}	-55 to +150°C	





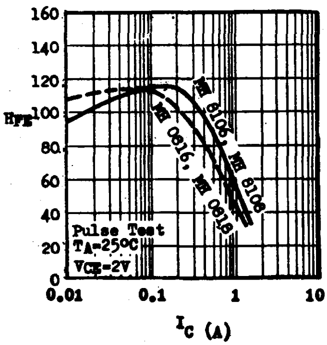
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
MH 8106, MH 0816		70			V	
MH 8108, MH 0818		90			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=10mA I_B=0
MH 8106, MH 0816		60			V	
MH 8108, MH 0818		80			V	
Collector Cutoff Current	I_{CBO}			0.5	μA	V_{CB}=60V I_E=0
Emitter Cutoff Current	I_{EBO}			1	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*			0.5	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *			1	V	I_C=500mA V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1 *	40		240		I_C=200mA V_{CE}=2V
	H_{FE} 2 *	15				I_C=1A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	50	100		MHz	I_C=100mA V_{CE}=4V
Collector-Base Capacitance	Cob					V_{CB}=10V I_E=0 f=1MHz
MH 8106, MH 8108			12		pF	
MH 0816, MH 0818			18		pF	

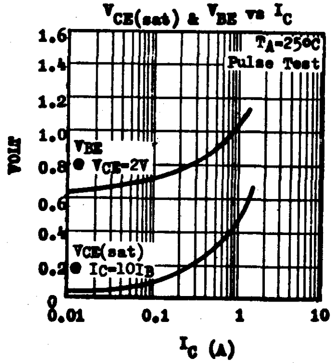
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

Note : H_{FE} 1 is classified as follows . Group A : 40-80 Group B : 70-140 Group C : 120-240

H_{FE} vs I_C



$V_{CE(sat)}$ & V_{BE} vs I_C



MH8500 MH0850

COMPLEMENTARY EPIBASE TRANSISTORS FOR 20-25W AF OUTPUT

THE MH 8500 (NPN), MH 0850 (PNP) ARE COMPLEMENTARY SILICON POWER TRANSISTORS FABRICATED BY ADVANCED EPIBASE TECHNOLOGY. THEY FEATURE MATCHED COMPLEMENTARY CHARACTERISTICS, HIGH FREQUENCY RESPONSE, GOOD SAFE OPERATING AREA AND ARE BEST SUITABLE FOR THE OUTPUT STAGES OF 20-25W HI-FI AMPLIFIERS. THEY ARE ALSO SUITABLE FOR SWITCHES UP TO 4A COLLECTOR CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	70V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	60V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	4A
Collector Peak Current (t≤10mS)	I_{CM}	8A
Total Power Dissipation (T_C≤25°C)	P_{tot}	40W
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	-55 to +150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

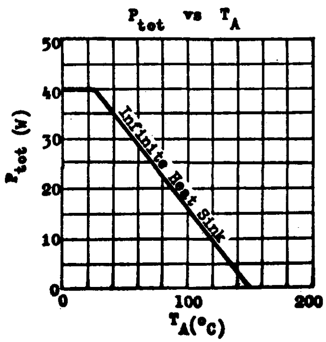
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60			V	I_C=100mA I_B=0
Collector Cutoff Current	I_{CES}			10	μA	V_{CE}=70V V_{BE}=0
Emitter Cutoff Current	I_{EBO}			10	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.4	1.2	V	I_C=3A I_B=0.3A
Base-Emitter Voltage	V_{BE} *		1.05	1.5	V	I_C=3A V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1 *	40		240		I_C=1A V_{CE}=2V
	H_{FE} 2 *	30				I_C=0.01A V_{CE}=2V
	H_{FE} 3 *	15				I_C=3A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	5			MHz	I_C=0.5A V_{CE}=4V

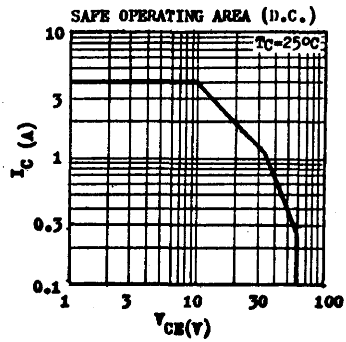
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

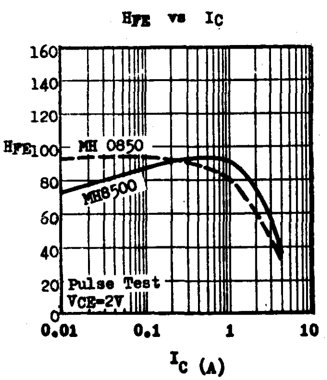
Note : H_{FE} 1 is classified as follows . Group A : 40-80 Group B : 70-140
Group C : 120-240

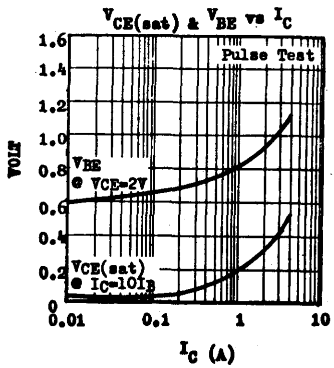
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









MH8700 MH0870

COMPLEMENTARY EPIBASE TRANSISTORS FOR 10-15W AF OUTPUT

The MH8700 (NPN), MH0870 (PNP) are complementary silicon power transistors fabricated by advanced epibase technology. They feature matched complementary characteristics, high frequency response, good safe operating area and are best suitable for the output stage of 10-15W Hi-Fi Amplifiers. They are also suitable for switches up to 4A collector current.

CASE
TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS: For p-n-p devices, voltage and current values are negative

Collector-Emitter Voltage ($V_{BE}=0$)	V_{CES}	60V
Collector-Emitter Voltage (Base Open)	V_{CEO}	50V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	4A
Collector Peak Current (t $\leq$ 10mS)	I_{CM}	7A
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	30W
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	−55 to +150°C

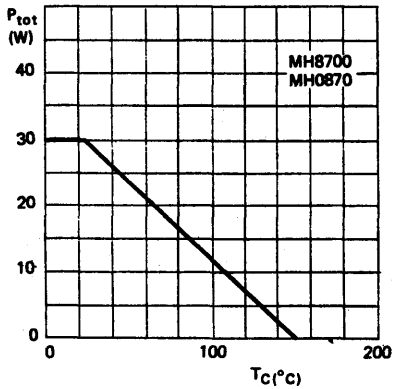
ELECTRICAL CHARACTERISTICS ($T_A=25°C$)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}	50			V	$I_C=100mA$ $I_B=0$
Collector Cutoff Current	I_{CES}			10	μA	$V_{CE}=60V$ $V_{BE}=0$
Emitter Cutoff Current	I_{EBO}			10	μA	$V_{EB}=5V$ $I_C=0$
Collector-Emitter Saturation Voltage	$V_{CE\,(sat)}$		0.33	0.8	V	$I_C=2A$ $I_B=0.2A$
Base-Emitter Voltage	V_{BE}		0.82	1.2	V	$I_C=1A$ $V_{CE}=2V$
D.C. Current Gain	$^*H_{FE\,1}$	40		240		$I_C=1A$ $V_{CE}=2V$
	$H_{FE\,2}$	30				$I_C=0.01A$ $V_{CE}=2V$
Current Gain-Bandwidth Product	f_T	5			MHz	$I_C=0.5A$ $V_{CE}=4V$

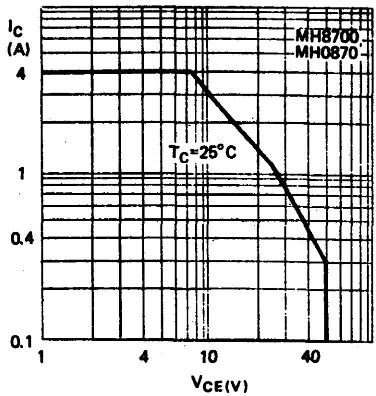
$^*H_{FE\,1}$ is classified as follows. **Group A : 40–80** **Group B : 70–140**
Group C : 120–240

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

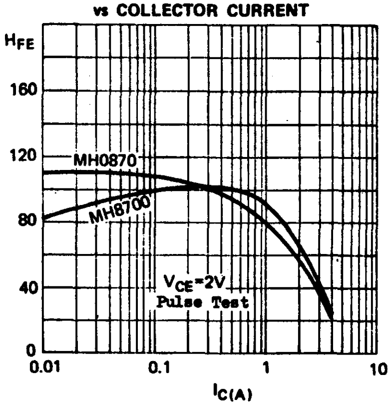
RATED POWER vs CASE TEMPERATURE



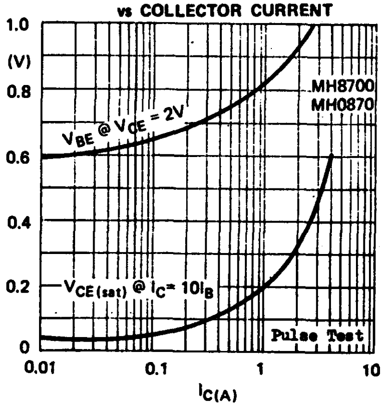
SAFE OPERATING AREA (D.C.)



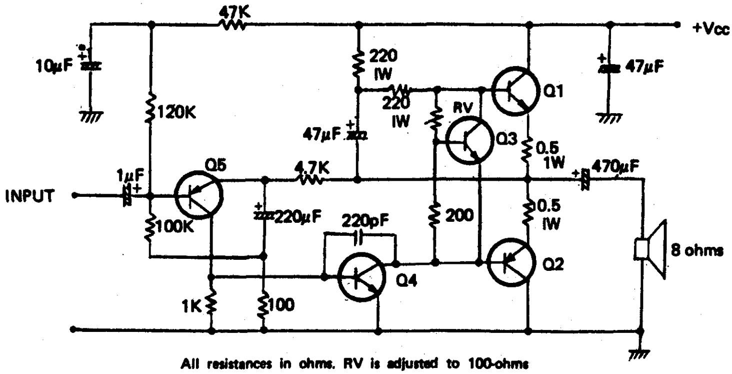
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



VBE AND VCE(sat)
vs COLLECTOR CURRENT



APPLICATION 1: 10W OTL AUDIO AMPLIFIER



All resistances in ohms. RV is adjusted to 100-ohms at which quiescent collector current of Q_1 = 5mA.

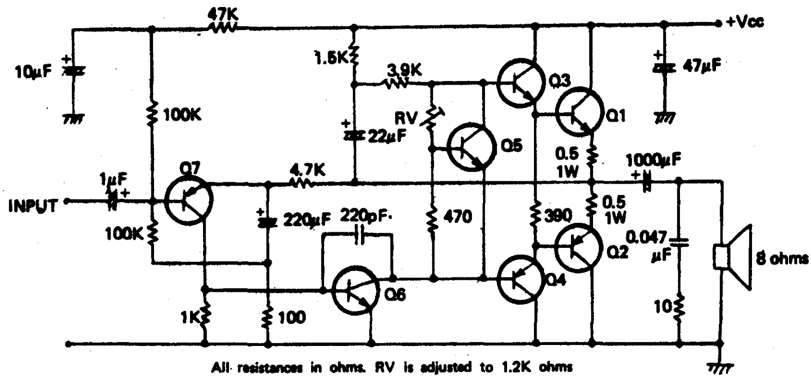
TRANSISTORS

Q_1	:	MH8700, H_{FE} GROUP B to C, mounted on heat sink.
Q_2	:	MH0870, H_{FE} GROUP B to C, mounted on heat sink.
Q_3	:	BC238, H_{FE} GROUP B.
Q_4	:	BC337, With X-67 heat sink mounted on chassis.
Q_5	:	BC308, H_{FE} GROUP B to C.

CIRCUIT PERFORMANCE

Supply Voltage	:	32V (37V @ no signal)
Rated Output	:	10W
Max Undistorted Output	:	11.5W
Input Sensitivity	:	200mV @ 10W output
Input Impedance	:	110 Kohms @ 1kHz
Frequency Response	:	30Hz to 70KHz, −3dB
Total Harmonic Distortion	:	less than 0.5% @ 10W, 1KHz
Current Drain	:	50mA @ no signal 560mA @ 10W output

APPLICATION 2: 15W OTL AUDIO AMPLIFIER



All resistances in ohms. RV is adjusted to 1.2K ohms at which quiescent collector current of Q_1 = 5mA.

TRANSISTORS

Q_1	:	MH8700, H_{FE} GROUP A to B, mounted on heat sink.
Q_2	:	MH0870, H_{FE} GROUP A to B, mounted on heat sink.
Q_3	:	BC182, H_{FE} GROUP A to B.
Q_4	:	BC212, H_{FE} GROUP A to B.
Q_5	:	BC238, H_{FE} GROUP B.
Q_6	:	BC237, H_{FE} GROUP A to B.
Q_7	:	BC307, H_{FE} GROUP B.

CIRCUIT PERFORMANCE

Supply Voltage	: 38V (44V @ no signal)
Rated Output	: 15W
Max Undistorted Output	: 16.5W
Input Sensitivity	: 230mV @ 15W output
Input Impedance	: 100Kohms @ 1kHz
Frequency Response	: 17Hz to 55kHz, –3dB 34Hz to 35kHz, –1dB
Total Harmonic Distortion	: less than 0.1% @ 15W output, 1KHz less than 0.3% @ 15W output, 10KHz
Current Drain	: 20mA @ no signal 630mA @ 15W output

ML555

PRECISION TIMER

FEATURES

- Timing from microseconds through hours
- Monostable and astable operations
- Adjustable duty cycle
- Current output can source or sink 200mA
- Output can drive TTL
- Temperature stability of 0.005% per °C
- Normally on and normally off output

APPLICATIONS

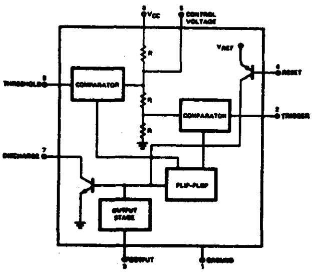
- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

DESCRIPTION

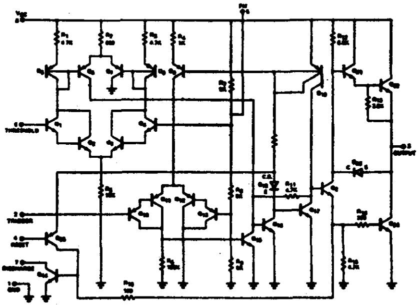
The ML555 monolithic integrated circuit is a highly stable timer for precision timing and oscillator applications. Additional terminals are provided for triggering or resetting if desired. As a timer, the ML555 is capable of producing accurate time delay from microseconds through hours. As an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor.

The ML555 may be triggered and reset on falling waveforms and the output can drive TTL circuits with source or sink current up to 200mA.

BLOCK DIAGRAM



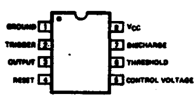
SCHEMATIC DIAGRAM



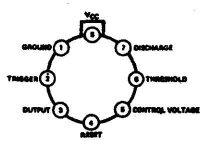
ORDERING INFORMATION

Package Type	Temperature Range	Order Number
MINI DIP	0°C to +70°C	ML555V
TO - 99	0°C to +70°C	ML555T

PIN CONFIGURATIONS (TOP VIEW)



MINI DIP



TO - 99

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	+18V
Power Dissipation	600mW
Operating Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 seconds)	+300°C

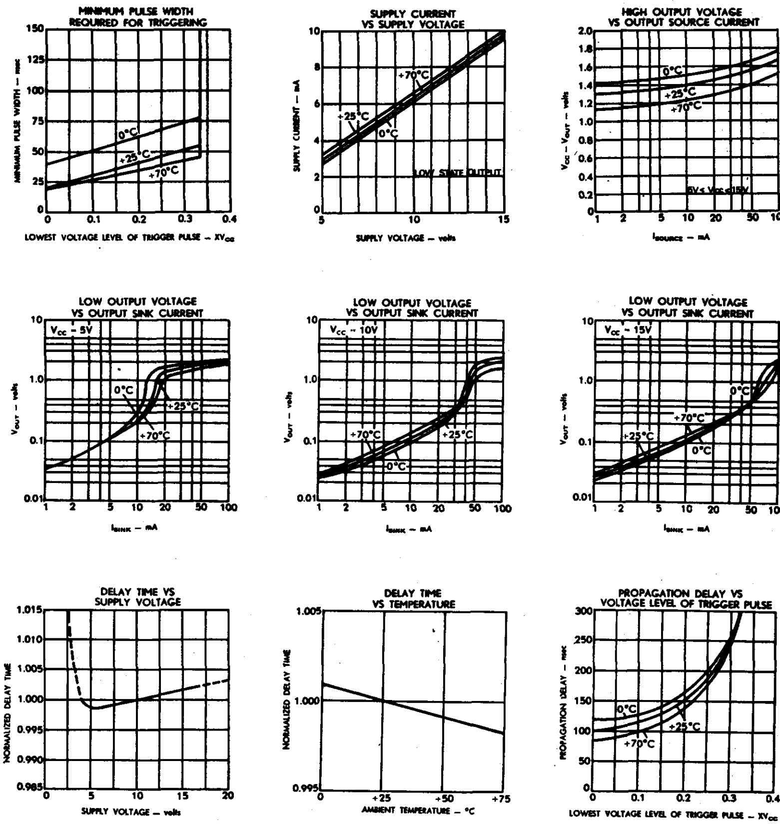
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$, $V_{CC} = +5V$ to +15 unless otherwise specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Supply Voltage	4.5		16	V	
Supply Current					Low State Output, Note 1
		3	6	mA	$V_{CC} = 5V$, $R_L = \infty$
		10	15	mA	$V_{CC} = 15V$, $R_L = \infty$
Timing Error					R_A, $R_B = 1K\Omega$ to $100K\Omega$, $C = 0.1\mu F$,
Initial Accuracy		1.0		%	Note 2
Drift with Temperature		50		ppm/°C	
Drift with Supply Voltage		0.1		%/V	
Threshold Voltage		2/3		$\times V_{CC}$	
Trigger Voltage		1/3		$\times V_{CC}$	
Trigger Current		0.5		μA	
Reset Voltage	0.4	0.7	1.0	V	
Reset Current		0.1		mA	
Threshold Current		0.1	0.25	μA	Note 3
Control Voltage Level	2.6	3.33	4.0	V	$V_{CC} = 5V$
	9.0	10.0	11.0	V	$V_{CC} = 15V$
Output Voltage (Low)					$V_{CC} = 5V$
		0.25	0.35	V	$I_{sink} = 5.0mA$
					$V_{CC} = 15V$
		0.1	0.25	V	$I_{sink} = 10mA$
		0.4	0.75	V	$I_{sink} = 50mA$
		2.0	2.5	V	$I_{sink} = 100mA$
		2.5		V	$I_{sink} = 200mA$
Output Voltage (High)					$I_{source} = 100mA$
	2.75	3.3		V	$V_{CC} = 5V$
	12.75	13.3		V	$V_{CC} = 15V$
					$I_{source} = 200mA$
		12.5		V	$V_{CC} = 15V$
Rise Time of Output		100		ns	
Fall Time of Output		100		ns	

NOTES:

1. Supply current when output high is typically 1mA less.
2. Tested at $V_{CC} = 5V$ and $V_{CC} = 15V$.
3. This will determine the maximum value of $R_A + R_B$. For 15V operation, the maximum total $R = 20M\Omega$.

TYPICAL CHARACTERISTICS



APPLICATION INFORMATION

Monostable Operation

When the timer is operated as a monostable multivibrator, one external capacitor, C, and one external resistor, R_A, are used as shown in Figure 1. When the trigger input is reduced below 1/3 V_{CC}, the timer internal flip-flop is set. This releases the short circuit across the external capacitor and the output goes HIGH. The voltage across the capacitor begins to rise exponentially with the time constant R_AC. When the capacitor voltage reaches 2/3 V_{CC}, the internal comparator resets the flip-flop and the external capacitor, C, is rapidly discharged provided the trigger voltage is returned above 1/3 V_{CC}. The output is now in LOW state and a new timing cycle may be initiated. The time that the output is in the HIGH state is given by 1.1 R_AC or can be taken directly from Figure 2. Both the charge rate and internal threshold are directly proportional to the V_{CC} supply voltage. Thus, the timer output pulse width is independent of the power supply voltage. If a LOW is applied to the reset input, the output is forced LOW and the external capacitor discharged regardless of the other inputs.

When the reset function is not in use, it is recommended that PIN 4 connected to V_{CC} to avoid any possibility of false triggering.

Astable Operation

When the timer is operated in the astable mode, two external resistors, R_A and R_B, and one external capacitor, C, are used as shown in Figure 3. With this connection, it will trigger itself and free run as a multivibrator. The external capacitor charges through Ra + Rb and discharges through Rb only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

In this mode of operation, the capacitor charges and discharges between 1/3 V_{CC} and 2/3 V_{CC}. As in the triggered mode, the charge and discharge times, and therefore the frequency are independent of the supply voltage.

The charge time (output high) is given by

$$t_1 = 0.693\ (Ra + Rb)\ C$$

And the discharge time (output low) by:

$$t_2 = 0.693\ (Rb)\ C$$

Thus the total period is:

$$T = t_1 + t_2 = 0.693\ (Ra + 2Rb)\ C$$

The frequency of oscillation is:

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)\,C}$$

The duty cycle is:

$$D = \frac{R_B}{R_A + 2R_B}$$

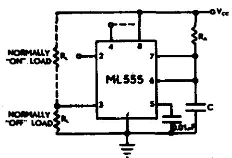


Fig. 1 Monostable Operation

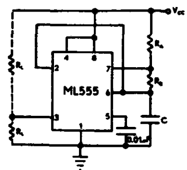


Fig. 3 Astable Operation

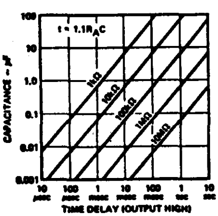


Fig. 2. Monostable Pulse Width.

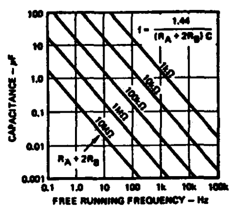


Fig. 4. Astable Free Running Frequency.

ML1060

SIX-DIGIT LED DISPLAY DRIVER

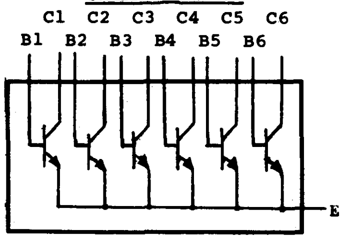
GENERAL DESCRIPTION

The ML1060 is a monolithic silicon chip consisting of six NPN common-emitter transistors. It features low leakage, low VCE(sat), small chip size and CMOS compatible.

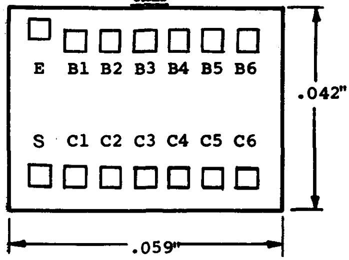
The ML1060 is designed for use as an LED/CMOS digit driver interface in electronic watch systems and calculators using common-cathode multiplexed LED displays. Wire bonding by hybrid assemblers is facilitated by the large, well spaced 5x5 mils bonding pads.

For silicon chip in plastic dual-in-line package, please order part no. ML1060-DIP.

SCHEMATIC DIAGRAM



CHIP

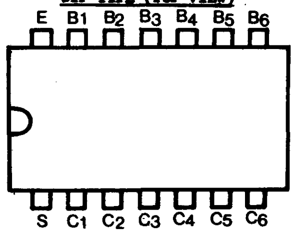


ABSOLUTE MAXIMUM RATINGS (DIP TYPE)

Any one transistor :

Collector-Emitter Voltage	9V
Emitter-Base Voltage	4V
Collector Current	300mA
Base Current	30mA
Collector Dissipation ($T_A \leq 25°C$)	500mW
Total Package Dissipation ($T_A < 25°C$)	750mW
Operating Temperature Range	-25 to 85°C
Storage Temperature Range	-55 to 150°C

DIP TYPE (TOP VIEW)

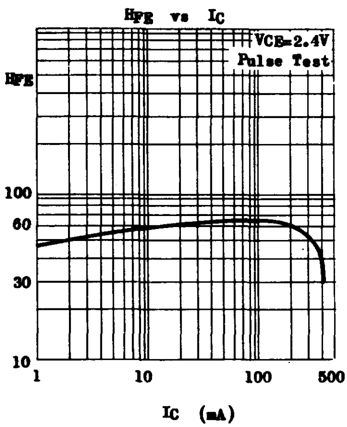


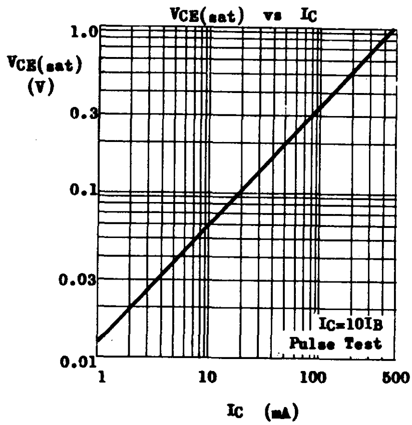
Note : The S-terminal (substrate) must be connected to a voltage which is more negative than any collector voltage.

ELECTRICAL CHARACTERISTICS PER TRANSISTOR (T_A=25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CEO}	9	17		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	4	7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CER}			0.25	μA	V_{CE}=4V R_{BE}=10KΩ
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.25	0.4	V	I_C=63mA I_B=6.3mA
Base-Emitter Voltage	V_{BE}		0.87	1.0	V	I_E=1mA V_{CE}=2.4V
D.C. Current Gain	H_{FE}	20	65			I_C=63mA V_{CE}=2.4V
Current Gain-Bandwidth Product	f_T		300		MHz	I_C=50mA V_{CE}=2.4V
Output Capacitance	Cob		11		pF	V_{CB}=2V I_E=0 f=1MHz

TYPICAL CHARACTERISTICS (T_A=25°C)





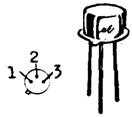
ML2005

5V – 200MA POSITIVE VOLTAGE REGULATOR

FEATURES

* LOW INPUT VOLTAGE REQUIREMENT
* LOW OUTPUT IMPEDANCE
* OUTPUT SHORT CIRCUIT PROTECTION
* HIGH TEMPERATURE STABILITY
* AVAILABLE IN CASE TO-39 / TO-220B

CASE TO-39



ORDER PART NO.
ML2005C

CASE TO-220B

ORDER PART NO.
ML2005P

1. Input
2. Output
3. Ground

ABSOLUTE MAXIMUM RATINGS

		ML2005C	ML2005P
Input Voltage	V_I	20V	20V
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	5W	12W
($T_A \leq 25^oC$)		0.9W	1.5W
Junction Temperature	T_j	175°C	150°C
Operating Temperature Range	Top	-25 to 85°C	-25 to 85°C
Storage Temperature Range	Tstg	-65 to 175°C	-55 to 150°C

THERMAL RESISTANCE

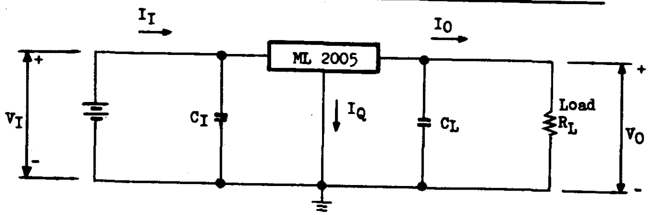
Junction to Case	θ_{jc}	30°C/W max.	10.4°C/W max.
Junction to Ambient	θ_{ja}	167°C/W max.	83.3°C/W max.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

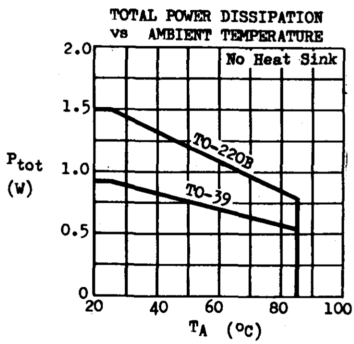
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS *
Output Voltage	V_O	4.5 4.75	5 5	 5.25	V V	V_I=7V I_O=150mA V_I=10V I_O=150mA
Load Regulation	ΔV_O		20	100	mV	V_I=10V I_O=5-150mA
Line Regulation	ΔV_O		20	100	mV	I_O=150mA V_I=7.5-15V
Quiescent Current	I_Q		20	30	mA	V_I=10V I_O=0
Output Short Circuit Current	I_{SC}		220	300	mA	V_I=10V V_O=0
Ripple Rejection (f=100Hz)	$\Delta V_I/\Delta V_O$	38	55		dB	I_O=150mA V_I=9-11V
Output Resistance	R_O		0.1		ohm	V_I=10V I_O=150mA
Output Noise Voltage	$\overline{En}$		40		µV	V_I=10V f=10Hz-100KHz I_O=150mA
Temperature Coefficient	$\Delta V_O/\Delta T_A$		0.85		mV/°C	V_I=10V I_O=5mA T_A=0 - 70°C

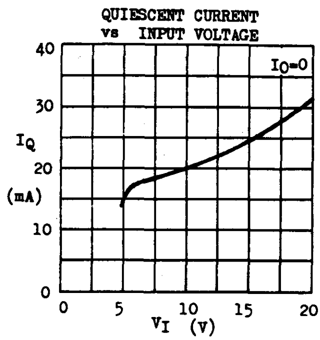
* Test duration less than 10 Sec.

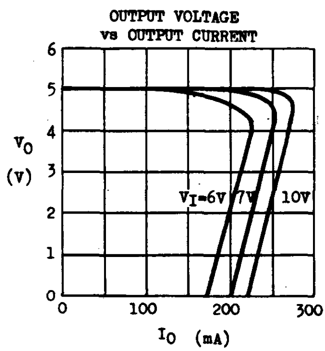
TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

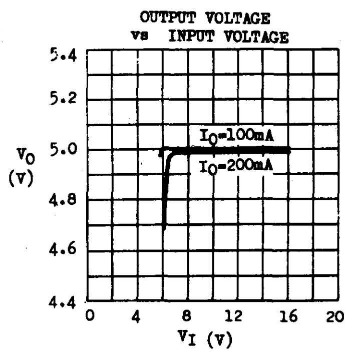


Test duration less than 10sec. C_I and C_L greater than 1µF.



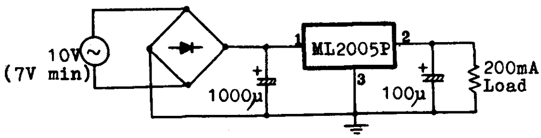




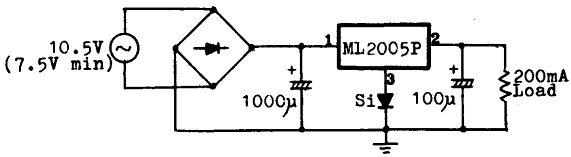


CIRCUIT APPLICATIONS

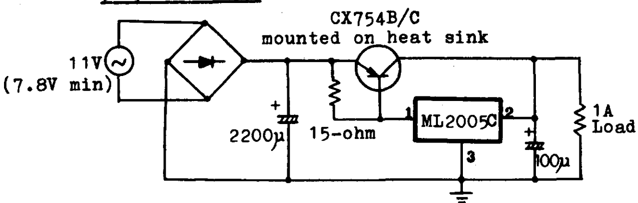
5V / 200mA OUTPUT



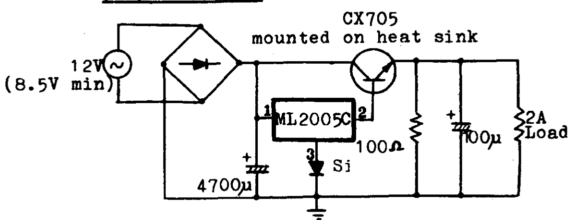
5.8V / 200mA OUTPUT



5V / 1A OUTPUT



5V / 2A OUTPUT



ML9400

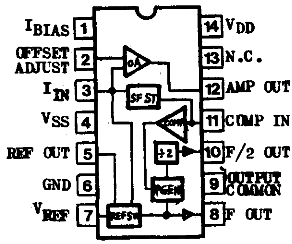
VOLTAGE-TO-FREQUENCY CONVERTER

DESCRIPTION

The ML9400 is a low cost voltage-to-frequency converter combining Bipolar and CMOS technology on a single chip. The converter accepts a variable analog input signal and generates an output pulse train whose frequency is linearly proportional to the input voltage. A complete V to F system requires addition of only 2 capacitors, 3 resistors, and 2 supply voltages. F to V conversion is also possible.

FEATURES

* 10Hz to 100kHz operation
* ± 0.01% typical linearity to 10kHz
* ± 25PPM/°C typ. gain temperature stability
* Open collector output
* Output can drive 5TTL loads as well as CMOS
* Pulse and square wave outputs
* Programmable scale factor
* Low power dissipation: 27mW typical



14-Pin Plastic DIP

APPLICATIONS

* Precision V/F Converters
* Precision F/V Converters
* 13 bit A/D Converters
* μP data acquisition
* Ultra long time interval integrator
* Digital scales
* Thermostats
* Digital panel meters
* Phase locked loops
* Remote control
* FSK data transmission
* Analog data transmission & recording
* VCO
* Communications scrambler
* Sound in Video Games

ABSOLUTE MAXIMUM RATINGS

V_{DD} to V_{SS}	18V
I_{IN}	± 10mA
I_{REF}	± 10mA
V_{Omax} - $V_{O\ COM}$	18V
$\lvert V_{REF} - V_{SS} \rvert$	1.5V
Operating temp.	0°C-70°C

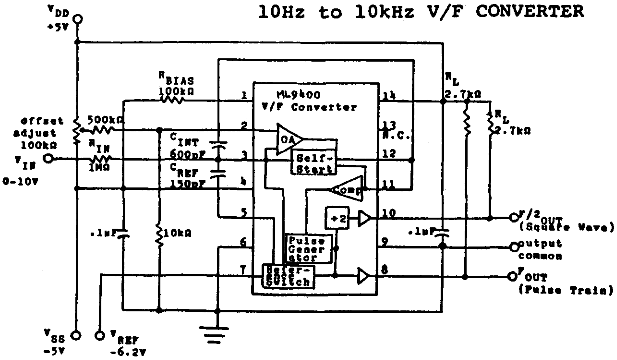
VOLTAGE TO FREQUENCY CONVERSION

TYPICAL ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{DD}=5V, V_{SS}=-5V, V_{REF}=-6.2V, R_{BIAS}=100KΩ, T_A=25°C

INPUT CIRCUIT	I_{in}	: 10pA	@ V_{in} = 10V, R_{in} = 1MΩ
	V_{io}(offset)	: <± 10mV	@ 0°C < T_A < 70°C
	V_{io}(drift)	: <± 5PPM/°C	@ 0°C < T_A < 70°C
SUPPLY REQUIREMENTS	I_{DD}	: 2mA	
	I_{SS}	: -1.5mA	
OUTPUTS	V_{OL}	: 0.4V	@ I_o = 10mA
CONVERSION ACCURACY	Linearity(10kHz)	: ± 0.01%	@ V_{in} = 0 to 10V
	(100kHz)	: ± 0.1%	@ V_{in} = 0 to 10V
	Full Scale Temperature Stability	: ± 25PPM/°C	@ 0°C < T_A < 70°C

TYPICAL APPLICATION
10Hz to 10kHz V/F CONVERTER



EQUATIONS

$f_{OUT} = \frac{V_{in}}{(R_{in})} \times \frac{1}{(V_{REF})\,(C_{REF})}$

$R_{in} = \frac{V_{in}\ (MAX)}{10\mu A}$

$82K \leq R_{BIAS} \leq 120K$

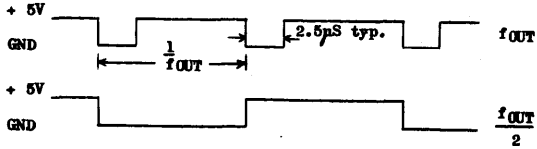
$3C_{REF} < C_{INT} < 5C_{REF}$

For optimum stability:

$C_{INT} \cong 4 \times C_{REF}$

NOTES

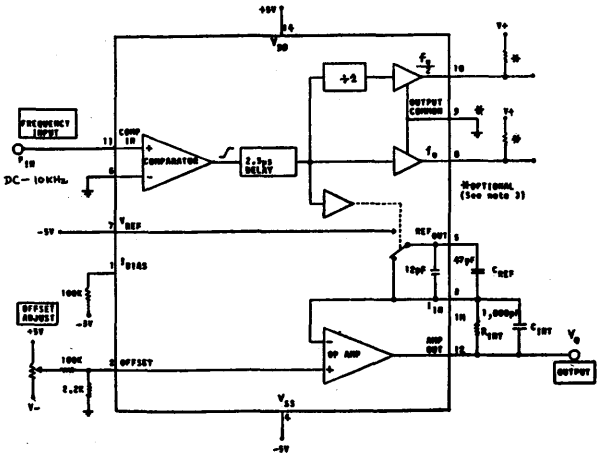
1. To adjust f_{min}, set V_{in}=10mV and adjust the 100K offset for 10Hz out.
2. To adjust f_{max}, set V_{in}=10V and adjust R_{in} or V_{REF} for 10kHz out.
3. Output waveforms :



4. To increase f_{OUT}(MAX) to 100kHz change C_{REF} to 20pF and C_{INT} to 80pF.
5. For high performance applications use high stability components for R_{in}, C_{REF}, and V_{REF}. (metal film resistors and glass film capacitors.) Also separate the output ground (Pin 9) from the input ground (Pin 6).

FREQUENCY TO VOLTAGE CONVERSION

INPUT	Frequency[2]	:	10Hz to 100kHz
	Voltage[1]	:	min -0.2V, +0.2V max -2V, +V_{DD}
	Waveform	:	Sine, Triangular, Square, or Pulse
	Duty Cycle	:	0.5μS min negative pulse width 5.0μS min positive pulse width
	Impedance	:	>10MΩ (FET INPUT)
OUTPUT	V_{OUT} Range	:	0 to 4V (V_{DD}^{-1})
	V_{OUT}	:	$= [V_{REF} \times C_{REF} \times R_{INT}] F_{IN}$
	Response Time	:	$R_{INT} \times C_{INT}$
	Ripple	:	Inversely proportional to C_{INT} and input frequency
	Loading	:	2KΩ min
ACCURACY	Better than 0.1% FS		

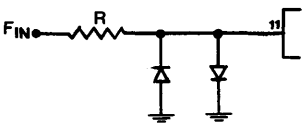


DC –10KHz F/V CONVERTER

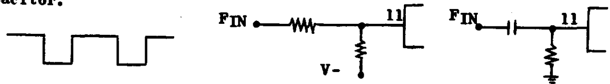
NOTES

1. The input signal must cross through zero in order to trip the comparator. In order to overcome the hysteresis the amplitude must be greater than ±100mV. If the comparator input voltage exceeds -2.5V then the Op Amp output will go to its maximum positive output voltage for the duration of the overvoltage.

   If the input voltage has a wide amplitude variation then a pair of back to back diodes may be used to limit the voltage to ± 0.7V.



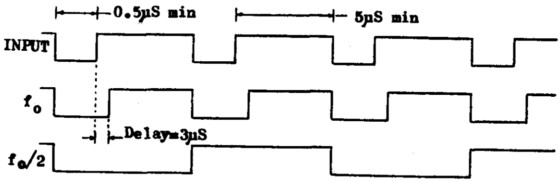
If only a unipolar input signal (F_{IN}) is available it is recommended that either an offset circuit using resistor be used or that the signal be coupled in via a capacitor.



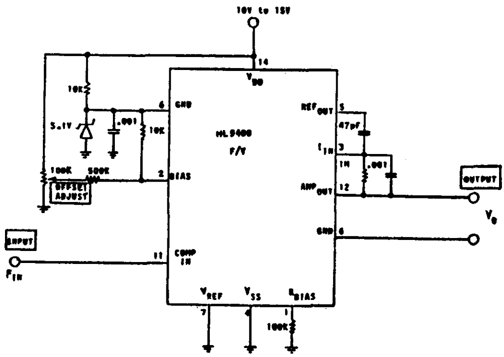
The output voltage of the Op Amp is referenced to Pin 6 (GND). So if Pin 6 is used to determine the comparator threshold the Op Amp output reference will also be shifted.

2. For 100KHz maximum input R_{INT} should be decreased to 100KΩ.
3. f_o and $f_o/2$ are not used in the F/V mode. However, these outputs may be useful for some applications, such as a buffer to feed additional circuitry. f_o will then follow the input frequency waveform; except that f_o will go high 3μS after F_{IN} goes high. $f_o/2$ will be square wave with a frequency of one half f_o.

   If these outputs are not used then Pins 8, 9, and 10 may be left floating or connected to ground.



SINGLE SUPPLY F/V



NOTES :

1. The input is now referenced to 5.1V (Pin 6). The input signal must therefore be restricted to be greater than 3 volts (Pin 6 -2V) and less than 10 to 15V (V_{DD}).

   If the signal is AC coupled then a resistor (100K to 10MΩ) must be placed between the input (Pin 11) and Pin 6.
2. The output will now be referenced to Pin 6 which is at 5.1V (V_Z). For frequency meter applications a 1mA meter with a series scaling resistor can be placed across Pins 6 and 12.

MPS3638 and similar types

SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

CASE TO-92A

EBC

THE FOLLOWING TRANSISTORS ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING UP TO 500mA COLLECTOR CURRENT. THEIR MAXIMUM POWER DISSIPATION=500mW @ $T_A \leq 25°C$.

D.C. CHARACTERISTICS (T_A=25°C) For p-n-p devices, voltage and current values are negative

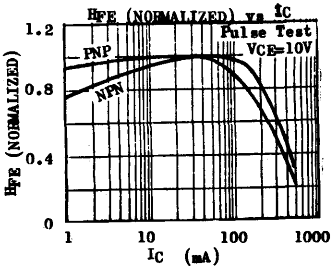
TYPE	POLARITY	BV_{CBO} (V)	LV_{CEO} (V)	BV_{EBO} (V)	I_{CES} @ V_{CE} (nA) (V)	H_{FE} @ I_C/V_{CE} (mA)(V)	$V_{CE(sat)}$ (V)	& $V_{BE(sat)}$ @ I_C/I_B (V) (mA)(mA)
		min	min	min	max	min-max	max	min-max
MPS3638	PNP	25	25	4	35 @ 15	20- @ 10/10 30- @ 50/1 20- @ 300/2	0.25 1.0	-1.1 @ 50/2.5 0.8-2.0 @ 300/30
MPS3638A	PNP	25	25	4	35 @ 15	80- @ 1/10 100- @ 10/10 100- @ 50/1 20- @ 300/2	0.25 1.0	-1.1 @ 50/2.5 0.8-2.0 @ 300/30
PN3641	NPN	60	30	5	50 @ 50	40-120 @ 150/10 15- @ 500/10	0.22	@ 150/15
PN3642	NPN	60	45	5				
PN3643	NPN	60	30	5	50 @ 50	100-300 @ 150/10 25- @ 500/10	0.22	@ 150/15
PN3644	PNP	45	45	5	35 @ 30	40- @ 0.1/10 80- @ 1/10 100- @ 10/10 80-240 @ 50/1 100-300 @ 150/10 20- @ 300/2	0.25 0.4 1.0	-1.0 @ 50/2.5 -1.3 @ 150/15 0.8-2.0 @ 300/30
PN3645	PNP	60	60	5	35 @ 50			
PN5128	NPN	15	12	3	50 @ 10	20- @ 10/10 35-350 @ 50/10	0.25	-1.1 @ 150/15
PN5142	PNP	20	20	4	50 @ 12	30- @ 50/1 15- @ 300/10	0.5 2.0	-1.5 @ 50/2.5 0.8-2.5 @ 300/30

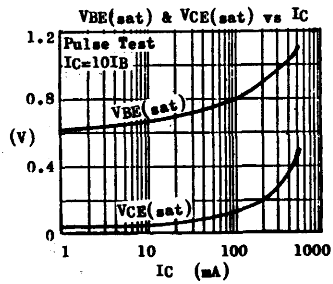
A.C. CHARACTERISTICS (T_A=25°C) For p-n-p devices, voltage and current values are negative.

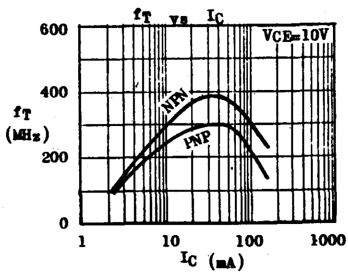
TYPE	f_T @ I_C/V_{CE} (MHz)(mA)(V)	Cob @ V_{CB}=10V I_E=0 (pF)	Cib @ V_{EB}=0.5V I_C=0 (pF)	t_{on} (nS)	t_{off} (nS)	NOTE
	min	max	max	max	max	
MPS3638	100 @ 50/3	20	65	75	170	
MPS3638A	150 @ 50/3	10	25			t_{on} @ I_C=300mA I_{B1}=30mA
PN3641	150 @ 50/5	8				
PN3642	150 @ 50/5					
PN3643	250 @ 50/5					t_{off} @ I_C=300mA I_{B1}=30mA $-I_{B2}$=30mA
PN3644	200 @ 20/20	8	25	40	100	
PN3645						
PN5128	150 @ 50/5	10	30	100	200	
PN5142	100 @ 50/3					

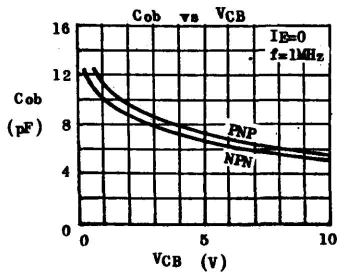
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









MPS4354, 5, 6 PN3567, 8, 9

COMPLEMENTARY
SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

CASE TO-92A

EBC

THE MPS4354, 5, 6 (PNP) AND PN3567, 8, 9 (NPN) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS DESIGNED FOR AF MEDIUM POWER AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS.

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

		PNP		NPN	
		MPS4354 MPS4355	MPS4356	PN3567 PN3569	PN3568
Collector-Base Voltage	V_{CBO}	60V	80V	80V	80V
Collector-Emitter Voltage	V_{CEO}	60V	80V	40V	60V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V	5V
Collector Current	I_C	1A			
Total Power Dissipation ($T_A < 25°C$)	P_{tot}	625mW derate 5mW/°C above 25°C			
($T_C < 25°C$)		1.5W derate 12mW/°C above 25°C			
Operating Junction & Storage Temperature	Tj, Tstg	-55 to 150°C			

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MPS TYPES MIN	MPS TYPES MAX	PN TYPES MIN	PN TYPES MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1		Note 1		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	Note 1		Note 1		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	Note 1		Note 1		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		50			nA	V_{CB}=50V I_E=0
			5			μA	V_{CB}=50V I_E=0 T_A=75°C
					50	nA	V_{CB}=40V I_E=0
					5	μA	V_{CB}=40V I_E=0 T_A=75°C
Emitter Cutoff Current	I_{EBO}		100		25	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.15		0.25	V	I_C=150mA I_B=15mA
			0.5			V	I_C=500mA I_B=50mA
			1			V	I_C=1A I_B=0.1A (Note 2)
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		0.9			V	I_C=150mA I_B=15mA
			1.1			V	I_C=500mA I_B=50mA
			1.2			V	I_C=1A I_B=0.1A (Note 2)

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

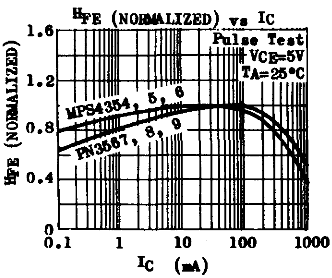
Note 1 : equal to the values of absolute maximum ratings. Note 2 : for MPS4355 only

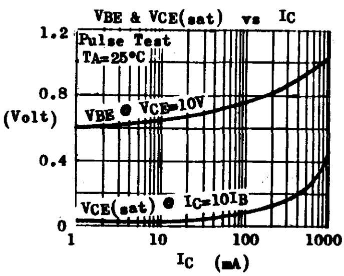
PARAMETER	SYMBOL	MPS TYPES MIN	MPS TYPES MAX	PN TYPES MIN	PN TYPES MAX	UNIT	TEST CONDITIONS
Base-Emitter Voltage	V_{BE} *				1.1	V	I_C=150mA V_{CE}=1V
			1.1			V	I_C=500mA V_{CE}=0.5V
			1.2			V	I_C=1A V_{CE}=1V (Note 2)
Current Gain-Bandwidth Product	f_T	100	500	60	600	MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Ccb		30		20	pF	V_{CB}=10V I_E=0 f=140KHz
Emitter-Base Capacitance	Ceb		110		80	pF	V_{EB}=0.5V I_C=0 f=140KHz
Noise Figure	NF		3			dB	I_C=0.1mA V_{CE}=10V R_G=1KΩ f=1KHz
Turn-On Time	t_{on}		100			nS	Vcc=30V I_C=500mA I_{B1}=50mA
Turn-Off Time	t_{off}		400			nS	Vcc=30V I_C=500mA I_{B1}=$-I_{B2}$=50mA

D.C. CURRENT GAIN — H_{FE} AT T_A=25°C *

@ I_C/V_{CE}	MPS4354 MIN	MPS4354 MAX	MPS4355 MIN	MPS4355 MAX	MPS4356 MIN	MPS4356 MAX	PN3567 MIN	PN3567 MAX	PN3568 MIN	PN3568 MAX	PN3569 MIN	PN3569 MAX
0.1mA/10V	25		60		25							
1mA/10V	40		75		40							
10mA/10V	50	500	100	400	50	250						
100mA/10V	40		75		40							
500mA/10V	30		75		30							
30mA/1V							40		40		100	
150mA/1V							40	120	40	120	100	300

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%   Note 2 : for MPS4355 only.





MPS6530 through MPS6535

COMPLEMENTARY

SILICON GENERAL PURPOSE AMPLIFIERS & SWITCHES

CASE TO-92A

EBC

THE MPS6530 THROUGH MPS6535 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS UP TO 600mA COLLECTOR CURRENT. THE MPS6530, MPS6531, MPS6532 ARE NPN AND ARE COMPLEMENTARY TO THE PNP MPS6533, MPS6534, MPS6535 RESPECTIVELY.

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

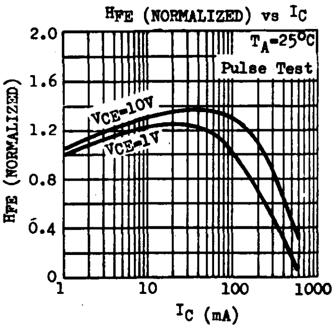
		NPN		PNP	
		MPS6530 MPS6531	MPS6532	MPS6533 MPS6534	MPS6535
Collector-Base Voltage	V_{CBO}	60V	50V	40V	30V
Collector-Emitter Voltage	V_{CEO}	40V	30V	40V	30V
Emitter-Base Voltage	V_{EBO}	5V	5V	4V	4V
Collector Current	I_C	0.6A			
Total Power Dissipation ($T_C \leq 25^oC$)	Ptot	1.2W			
($T_A \leq 25^oC$)		500mW			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C			

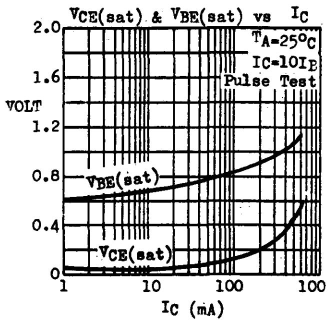
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.01mA I_E=0
MPS6530, MPS6531		60			V	
MPS6532		50			V	
MPS6533, MPS6534		40			V	
MPS6535		30			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=10mA I_B=0
MPS6530, MPS6531		40			V	
MPS6532		30			V	
MPS6533, MPS6534		40			V	
MPS6535		30			V	
Emitter-Base Breakdown Voltage	BV_{EBO}					I_E=0.01mA I_C=0
MPS6530, 1, 2		5			V	
MPS6533, 4, 5		4			V	
Collector Cutoff Current	I_{CBO}					
MPS6530, MPS6531				50	nA	V_{CB}=40V I_E=0
MPS6532				100	nA	V_{CB}=30V I_E=0
MPS6533, MPS6534				50	nA	V_{CB}=30V I_E=0
MPS6535				100	nA	V_{CB}=20V I_E=0

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector Cutoff Current	I_{CBO}					
MPS6530, MPS6531				2	µA	V_{CB}=40V I_E=0 T_A=60°C
MPS6532				5	µA	V_{CB}=30V I_E=0 T_A=60°C
MPS6533, MPS6534				2	µA	V_{CB}=30V I_E=0 T_A=60°C
MPS6535				5	µA	V_{CB}=20V I_E=0 T_A=60°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*					I_C=100mA I_B=10mA
MPS6530, MPS6532				0.5	V	
MPS6531				0.3	V	
MPS6533, MPS6535				0.5	V	
MPS6534				0.3	V	
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*					I_C=100mA I_B=10mA
MPS6530, MPS6531				1.0	V	
MPS6532				1.2	V	
MPS6533, MPS6534				1.0	V	
MPS6535				1.2	V	
D.C. Current Gain MPS6530, MPS6533	H_{FE} *	30				I_C=10mA V_{CE}=1V
		40		120		I_C=100mA V_{CE}=1V
		25				I_C=500mA V_{CE}=10V
D.C. Current Gain MPS6531, MPS6534	H_{FE} *	60				I_C=10mA V_{CE}=1V
		90		270		I_C=100mA V_{CE}=1V
		50				I_C=500mA V_{CE}=10V
D.C. Current Gain MPS6532, MPS6535	H_{FE} *	30				I_C=100mA V_{CE}=1V
Collector-Base Capacitance	Cob					V_{CB}=10V I_E=0 f=100kHz
MPS6530, 1, 2			3.8	5	pF	
MPS6533, 4, 5			4.8	6	pF	
Current Gain-Bandwidth Product	f_T		250		MHz	I_C=50mA V_{CE}=10V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





MPS6560 MPS6561 MPS6562 MPS6563

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

THE MPS6560, MPS6561 (NPN) AND MPS6562, MPS6563 (PNP) ARE SILICON PLANAR EPITAXIAL TRANSISTORS DESIGNED FOR COMPLEMENTARY SYMMETRY AUDIO OUTPUT APPLICATIONS. THEY FEATURE LOW COLLECTOR TO EMITTER SATURATION VOLTAGE (0.23V TYPICAL @ I_C=500mA).

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

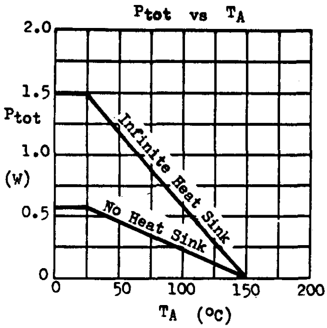
		MPS6560(NPN) MPS6562(PNP)	MPS6561(NPN) MPS6563(PNP)
Collector-Base Voltage	V_{CBO}	25V	20V
Collector-Emitter Voltage	V_{CEO}	25V	20V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	0.6A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1.5W	
($T_A \leq 25^oC$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

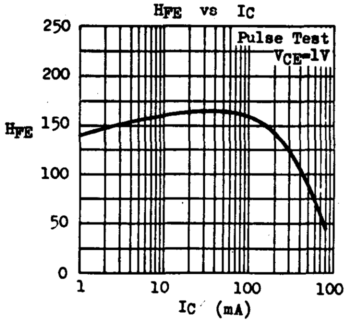
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

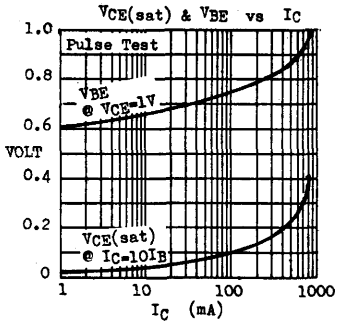
PARAMETER	SYMBOL	MPS6560(NPN) MPS6562(PNP) MIN	MAX	MPS6561(NPN) MPS6563(PNP) MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	25		20		V	I_C=0.1mA I_E=0
Collector Cutoff Current	I_{CBO}		100		100	nA	V_{CB}=20V I_E=0
Collector Cutoff Current	I_{CEO}		100		100	nA	V_{CE}=V_{CEO} I_B=0
Emitter Cutoff Current	I_{EBO}		100		100	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.5			V	I_C=500mA I_B=50mA
					0.5	V	I_C=350mA I_B=35mA
Base-Emitter Voltage	V_{BE} *		1.2			V	I_C=500mA V_{CE}=1V
					1.2	V	I_C=350mA V_{CE}=1V
D.C. Current Gain	H_{FE} *	35		35			I_C=10mA V_{CE}=1V
		50		50			I_C=100mA V_{CE}=1V
		50	200				I_C=500mA V_{CE}=1V
				50	200		I_C=350mA V_{CE}=1V
Current Gain-Bandwidth Product	f_T	60		60		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		30		30	pF	V_{CB}=10V I_E=0 f=100kHz

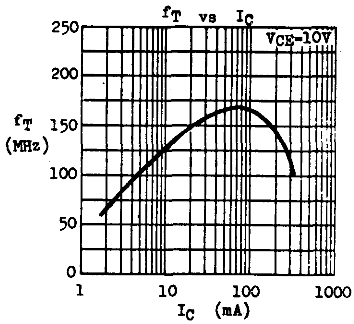
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS
(T_A=25°C unless otherwise noted)





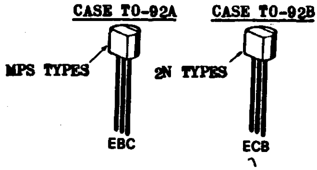




MPS6565 and similar types

NPN SILICON AF SMALL SIGNAL TRANSISTORS

THE ABOVE TYPES ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIERS AND DIRECT COUPLED CIRCUITS. THEIR MAXIMUM POWER DISSIPATION = 360mW AT $T_A \leq 25°C$.

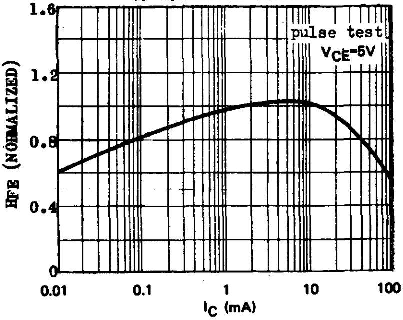


DEVICE SPECIFICATIONS (T_A=25°C)

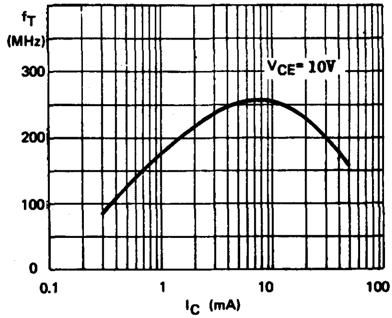
DEVICE TYPE	LVCEO (V)	BVEBO (V)	ICBO ● VCB (nA) (V)	HFE ● IC/VCE (mA)(V)	VCE(sat) ● IC/IB (V) (mA)(mA)	NOTE
	min	min	max	min-max	max	
MPS/2N2711	18	5	500 ● 18	30-90 ● 2/4.5		Cob< 4pF ● VCB=10V
MPS/2N2712	18	5	500 ● 18	75-225 ● 2/4.5		Cob<12pF ● VCB=10V
MPS/2N2716	18	5	500 ● 18	75-225 ● 2/4.5		Cob< 5pF ● VCB=10V
MPS/2N2923 MPS/2N2924 MPS/2N2925	25	5	500 ● 25	90-180*● 2/10 150-300*● 2/10 235-470*● 2/10		* hfe ● 1KHz
MPS/2N3390 MPS/2N3391 MPS/2N3392 MPS/2N3393 MPS/2N3394 MPS/2N3395 MPS/2N3396 MPS/2N3397 MPS/2N3398	25	5	100 ● 18	400-800 ● 2/4.5 250-500 ● 2/4.5 150-300 ● 2/4.5 90-180 ● 2/4.5 55-110 ● 2/4.5 150-500 ● 2/4.5 90-500 ● 2/4.5 55-500 ● 2/4.5 55-800 ● 2/4.5		
MPS/2N3707 MPS/2N3708 MPS/2N3709 MPS/2N3710 MPS/2N3711	30	6	100 ● 20	100-400 ● 0.1/5 45-660 ● 1/5 45-165 ● 1/5 90-330 ● 1/5 180-660 ● 1/5	1.0 ● 10/0.5	For MPS/2N3707 only NF< 5dB ● IC=0.1mA VCE=5V RG=10KΩ f=30-15K Hz
MPS/2N5172	25	5	100 ● 25	100-500 ● 10/10	0.25 ● 10/1	
MPS 6512 MPS 6513	30	4	50 ● 30	50-100 ● 2/10 30- ● 100/10 90-180 ● 2/10 60- ● 100/10	0.5 ● 50/5	Cob< 3.5pF ● VCB=10V
MPS 6565 MPS 6566	45	4	100 ● 30	40-160 ● 10/10 100-400 ● 10/10	0.4 ● 10/1	Cob< 3.5pF ● VCB=10V fT>200MHz ● IC=10mA VCE=10V
MPS 6573	35	4	100 ● 35	100- ● 0.1/5 200-500 ● 10/5	0.5 ● 10/1	* HFE GROUPINGS :
MPS 6574	35	4	100 ● 35	100-300*● 1/5	0.5 ● 10/1	Y = 100-150
MPS 6575	45	4	100 ● 45	100- ● 0.1/5 200-500 ● 10/5	0.5 ● 10/1	B = 125-185 G = 150-225
MPS 6576	45	4	100 ● 45	100-300*● 1/5	0.5 ● 10/1	S = 200-300

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

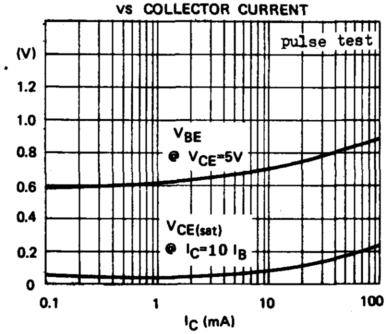
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



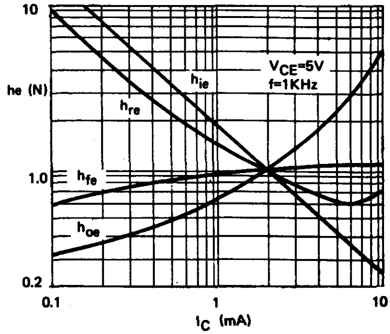
CURRENT GAIN – BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



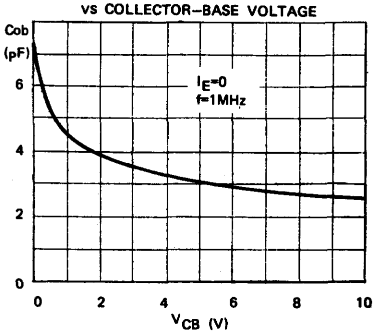
V_{BE} AND $V_{CE(sat)}$
vs COLLECTOR CURRENT



h–PARAMETERS (NORMALIZED)
vs COLLECTOR CURRENT *



COLLECTOR–BASE CAPACITANCE
vs COLLECTOR–BASE VOLTAGE



*Typical values at I_C=2mA V_{CE}=5V		
H_{FE}(D.C.)	300	500
h_{ie}(1KHz)	4.5Kohms	8.7Kohms
h_{fe}(1KHz)	330	600
h_{re}(1KHz)	$2x10^{-4}$	$3x10^{-4}$
h_{oe}(1KHz)	30μmhos	60μmhos

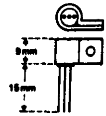
MPS8000

NPN RF MEDIUM POWER AMPLIFIER & DRIVER

THE MPS8000 IS AN NPN SILICON PLANAR EPITAXIAL TRANSISTOR DESIGNED FOR RF DRIVER AND LOW POWER OUTPUT STAGE IN CB EQUIPMENT OPERATING TO 30MHz.

CASE TO-92A

X-67 HEAT SINK



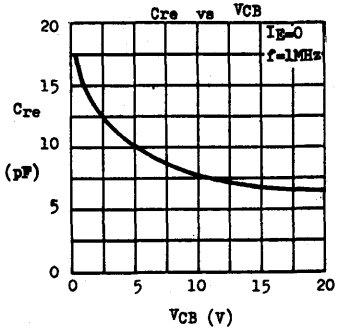
ABSOLUTE MAXIMUM RATINGS

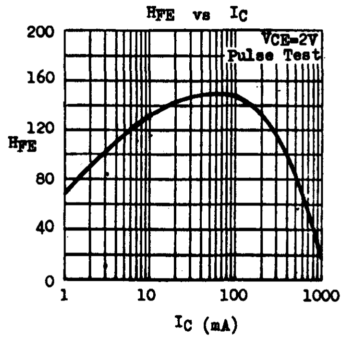
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	60V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	30V
Emitter-Base Voltage	V_{EBO}	3V
Collector Current	I_C	0.5A
Collector Peak Current	I_{CM}	1A
Total Power Dissipation @ $T_C \leq 25°C$	P_{tot}	1.5W
With X-67 Heat Sink @ $T_A \leq 25°C$		800mW
No Heat Sink @ $T_A \leq 25°C$		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

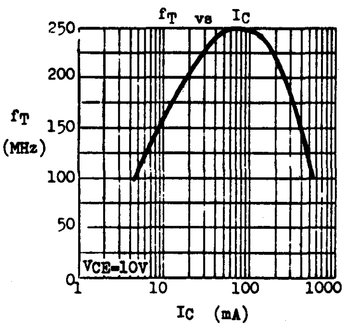
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

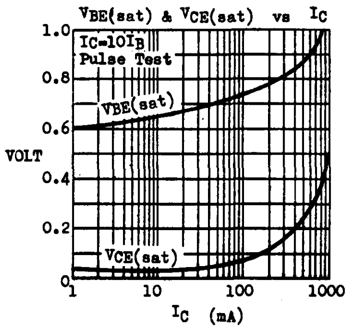
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CES}	60			V	I_C=50mA (Pulsed) V_{BE}=0
Emitter-Base Breakdown Voltage	BV_{EBO}	3	6		V	I_E=1mA I_C=0
Collector Cutoff Current	I_{CBO}			10	µA	V_{CB}=50V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.07	0.3	V	I_C=100mA I_B=10mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$		0.72		V	I_C=100mA I_B=10mA
D.C. Current Gain	H_{FE}	30	150			I_C=100mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	150	240		MHz	I_C=50mA V_{CE}=10V
Power Output	P_{out}	350			mW	Vcc=13.6V f=27MHz P_{in}=21.8mW

TYPICAL CHARACTERISTICS AT T_A=25°C

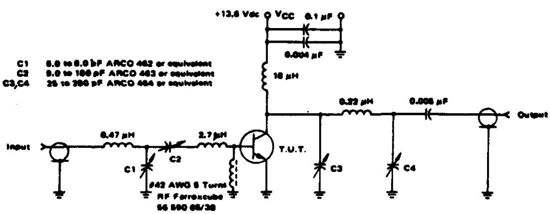








27 MHz TEST CIRCUIT



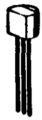
EC TEST 3 NO. 1B
2.78.8300

MPS-A05 MPS-A06 MPS-A55 MPS-A56

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

THE MPS-A05, MPS-A06, MPS-A55, MPS-A56 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF DRIVERS AND OUTPUTS, AS WELL AS FOR UNIVERSAL APPLICATIONS. THE MPS-A05, MPS-A06 ARE NPN AND ARE COMPLEMENTARY TO THE PNP MPS-A55 AND MPS-A56 RESPECTIVELY.

CASE TO-92A



EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

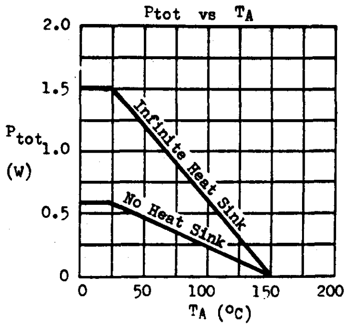
		MPS-A05(NPN) MPS-A55(PNP)	MPS-A06(NPN) MPS-A56(PNP)
Collector-Base Voltage	V_{CBO}	60V	80V
Collector-Emitter Voltage	V_{CEO}	60V	80V
Emitter-Base Voltage	V_{EBO}	4V	
Collector Current	I_C	0.5A	
Collector Peak Current ($t \leq 10mS$)	I_{CM}	1.5A	
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	1.5W	
($T_A \leq 25°C$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

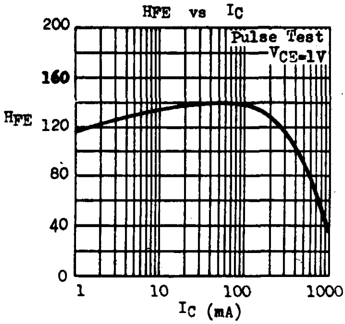
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

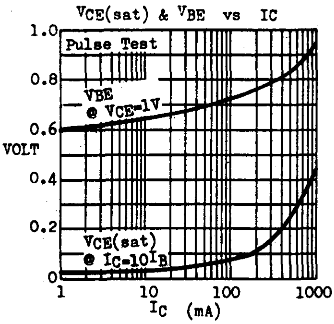
PARAMETER	SYMBOL	MPS-A05(NPN) MPS-A55(PNP) MIN	MAX	MPS-A06(NPN) MPS-A56(PNP) MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60		80		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	4		4		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		100		100	nA	V_{CB}=V_{CBO} I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.25		0.25	V	I_C=100mA I_B=10mA
Base-Emitter Saturation Voltage	V_{BE} *		1.2		1.2	V	I_C=100mA V_{CE}=1V
D.C. Current Gain	H_{FE} *	50		50			I_C=10mA V_{CE}=1V
		50		50			I_C=100mA V_{CE}=1V
Current Gain-Bandwidth Product	f_T						
MPS-A05, 06 only		50		50		MHz	I_C=100mA V_{CE}=1V
MPS-A55, 56 only		100		100		MHz	I_C=100mA V_{CE}=2V
Collector-Base Capacitance	Cob		20		20	pF	V_{CB}=10V I_E=0 f=1MHz

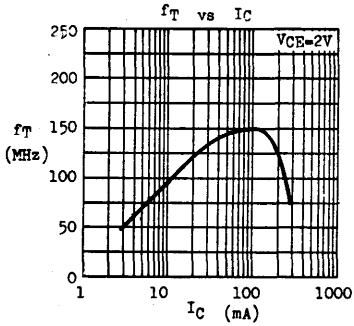
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS
(T_A=25°C unless otherwise noted)









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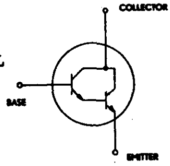
MPS-A13 MPS-A14 MPS-A65 MPS-A66

NPN PNP SILICON DARLINGTON AF MEDIUM POWER TRANSISTORS

THE MPS-A13, MPS-A14 (NPN) AND MPS-A65, MPS-A66 (PNP) ARE SILICON PLANAR EPITAXIAL DARLINGTON TRANSISTORS FOR AF AMPLIFIERS REQUIRING HIGH INPUT IMPEDANCE.



CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

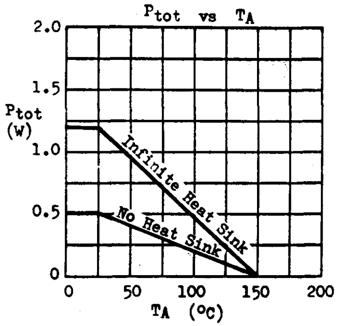
		MPS-A13(NPN) MPS-A14(NPN)	MPS-A65(PNP) MPS-A66(PNP)
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	30V	30V
Emitter-Base Voltage	V_{EBO}	10V	8V
Collector Current	I_C	0.3A	
Total Power Dissipation ($T_C \leqslant 25^oC$)	P_{tot}	1.2W	
($T_A \leqslant 25^oC$)		0.5W	
Operating Junction & Storage Temperature	T_j. T_{stg}	-55 to 150°C	

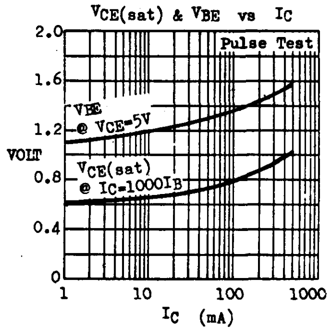
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

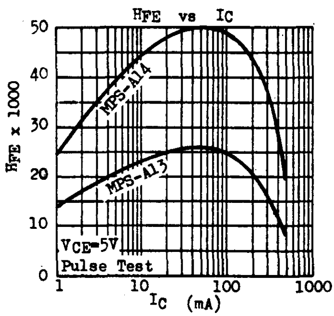
PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage		BV_{CES}	30			V	I_C=0.1mA I_B=0
Collector Cutoff Current		I_{CBO}			100	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current		I_{EBO}			100	nA	V_{EB}=V_{EBO} I_C=0
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$*		0.75	1.5	V	I_C=100mA I_B=0.1mA
Base-Emitter Voltage		V_{BE} *		1.35	2.0	V	I_C=100mA V_{CE}=5V
D.C. Current Gain	MPS-A13	H_{FE} *	5			x10^3	I_C=10mA V_{CE}=5V
	MPS-A14		10			x10^3	
	MPS-A65		50			x10^3	
	MPS-A66		75			x10^3	
D.C. Current Gain	MPS-A13	H_{FE} *	10			x10^3	I_C=100mA V_{CE}=5V
	MPS-A14		20			x10^3	
	MPS-A65		20			x10^3	
	MPS-A66		40			x10^3	
Current Gain-Bandwidth Product		f_T					I_C=10mA V_{CE}=5V
	MPS-A13, 14		125			MHz	
	MPS-A65, 66		100			MHz	
Collector-Base Capacitance		Cob					V_{CB}=10V I_E=0
	MPS-A13, 14			3		pF	f=100kHz
	MPS-A65, 66			4		pF	
Noise Figure (f=1kHz R_G=100KΩ)		NF		2		dB	I_C=1mA V_{CE}=5V

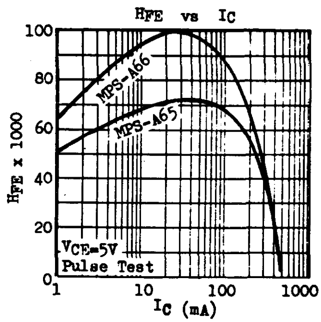
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS
(T_A=25°C unless otherwise noted)







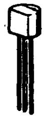


MPS-A20 MPS-A70

COMPLEMENTARY SILICON AF SMALL SIGNAL TRANSISTORS

THE MPS-A20 (NPN) AND MPS-A70 (PNP) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL APPLICATIONS. THEY ARE SUPPLIED IN SELECTED H_{FE} GROUPS.

CASE TO-92A



EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

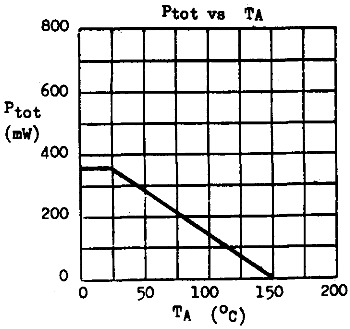
		MPS-A20 (NPN) MPS-A70 (PNP)
Collector-Base Voltage	V_{CBO}	45V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	100mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	350mW derate 2.8mW/°C above 25°C
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

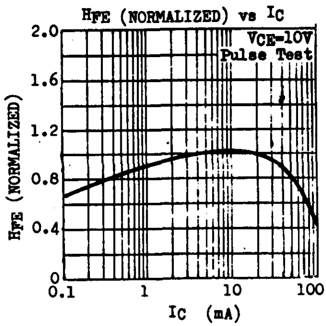
ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

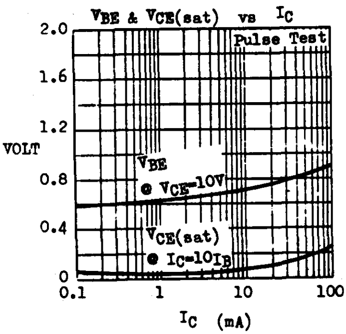
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	45			V	$I_C=0.1mA$ $I_E=0$
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			V	$I_C=1mA$ $I_B=0$
Emitter-Base Breakdown Voltage	BV_{EBO}	4			V	$I_E=0.1mA$ $I_C=0$
Collector Cutoff Current	I_{CBO}			100	nA	$V_{CB}=30V$ $I_E=0$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.08 0.25	0.25	V V	$I_C=10mA$ $I_B=1mA$ $I_C=100mA$ $I_B=10mA$
Base-Emitter Voltage	V_{BE} *		0.67		V	$I_C=5mA$ $V_{CE}=10V$
D.C. Current Gain	H_{FE} *	40		400		$I_C=5mA$ $V_{CE}=10V$
GROUP R		40	70	100		
GROUP W		80	140	200		
GROUP B		120	200	300		
GROUP Y		150	270	400		
Current Gain-Bandwidth Product	f_T	125	200		MHz	$I_C=5mA$ $V_{CE}=10V$
Collector-Base Capacitance	Cob		2.7	4	pF	$V_{CB}=10V$ $I_E=0$ f=1MHz
Noise Figure	NF		2		dB	$I_C=0.1mA$ $V_{CE}=10V$ $R_G=10K\Omega$ f=30Hz-15KHz

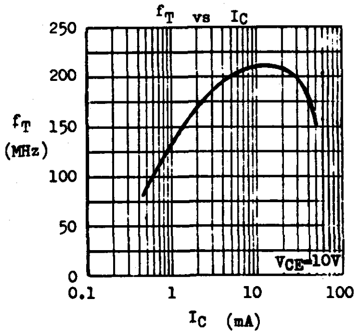
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)









MPS-A42 MPS-A43

NPN SILICON GENERAL PURPOSE HIGH VOLTAGE TRANSISTORS

THE MPS-A42, MPS-A43 ARE NPN SILICON PLANAR TRANSISTORS FOR GENERAL PURPOSE HIGH VOLTAGE APPLICATIONS SUCH AS TV VIDEO OUTPUT STAGE AND GAS DISCHARGE TUBE DRIVER.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS

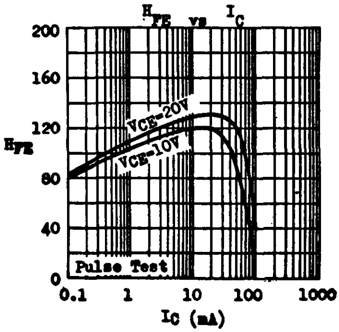
		MPS-A42	MPS-A43
Collector-Base Voltage	V_{CBO}	300V	200V
Collector-Emitter Voltage	V_{CEO}	300V	200V
Emitter-Base Voltage	V_{EBO}	6V	6V
Collector Current	I_C	100mA	
Collector Peak Current (t ≤10mS)	I_{CM}	500mA	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1.5W	
($T_A \leq 25^oC$)		625mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

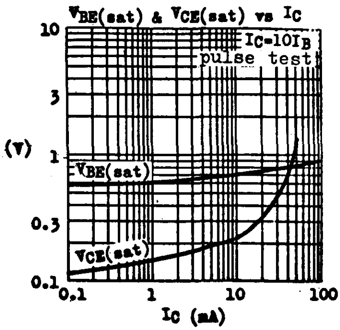
ELECTRICAL CHARACTERISTICS (T_A=25°C)

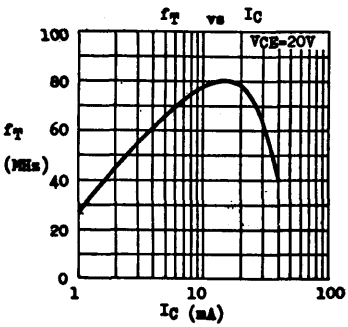
PARAMETER	SYMBOL	MPS-A42 MIN	MPS-A42 MAX	MPS-A43 MIN	MPS-A43 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	300		200		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown	LV_{CEO}	300		200		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		6		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		0.1			µA	V_{CB}=200V I_E=0
					0.1	µA	V_{CB}=160V I_E=0
Emitter Cutoff Current	I_{EBO}		0.1			µA	V_{EB}=6V I_C=0
					0.1	µA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.5		0.4	V	I_C=20mA I_B=2mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$		0.9		0.9	V	I_C=20mA I_B=2mA
D.C. Current Gain	H_{FE}	25		25			I_C=1mA V_{CE}=10V
		40		40			I_C=10mA V_{CE}=10V
		40		50	200		I_C=30mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	50		50		MHz	I_C=10mA V_{CE}=20V
Collector-Base Capacitance	C_{cb}		3		4	pF	V_{CB}=20V I_E=0 f=1MHz

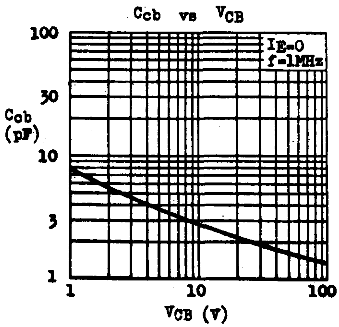
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









MPS-D01

NPN SILICON GENERAL PURPOSE HIGH VOLTAGE TRANSISTOR

THE MPS-D01 IS NPN SILICON PLANAR TRANSISTOR FOR GENERAL PURPOSE HIGH VOLTAGE AMPLIFIERS AND GAS DISCHARGE DISPLAY DRIVING APPLICATIONS. IT FEATURES 200V MIN COLLECTOR-EMITTER BREAK-DOWN VOLTAGE.

CASE TO-92A

ABSOLUTE MAXIMUM RATINGS

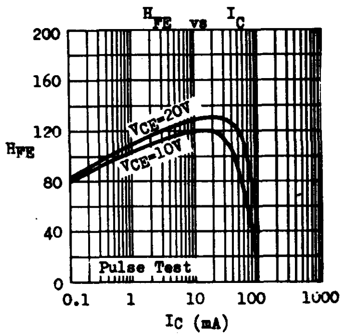
Collector-Base Voltage	V_{CBO}	200V
Collector-Emitter Voltage	V_{CEO}	200V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	100mA
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}	500mA
Total Power Dissipation ($T_C \leqslant 25^oC$)	P_{tot}	1.5W
($T_A \leqslant 25^oC$)		625mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to +150°C

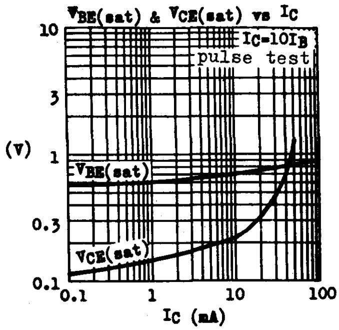
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

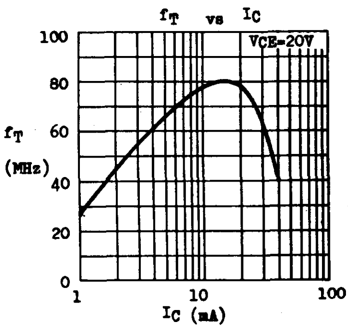
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	200			V	I_C=10μA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	200			V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	4			V	I_E=10μA I_C=0
Collector Cutoff Current	I_{CBO}			0.1	μA	V_{CB}=80V I_E=0
				4	μA	V_{CB}=80V I_E=0 T_A=75°C
Collector Cutoff Current	I_{CES}			0.1	μA	V_{CE}=80V V_{BE}=0
				4	μA	V_{CE}=80V V_{BE}=0 T_A=75°C
D.C. Current Gain	H_{FE}	25				I_C=10mA V_{CE}=10V
		20				I_C=30mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	40	80		MHz	I_C=10mA V_{CE}=20V
Collector-Base Capacitance	Cob		3		pF	V_{CB}=30V I_E=0 f=1MHz

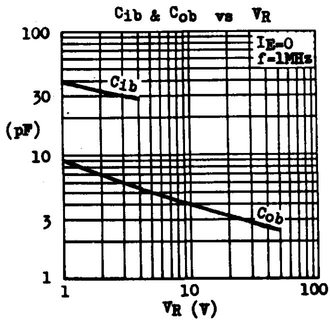
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









MPS-D05 MPS-D55

COMPLEMENTARY

SILICON GENERAL PURPOSE AMPLIFIERS & SWITCHES

THE MPS-D05 (NPN) AND MPS-D55 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AF AMPLIFIERS AND DRIVERS FOR LED DISPLAY.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

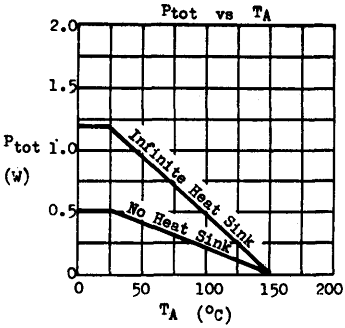
Collector-Base Voltage	V_{CBO}	25V
Collector-Emitter Voltage	V_{CEO}	25V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	0.5A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1.2W
($T_A \leq 25^oC$)		500mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

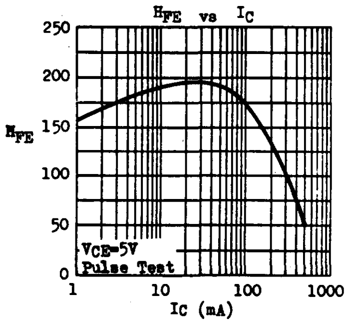
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

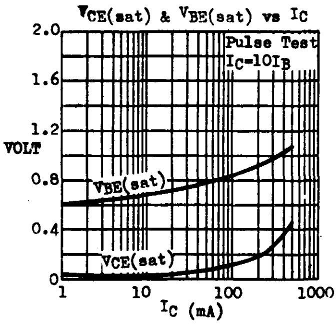
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	25			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	25			V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}			1	µA	V_{CB}=20V I_E=0
Collector Cutoff Current	I_{CES}			1	µA	V_{CE}=20V V_{BE}=0
Emitter Cutoff Current	I_{EBO}			0.1	µA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.1	0.5	V	I_C=100mA I_B=10mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		0.85		V	I_C=100mA I_B=10mA
D.C. Current Gain	H_{FE} *	50				I_C=50mA V_{CE}=5V
		80	170			I_C=100mA V_{CE}=5V
		30				I_C=500mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T	100	200		MHz	I_C=50mA V_{CE}=10V

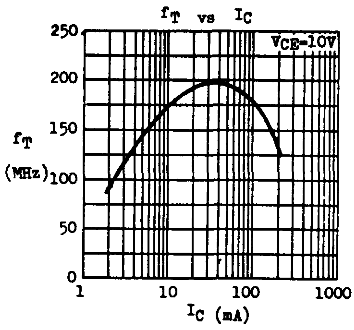
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS
(T_A=25°C unless otherwise noted)









MPS-L01

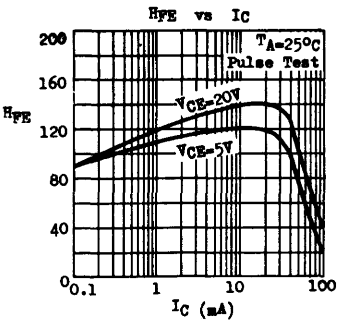
NPN SILICON GENERAL PURPOSE HIGH VOLTAGE TRANSISTORS

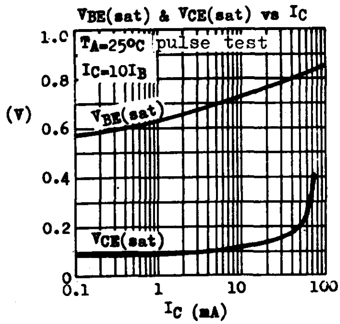
THE MPS-L01 IS NPN SILICON PLANAR EPITAXIAL TRANSISTOR FOR GENERAL PURPOSE HIGH VOLTAGE AMPLIFIERS AND GAS DISCHARGE DISPLAY DRIVING APPLICATIONS. IT FEATURES LOW COLLECTOR-EMITTER SATURATION VOLTAGE AND HIGH FREQUENCY RESPONSE.

CASE TO-92A

ABSOLUTE MAXIMUM RATING

Collector-Base Voltage	V_{CBO}	140V *
Collector-Emitter Voltage	V_{CEO}	120V *
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	100mA
Collector Peak Current ($t \leq 10mS$)	I_{CM}	500mA
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	1.2W
@ $T_A \leq 25^oC$		500mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to +150°C



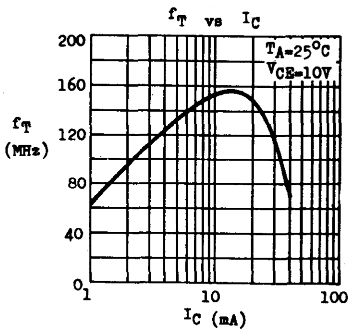


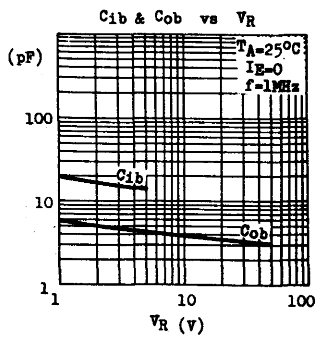
ELECTRICAL CHARACTERISTICS (TA=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO} *	140			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	120			V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_C=10μA I_C=0
Collector Cutoff Current	I_{CBO}			1	μA	V_{CB}=75V I_E=0
Collector Cutoff Current	I_{CER}			10	μA	V_{CE}=100V R_{BE}=1kΩ
Emitter Cutoff Current	I_{EBO}			0.1	μA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$			0.2 0.3	V V	I_C=10mA I_B=1mA I_C=50mA I_B=5mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$			1.2 1.4	V V	I_C=10mA I_B=1mA I_C=50mA I_B=5mA
D.C. Current Gain	H_{FE}	50		300		I_C=10mA V_{CE}=5V
Current Gain Bandwidth Product	f_T	60	150		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		4	8	pF	V_{CB}=10V I_E=0 f=1MHz
Small Signal Current Gain	h_{fe}	30				I_C=1mA V_{CE}=10V f=1kHz

* Special classification of breakdown voltage is available as follows.

ORDER PART NO.	BV_{CBO} (min)	LV_{CEO} (min)
MPS-L01	140V	120V
MPS-L01A	140V	140V
MPS-L01B	170V	170V





MSB492

PNP SILICON PLANAR EPITAXIAL MEDIUM POWER TRANSISTOR

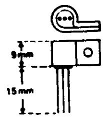
THE MSB492 IS PNP SILICON PLANAR EPITAXIAL TRANSISTOR INTENDED TO REPLACE THE GERMANIUM TYPE 2SB492. IT FEATURES HIGH CURRENT CAPACITY AND IS SUITABLE FOR STROBO FLASH AND AUDIO POWER AMPLIFIER APPLICATIONS.

THE MSB492 IS PACKED IN TO-92A PLASTIC CASE WITH OPTIONAL X-67 HEAT SINK.

TO–92A CASE

EBC

WITH X–67 HEAT SINK



ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	$-V_{CBO}$	25V
Collector-Emitter Voltage (R_{BE}=100Ω)	$-V_{CER}$	25V
Emitter-Base Voltage	$-V_{EBO}$	6V
Collector Current	$-I_C$	2A
Collector Peak Current (t ≤10mS)	$-I_{CM}$	4A
Total Power Dissipation @ $T_C \leq 25^oC$	Ptot	1.5W
With X-67 Heat Sink, $T_A \leq 25^oC$		800mW
No Heat Sink, $T_A \leq 25^oC$		625mW
Operating Junction & Storage Temperature	Tj & Tstg	-55 to +150°C

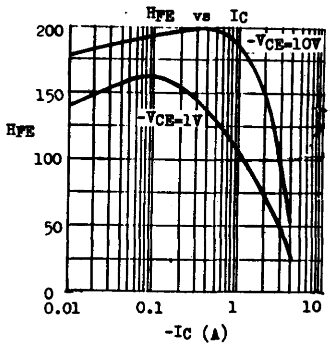
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

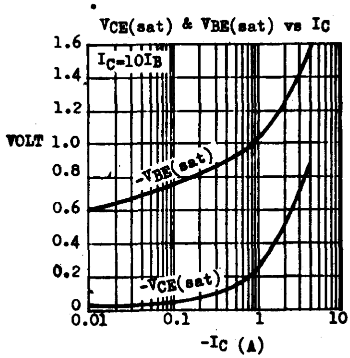
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector Cutoff Current	$-I_{CEO}$			10	μA	$-V_{CE}$=15V I_B=0
Emitter Cutoff Current	$-I_{EBO}$			10	μA	$-V_{EB}$=6V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE}(sat)$*		0.25	0.5	V	$-I_C$=1A $-I_B$=0.1A
Base-Emitter Saturation Voltage	$-V_{BE}(sat)$*		1	1.3	V	$-I_C$=1A $-I_B$=0.1A
D.C. Current Gain (note)	H_{FE} 1 *	80	160	360		$-I_C$=0.2A $-V_{CE}$=1V
	H_{FE} 2 *	40	75			$-I_C$=2A $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T		100		MHz	$-I_C$=0.1A $-V_{CE}$=4V
Collector-Base Capacitance	Cob		28		pF	$-V_{CB}$=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

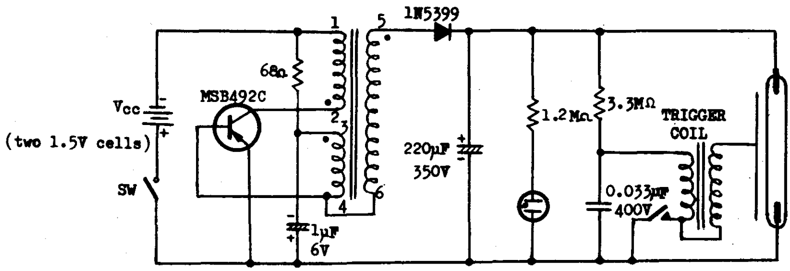
note : H_{FE} 1 is classified as follws. Group B : 80-160 Group C : 120-240
Group D : 180-360

TYPICAL CHARACTERISTICS (T_A=25°C, Pulse Test)





TYPICAL APPLICATION : STROBO FLASH UNIT



Coil D.C. Resistance	1-2	:	0.15 ohm
	3-4	:	0.25 ohm
	5-6	:	190 ohm
Coil Turn Ratio	1-2	:	1.5
	3-4	:	1.0
	5-6	:	200
Standby Current	150mA	@	Vcc=3V
	60mA	@	Vcc=2V
Recycling Time	9 Sec. using zinc carbon battery.		

12.77.0810C(L)

RN4918 RN4919 RN4920

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

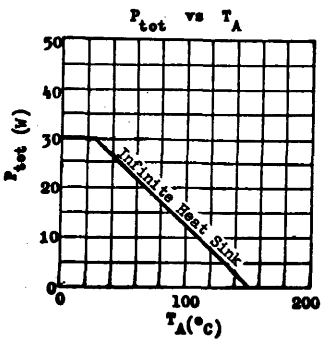
THE RN 4918, RN 4919 AND RN 4920 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE RN 4918, RN 4919 AND RN 4920 ARE COMPLEMENTARY TO RN 4921, RN 4922 AND RN 4923 RESPECTIVELY.

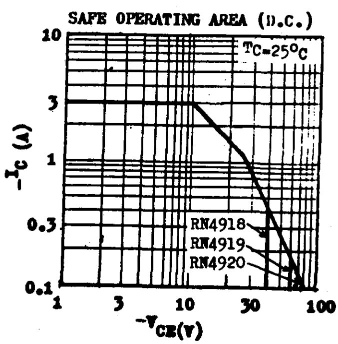
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		RN 4918	RN 4919	RN 4920
Collector-Base Voltage	$-V_{CBO}$	40V	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	40V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		3A	
Base Current	$-I_B$		1A	
Total Power Dissipation @ $T_C \leq 25^{\circ}C$	P_{tot}		30W	
Operating and Storage Junction Temperature Range	T_j, T_{stg}		-55 to +150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	4.17°C/W	max.

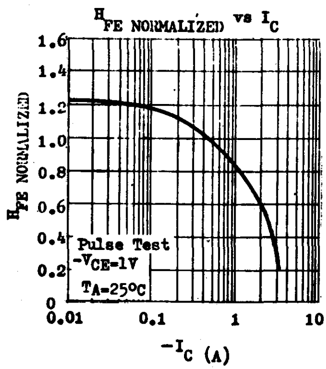


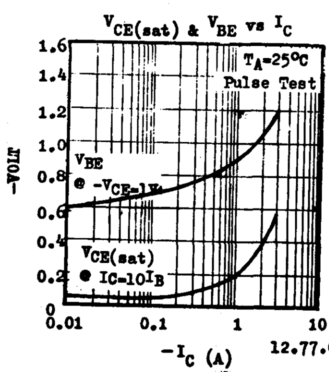


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *				$-I_C$=0.1A I_B=0
RN4918		40		V	
RN4919		60		V	
RN4920		80		V	
Collector Cutoff Current	$-I_{CBO}$		0.1	mA	V_{CB}=Rated V_{CBO} I_E=0
Collector Cutoff Current RN4918	$-I_{CEO}$		0.5	mA	$-V_{CE}$=20V I_B=0
RN4919			0.5	mA	$-V_{CE}$=30V I_B=0
RN4920			0.5	mA	$-V_{CE}$=40V I_B=0
Collector Cutoff Current	$-I_{CEV}$		0.1	mA	V_{CE}=Rated V_{CEO} $-V_{EB}$=1.5V
			0.5	mA	V_{CE}=Rated V_{CEO} $-V_{EB}$=1.5V T_C=125°C
Emitter Cutoff Current	$-I_{EBO}$		1	mA	$-V_{EB}$=5V I_C=0
Base-Emitter voltage	$-V_{BE}$ *		1.3	V	$-I_C$=1A $-V_{CE}$=1V
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$*		1.3	V	$-I_C$=1A $-I_B$=0.1A
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*		0.6	V	$-I_C$=1A $-I_B$=0.1A
D.C. Current Gain	H_{FE} *	40			$-I_C$=50mA $-V_{CE}$=1V
		20	100		$-I_C$=500mA $-V_{CE}$=1V
		10			$-I_C$=1A $-V_{CE}$=1V
Current Gain-Bandwidth Product	f_T	3		MHz	$-I_C$=250mA $-V_{CE}$=10V
Collector-Base Capacitance	Cob		100	pF	$-V_{CB}$=10V I_E=0 f= 1MHz
Small Signal Current Gain	h_{fe}	25			$-I_C$=250mA $-V_{CE}$=10V f=1kHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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RN4921 RN4922 RN4923

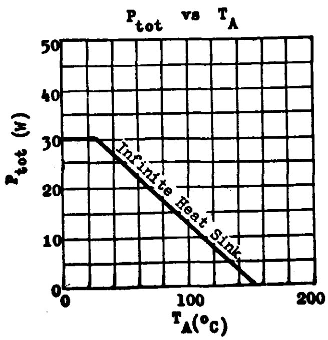
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

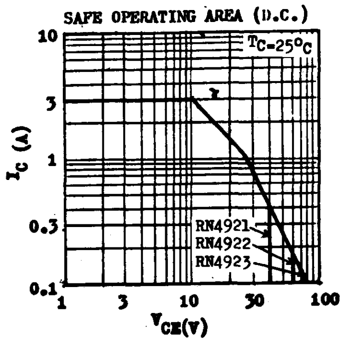
THE RN 4921, RN 4922 AND RN 4923 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE RN 4921, RN 4922 AND RN 4923 ARE COMPLEMENTARY TO RN 4918, RN 4919 AND RN 4920 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		RN 4921	RN 4922	RN 4923
Collector-Base Voltage	V_{CBO}	40V	60V	80V
Collector-Emitter Voltage	V_{CEO}	40V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		3A	
Base Current	I_B		1A	
Total Power Dissipation @ T_C<25°C	Ptot		30W	
Operating and Storage Junction Temperature Range	T_j, T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	4.17 °C/W	max.



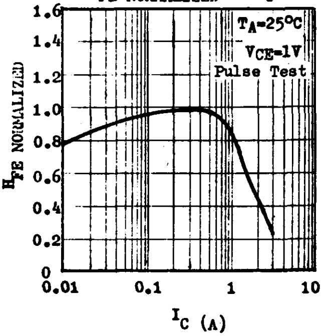


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

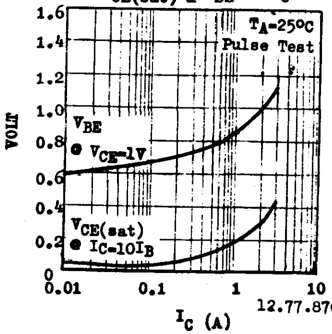
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *				I_C=0.1A I_B=0
RN 4921		40		V	
RN 4922		60		V	
RN 4923		80		V	
Collector Cutoff Current	I_{CBO}		0.1	mA	V_{CB}=Rated V_{CBO} I_E=0
Collector Cutoff Current RN 4921	I_{CEO}		0.5	mA	V_{CE}=20V I_B=0
RN 4922			0.5	mA	V_{CE}=30V I_B=0
RN 4923			0.5	mA	V_{CE}=40V I_B=0
Collector Cutoff Current	I_{CEV}		0.1	mA	V_{CE}=Rated V_{CEO} V_{EB}=1.5V
			0.5	mA	V_{CE}=Rated V_{CEO} V_{EB}=1.5V T_C=125°C
Emitter Cutoff Current	I_{EBO}		1	mA	V_{EB}=5V I_C=0
Base-Emitter voltage	V_{BE} *		1.3	V	I_C=1A V_{CE}=1V
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.3	V	I_C=1A I_B=0.1A
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.6	V	I_C=1A I_B=0.1A
D.C. Current Gain	H_{FE} *	40			I_C=50mA V_{CE}=1V
		20	100		I_C=500mA V_{CE}=1V
		10			I_C=1A V_{CE}=1V
Current Gain-Bandwidth Product	f_T	3		MHz	I_C=250mA V_{CE}=10V
Collector-Base Capacitance	Cob		100	pF	V_{CB}=10V I_E=0 f=1MHz
Small Signal Current Gain	hfe	25			I_C=250mA V_{CE}=10V f=1kHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

H_{FE} NORMALIZED vs I_C



$V_{CE(sat)}$ & V_{BE} vs I_C



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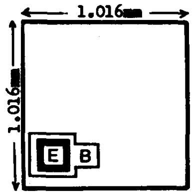
S110

NPN SILICON PLANAR PHOTO TRANSISTOR CHIP

THE S110 IS AN NPN SILICON PLANAR PHOTO TRANSISTOR CHIP DESIGNED FOR APPLICATIONS REQUIRING HIGH RADIATION SENSITIVITY AND STABLE CHARACTERISTICS.

THE REAR SURFACE IS COVERED BY A GOLD LAYER TO ELIMINITE THE NECESSITY FOR PREFORMS IN ASSEMBLY, AND THERMAL COMPRESSION OR ULTRASONIC BONDING TECHNIQUE MAY BE USED UPON THE ALUMINIUM TOP CONTACTS.



CHIP GEOMETRY

PHYSICAL DETAILS

Chip Size : 1.016 ± 0.101mm square (40 ± 0.4mil square)

Chip Thickness : 0.15 ± 0.025mm (6 ± 1mil)

Bonding Pads Area : Emitter : 0.143mm square

Base : 0.143mm square

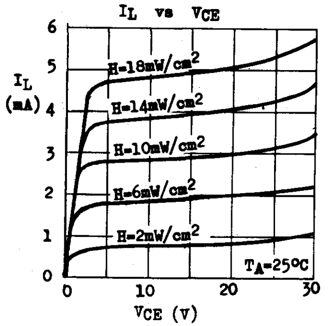
PRINCIPAL DEVICE : FPT 100 series

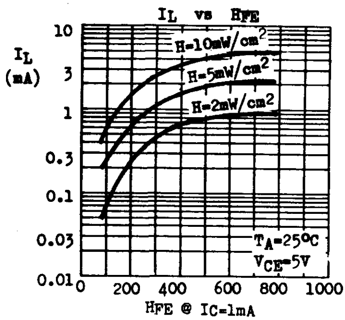
ELECTRICAL CHARACTERISTICS IN DARKNESS AT $T_A=25^oC$

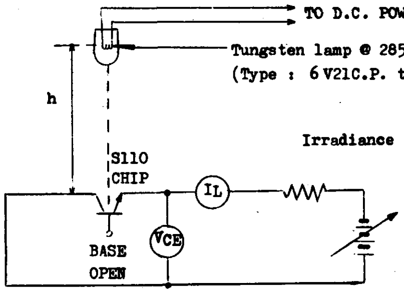
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CEO}	30			V	$I_C=1\mu A$ $I_B=0$
Emitter-Collector Breakdown Voltage	BV_{ECO}	5			V	$I_E=0.1mA$ $I_B=0$
Collector Cutoff Current	I_{CEO}			100	nA	$V_{CE}=15V$ $I_B=0$
D.C. Current Gain	H_{FE} *	150	350	850		$V_{CE}=5V$ $I_C=1mA$

* H_{FE} can be grouped at max/min = 2 : 1 upon request.

LIGHT CURRENT (I_L) CHARACTERISTICS





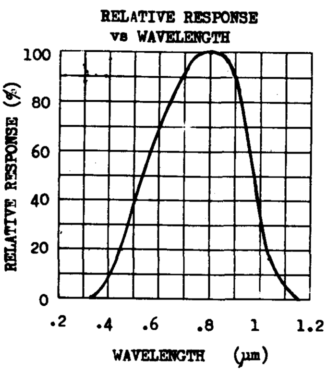


Tungsten lamp @ 2854°K colour temperature
(Type : 6 V21C.P. tungsten lamp)

$$\text{Irradiance (H)} = \frac{\text{Radiated Power from Lamp}}{4\pi h^2}$$

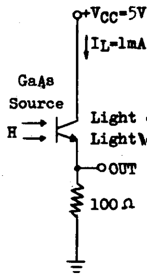
where h is the distance measured from plan of filament to plan of chip.

SPECTRAL CHARACTERISTICS (T_A=25°C)



SWITCHING CHARACTERISTICS (T_A=25°C)

The switching characteristics is measured with the following circuit arrangement.



Light current rise time: 2.8μS typ.
Light current fall time: 2.8μS typ.

2N930 2N3548
COMPLEMENTARY
SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2N930 (NPN) AND 2N3548 (PNP) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIERS AND DIRECT COUPLED CIRCUITS.

CASE TO-18

CBE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		2N930(NPN)	2N3548(PNP)
Collector-Base Voltage	V_{CBO}	45V	60V
Collector-Emitter Voltage	V_{CEO}	45V	45V
Emitter-Base Voltage	V_{EBO}	5V	6V
Collector Current	I_C	100mA **	100mA
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	300mW	400mW
Junction Temperature	T_j	175°C	200°C
Storage Temperature Range	T_{stg}	-65 to 200°C	

** 30mA in JEDEC registration.

ELECTRICA CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N930 MIN	2N930 MAX	2N3548 MIN	2N3548 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}	45		45		V	I_C=10mA (Pulsed) I_B=0
Collector Cutoff Current	I_{CES}		10		10	nA	V_{CE}=45V V_{BE}=0
			10		10	µA	V_{CE}=45V V_{BE}=0 T_A=170°C
Emitter Cutoff Current	I_{EBO}		10		10	nA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1		1	V	I_C=10mA I_B=0.5mA
Base-Emitter Breakdown Voltage	$V_{BE(sat)}$	0.6	1	0.6	1	V	I_C=10mA I_B=0.5mA
D.C. Current Gain	H_{FE}	100	300	100	300		I_C=10µA V_{CE}=5V
				150			I_C=100µA V_{CE}=5V
		150					I_C=500µA V_{CE}=5V
			600		600		I_C=10mA V_{CE}=5V
		20		20			I_C=10µA V_{CE}=5V T_A=-55°C
Current Gain-Bandwidth Product	f_T	30				MHz	I_C=0.5mA V_{CE}=5V
				60	150	MHz	I_C=1mA V_{CE}=5V
Collector-Base Capacitance	Cob		8		8	pF	V_{CB}=5V I_E=0 f=1MHz
Noise Figure	NF		3		4	dB	I_C=10µA V_{CE}=5V R_G=10KΩ f=10Hz-15KHz

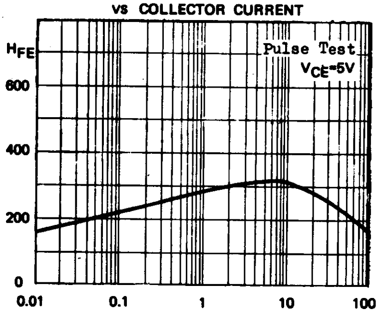
PARAMETER	SYMBOL	2N930 MIN MAX	2N3548 MIN MAX	UNIT	TEST CONDITIONS
Small Signal Current Gain	h_{fe}	150 600			I_C=1mA V_{CE}=5V f=1KHz

COMMON BASE h - PARAMETERS (for 2N930 only)

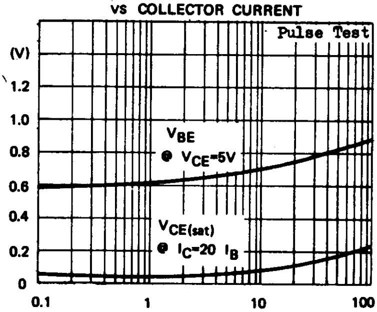
h - PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Input Impedance	h_{ib}	25	32	Ω	I_C=1mA V_{CB}=5V f=1KHz
Output Admittance	h_{ob}		1	μ℧	
Voltage Feedback Ratio	h_{rb}		6	$x10^{-4}$	

TYPICAL CHARACTERISTICS AT T_A=25°C

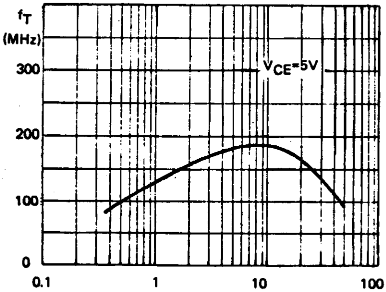
D.C. CURRENT GAIN
VS COLLECTOR CURRENT



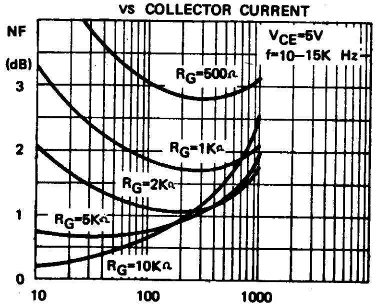
VBE AND VCE(sat)
VS COLLECTOR CURRENT



CURRENT GAIN – BANDWIDTH PRODUCT
VS COLLECTOR CURRENT



BROAD BAND NOISE FIGURE
VS COLLECTOR CURRENT



2N2102 2N4036
COMPLEMENTARY
SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

CASE TO-39

C E B

THE 2N2102(NPN) AND 2N4036(PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS.

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

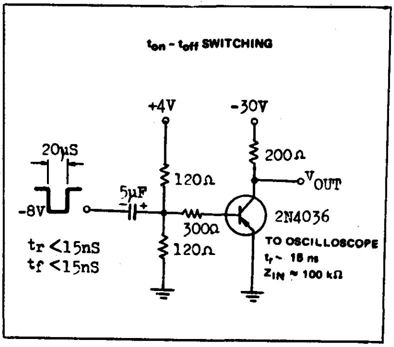
		2N2102(NPN)	2N4036(PNP)
Collector-Base Voltage	V_{CBO}	120V	90V
Collector-Emitter Voltage	V_{CEO}	65V	65V
Emitter-Base Voltage	V_{EBO}	7V	7V
Collector Current	I_C	1A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	7W	
($T_A \leq 25^oC$)		1W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200°C	

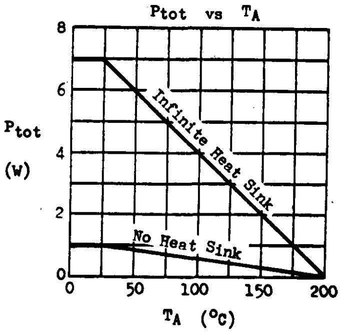
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

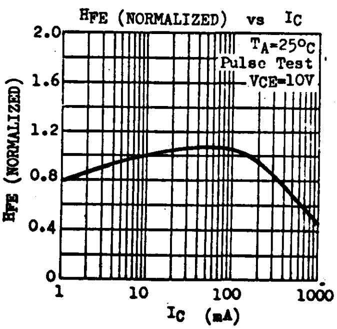
PARAMETER	SYMBOL	2N2102 MIN	2N2102 MAX	2N4036 MIN	2N4036 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	120		90		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CER} *	80				V	I_C=100mA R_{BE}=10Ω
Collector-Emitter Breakdown Voltage	LV_{CEV} *			85		V	I_C=100mA V_{EB}=1.5V
Collector-Emitter Breakdown Voltage	LV_{CEO} *	65		65		V	I_C=100mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	7		7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		2			nA	V_{CB}=60V I_E=0
					100	nA	V_{CB}=90V I_E=0
Collector Cutoff Current	I_{CEV}				100	µA	V_{CE}=30V V_{EB}=1.5V T_A=150°C
Emitter Cutoff Current	I_{EBO}		5		20	nA	V_{EB}=5V I_C=0
D.C. Current Gain	H_{FE} *	10					I_C=0.01mA V_{CE}=10V
		20		20			I_C=0.1mA V_{CE}=10V
		40	120	40	140		I_C=150mA V_{CE}=10V
		25		20			I_C=500mA V_{CE}=10V
		10					I_C=1A V_{CE}=10V
		35					I_C=10mA V_{CE}=10V
				20	200		I_C=150mA V_{CE}=2V

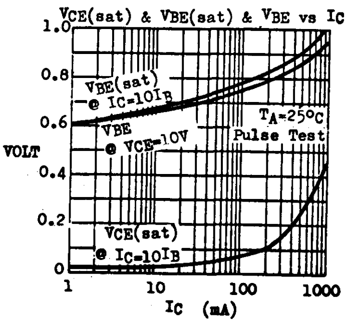
PARAMETER	SYMBOL	2N2102 MIN	2N2102 MAX	2N4036 MIN	2N4036 MAX	UNIT	TEST CONDITIONS
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.5		0.65	V	I_C=150mA I_B=15mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.1		1.4	V	I_C=150mA I_B=15mA
Current Gain-Bandwidth Product	f_T	60		60		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		10		30	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib		80		90	pF	V_{EB}=0.5V I_C=0 f=1MHz
Noise Figure	NF		6			dB	I_C=0.3mA V_{CE}=10V f=1kHz R_G=510Ω
Turn-On Time	ton				110	nS	I_C=150mA I_{B1}=15mA Vcc=30V
Turn-Off Time	toff				700	nS	I_C=150mA I_{B1}=$-I_{B2}$=15mA Vcc=30V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%









2N2222 2N2222A PN2222 PN2222A

NPN SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

THE 2N2222, 2N2222A, PN2222, PN2222A ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS. THEY ARE COMPLEMENTARY TO THE PNP TYPE 2N2907, 2N2907A, PN2907, PN2907A RESPECTIVELY. THE 2N2222, 2N2222A ARE PACKED IN TO-18. THE PN2222, PN2222A ARE PACKED IN TO-92A.

CASE TO-18

CBE

2N2222
2N2222A

CASE TO-92A

EBC

PN2222
PN2222A

ABSOLUTE MAXIMUM RATINGS		2N2222	2N2222A	PN2222	PN2222A
Collector-Base Voltage	V_{CBO}	60V	75V	60V	75V
Collector-Emitter Voltage	V_{CEO}	30V	40V	30V	40V
Emitter-Base Voltage	V_{EBO}	5V	6V	5V	6V
Collector Current	I_C	0.8A	0.8A	0.8A	0.8A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1.8W	1.8W	1.2W	1.2W
($T_A \leq 25^oC$)		500mW	500mW	500mW	500mW
Junction Temperature	T_j	175°C	175°C	150°C	150°C
Storage Temperature Range	T_{stg}	-65 to 200°C		-55 to 150°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

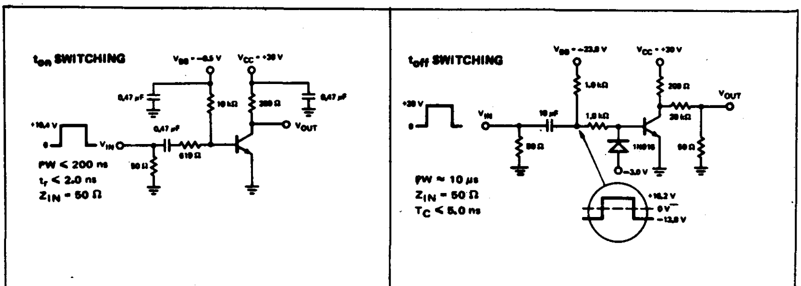
PARAMETER	SYMBOL	2N2222 PN2222 MIN	2N2222 PN2222 MAX	2N2222A PN2222A MIN	2N2222A PN2222A MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60		75		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	30		40		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5		6		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		10			nA	V_{CB}=50V I_E=0
					10	nA	V_{CB}=60V I_E=0
			10			µA	V_{CB}=50V I_E=0 T_A=150°C
					10	µA	V_{CB}=60V I_E=0 T_A=150°C
Collector Cutoff Current	I_{CEV}				10	nA	V_{CE}=60V V_{EB}=3V
Emitter Cutoff Current	I_{EBO}		10		10	nA	V_{EB}=3V I_C=0
Base Cutoff Current	I_{BL}				20	nA	V_{CE}=60V V_{EB}=3V

2N2222 2N2222A PN2222 PN2222A

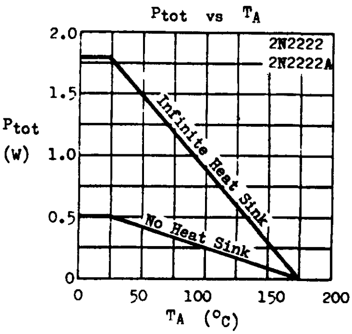
PARAMETER	SYMBOL	2N2222 PN2222 MIN	2N2222 PN2222 MAX	2N2222A PN2222A MIN	2N2222A PN2222A MAX	UNIT	TEST CONDITIONS
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.4		0.3	V	I_C=150mA I_B=15mA
			1.6		1.0	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.3	0.6	1.2	V	I_C=150mA I_B=15mA
			2.6		2.0	V	I_C=500mA I_B=50mA
D.C. Current Gain	H_{FE} *	35		35			I_C=0.1mA V_{CE}=10V
		50		50			I_C=1mA V_{CE}=10V
		75		75			I_C=10mA V_{CE}=10V
		100	300	100	300		I_C=150mA V_{CE}=10V
		30		40			I_C=500mA V_{CE}=10V
		50		50			I_C=150mA V_{CE}=1V
				35			I_C=10mA V_{CE}=10V T_A=-55°C
Current Gain-Bandwidth Product	f_T	250		300		MHz	I_C=20mA V_{CE}=20V
Collector-Base Capacitance	Cob		8		8	pF	V_{CB}=10V I_E=0 f=100kHz
Emitter-Base Capacitance	Cib		25		25	pF	V_{EB}=0.5V I_C=0 f=100kHz
Collector-Base Time Constant	Ccrbb'				150	pS	I_C=20mA V_{CE}=20V f=31.8MHz
Noise Figure	NF				4	dB	I_C=0.1mA V_{CE}=10V f=1kHz RG=1kΩ
Input Impedance	hie			2	8	KΩ	I_C=1mA V_{CE}=10V f=1kHz
				0.25	1.25	KΩ	I_C=10mA V_{CE}=10V f=1kHz
Voltage Feedback Ratio	h_{re}				8	$x10^{-4}$	I_C=1mA V_{CE}=10V f=1kHz
					4	$x10^{-4}$	I_C=10mA V_{CE}=10V f=1kHz
Small Signal Current Gain	hfe			50	300		I_C=1mA V_{CE}=10V f=1kHz
				75	375		I_C=10mA V_{CE}=10V f=1kHz
Output Admittance	h_{oe}			5	35	μ℧	I_C=1mA VCE=10V f=1kHz
				25	200	μ℧	I_C=10mA V_{CE}=10V f=1kHz
Delay Time	t_d				10	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
Rise Time	t_r				25	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
Storage Time	t_s				225	nS	I_C=150mA I_{B1}=-I_{B2}=15mA V_{CC}=30V
Fall Time	t_f				60	nS	I_C=150mA I_{B1}=-I_{B2}=15mA V_{CC}=30V

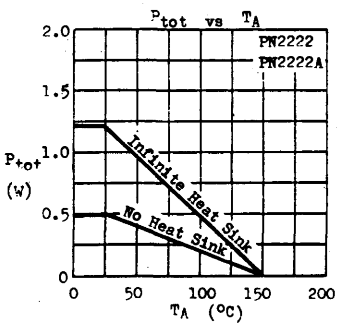
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

SWITCHING TIME TEST CIRCUITS



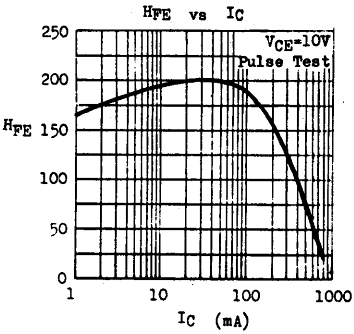
All waveforms are monitored on an oscilloscope with $R_{in} \geqslant 100K\Omega$, $C_{in} \leqslant 12pF$, $t_r \leqslant 5nS$.

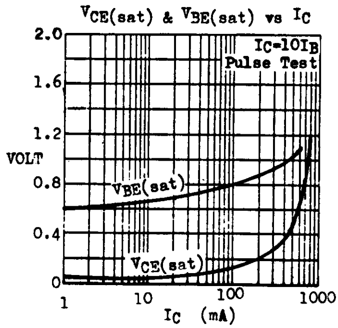


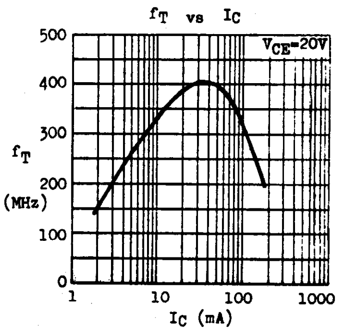


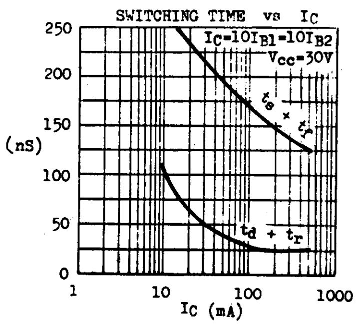
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2N2586 2N3964

COMPLEMENTARY

SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2N2586 (NPN) AND 2N3964 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF LOW NOISE SMALL SIGNAL AMPLIFIER CIRCUITS.

CASE TO-18

CBE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		2N2586(NPN)	2N3964(PNP)
Collector-Base Voltage	V_{CBO}	60V	45V
Collector-Emitter Voltage	V_{CEO}	45V	45V
Emitter-Base Voltage	V_{EBO}	6V	6V
Collector Current	I_C	100mA**	200mA
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	600mW	1.2W
($T_A \leq 25^oC$)		300mW	360mW
Junction Temperature	T_j	175°C	200°C
Storage Temperature Range	T_{stg}	-65 to 200°C	

** 30mA in JEDEC registration.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N2586 MIN	2N2586 MAX	2N3964 MIN	2N3964 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60		45		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	BV_{CES}			45		V	I_C=0.01mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	45				V	I_C=10mA(Pulsed) I_B=0
				45		V	I_C=5mA(Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		6		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		2			nA	V_{CB}=45V I_E=0
					10	nA	V_{CB}=40V I_E=0
Collector Cutoff Current	I_{CES}		2			nA	V_{CE}=45V V_{BE}=0
					10	nA	V_{CE}=40V V_{BE}=0
			10			μA	V_{CE}=45V V_{BE}=0 T_A=170°C
					10	μA	V_{CE}=40V V_{BE}=0 T_A=150°C

PARAMETER	SYMBOL	2N2586 MIN	2N2586 MAX	2N3964 MIN	2N3964 MAX	UNIT	TEST CONDITIONS
Emitter Cutoff Current	I_{EBO}	2				nA	V_{EB}=5V I_C=0
					10	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.5		0.25	V	I_C=10mA I_B=0.5mA
					0.4	V	I_C=50mA I_B=5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.7	0.9		0.9	V	I_C=10mA I_B=0.5mA
					0.95	V	I_C=50mA I_B=5mA
D.C. Current Gain	H_{FE}	80		180			I_C=1µA V_{CE}=5V
		120	360	250	500		I_C=10µA V_{CE}=5V
				250			I_C=100µA V_{CE}=5V
		150					I_C=500µA V_{CE}=5V
				250	600		I_C=1mA V_{CE}=5V
			600	200			I_C=10mA V_{CE}=5V
				180			I_C=50mA V_{CE}=5V
		40		100			I_C=10µA V_{CE}=5V T_A=-55°C
					800		I_C=1mA V_{CE}=5V T_A=100°C
				90			I_C=50mA V_{CE}=5V T_A=-55°C
Current Gain-Bandwidth Product	f_T	45		50	160		I_C=0.5mA V_{CE}=5V
Collector-Base Capacitance	Cob		7		6	pF	V_{CB}=5V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib				15	pF	V_{EB}=0.5V I_C=0 f=1MHz
Noise Figure	NF						
			3			dB	I_C=10µA V_{CE}=5V R_G=10KΩ f=1kHz
			3.5			dB	I_C=1µA V_{CE}=5V R_G=1MΩ f=1kHz
			2			dB	I_C=10µA V_{CE}=5V R_G=10KΩ f=10KHz
			2			dB	I_C=1µA V_{CE}=5V R_G=1MΩ f=10KHz
Noise Figure	NF						
					2	dB	I_C=20µA V_{CE}=5V R_G=10KΩ f=10Hz-10KHz
					2	dB	I_C=20µA V_{CE}=5V R_G=10KΩ f=10KHz
					2	dB	I_C=20µA V_{CE}=5V R_G=10KΩ f=1KHz
					4	dB	I_C=20µA V_{CE}=5V R_G=10KΩ f=100Hz
					8	dB	I_C=20µA V_{CE}=5V R_G=10KΩ f=10Hz
Input Impedance	hie	4.5	18	6	20	KΩ	I_C=1mA V_{CE}=5V f=1KHz
Voltage Feedback Ratio	hre				10	$x10^{-4}$	I_C=1mA V_{CE}=5V f=1KHz
Small Signal Current Gain	hfe	150	600	250	700		I_C=1mA V_{CE}=5V f=1KHz
Output Admittance	hoe		100	5	50	µ℧	I_C=1mA V_{CE}=5V f=1KHz

2N2907 2N2907A PN2907 PN2907A

PNP SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

THE 2N2907, 2N2907A, PN2907, PN2907A ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS. THEY ARE COMPLEMENTARY TO THE NPN TYPE 2N2222, 2N2222A, PN2222, PN2222A RESPECTIVELY. THE 2N2907, 2N2907A ARE PACKED IN TO-18. THE PN2907, PN2907A ARE PACKED IN TO-92A.

CASE TO-18

CBE

2N2907
2N2907A

CASE TO-92A

EBC

PN2907
PN2907A

ABSOLUTE MAXIMUM RATINGS		2N2907	2N2907A	PN2907	PN2907A
Collector-Base Voltage	$-V_{CBO}$	60V	60V	60V	60V
Collector-Emitter Voltage	$-V_{CEO}$	40V	60V	40V	60V
Emitter-Base Voltage	$-V_{EBO}$	5V	5V	5V	5V
Collector Current	$-I_C$	0.6A	0.6A	0.6A	0.6A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1.8W	1.8W	1.2W	1.2W
($T_A \leq 25^oC$)		400mW	400mW	500mW	500mW
Junction Temperature	T_j	200°C	200°C	150°C	150°C
Storage Temperature Range	T_{stg}	-65 to 200°C		-55 to 150°C	

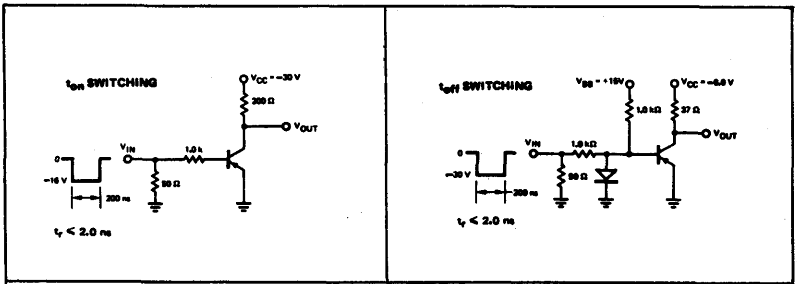
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N2907 PN2907 MIN	2N2907 PN2907 MAX	2N2907A PN2907A MIN	2N2907A PN2907A MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	60		60		V	$-I_C$=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	40		60		V	$-I_C$=10mA I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5		5		V	$-I_E$=0.01mA I_C=0
Collector Cutoff Current	$-I_{CBO}$		20		10	nA	$-V_{CB}$=50V I_E=0
			20		10	μA	$-V_{CB}$=50V I_E=0 T_A=150°C
Collector Cutoff Current	$-I_{CEV}$		50		50	nA	$-V_{CE}$=30V $-V_{EB}$=0.5V
Base Cutoff Current	$-I_{BL}$		50		50	nA	$-V_{CE}$=30V $-V_{EB}$=0.5V
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*		0.4		0.4	V	$-I_C$=150mA $-I_B$=15mA
			1.6		1.6	V	$-I_C$=500mA $-I_B$=50mA

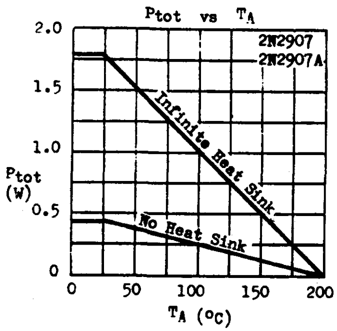
PARAMETER	SYMBOL	2N2907 PN2907 MIN	2N2907 PN2907 MAX	2N2907A PN2907A MIN	2N2907A PN2907A MAX	UNIT	TEST CONDITIONS
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.3		1.3	V	$-I_C=150mA$ $-I_B=15mA$
			2.6		2.6	V	$-I_C=500mA$ $-I_B=50mA$
D.C. Current Gain	H_{FE} *	35		75			$-I_C=0.1mA$ $-V_{CE}=10V$
		50		100			$-I_C=1mA$ $-V_{CE}=10V$
		75		100			$-I_C=10mA$ $-V_{CE}=10V$
		100	300	100	300		$-I_C=150mA$ $-V_{CE}=10V$
		30		50			$-I_C=500mA$ $-V_{CE}=10V$
Current Gain-Bandwidth Product	f_T	200		200		MHz	$-I_C=50mA$ $-V_{CE}=20V$
Collector-Base Capacitance	Cob		8		8	pF	$-V_{CB}=10V$ $I_E=0$ f=100kHz
Emitter-Base Capacitance	Cib		30		30	pF	$-V_{EB}=2V$ $I_C=0$ f=100kHz
Turn-On Time	t_{on}				45	nS	$-I_C=150mA$ $-I_{B1}=15mA$ $-V_{cc}=30V$
Turn-Off Time	t_{off}				100	nS	$-I_C=150mA$ $-I_{B1}=I_{B2}=15mA$ $-V_{cc}=6V$
Delay Time	t_d		10		10	nS	$-I_C=150mA$ $-I_{B1}=15mA$ $-V_{cc}=30V$
Rise Time	t_r		40		40	nS	$-I_C=150mA$ $-I_{B1}=15mA$ $-V_{cc}=30V$
Storage Time	t_s		80		80	nS	$-I_C=150mA$ $-I_{B1}=I_{B2}=15mA$ $-V_{cc}=6V$
Fall Time	t_f		30		30	nS	$-I_C=150mA$ $-I_{B1}=I_{B2}=15mA$ $-V_{cc}=6V$

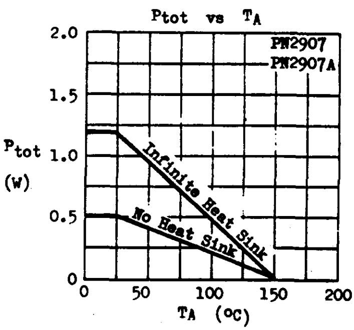
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

SWITCHING TIME TEST CIRCUITS



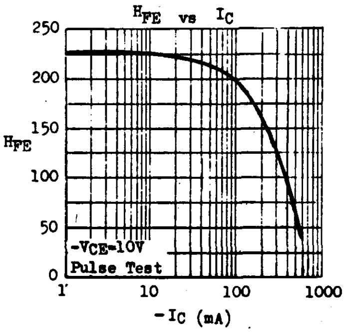
All waveforms are monitored on an oscilloscope with $R_{in} \geq 100K\Omega$, $C_{in} \leq 12pF$, $t_r \leq 5nS$.

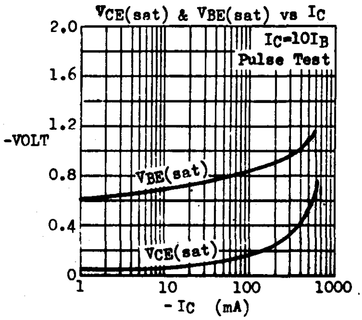


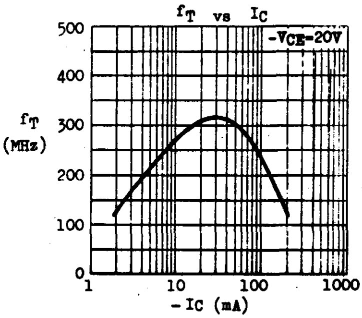


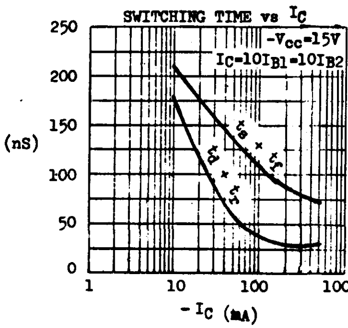
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2N3019 2N3020

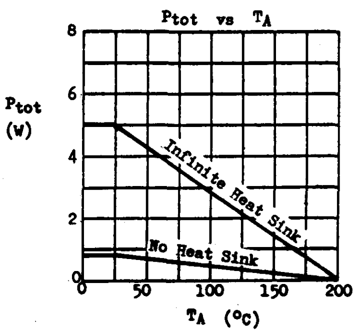
NPN SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

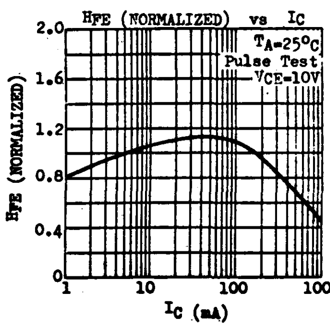
THE 2N3019, 2N3020 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THEY ARE COMPLEMENTARY TO THE PNP 2N4033, 2N4031.

CASE TO-39

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	140V
Collector-Emitter Voltage	V_{CEO}	80V
Emitter-Base Voltage	V_{EBO}	7V
Collector Current	I_C	1A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	5W
($T_A \leq 25^oC$)		800mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200°C

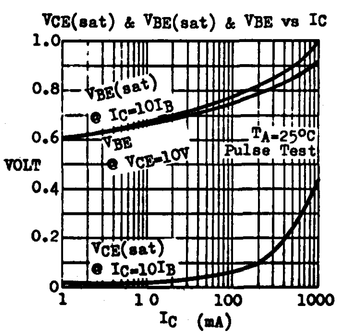


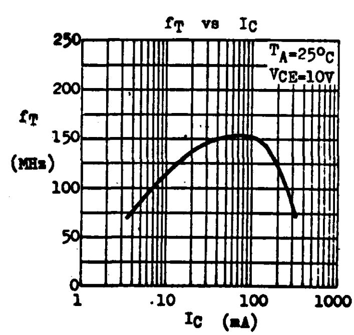


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N3019 MIN	2N3019 MAX	2N3020 MIN	2N3020 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	140		140		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	80		80		V	I_C=30mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	7		7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		10 10		10 10	nA µA	V_{CB}=90V I_E=0 V_{CB}=90V I_E=0 T_A=150°C
Emitter Cutoff Current	I_{EBO}		10		10	nA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.2 0.5		0.2 0.5	V V	I_C=150mA I_B=15mA I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.1		1.1	V	I_C=150mA I_B=15mA
D.C. Current Gain	H_{FE} *	50 90 100 50 15 40	 300	30 40 40 30 15	100 120 120 100		I_C=0.1mA V_{CE}=10V I_C=10mA V_{CE}=10V I_C=150mA V_{CE}=10V I_C=500mA V_{CE}=10V I_C=1A V_{CE}=10V I_C=150mA V_{CE}=10V T_A=-55°C
Current Gain-Bandwidth Product	f_T	100		80		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		12		12	pF	V_{CB}=10V I_E=0
Emitter-Base Capacitance	Cib		60		60	pF	V_{EB}=0.5V I_C=0 f=1MHz
Collector-Base Time Constant	Ccrbb'		400		400	pS	I_C=10mA V_{CE}=10V f=4MHz
Noise Figure	NF		4			dB	I_C=0.1mA V_{CE}=10V R_G=1KΩ f=1kHz
Small Signal Current Gain (f=1kHz)	h_{fe}	80	400	30	200		I_C=1mA V_{CE}=5V

Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





1.78.8100B

2N3053 2N4037

COMPLEMENTARY

SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE 2N3053 (NPN) AND 2N4037 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS.

CASE TO-39

C E B

ABSOLUTE MAXIMUM RATINGS — For p-n-p devices, voltage and current values are negative.

		2N3053(NPN)	2N4037(PNP)
Collector-Base Voltage	V_{CBO}	60V	60V
Collector-Emitter Voltage	V_{CEO}	40V	40V
Emitter-Base Voltage	V_{EBO}	5V	7V
Collector Current	I_C	0.7A	1A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	7W	
($T_A \leq 25^oC$)		1W	
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200°C	

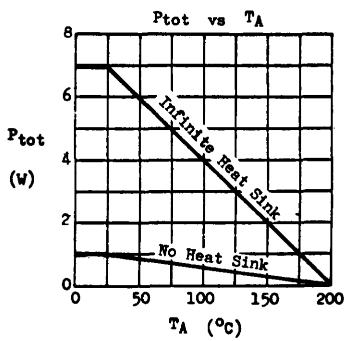
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

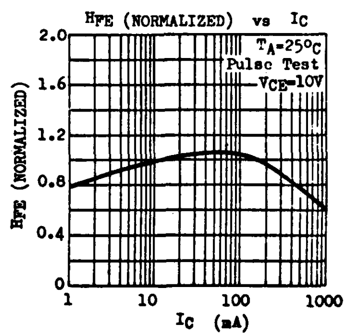
PARAMETER	SYMBOL	2N3053 MIN	2N3053 MAX	2N4037 MIN	2N4037 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60		60		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CER} *	50				V	I_C=100mA R_{BE}=10Ω
				60		V	I_C=100mA R_{BE}=200Ω
Collector-Emitter Breakdown Voltage	LV_{CEV} *			60		V	I_C=100mA V_{EB}=1.5V
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40		40		V	I_C=100mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5		7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CEV}		0.25			μA	V_{CE}=30V V_{EB}=1.5V
Collector Cutoff Current	I_{CBO}				0.25	μA	V_{CB}=60V I_E=0
Collector Cutoff Current	I_{CEO}				5	μA	V_{CE}=30V I_B=0
Emitter Cutoff Current	I_{EBO}		0.25			μA	V_{EB}=4V I_C=0
					1	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1.4		1.4	V	I_C=150mA I_B=15mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.7			V	I_C=150mA I_B=15mA
D.C. Current Gain	H_{FE} *			15			I_C=1mA V_{CE}=10V
		50	250	50	250		I_C=150mA V_{CE}=10V
		25					I_C=150mA V_{CE}=2.5V

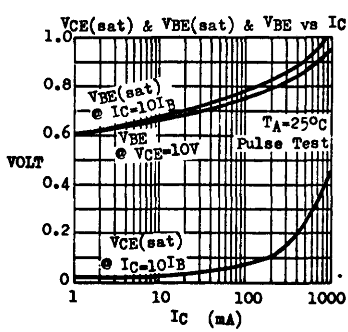
PARAMETER	SYMBOL	2N3053 MIN	2N3053 MAX	2N4037 MIN	2N4037 MAX	UNIT	TEST CONDITIONS
Current Gain-Bandwidth Product	f_T	100		60		MHz	I_C=50mA V_{CE}=10V
Collector-Base Capacitance	Cob		15		30	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib		80		90	pF	V_{EB}=0.5V I_C=0 f=1MHz

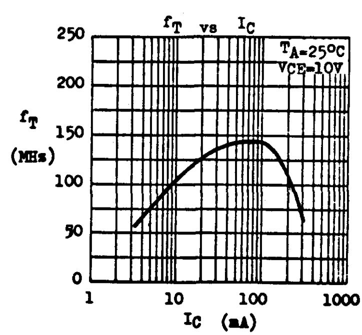
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS









2N3107 through 2N3110

NPN SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE 2N3107 THROUGH 2N3110 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THEY ARE COMPLEMENTARY TO THE PNP 2N4032, 2N4030.

CASE TO-39

C E B

ABSOLUTE MAXIMUM RATINGS

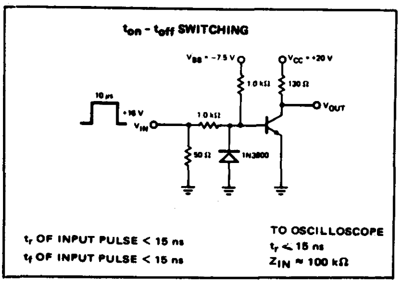
		2N3107 2N3108	2N3109 2N3110
Collector-Base Voltage	V_{CBO}	100V	80V
Collector-Emitter Voltage	V_{CEO}	60V	40V
Emitter-Base Voltage	V_{EBO}	7V	7V
Collector Current	I_C	1A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	5W	
($T_A \leq 25^oC$)		800mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200°C	

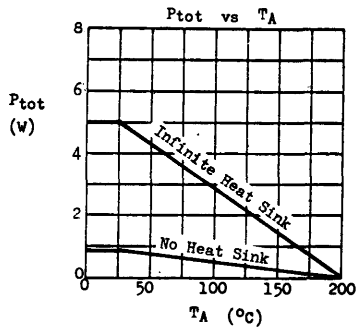
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

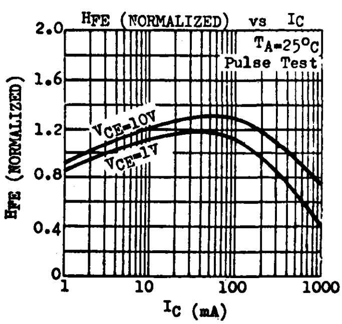
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}				I_C=0.1mA I_E=0
2N3107, 2N3108		100		V	
2N3109, 2N3110		80		V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *				I_C=30mA I_B=0
2N3107, 2N3108		60		V	
2N3109, 2N3110		40		V	
Emitter-Base Breakdown Voltage	BV_{EBO}	7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CES}		10	nA	V_{CE}=60V V_{BE}=0
Collector Cutoff Current (T_A=150°C)	I_{CBO}		10	μA	V_{CB}=60V I_E=0
Emitter Cutoff Current	I_{EBO}		10	nA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.25	V	I_C=150mA I_B=15mA
			1.0	V	I_C=1A I_B=0.1A
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.1	V	I_C=150mA I_B=15mA
			2.0	V	I_C=1A I_B=0.1A
D.C. Current Gain	H_{FE} *				
2N3107, 2N3109 only		35			I_C=0.1mA V_{CE}=10V
		100	300		I_C=150mA V_{CE}=1V
		40			I_C=500mA V_{CE}=10V

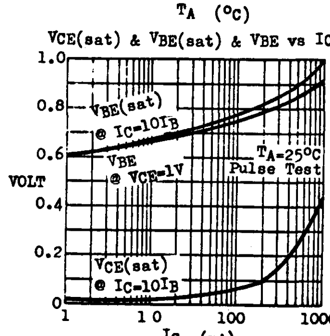
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
2N3107, 2N3109 only	HFE *	30			Ic=150mA VCE=10V TA=-55°C
D.C. Current Gain	HFE *	20			Ic=0.1mA VCE=10V
		40	120		Ic=150mA VCE=1V
2N3108, 2N3110 only		25			Ic=500mA VCE=10V
		15			Ic=150mA VCE=10V TA=-55°C
Current Gain-Bandwidth Product	f_T				Ic=50mA VCE=10V
2N3107, 2N3109		70		MHz	
2N3108, 2N3110		60		MHz	
Collector-Base Capacitance	Cob				VCB=10V IE=0 f=1MHz
2N3107, 2N3108			20	pF	
2N3109, 2N3110			25	pF	
Emitter-Base Capacitance	Cib		80	pF	VEB=0.5V IC=0 f=1MHz
Noise Figure (f=1KHz)	NF		7	dB	Ic=30µA VCE=10V RG=1KΩ
Turn-On Time	ton		200	nS	Ic=150mA IB1=7.5mA
Turn-Off Time 2N3107, 2N3109	toff		1000	nS	Ic=150mA IB1=-IB2=7.5mA
2N3108, 2N3110			600	nS	

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%









1.78.8100B/A

2N3563 2N5130 2N5132
PN3563 PN5130 PN5132

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE ABOVE TYPES ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF SMALL SIGNAL APPLICATIONS.

2N/PN3563 ———— f_T = 600MHz min

2N/PN5130 ———— f_T = 450MHz min

2N/PN5132 ———— f_T = 200MHz min

CASE TO-106

2N3563
2N5130
2N5132

CBE

CASE TO-92A

PN3563
PN5130
PN5132

EBC

ABSOLUTE MAXIMUM RATINGS

		2N3563 2N5130	2N5132	PN3563 PN5130	PN5132
Collector-Base Voltage	V_{CBO}	30V	20V	30V	20V
Collector-Emitter Voltage	V_{CEO}	12V	20V	12V	20V
Emitter-Base Voltage	V_{EBO}	2V	3V	2V	3V
Collector Current	I_C	50mA	50mA	50mA	50mA
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	200mW	200mW	250mW	250mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C		-55 to 150°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

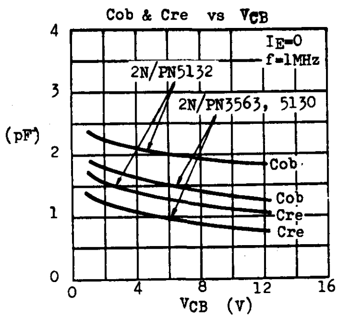
PARAMETER	SYMBOL	2N/PN3563 MIN	2N/PN3563 MAX	2N/PN5130 MIN	2N/PN5130 MAX	2N/PN5132 MIN	2N/PN5132 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30		30				V	I_C=0.1mA I_E=0
						20		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	12		12				V	I_C=3mA I_B=0
						20		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	2		2		3		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		50					nA	V_{CB}=15V I_E=0
					50		50	nA	V_{CB}=10V I_E=0
Collector Cutoff Current (T_A=65°C)	I_{CBO}		5					µA	V_{CB}=15V I_E=0
					5		5	µA	V_{CB}=10V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *				0.6		0.2	V	I_C=10mA I_B=1mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$ *				1		0.9	V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE} *				1		0.9	V	I_C=10mA V_{CE}=10V
D.C. Current Gain	H_{FE} *	20	200	15	250				I_C=8mA V_{CE}=10V
						30	400		I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	600		450				MHz	I_C=8mA V_{CE}=10V
						200		MHz	I_C=10mA V_{CE}=15V

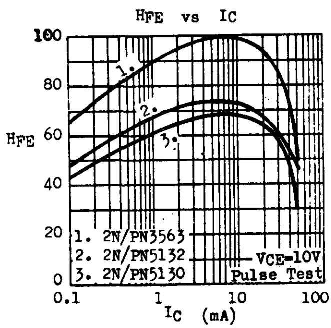
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

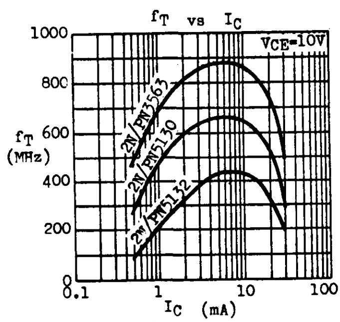
2N3563 2N5130 2N5132
PN3563 PN5130 PN5132

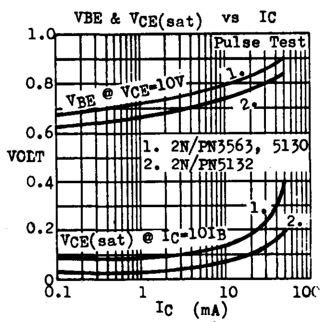
PARAMETER	SYMBOL	2N/PN3563 MIN	TYP	MAX	2N/PN5130 MIN	TYP	MAX	2N/PN5132 MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Capacitance	Cob		1.3	1.7		1.3	1.7		1.8	3.5	pF	V_{CB}=10V I_E=0 f=1MHz
Feedback Time Constant	$C_c r_{bb'}$	8	18	25		15					pS	I_C=8mA V_{CE}=10V f=79.8MHz
	$C_c r_{bb'}$		25			18			25		pS	I_C=1mA V_{CE}=5V f=31.8MHz
Available Power Gain	Gpe	14	17			17					dB	I_C=8mA V_{CE}=10V f=200MHz
Noise Figure	NF		4			4					dB	I_C=1mA V_{CE}=6V R_G=400Ω f=60MHz

TYPICAL CHARACTERISTICS AT T_A=25°C









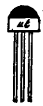
2.78.3100B.3100B.3300A

2N3565 2N5138 PN3565 PN5138

COMPLEMENTARY SILICON AF SMALL SIGNAL TRANSISTORS

THE 2N3565 (NPN) AND 2N5138 (PNP) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF HIGH GAIN SMALL SIGNAL AMPLIFIER AND DIRECT COUPLED CIRCUITS. THEY ARE SUPPLIED IN CASE TO-106 AND ARE ELECTRICALLY EQUIVALENT TO THE TO-92 TYPE PN3565, PN5138.

CASE TO-106



CBE

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		(NPN) 2N3565	(PNP) 2N5138	(NPN) PN3565	(PNP) PN5138
Collector-Base Voltage	V_{CBO}	30V	30V	30V	30V
Collector-Emitter Voltage	V_{CEO}	25V	30V	25V	30V
Emitter-Base Voltage	V_{EBO}	6V	5V	6V	5V
Collector Current	I_C	50mA	50mA	50mA	50mA
Total Power Dissipation ($T_C \leq 65^oC$)	P_{tot}	300mW	300mW	750mW	750mW
($T_A \leq 25^oC$)		200mW	200mW	300mW	300mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C		-55 to 150°C	

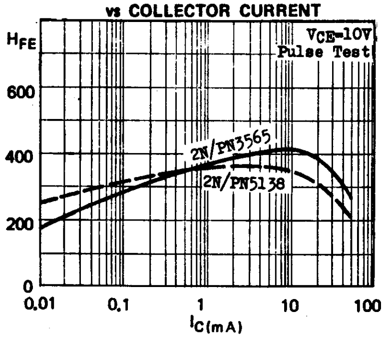
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N/PN3565 MIN	2N/PN3565 MAX	2N/PN5138 MIN	2N/PN5138 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30		30		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	25				V	I_C=2mA (Pulsed) I_B=0
				30		V	I_C=10mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		5		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		50			nA	V_{CB}=25V I_E=0
					50	nA	V_{CB}=20V I_E=0
					3	µA	V_{CB}=20V I_E=0 T_A=65°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.35			V	I_C=1mA I_B=0.1mA
					0.3	V	I_C=10mA I_B=0.5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$				1	V	I_C=10mA I_B=0.5mA
D.C. Current Gain	H_{FE}	70		50	800		I_C=0.1mA V_{CE}=10V
		150	600	50			I_C=1mA V_{CE}=10V

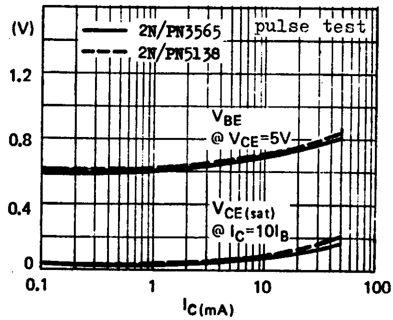
PARAMETER	SYMBOL	2N/PN3565 MIN	2N/PN3565 MAX	2N/PN5138 MIN	2N/PN5138 MAX	UNIT	TEST CONDITIONS
D.C. Current Gain	H_{FE}			50			I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	40	240			·	I_C=1mA V_{CE}=5V
				30			I_C=0.5mA V_{CE}=5V
Small Signal Current Gain	h_{fe}	120	750	40	1000		I_C=1mA V_{CE}=10V f=1KHz
Collector-Base Capacitance	Cob		4		7	pF	V_{CB}=5V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib				30	pF	V_{EB}=0.5V I_C=0 f=1MHz

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

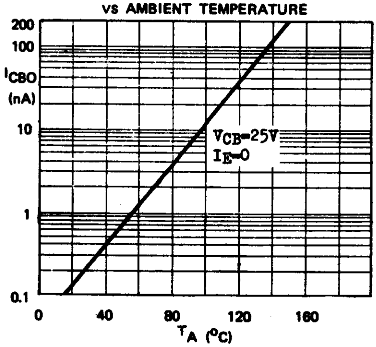
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



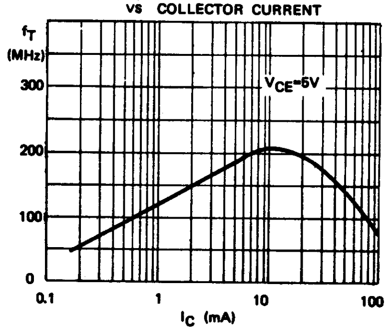
VBE AND VCE(sat)
vs COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT
vs AMBIENT TEMPERATURE



CURRENT GAIN — BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



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2N3691 2N3692 2N3693 2N3694

NPN SILICON TRANSISTORS
FOR SMALL SIGNAL PROCESSING APPLICATIONS

THE 2N3691 THROUGH 2N3694 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN SMALL SIGNAL PROCESSING CIRCUITS AT D.C. TO FREQUENCIES BEYOND 27MHz. THE 2N3693 IS SPECIALLY RECOMMENDED FOR VIDEO AMPLIFIER, FM-IF STAGE AND AM-CONVERTER STAGE UP TO THE SHORT WAVE BAND.

CASE TO-106

CBE

ABSOLUTE MAXIMUM RATINGS		2N3691 2N3692	2N3693 2N3694
Collector-Base Voltage	V_{CBO}	35V	45V
Collector-Emitter Voltage	V_{CEO}	25V	45V
Emitter-Base Voltage	V_{EBO}	4V	4V
Collector Current	I_C	50mA	
Total Power Dissipation ($T_C \leq 65°C$)	P_{tot}	300mW	
($T_A \leq 25°C$)		200mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C	

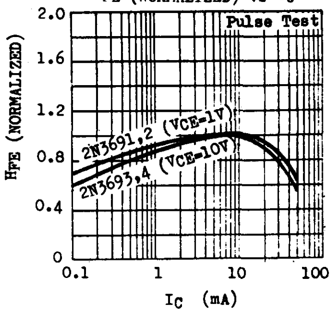
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
2N3691,2		35			V	
2N3693,4		45			V	
Collector-Emitter Breakdown Voltage	LV_{CEO}					I_C=10mA(Pulsed)
2N3691,2		25			V	I_B=0
2N3693,4		45			V	
Emitter-Base Breakdown Voltage	BV_{EBO}	4			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}					
2N3691,2				50	nA	V_{CB}=30V I_E=0
2N3693,4				50	nA	V_{CB}=35V I_E=0
Collector Cutoff Current	I_{CBO}					
2N3691,2				5	µA	V_{CB}=30V I_E=0 T_A=65°C
2N3693,4				5	µA	V_{CB}=35V I_E=0 T_A=65°C
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.08	0.7	V	I_C=10mA I_B=1mA

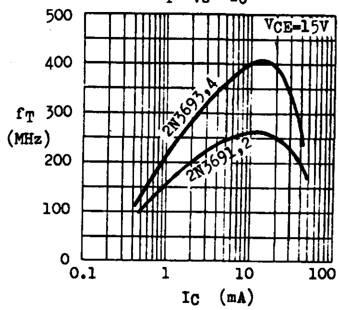
PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Base-Emitter Saturation Voltage		$V_{BE(sat)}$		0.74	0.9	V	I_C=10mA I_B=1mA
D.C. Current Gain		H_{FE}					
	2N3691		40	80	160		I_C=10mA V_{CE}=1V
	2N3692		100	150	400		I_C=10mA V_{CE}=1V
	2N3693		40	85	160		I_C=10mA V_{CE}=10V
	2N3694		100	150	400		I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product		f_T					
	2N3691,2		200	260		MHz	I_C=10mA V_{CE}=15V
	2N3693,4		200	400		MHz	I_C=10mA V_{CE}=15V
Collector-Base Capacitance		Cob					V_{CB}=10V I_E=0
	2N3691,2			2.7	6	pF	f=1MHz
	2N3693,4			1.8	3.5	pF	
Feedback Time Constant		$C_c r_{bb'}$					I_C=1mA V_{CE}=5V
	2N3691,2			65		pS	f=31.8MHz
	2N3693,4			23		pS	
	2N3693,4 only	$C_c r_{bb'}$			55	pS	I_C=10mA V_{CE}=15V f=80MHz
Available Power Gain	2N3693,4 only	Gpe		32		dB	I_C=7mA V_{CE}=10V f=10.7MHz
Noise Figure	2N3693,4 only	NF		4		dB	I_C=3mA V_{CE}=10V f=1MHz R_G=300Ω

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

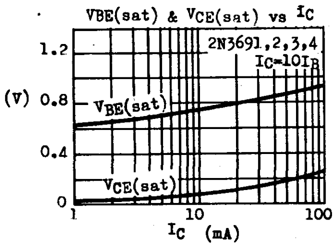
H_{FE} (NORMALIZED) vs I_C

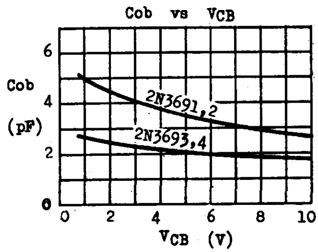


f_T vs I_C



2N3691 2N3692 2N3693 2N3694





<u>TRANSISTORS EQUIVALENT TO 2N3691,2,3,4 FAMILY</u>

THE FOLLOWING NPN TRANSISTORS ARE SUPPLIED IN CASE TO-92B. THEIR ELECTRICAL CHARACTERISTICS ARE CLOSELY EQUIVALENT TO THE 2N3691,2,3,4 FAMILY.

CASE TO-92B

ECB

SPECIFICATIONS AT T_A=25°C

	TYPE (NPN)	LV_{CEO} (V)	h_{FE} @ I_C/V_{CE} (mA)(V)	f_T @ I_C/V_{CE} (MHz)(mA)(V)	Cob @ V_{CB}=10V (pF) f=1MHz	Note
		min	min-max	min-max	max	
≈2N3691	2N3843,A 2N3844,A 2N3845,A	30	20-40 @ 2/4.5 35-70 @ 2/4.5 60-120 @ 2/4.5	60-230 @ 2/10 90-250 @ 2/10 120-290 @ 2/10	4	<u>For Suffix "A" only</u> NF <8.5dB @ I_C=1mA V_{CE}=12V R_G=20Ω f=2MHz
≈2N3693,4	2N3854 2N3855 2N3856 2N3854A 2N3855A 2N3856A	18 18 18 30 30 30	35-70 @ 2/4.5 60-120 @ 2/4.5 100-200 @ 2/4.5 35-70 @ 2/4.5 60-120 @ 2/4.5 100-200 @ 2/4.5	100-350 @ 5/10 130-450 @ 5/10 140-500 @ 5/10 100-350 @ 5/10 130-450 @ 5/10 140-500 @ 5/10	3.5	Ccrbb' < 90pS @ I_C=5mA V_{CE}=10V f=31.8MHz
≈2N3692	2N3858 2N3859 2N3860	30	60-120 @ 2/4.5 100-200 @ 2/4.5 150-300 @ 2/4.5	90-250 @ 2/10 90-250 @ 2/10 90-250 @ 2/10	4	Ccrbb' < 150pS @ I_C=2mA V_{CE}=10V f=2MHz
	2N5232,A	50	250-500 @ 2/5		4	<u>For 2N5232A only</u> NF < 5dB *

2.78.4300A.3300A.4300A/B

* NF @ I_C=0.1mA V_{CE}=5V
R_G=5KΩ f=30Hz-15KHz

2N3702 through 2N3706
MPS3702 through MPS3706

PNP NPN SILICON GENERAL PURPOSE AF TRANSISTORS

THE ABOVE TYPES ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AF MEDIUM POWER APPLICATIONS. THE 2N3702 SERIES ARE SUPPLIED IN CASE TO-92B. THE MPS3702 SERIES ARE SUPPLIED IN CASE TO-92A.

CASE TO-92B

ECB

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS		(PNP) 2N/MPS3702	(PNP) 2N/MPS3703	(NPN) 2N/MPS3704 2N/MPS3705	(NPN) 2N/MPS3706
Collector-Base Voltage	V_{CBO}	40V	50V	50V	40V
Collector-Emitter Voltage	V_{CEO}	25V	30V	30V	20V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V	5V
Collector Current	I_C	0.2A	0.2A	0.8A	0.8A
Collector Peak Current	I_{CM}	0.6A	0.6A		
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	1W			
($T_A \leq 25^oC$)		360mW			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C			

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	↑			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	Note 1			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	↓			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*					
2N/MPS3702,3			0.1	0.25	V	I_C=50mA I_B=5mA
2N/MPS3704			0.12	0.6	V	I_C=100mA I_B=5mA
2N/MPS3705			0.15	0.8	V	I_C=100mA I_B=5mA
2N/MPS3706			0.15	1	V	I_C=100mA I_B=5mA
Base-Emitter Voltage	V_{BE} *					
2N/MPS3702,3		0.6	0.78	1	V	I_C=50mA V_{CE}=5V
2N/MPS3704,5,6		0.5	0.83	1	V	I_C=100mA V_{CE}=2V
D.C. Current Gain	H_{FE} *					
2N/MPS3702		60		300		I_C=50mA V_{CE}=5V
2N/MPS3703		30		150		I_C=50mA V_{CE}=5V
2N/MPS3704		100		300		I_C=50mA V_{CE}=2V

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

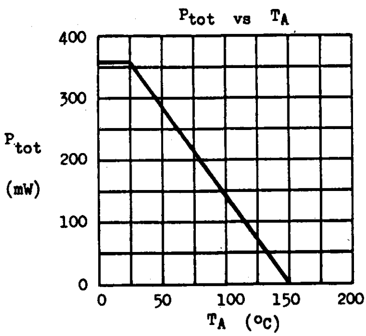
2N3702 through 2N3706
MPS3702 through MPS3706

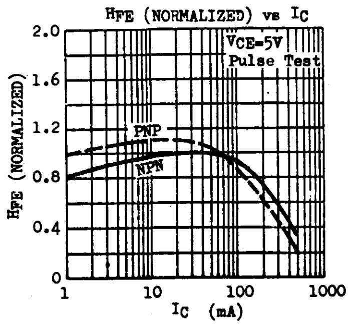
PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
D.C. Current Gain	2N/MPS3705	H_{FE} *	50		150		I_C=50mA V_{CE}=2V
	2N/MPS3706		30		600		I_C=50mA V_{CE}=2V
Current Gain-Bandwidth Product		f_T					
	2N/MPS3702,3		100			MHz	I_C=50mA V_{CE}=5V
	2N/MPS3704,5,6		100			MHz	I_C=50mA V_{CE}=2V
Collector-Base Capacitance		Cob					
	2N/MPS3702,3			5	12	pF	V_{CB}=10V I_E=0
	2N/MPS3704,5,6			4	12	pF	f=1MHz

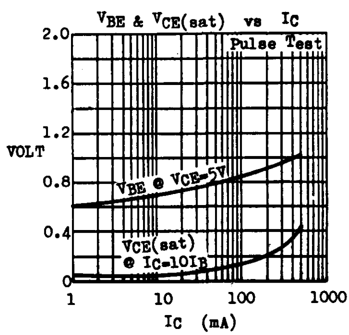
Note 1 : equal to the values of absolute maximum ratings.

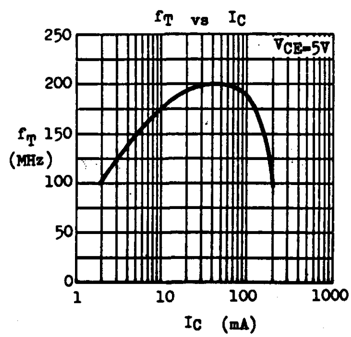
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)





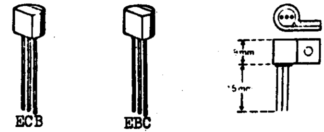




TRANSISTORS EQUIVALENT TO 2N/MFS3702 FAMILY

THE FOLLOWING TRANSISTORS, WHICH ARE CLOSELY EQUIVALENT TO THE 2N/MPS3702 FAMILY, ARE ALSO AVAILABLE.

TO-92B TO-92A WITH X-67 HEAT SINK



SPECIFICATIONS AT T_A=25°C For p-n-p devices, voltage and current values are negative.

TYPE	POLARITY	CASE (P_{tot})	LVCEO (V)	BVEBO (V)	ICBO @ VCB (µA) (V)	HFE @ IC/VCE (mA) (V)	VCE(sat) @ IC/IB (V) (mA)(mA)	fT @ IC (MHz)(mA)
			min	min	max	min-max	max	min
2N3402	NPN	TO-92B with X-67 Heat Sink (560mW)	25	5	0.1 @ 25	75-225 @ 2/4.5	0.3 @ 50/3	
2N3403			25	5	0.1 @ 25	180-540 @ 2/4.5	0.3 @ 50/3	
2N3404			50	5	0.1 @ 50	75-225 @ 2/4.5	0.3 @ 50/3	
2N3405			50	5	0.1 @ 50	180-540 @ 2/4.5	0.3 @ 50/3	
2N4425			40	5	*0.03@ 40	180-540 @ 2/4.5	0.3 @ 50/3	
2N3414	NPN	TO-92B (360mW)	25	5	0.1 @ 25	75-225 @ 2/4.5	0.3 @ 50/3	
2N3415			25	5	0.1 @ 25	180-540 @ 2/4.5	0.3 @ 50/3	
2N3416			50	5	0.1 @ 50	75-225 @ 2/4.5	0.3 @ 50/3	
2N3417			50	5	0.1 @ 50	180-540 @ 2/4.5	0.3 @ 50/3	
2N4424			40	5	*0.03@ 40	180-540 @ 2/4.5	0.3 @ 50/3	
2N5220	NPN	TO-92A (350mW)	15	3	0.1 @ 10	25- @ 10/10 30-600 @ 50/10	0.5 @ 150/15	100 @ 20
2N5221	PNP		15	3	0.1 @ 10	25- @ 10/10 30-600 @ 50/10	0.5 @ 150/15	100 @ 20
2N5225	NPN		25	4	0.3 @ 15	25- @ 10/10 30-600 @ 50/10	0.8 @ 100/10	50 @ 20
2N5226	PNP		25	4	0.3 @ 15	25- @ 10/10 30-600 @ 50/10	0.8 @ 100/10	50 @ 20
2N5354	PNP	TO-92B (360mW)	25	4	*0.1 @ 25	40-120 @ 50/1 20- @ 300/5	0.25 @ 50/2.5 1.0 @ 300/30	
2N5355	PNP		25	4	*0.1 @ 25	100-300 @ 50/1 40- @ 300/5		
2N5356	PNP		25	4	*0.1 @ 25	250-500 @ 50/1 75- @ 300/5		
2N5365	PNP	TO-92B (360mW)	40	4	*0.1 @ 40	40-120 @ 50/1 20- @ 300/5	0.25 @ 50/2.5 1.0 @ 300/30	
2N5366	PNP		40	4	*0.1 @ 40	100-300 @ 50/1 40- @ 300/5		
2N5367	PNP		40	4	*0.1 @ 40	250-500 @ 50/1 75- @ 300/5		

* I_{CES}

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TRANSISTORS EQUIVALENT TO 2N/MFS3702 FAMILY

<table>
<tr><th>TYPE</th><th>POLARITY</th><th>CASE
(P_{tot})</th><th>LV_{CEO}
(V)</th><th>BV_{EBO}
(V)</th><th>I_{CES} @ V_{CE}
(µA) (V)</th><th>H_{FE} @ I_C/V_{CE}
(mA)(V)</th><th>$V_{CE(sat)}$ @ I_C/I_B
(V) (mA)(mA)</th><th>f_T @ I_C
(MHz)(mA)</th></tr>
<tr><td></td><td></td><td rowspan="4">TO-92B
(400mW)</td><td>min</td><td>min</td><td>max</td><td>min-max</td><td>max</td><td>min</td></tr>
<tr><td>2N5418</td><td>NPN</td><td>25</td><td>4</td><td>0.1 @ 25</td><td>40-120 @ 50/1
20- @ 300/5</td><td rowspan="3">0.25 @ 50/2.5
1.0 @ 300/30</td><td rowspan="3"></td></tr>
<tr><td>2N5419</td><td>NPN</td><td>25</td><td>4</td><td>0.1 @ 25</td><td>100-300 @ 50/1
40- @ 300/5</td></tr>
<tr><td>2N5420</td><td>NPN</td><td>25</td><td>4</td><td>0.1 @ 25</td><td>250-500 @ 50/1
75- @ 300/5</td></tr>
<tr><td>2N5447</td><td>PNP</td><td colspan="7" rowspan="5">These are TO-92F transistors. Their electrical characteristics are exactly identical to 2N3702, 3, 4, 5, 6 respectively.</td></tr>
<tr><td>2N5448</td><td>PNP</td></tr>
<tr><td>2N5449</td><td>NPN</td></tr>
<tr><td>2N5450</td><td>NPN</td></tr>
<tr><td>2N5451</td><td>NPN</td></tr>
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2N3707 through 2N3711
2N4058 through 2N4062

NPN PNP SILICON AF SMALL SIGNAL TRANSISTORS

THE 2N3707 THROUGH 2N3711 (NPN) AND 2N4058 THROUGH 2N4062 (PNP) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS (For p-n-p devices, voltage and current values are negative)		(NPN) 2N3707 thru' 2N3711	(PNP) 2N4058 thru' 2N4062
Collector-Base Voltage	V_{CBO}	30V	30V
Collector-Emitter Voltage	V_{CEO}	30V	30V
Emitter-Base Voltage	V_{EBO}	6V	6V
Collector Current	I_C	200mA	100mA **
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	360mW derate 2.88mW/°C above 25°C	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

** 30mA in JEDEC registration.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

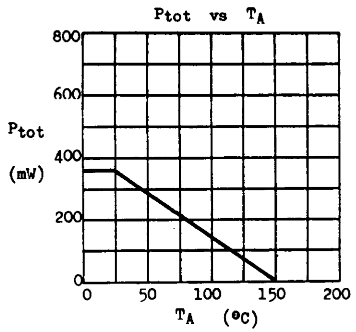
PARAMETER	SYMBOL	NPN MIN	NPN MAX	PNP MIN	PNP MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30		30		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	30		30		V	I_C=1mA I_B=0(Pulsed)
Collector Cutoff Current	I_{CBO}		100		100	nA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}		100		100	nA	V_{EB}=6V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1		0.7	V	I_C=10mA I_B=0.5mA
Base-Emitter Voltage	V_{BE}	0.5	1	0.5	1	V	I_C=1mA V_{CE}=5V
Noise Figure *	NF						
					5	dB	I_C=0.1mA V_{CE}=5V R_G=5KΩ f=30Hz-15KHz
			5			dB	I_C=0.1mA V_{CE}=5V R_G=10KΩ f=30Hz-15KHz

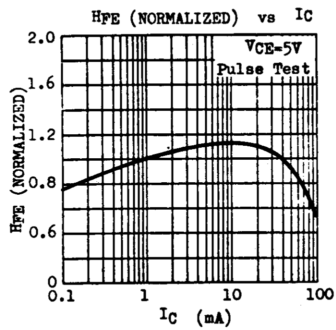
* For 2N3707 and 2N4058 only.

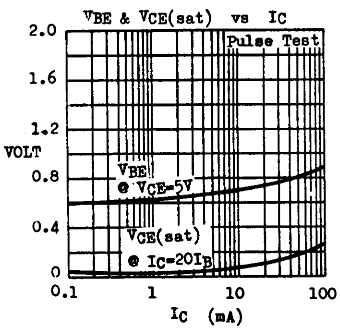
D.C. AND SMALL SIGNAL CURRENT GAIN (H_{FE}, h_{fe}) AT V_{CE}=5V T_A=25°C

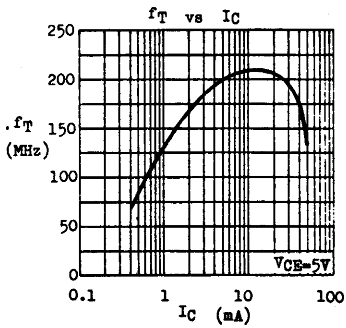
PARAMETER (NPN / PNP)	2N3707 / 2N4058 MIN	MAX	2N3708 / 2N4059 MIN	MAX	2N3709 / 2N4060 MIN	MAX	2N3710 / 2N4061 MIN	MAX	2N3711 / 2N4062 MIN	MAX
H_{FE} at I_C=0.1mA	100	400								
H_{FE} at I_C=1mA			45	660	45	165	90	330	180	660
h_{fe} at I_C=0.1mA f=1KHz	100	550								
h_{fe} at I_C=1mA f=1KHz			45	800	45	250	90	450	180	800

TYPICAL CHARACTERISTICS AT T_A=25°C









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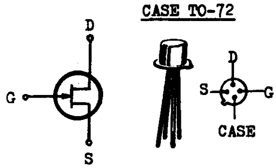
2N3823

N-CHANNEL JUNCTION FIELD EFFECT TRANSISTORS

THE 2N3823 IS AN N-CHANNEL JFET DESIGNED FOR RF AMPLIFIER AND MIXER APPLICATIONS. IT FEATURES LOW CROSS-MODULATION, LOW NOISE FIGURE AND GOOD POWER GAIN AT FREQUENCY UP TO 450MHz. THE DEVICE IS ALSO SUITABLE FOR ANALOG SWITCHING WHERE LOW JUNCTION CAPACITANCE IS ESSENTIAL.

CASE TO-72



THE S,D,G TERMINALS ARE ELECTRICALLY ISOLATED FROM CASE.

ABSOLUTE MAXIMUM RATINGS

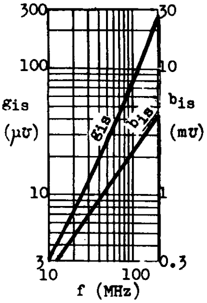
Drain-Gate Voltage	V_{DG}	30V
Drain-Source Voltage	V_{DS}	30V
Gate-Source Voltage	V_{GS}	-30V
Gate Current	I_G	10mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	300mW derate 2mW/^{o}C above 25^{o}C
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 175^{o}C

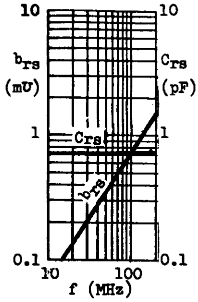
ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted) * Common Source

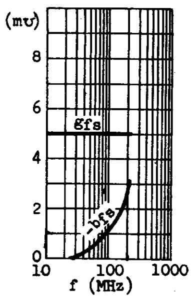
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Gate-Source Breakdown Voltage	$-BV_{GSS}$	30			V	$-I_G$=1μA V_{DS}=0
Gate Cutoff Current	$-I_{GSS}$			0.5 0.5	nA μA	$-V_{GS}$=20V V_{DS}=0 $-V_{GS}$=20V V_{DS}=0 T_A=150^{o}C
Zero-Gate-Voltage Drain Current	I_{DSS}	4	10	20	mA	V_{DS}=15V V_{GS}=0
Gate Source Voltage	$-V_{GS}$	1	3.2	7.5	V	V_{DS}=15V I_D=0.4mA
Gate Source Cutoff Voltage	$-V_{GS(off)}$		3.5	8	V	V_{DS}=15V I_D=0.5nA
Forward Transfer Admittance	$\|y_{fs}\|$ *	3.5	5	6.5	m℧	V_{DS}=15V V_{GS}=0 f=1kHz
Output Admittance	$\|y_{os}\|$ *		20	35	μ℧	V_{DS}=15V V_{GS}=0 f=1kHz
Input Capacitance	C_{iss} *		3.5	6	pF	V_{DS}=15V V_{GS}=0 f=1MHz
Feedback Capacitance	C_{rss} *		0.7	2	pF	V_{DS}=15V V_{GS}=0 f=1MHz

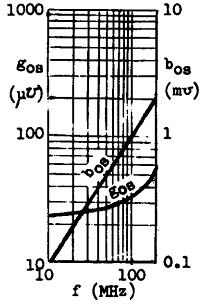
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Forward Transfer Admittance	$\lvert y_{fs} \rvert$ *	3.2	5.5		m℧	V_{DS}=15V V_{GS}=0 f=200MHz
Input Conductance	g_{is} *		250	800	μ℧	V_{DS}=15V V_{GS}=0 f=200MHz
Output Conductance	g_{os} *		60	200	μ℧	V_{DS}=15V V_{GS}=0 f=200MHz
Spot Noise Figure	NF *		1	2.5	dB	V_{DS}=15V V_{GS}=0 f=100MHz R_G=1KΩ
Power Gain	Gps *		12		dB	V_{DS}=15V I_D=5mA f=400MHz
Equivalent Noise Input Voltage	$\overline{En}$ *		8		nV/√Hz	V_{DS}=15V I_D=1mA f=100Hz
"On" Resistance	$r_{ds(on)}$		170		Ω	V_{DS}=100mV V_{GS}=0

TYPICAL COMMON SOURCE y-RARAMETER AT V_{DS}=15V V_{GS}=0 T_A=25°C

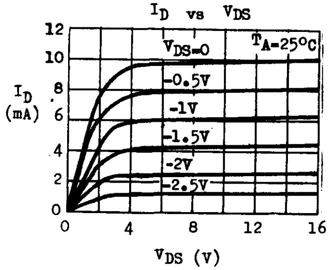




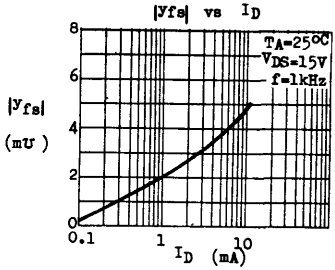




I_D vs V_{DS}



$\lvert y_{fs} \rvert$ vs I_D



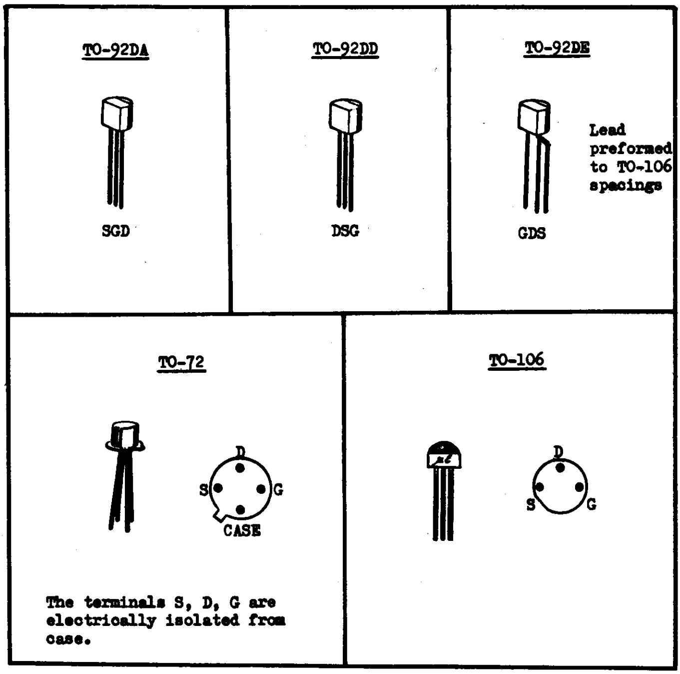
3.78.S320/2.5

2N3823 AND SIMILAR TYPES ——— SPECIFICATIONS AT $T_A=25°C$

TYPE	CASE	BV_{GSS} @ $-I_G$		@ $V_{DS}=15V$		@ $V_{DS}=15V$ $V_{GS}=0$				
				$-V_{GS(off)}$ @ I_D		I_{DSS}	@ f=1kHz		@ f=1MHz	
							$\|Y_{fs}\|$	$\|Y_{os}\|$	C_{iss}	C_{rss}
		(V)	(µA)	(V)	(nA)	(mA)	(m℧)	(µ℧)	(pF)	(pF)
		min		min-max		min-max	min-max	max	max	max
BF244A BF244B BF244C	TO-92DA	30	1	0.5-8	10	2-6.5 6-15 12-25	3-6.5			
BF245A BF245B BF245C	TO-92DE	30	1	0.5-8	10	2-6.5 6-15 12-25	3-6.5			
BF256A BF256B BF256C	TO-92DE	30	1	0.5-7.5	200µA	3-7 6-13 11-18	4.5-			
2N3819	TO-92DA	25	1	-8	2	2-20	2-6.5	50	8	4
2N3823	TO-72	30	1	-8	0.5	4-20	3.5-6.5	35	6	2
2N4302* 2N4303* 2N4304*	TO-106	30	1	-4 -6 -10	10 10 10	0.5-5 4-10 0.5-15	1- 2- 1-	50	6	3
2N4416	TO-72	30	1	-6	1	5-15	4.5-7.5	50	4	0.8
2N5103 2N5104	TO-72	25 25	10 1	0.5-4	1	1-8 2-6	2-8 3.5-7.5	100	5	1
2N5163	TO-106	25	1	0.4-8	1µA	1-40	2-9	200	12	3
2N5245 2N5246 2N5247	TO-92DE	30	1	1-6 0.5-4 1.5-8	10 10 10	5-15 1.5-7 8-24	4.5-7.5 3-6 4.5-8	50 50 70	4.5	1
2N5248	TO-92DA	30	1	1-8	10	4-20	3.5-6.5	50	6	2
2N5457 2N5458 2N5459	TO-92DD	25	10	0.5-6 1-7 2-8	10 10 10	1-5 2-9 4-16	1-5 1.5-5.5 2-6	50	7	3
2N5484 2N5485 2N5486	TO-92DD	25	1	0.3-3 0.5-4 2-6	10 10 10	1-5 4-10 8-20	3-6 3.5-7 4-8	50 60 75	5	1
2N5556 2N5557 2N5558	TO-72	30	10	0.2-4 0.8-5 1.5-6	1 1 1	0.5-2.5 2-5 4-10	1.5-6.5	20	6	3
2N5668 2N5669 2N5670	TO-92DD	25	10	0.2-4 1-6 2-8	10 10 10	1-5 4-10 8-20	1.5-6.5 2-6.5 3-7.5	20 50 75	7	3

* $V_{GS(off)}$, I_{DSS}, y_{fs}, y_{os}, C_{iss} and C_{rss} are tested @ $V_{DS}=20V$

JFET LEAD CODE



2N3825 2N3827

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE 2N3825, 2N3827 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF AND IF SMALL SIGNAL AMPLIFIER APPLICATIONS.

2N3825 —— f_T = 550MHz typ. @ I_C=2mA
2N3827 —— f_T = 350MHz typ. @ I_C=2mA

CASE TO-92B

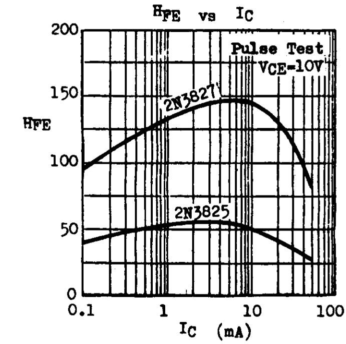
ECB

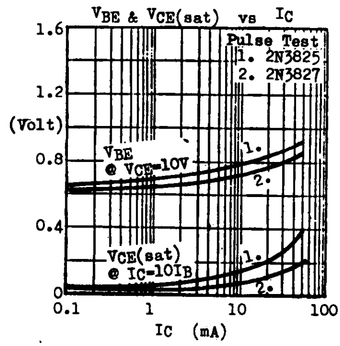
ABSOLUTE MAXIMUM RATINGS		2N3825	2N3827
Collector-Base Voltage	V_{CBO}	30V	60V
Collector-Emitter Voltage	V_{CEO}	15V	45V
Emitter-Base Voltage	V_{EBO}	4V	4V
Collector Current	I_C	50mA	
Total Power Dissipation ($T_A \leq 25^\circ C$)	Ptot	250mW	
Operating Junction & Storage Temperature	Tj, Tstg	-55 to 150°C	

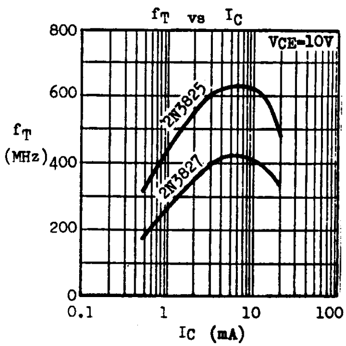
ELECTRICAL CHARACTERISTICS (T_A=25°C)

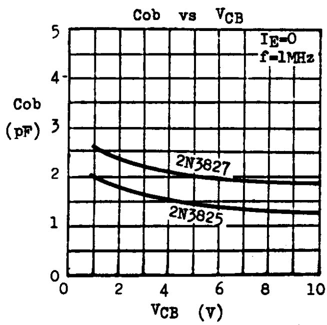
PARAMETER	SYMBOL	2N3825 MIN	2N3825 MAX	2N3827 MIN	2N3827 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30		60		V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	15		45		V	I_C=1mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	4		4		V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}		100			nA	V_{CB}=15V I_E=0
					100	nA	V_{CB}=30V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.25			V	I_C=2mA I_B=0.2mA
D.C. Current Gain	H_{FE}	20					I_C=2mA V_{CE}=10V
				100	400		I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	200	800			MHz	I_C=2mA V_{CE}=10V
				200	800	MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		3.5		3.5	pF	V_{CB}=10V I_E=0 f=1MHz
Noise Figure	NF		5.5			dB	I_C=1mA V_{CE}=5V R_G=500Ω f=1MHz

TYPICAL CHARACTERISTICS AT TA=25°C









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2N4030 through 2N4033

PNP SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE 2N4030 THROUGH 2N4033 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS UP TO 1 AMPERE. THE 2N4030, 2N4031, 2N4032, 2N4033 ARE COMPLEMENTARY TO THE NPN 2N3108, 2N3020, 2N3107, 2N3019 RESPECTIVELY.

CASE TO-39

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ABSOLUTE MAXIMUM RATINGS

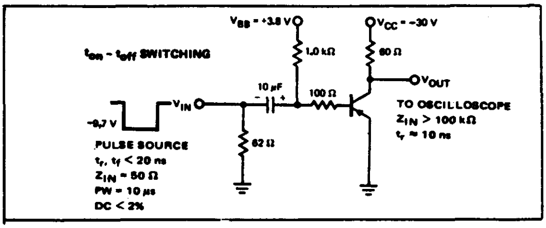
		2N4030 2N4032	2N4031 2N4033
Collector-Base Voltage	$-V_{CBO}$	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	60V	80V
Emitter-Base Voltage	$-V_{EBO}$	5V	5V
Collector Current	$-I_C$	1A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	4W	
($T_A \leq 25^oC$)		800mW	
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200°C	

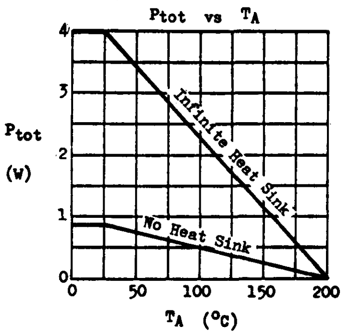
ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

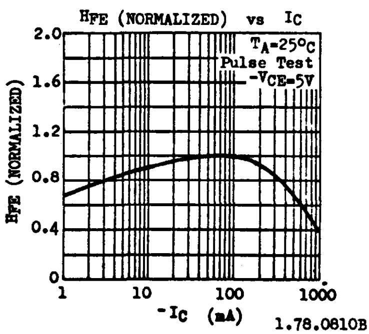
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$				$-I_C=0.01mA$ $I_E=0$
2N4030, 2N4032		60		V	
2N4031, 2N4033		80		V	
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *				$-I_C=10mA$ $I_B=0$
2N4030, 2N4032		60		V	
2N4031, 2N4033		80		V	
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5		V	$-I_E=0.01mA$ $I_C=0$
Collector Cutoff Current	$-I_{CBO}$				
2N4030, 2N4032			50	nA	$-V_{CB}=50V$ $I_E=0$
2N4031, 2N4033			50	nA	$-V_{CB}=60V$ $I_E=0$
Collector Cutoff Current	$-I_{CBO}$				
2N4030, 2N4032			50	µA	$-V_{CB}=50V$ $I_E=0$ $T_A=150^oC$
2N4031, 2N4033			50	µA	$-V_{CB}=60V$ $I_E=0$ $T_A=150^oC$
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*		0.15	V	$-I_C=150mA$ $-I_B=15mA$
			0.5	V	$-I_C=500mA$ $-I_B=50mA$
2N4030, 2N4032 only	$-V_{CE(sat)}$*		1.0	V	$-I_C=1A$ $-I_B=0.1A$
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$*		0.9	V	$-I_C=150mA$ $-I_B=15mA$
Base-Emitter Voltage	$-V_{BE}$ *		1.1	V	$-I_C=500mA$ $-V_{CE}=0.5V$
2N4030, 2N4032 only			1.2	V	$-I_C=1A$ $-V_{CE}=1V$

PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
D.C. Current Gain					
2N4030, 2N4031 only	H_{FE} *	30			$-I_C=0.1mA$ $-V_{CE}=5V$
		40	120		$-I_C=100mA$ $-V_{CE}=5V$
		25			$-I_C=500mA$ $-V_{CE}=5V$
D.C. Current Gain					
2N4032, 2N4033 only	H_{FE} *	75			$-I_C=0.1mA$ $-V_{CE}=5V$
		100	300		$-I_C=100mA$ $-V_{CE}=5V$
		70			$-I_C=500mA$ $-V_{CE}=5V$
D.C. Current Gain 2N4030	H_{FE} *	15			$-I_C=1A$ $-V_{CE}=5V$
2N4031		10			
2N4032		40			
2N4033		25			
D.C. Current Gain 2N4030, 2N4031	H_{FE} *	15			$-I_C=100mA$ $-V_{CE}=5V$ $T_A=-55°C$
2N4032, 2N4033		40			
Current Gain-Bandwidth Product	f_T				$-I_C=50mA$ $-V_{CE}=10V$
2N4030, 2N4031		100	400	MHz	
2N4032, 2N4033		150	500	MHz	
Collector-Base Capacitance	Cob		20	pF	$-V_{CB}=10V$ $I_E=0$ $f=1MHz$
Emitter-Base Capacitance	Cib		110	pF	$-V_{EB}=0.5V$ $I_C=0$ $f=1MHz$
Turn-On Time	ton		100	nS	$-I_C=500mA$ $-I_{B1}=50mA$
Storage Time	t_s		350	nS	$-I_C=500mA$ $-I_{B1}=I_{B2}=50mA$
Fall Time	t_f		50	nS	$-I_C=500mA$ $-I_{B1}=I_{B2}=50mA$

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%







1.78.0810B

2N4234 2N4235 2N4237 2N4238

COMPLEMENTARY
SILICON AF MEDIUM POWER AMPLIFIERS & SWITCHES

THE 2N4234, 2N4235 (PNP) AND 2N4237, 2N4238 (NPN) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF MEDIUM POWER DRIVERS AND OUTPUTS, AS WELL AS FOR SWITCHING APPLICATIONS ABOVE 1 AMPERE. THEY FEATURE LOW COLLECTOR-EMITTER SATURATION VOLTAGE (0.6V MAX @ I_C=1A).

CASE TO-39

C B
E

ABSOLUTE MAXIMUM RATINGS

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

		(PNP) 2N4234	(PNP) 2N4235	(NPN) 2N4237	(NPN) 2N4238
Collector-Base Voltage	V_{CBO}	40V	60V	50V	80V
Collector-Emitter Voltage	V_{CEO}	40V	60V	40V	60V
Emitter-Base Voltage	V_{EBO}	7V	7V	6V	6V
Collector Current	I_C	3A	3A	3A**	3A**
Total Power Dissipation ($T_C \leqslant 25^oC$)	P_{tot}	←6W, derate 34mW/^{o}C above 25^{o}C→			
($T_A \leqslant 25^oC$)		←1W, derate 5.7mW/^{o}C above 25^{o}C→			
Operating Junction & Storage Temperature	T_j, T_{stg}	-65 to 200^{o}C			

** 1A in JEDEC Registration

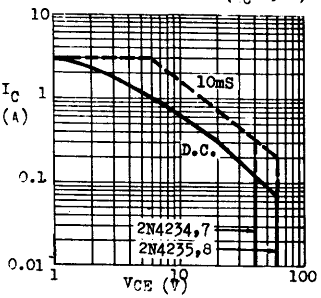
ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

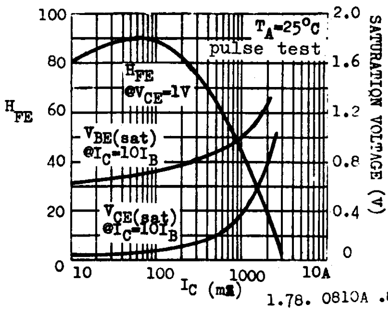
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}*					I_C=100mA I_B=0
2N4234, 2N4237		40			V	
2N4235, 2N4238		60			V	
Collector Cutoff Current	I_{CEV}					
2N4234				0.1	mA	V_{CE}=40V V_{EB}=1.5V
2N4235				0.1	mA	V_{CE}=60V V_{EB}=1.5V
2N4237				0.1	mA	V_{CE}=45V V_{EB}=1.5V
2N4238				0.1	mA	V_{CE}=75V V_{EB}=1.5V
Collector Cutoff Current	I_{CEV}					
2N4234				1	mA	V_{CE}=30V V_{EB}=1.5V T_A=150^{o}C
2N4235				1	mA	V_{CE}=40V V_{EB}=1.5V T_A=150^{o}C
2N4237				1	mA	V_{CE}=30V V_{EB}=1.5V T_A=150^{o}C
2N4238				1	mA	V_{CE}=50V V_{EB}=1.5V T_A=150^{o}C
Collector Cutoff Current	I_{CBO}			0.1		mA	V_{CB}=V_{CBO} I_E=0

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector Cutoff Current	I_{CEO}					
2N4234				1	mA	V_{CE}=30V I_B=0
2N4235				1	mA	V_{CE}=40V I_B=0
2N4237				0.7	mA	V_{CE}=40V I_B=0
2N4238				0.7	mA	V_{CE}=60V I_B=0
Emitter Cutoff Current	I_{EBO}			0.5	mA	V_{EB}=V_{EBO} I_C=0
Collector-Emitter Saturation Voltage 2N4234, 2N4235 only	$V_{CE}(sat)$*		0.35	0.6	V	I_C=1A I_B=125mA
Collector-Emitter Saturation Voltage 2N4237, 2N4238 only	$V_{CE}(sat)$*		0.18	0.3	V	I_C=500mA I_B=50mA
			0.35	0.6	V	I_C=1A I_B=0.1A
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.0	1.5	V	I_C=1A I_B=0.1A
Base-Emitter Voltage	V_{BE}*		0.78	1.0	V	I_C=250mA V_{CE}=1V
D.C. Current Gain 2N4234, 2N4235 only	H_{FE}*	40				I_C=100mA V_{CE}=1V
		30		150		I_C=250mA V_{CE}=1V
		20				I_C=500mA V_{CE}=1V
		10				I_C=1A V_{CE}=1V
D.C. Current Gain 2N4237, 2N4238 only	H_{FE}*	30				I_C=50mA V_{CE}=1V
		30		150		I_C=250mA V_{CE}=1V
		30				I_C=500mA V_{CE}=1V
		15				I_C=1A V_{CE}=1V
Current Gain-Bandwidth Product	f_T					
2N4234, 2N4235		3	70		MHz	I_C=100mA V_{CE}=10V
2N4237, 2N4238		2	70		MHz	I_C=100mA V_{CE}=10V
Collector-Base Capacitance	Cob			100	pF	V_{CB}=10V I_E=0 f=100KHz
Small Signal Current Gain	h_{fe}					
2N4234, 2N4235		25				I_C=50mA V_{CE}=10V f=1KHz
2N4237, 2N4238		30				I_C=100mA V_{CE}=10V f=1KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

SAFE OPERATING AREA(T_C=25°C)





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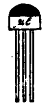
2N4248 2N4249 2N4250

PNP SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2N4248, 2N4249, 2N4250 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF LOW NOISE PREAMPLIFIER APPLICATIONS. THEY ARE SUPPLIED IN CASE TO-106. TO-92A EQUIVALENTS (PN4248, PN4249, PN4250) ARE ALSO AVAILABLE.

CASE TO-106



CBE

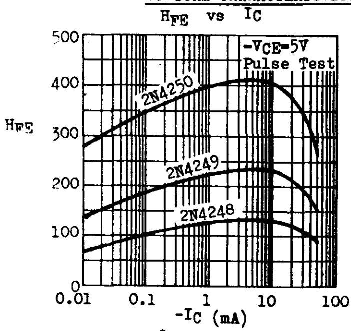
ABSOLUTE MAXIMUM RATINGS		2N4248	2N4250	2N4249
Collector-Base Voltage	$-V_{CBO}$	40V	40V	60V
Collector-Emitter Voltage	$-V_{CEO}$	40V	40V	60V
Emitter-Base Voltage	$-V_{EBO}$	5V	5V	5V
Collector Current	$-I_C$		50mA	
Total Power Dissipation ($T_C \leq 65^oC$)	P_{tot}		300mW	
($T_A \leq 25^oC$)			200mW	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 125°C	

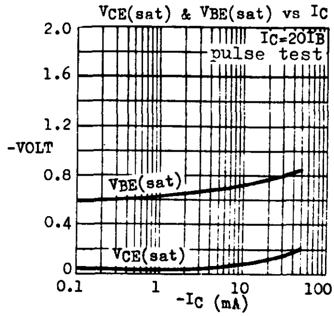
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

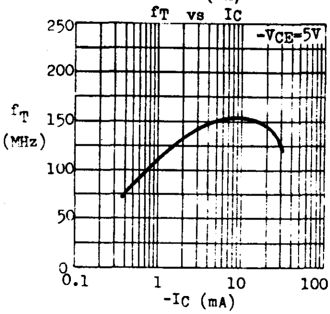
PARAMETER	SYMBOL	2N4248 MIN	2N4248 MAX	2N4249 MIN	2N4249 MAX	2N4250 MIN	2N4250 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	40		60		40		V	$-I_C$=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	$-BV_{CES}$	40		60		40		V	$-I_C$=0.01mA V_{BE}=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$	40		60		40		V	$-I_C$=5mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5		5		5		V	$-I_E$=0.01mA I_C=0
Collector Cutoff Current	$-I_{CBO}$		10 3		10 3		10 3	nA µA	$-V_{CB}$=40V I_E=0 $-V_{CB}$=40V I_E=0 T_A=65°C
Emitter Cutoff Current	$-I_{EBO}$		20		20		20	nA	$-V_{EB}$=3V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$		0.25		0.25		0.25	V	$-I_C$=10mA $-I_B$=0.5mA
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$		0.9		0.9		0.9	V	$-I_C$=10mA $-I_B$=0.5mA
D.C. Current Gain	H_{FE}	50 50 50		100 100 100	300	250 250 250	700		$-I_C$=100µA $-V_{CE}$=5V $-I_C$=1mA $-V_{CE}$=5V $-I_C$=10mA $-V_{CE}$=5V

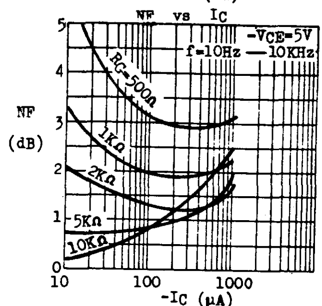
PARAMETER	SYMBOL	2N4248 MIN	2N4248 MAX	2N4249 MIN	2N4249 MAX	2N4250 MIN	2N4250 MAX	UNIT	TEST CONDITIONS
Small Signal Current Gain	h_{fe}	50	1000	100	550	250	800		$-I_C$=1mA $-V_{CE}$=5V f=1kHz
Input Impedance	h_{ie}			2.5	17	6	20	KΩ	$-I_C$=1mA $-V_{CE}$=5V f=1kHz
Output Admittance	h_{oe}			5	40	5	50	μ℧	$-I_C$=1mA $-V_{CE}$=5V f=1kHz
Voltage Feedback Ratio	h_{re}				10		10	$x10^{-4}$	$-I_C$=1mA $-V_{CE}$=5V f=1kHz
Current Gain-Bandwidth Product	f_T	40		40		50		MHz	$-I_C$=0.5mA $-V_{CE}$=5V
Collector-Base Capacitance	Cob		6		6		6	pF	$-V_{CB}$=5V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib		16		16		16	pF	$-V_{EB}$=0.5V I_C=0 f=1MHz
Noise Figure	NF				3		2	dB	$-I_C$=20μA $-V_{CE}$=5V R_G=10KΩ f=1kHz
					3		2	dB	$-I_C$=20μA $-V_{CE}$=5V R_G=10KΩ f=10Hz-10kHz
					3		2	dB	$-I_C$=250μA $-V_{CE}$=5V R_G=1KΩ f=1kHz

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)









1.78.0450B/0430B

2N4400 2N4401

NPN SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

CASE TO-92A

EBC

THE 2N4400, 2N4401 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS. THEY ARE COMPLEMENTARY TO THE PNP TYPE 2N4402 AND 2N4403 RESPECTIVELY.

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	60V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	6V
Collector Current	I_C	0.6A
Total Power Dissipation ($T_A \leqslant 25^oC$)	P_{tot}	500mW **
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

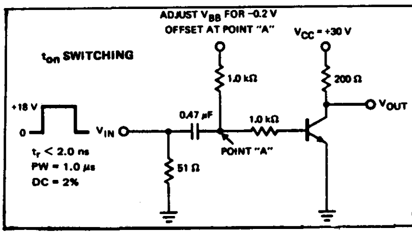
** 310mW in JEDEC registration.

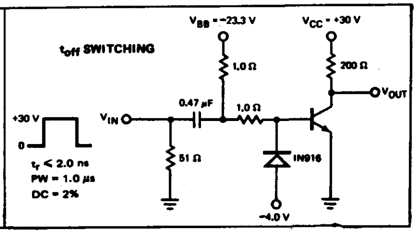
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N4400 MIN	2N4400 MAX	2N4401 MIN	2N4401 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60		60		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40		40		V	I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		6		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CEV}		0.1		0.1	μA	V_{CE}=35V V_{EB}=0.4V
Base Cutoff Current	I_{BL}		0.1		0.1	μA	V_{CE}=35V V_{EB}=0.4V
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.4		0.4	V	I_C=150mA I_B=15mA
			0.75		0.75	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*	0.75	0.95	0.75	0.95	V	I_C=150mA I_B=15mA
			1.2		1.2	V	I_C=500mA I_B=50mA
D.C. Current Gain	H_{FE} *			20			I_C=0.1mA V_{CE}=1V
		20		40			I_C=1mA V_{CE}=1V
		40		80			I_C=10mA V_{CE}=1V
		50	150	100	300		I_C=150mA V_{CE}=1V
		20		40			I_C=500mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	200		250		MHz	I_C=20mA V_{CE}=10V

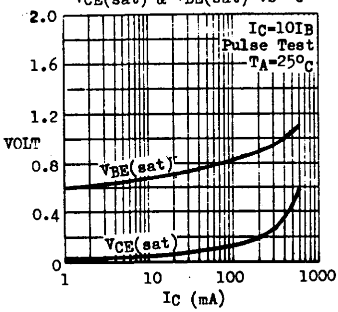
PARAMETER	SYMBOL	2N4400 MIN	2N4400 MAX	2N4401 MIN	2N4401 MAX	UNIT	TEST CONDITIONS
Collector-Base Capacitance	Cob		6.5		6.5	pF	V_{CB}=5V I_E=0 f=140kHz
Emitter-Base Capacitance	Cib		30		30	pF	V_{EB}=0.5V I_C=0 f=140kHz
Input Impedance	h_{ie}	0.5	7.5	1.0	15	KΩ	I_C=1mA V_{CE}=10V f=1kHz
Voltage Feedback Ratio	h_{re}	0.1	8.0	0.1	8.0	$x10^{-4}$	I_C=1mA V_{CE}=10V f=1kHz
Small Signal Current Gain	h_{fe}	20	250	40	500		I_C=1mA V_{CE}=10V f=1kHz
Output Admittance	h_{oe}	1	30	1	30	μ℧	I_C=1mA V_{CE}=10V f=1kHz
Delay Time	t_d		15		15	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
Rise Time	t_r		20		20	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
Storage Time	t_s		225		225	nS	I_C=150mA I_{B1}=$-I_{B2}$=15mA V_{CC}=30V
Fall Time	t_f		30		30	nS	I_C=150mA I_{B1}=$-I_{B2}$=15mA V_{CC}=30V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

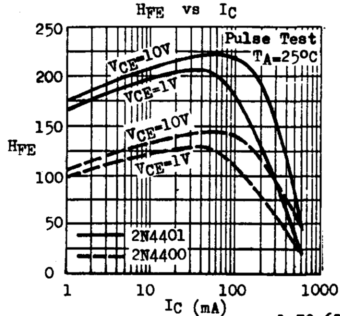




V_{CE}(sat) & V_{BE}(sat) vs I_C



H_{FE} vs I_C



1.78.6500B

2N4402 2N4403

PNP SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

THE 2N4402, 2N4403 ARE PNP SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS. THEY ARE COMPLEMENTARY TO THE NPN TYPE 2N4400 AND 2N4401 RESPECTIVELY.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	$-V_{CBO}$	40V
Collector-Emitter Voltage	$-V_{CEO}$	40V
Emitter-Base Voltage	$-V_{EBO}$	5V
Collector Current	$-I_C$	0.6A
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	500mW **
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

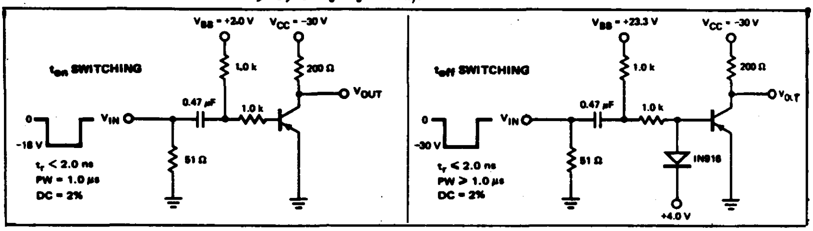
** 310mW in JEDEC registration.

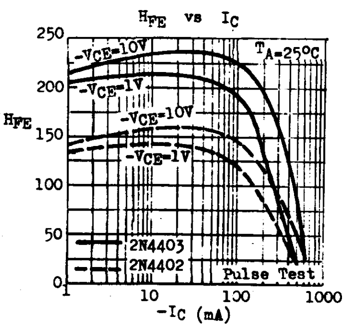
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

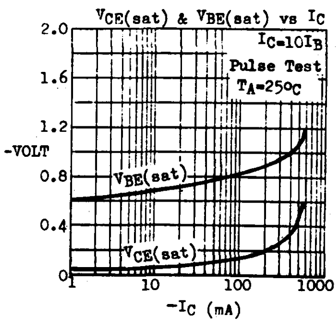
PARAMETER	SYMBOL	2N4402 MIN	2N4402 MAX	2N4403 MIN	2N4403 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$	40		40		V	$-I_C$=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *	40		40		V	$-I_C$=1mA I_B=0
Emitter-Base Breakdown Voltage	$-BV_{EBO}$	5		5		V	$-I_E$=0.1mA I_C=0
Collector Cutoff Current	$-I_{CEV}$		0.1		0.1	µA	$-V_{CE}$=35V $-V_{EB}$=0.4V
Base Cutoff Current	$-I_{BL}$		0.1		0.1	µA	$-V_{CE}$=35V $-V_{EB}$=0.4V
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$*		0.4 0.75		0.4 0.75	V V	$-I_C$=150mA $-I_B$=15mA $-I_C$=500mA $-I_B$=50mA
Base-Emitter Saturation Voltage	$-V_{BE(sat)}$*	0.75	0.95 1.3	0.75	0.95 1.3	V V	$-I_C$=150mA $-I_B$=15mA $-I_C$=500mA $-I_B$=50mA
D.C. Current Gain	H_{FE} *	 30 50 50 20	 150 	30 60 100 100 20	 300 		$-I_C$=0.1mA $-V_{CE}$=1V $-I_C$=1mA $-V_{CE}$=1V $-I_C$=10mA $-V_{CE}$=1V $-I_C$=150mA $-V_{CE}$=2V $-I_C$=500mA $-V_{CE}$=2V
Current Gain-Bandwidth Product	f_T	150		200		MHz	$-I_C$=20mA $-V_{CE}$=10V

PARAMETER	SYMBOL	2N4402 MIN	2N4402 MAX	2N4403 MIN	2N4403 MAX	UNIT	TEST CONDITIONS
Collector-Base Capacitance	Cob		8.5		8.5	pF	$-V_{CB}=10V$ $I_E=0$ f=140kHz
Emitter-Base Capacitance	Cib		30		30	pF	$-V_{EB}=0.5V$ $I_C=0$ f=140kHz
Input Impedance	hie	0.75	7.5	1.5	15	KΩ	$-I_C=1mA$ $-V_{CE}=10V$ f=1kHz
Voltage Feedback Ratio	h_{re}	0.1	8.0	0.1	8.0	$x10^{-4}$	$-I_C=1mA$ $-V_{CE}=10V$ f=1kHz
Small Signal Current Gain	h_{fe}	30	250	60	500		$-I_C=1mA$ $-V_{CE}=10V$ f=1kHz
Output Admittance	h_{oe}	1	100	1	100	$\mu℧$	$-I_C=1mA$ $-V_{CE}=10V$ f=1kHz
Delay Time	td		15		15	nS	$-I_C=150mA$ $-I_{B1}=15mA$ $-V_{CC}=30V$
Rise Time	t_r		20		20	nS	$-I_C=150mA$ $-I_{B1}=15mA$ $-V_{CC}=30V$
Storage Time	t_s		225		225	nS	$-I_C=150mA$ $-I_{B1}=I_{B2}=15mA$ $-V_{CC}=30V$
Fall Time	t_f		30		30	nS	$-I_C=150mA$ $-I_{B1}=I_{B2}=15mA$ $-V_{CC}=30V$

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%







1.78.0650B

2N4926 2N4927

NPN SILICON HIGH VOLTAGE AMPLIFIERS

THE 2N4926, 2N4927 ARE NPN SILICON PLANAR TRANSISTORS DESIGNED FOR HIGH VOLTAGE MEDIUM POWER AMPLIFIERS AND SWITCHING APPLICATIONS.

CASE TO-39

ABSOLUTE MAXIMUM RATINGS		2N4926	2N4927
Collector-Base Voltage	V_{CBO}	200V	250V
Collector-Emitter Voltage	V_{CEO}	200V	250V
Emitter-Base Voltage	V_{EBO}	7V	7V
Collector Current	I_C	100mA **	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	5W	
($T_A \leq 25^oC$)		1W	
Operating Junction & Storage	T_j, T_{stg}	-65 to 200°C	

** 50mA in JEDEC registration.

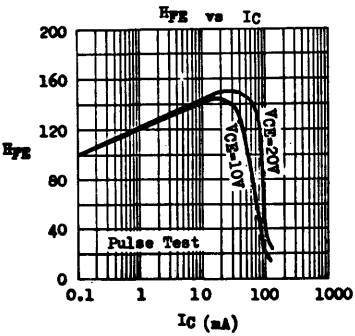
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

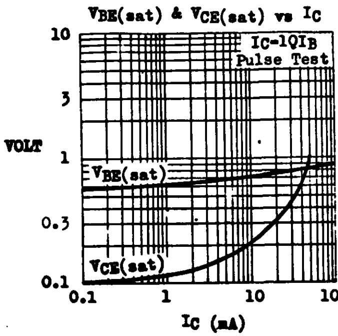
PARAMETER	SYMBOL	2N4926 MIN	2N4926 MAX	2N4927 MIN	2N4927 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	200		250		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}*	200		250		V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	7		7		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		0.1			µA	V_{CB}=100V I_E=0
			10			µA	V_{CB}=100V I_E=0 T_A=100°C
					0.1	µA	V_{CB}=150V I_E=0
					10	µA	V_{CB}=150V I_E=0 T_A=100°C
Emitter Cutoff Current	I_{EBO}				0.1	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		1		1	V	I_C=10mA I_B=1mA
			2		2	V	I_C=30mA I_B=3mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		1.2		1.2	V	I_C=10mA I_B=1mA
			1.5		1.5	V	I_C=50mA I_B=3mA
Base-Emitter Voltage	V_{BE} *		1.5		1.5	V	I_C=30mA V_{CE}=10V
D.C. Current Gain	H_{FE} *	10		10			I_C=3mA V_{CE}=10V
		15		15			I_C=10mA V_{CE}=10V
		20	200	20	200		I_C=30mA V_{CE}=10V
		20		20			I_C=50mA V_{CE}=20V

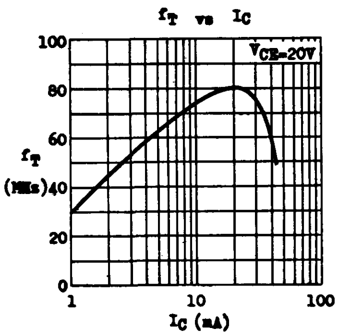
PARAMETER	SYMBOL	2N4926 MIN	2N4926 MAX	2N4927 MIN	2N4927 MAX	UNIT	TEST CONDITIONS
Current Gain-Bandwidth Product	f_T	30	300	30	300	MHz	I_C=10mA V_{CE}=20V
Collector-Base Capacitance	Cob		6		6	pF	V_{CB}=20V I_E=0 f=140kHz
Input Impedance	hie	75	2000	75	2000	ohms	I_C=10mA V_{CE}=10V f=1kHz
Voltage Feedback Ratio	hre	0.1	2	0.1	2	$x10^{-4}$	I_C=10mA V_{CE}=10V f=1kHz
Small Signal Current Gain	hfe	25	250	25	250		I_C=10mA V_{CE}=10V f=1kHz
Output Admittance	hoe		50		50	μ℧	I_C=10mA V_{CE}=10V f=1kHz
Real Part of Input Impedance	Re$\lvert h_{ie}\rvert$	4	200	4	200	ohms	I_C=10mA V_{CE}=20V f=5MHz

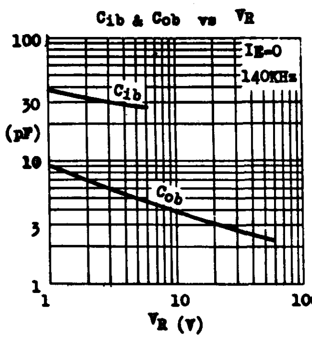
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

TYPICAL CHARACTERISTICS AT T_A=25°C









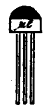
2.78.7300B

2N4964 through 2N4968

PNP NPN SILICON AF SMALL SIGNAL TRANSISTORS

THE 2N4964, 5 (PNP) AND 2N4966, 7, 8 (NPN) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIERS AND DIRECT COUPLED CIRCUITS.

CASE TO-106



CBE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		(PNP) 2N4964,5	(NPN) 2N4966,7	(NPN) 2N4968
Collector-Base Voltage	V_{CBO}	50V	50V	30V
Collector-Emitter Voltage	V_{CEO}	40V	40V	25V
Emitter-Base Voltage	V_{EBO}	5V	6V	6V
Collector Current	I_C	100mA	100mA**	100mA**
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}		200mW	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 125°C	

** 30mA in JEDEC registration.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

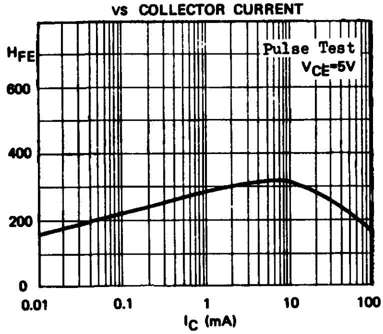
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	↑				I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	Note 1				I_C= 10mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	↓				I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}					
2N4964,5				25	nA	V_{CB}=20V I_E=0
2N4966,7				25	nA	V_{CB}=25V I_E=0
2N4968				50	nA	V_{CB}=25V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.08	0.4	V	I_C=10mA I_B=0.5mA
Base-Emitter Voltage	V_{BE}		0.68		V	I_C=10mA V_{CE}=5V
D.C. Current Gain	H_{FE}					
2N4964		30		120		I_C=10µA V_{CE}=5V
2N4965		80		400		
2N4966,8		40		200		
2N4967		100		600		
D.C. Current Gain	H_{FE}					
2N4964		40				I_C=10mA V_{CE}=5V
2N4965		100				
2N4966,8		50				
2N4967		120				

Note 1 : equal to the values of absolute maximum ratings.

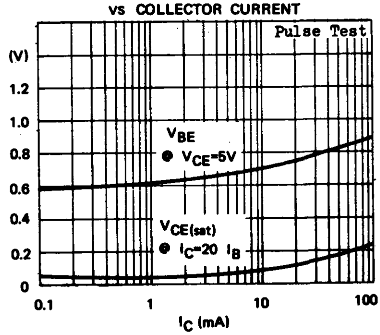
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Current Gain-Bandwidth Product	f_T					I_C=1mA V_{CE}=5V
2N4964,5		60			MHz	
2N4966,7,8		40			MHz	
Collector-Base Capacitance	Cob					V_{CB}=5V I_E=0
2N4964,5			4	8	pF	f=1MHz
2N4966,7,8			3	6	pF	
Noise Figure	NF			6	dB	I_C=10µA V_{CE}=5V R_G=10KΩ f=1KHz

TYPICAL CHARACTERISTICS AT T_A=25°C

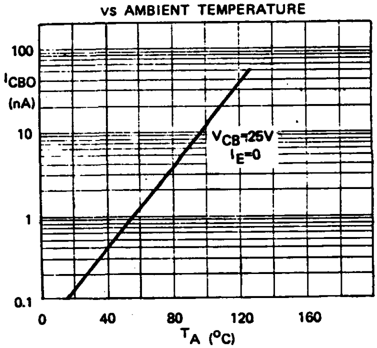
D.C. CURRENT GAIN
VS COLLECTOR CURRENT



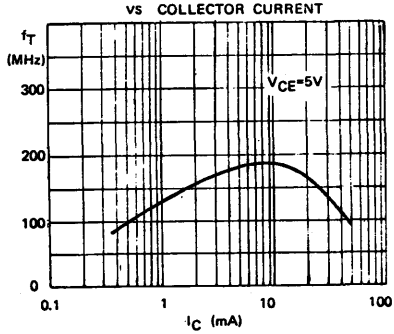
VBE AND VCE(sat)
VS COLLECTOR CURRENT



COLLECTOR CUTOFF CURRENT
VS AMBIENT TEMPERATURE



CURRENT GAIN – BANDWIDTH PRODUCT
VS COLLECTOR CURRENT



2N4994 2N4995

NPN SILICON RF SMALL TRANSISTORS

THE 2N4994, 2N4995 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF & IF SMALL SIGNAL APPLICATIONS.

CASE TO-92F

CEB

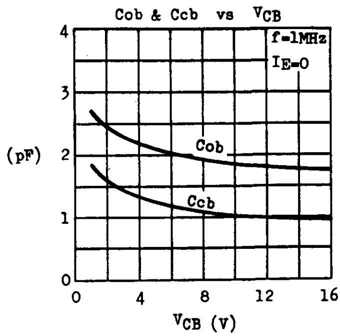
ABSOLUTE MAXIMUM RATINGS

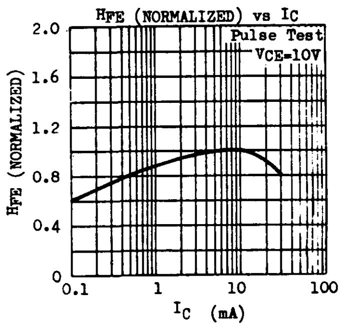
Collector-Base Voltage	V_{CBO}	60V
Collector-Emitter Voltage	V_{CEO}	45V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	30mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	360mW derate 2.88mW/^{o}C above 25^{o}C
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^{o}C

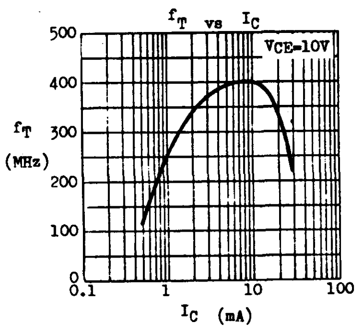
ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

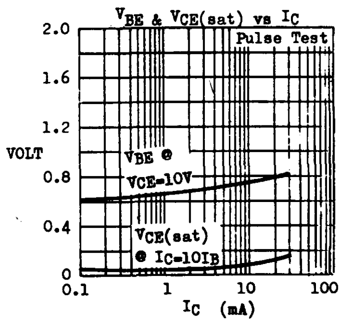
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	60			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	45			V	I_C=10mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	4			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}			100 5	nA µA	V_{CB}=30V I_E=0 V_{CB}=30V I_E=0 T_A=85^{o}C
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.1	0.5	V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}		0.67	0.8	V	I_C=1mA V_{CE}=10V
D.C. Current Gain 2N4994 2N4995	H_{FE}	 40 100	 80 150	 160 400		 I_C=10mA V_{CE}=10V I_C=10mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	200	400	800	MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	C_{cb}		1	3.5	pF	V_{CB}=10V I_E=0 f=1MHz
Feedback Time Constant	$C_c r_{bb'}$		30	100	pS	I_C=10mA V_{CE}=10V f=79.8MHz

TYPICAL CHARACTERISTICS AT $T_A=25^oC$









2N5086 2N5087 2N5088 2N5089

PNP NPN SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2N5086, 2N5087 (PNP) AND 2N5088, 2N5089 (NPN) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF LOW NOISE PREAMPLIFIER CIRCUITS.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		(PNP) 2N5086	(PNP) 2N5087	(NPN) 2N5088	(NPN) 2N5089
Collector-Base Voltage	V_{CBO}	50V	50V	35V	30V
Collector-Emitter Voltage	V_{CEO}	50V	50V	30V	25V
Emitter-Base Voltage	V_{EBO}	3V	3V	4.5V	4.5V
Collector Current	I_C	50mA			
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	350mW derate 2.8mW/^oC above 25^oC			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^oC			

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
2N5086,7		50			V	
2N5088		35			V	
2N5089		30			V	
Collector-Emitter Breakdown Voltage	LV_{CEO}					I_C=1mA (Pulsed) I_B=0
2N5086,7		50			V	
2N5088		30			V	
2N5089		25			V	
Collector Cutoff Current	I_{CBO}					
2N5086,7				10	nA	V_{CB}=10V I_E=0
2N5089				50	nA	V_{CB}=15V I_E=0
2N5088				50	nA	V_{CB}=20V I_E=0
2N5086,7				50	nA	V_{CB}=35V I_E=0
Emitter Cutoff Current	I_{EBO}					
All types				50	nA	V_{EB}=3V I_C=0
2N5088,9 only				100	nA	V_{EB}=4.5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$					I_C=10mA I_B=1mA
2N5086,7			0.08	0.3	V	
2N5088,9			0.08	0.5	V	

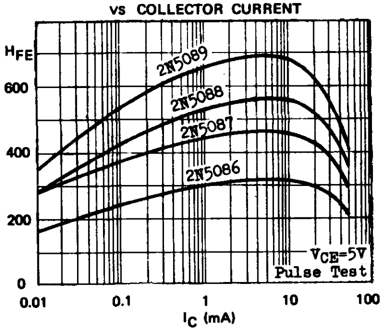
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Base-Emitter Voltage	V_{BE}					
2N5086,7			0.63	0.85	V	I_C=1mA V_{CE}=5V
2N5088, 9			0.7	0.8	V	I_C=10mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T					
2N5086,7		40	80		MHz	I_C=0.5mA V_{CE}=5V
2N5088,9		50	100		MHz	I_C=0.5mA V_{CE}=5V
Collector-Base Capacitance All types	Cob		3	4	pF	V_{CB}=5V I_E=0 f=100KHz
Emitter-Base Capacitance 2N5088,9 only	Cib		7	10	pF	V_{EB}=0.5V I_C=0 f=100KHz
Noise Figure	NF					
2N5086 only				3	dB	I_C=20μA V_{CE}=5V
2N5087 only				2	dB	R_G=10KΩ f=10Hz-15KHz
2N5086 only				3	dB	I_C=100μA V_{CE}=5V
2N5087 only				2	dB	R_G=3KΩ f=1KHz
2N5088 only				3	dB	I_C=100μA V_{CE}=5V
2N5089 only				2	dB	R_G=10KΩ f=10Hz-15KHz

D.C. AND SMALL SIGNAL CURRENT GAIN (H_{FE}, h_{fe}) AT V_{CE}=5V T_A=25°C

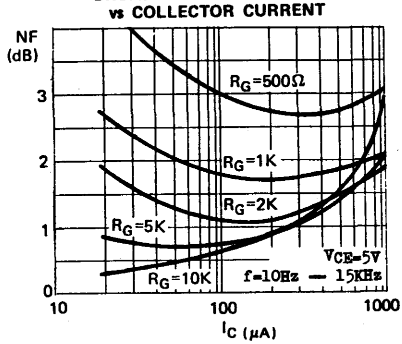
TYPE	H_{FE} @ I_C=0.1mA		H_{FE} @ I_C=1mA		H_{FE} @ I_C=10mA		h_{fe} @ I_C=1mA f=1kHz	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
2N5086	150	500	150		150		150	600
2N5087	250	800	250		250		250	900
2N5088	300	900	350		300		350	1400
2N5089	400	1200	450		400		450	1800

TYPICAL CHARACTERISTICS AT T_A=25°C

D.C. CURRENT GAIN vs COLLECTOR CURRENT



BROAD-BAND NOISE FIGURE vs COLLECTOR CURRENT



2N5209 2N5210

NPN SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2N5209, 2N5210 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF LOW NOISE PREAMPLIFIERS. THEY ARE COMPLEMENTARY TO THE PNP TYPE 2N5086, 2N5087.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS

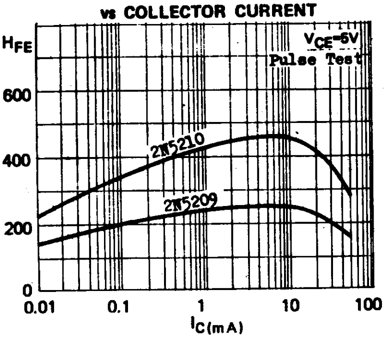
Collector-Base Voltage	V_{CBO}	50V
Collector-Emitter Voltage	V_{CEO}	50V
Emitter-Base Voltage	V_{EBO}	4.5V
Collector Current	I_C	50mA
Total Power Dissipation ($T_A \leqslant 25^oC$)	P_{tot}	350mW derate 2.8mW/^oC above 25^oC
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^oC

ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

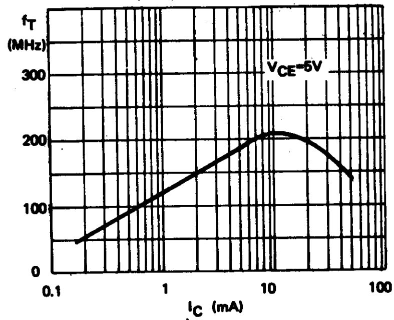
PARAMETER	SYMBOL	2N 5209 MIN	2N 5209 MAX	2N 5210 MIN	2N 5210 MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50		50		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	50		50		V	I_C=1mA (Pulsed) I_B=0
Collector Cutoff Current	I_{CBO}		50		50	nA	V_{CB}=35V I_E=0
Emitter Cutoff Current	I_{EBO}		50		50	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.7		0.7	V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}		0.85		0.85	V	I_C=1mA V_{CE}=5V
D.C. Current Gain	H_{FE}	100 150 150	300	200 250 250	600		I_C=0.1mA V_{CE}=5V I_C=1mA V_{CE}=5V I_C=10mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T	30		30		MHz	I_C=0.5mA V_{CE}=5V
Collector-Base Capacitance	Cob		4		4	pF	V_{CB}=5V I_E=0 f=1MHz
Small Signal Current Gain	hfe	150	600	250	900		I_C=1mA V_{CE}=5V f=1KHz
Noise Figure	NF		3		2	dB	I_C=20μA V_{CE}=5V R_G=22KΩ f=10Hz-15KHz
	NF		4		3	dB	I_C=20μA V_{CE}=5V R_G=10KΩ f=1KHz

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

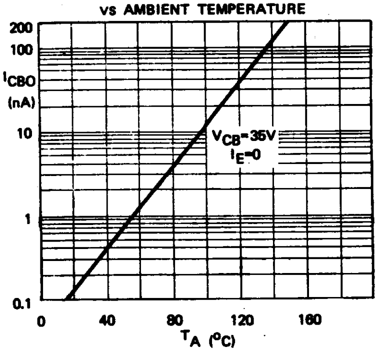
D.C. CURRENT GAIN vs COLLECTOR CURRENT



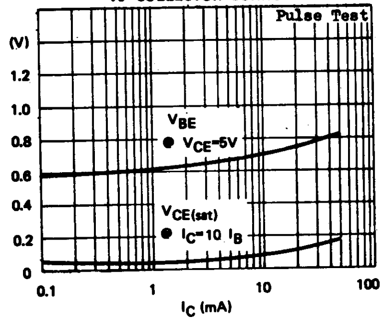
CURRENT GAIN – BANDWIDTH PRODUCT vs COLLECTOR CURRENT



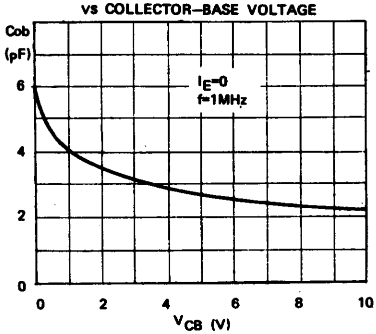
COLLECTOR CUTOFF CURRENT vs AMBIENT TEMPERATURE



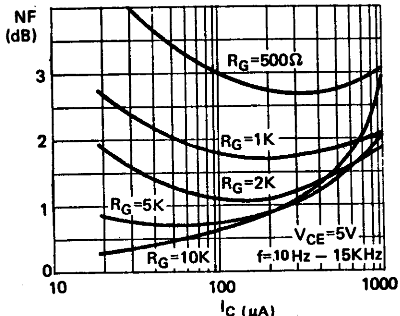
VBE AND VCE(sat) vs COLLECTOR CURRENT



COLLECTOR–BASE CAPACITANCE vs COLLECTOR–BASE VOLTAGE



BROAD-BAND NOISE FIGURE vs COLLECTOR CURRENT



2.78.4500B

2N5294 2N5296 2N5298

NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS

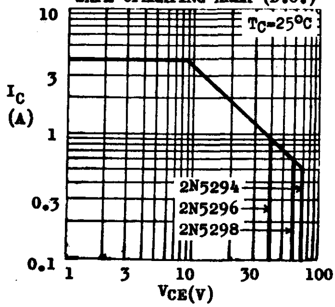
THE 2N 5294, 2N 5296 AND 2N 5298 ARE NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS DESIGNED FOR LOW SPEED SWITCHING AND AUDIO AMPLIFIER APPLICATIONS. THEY FEATURE LARGE SAFE OPERATING AREA.

CASE TO-220B

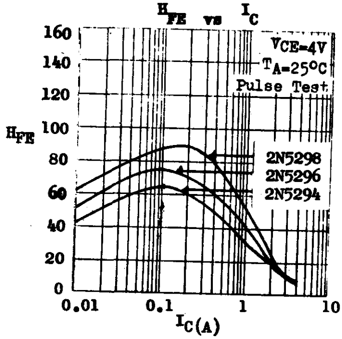
BCE

ABSOLUTE MAXIMUM RATINGS		2N 5294	2N 5296	2N 5298
Collector-Base Voltage	V_{CBO}	80V	60V	80V
Collector-Emitter Voltage	V_{CEO}	70V	40V	60V
Emitter-Base Voltage	V_{EBO}	7V	5V	5V
Collector Current	I_C		4A	
Base Current	I_B		2A	
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}		36W	
@ $T_A \leq 25^oC$			1.8W	
Junction Temperature	T_j		150^oC	
Storage Temperature Range	T_{stg}		-55 to $+150^oC$	
THERMAL RESISTANCE				
Junction to Case	θ_{jc}		$3.5^oC/W$ max.	
Junction to Ambient	θ_{ja}		$70^oC/W$ max.	

SAFE OPERATING AREA (D.C.)



H_{FE} vs I_C



ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}*					I_C=0.1A I_B=0
2N 5294		70			V	
2N 5296		40			V	
2N 5298		60			V	
Collector-Emitter Breakdown Voltage	LV_{CER}*					I_C=0.1A R_{BE}=100Ω
2N 5294		75			V	
2N 5296		50			V	
2N 5298		70			V	
Collector-Emitter Breakdown Voltage	LV_{CEV}*					I_C=0.1A VEB=1.5V
2N 5294/8		80			V	
2N 5296		60			V	
Collector Cutoff Current 2N 5294/8	I_{CER}			0.5	mA	V_{CE}=50V R_{BE}=100Ω
Collector Cutoff Current 2N 5294/8	I_{CER}			2	mA	V_{CE}=50V R_{BE}=100Ω T_C=150°C
Collector Cutoff Current 2N 5294/8	I_{CEV}			0.5	mA	V_{CE}=65V V_{EB}=1.5V
2N 5296				2	mA	V_{CE}=35V V_{EB}=1.5V
Collector Cutoff Current 2N 5294/8	I_{CEV}			3	mA	V_{CE}=65V V_{EB}=1.5V
2N 5296				5	mA	V_{CE}=35V V_{EB}=1.5V T_C=150°C
Emitter Cutoff Current 2N 5294	I_{EBO}			1	mA	V_{EB}=7V I_C=0
2N 5296/8				1	mA	V_{EB}=5V I_C=0
Base-Emitter Voltage 2N 5294	V_{BE} *		0.70	1.1	V	I_C=0.5A V_{CE}=4V
2N 5296			0.80	1.3	V	I_C= 1 A V_{CE}=4V
2N 5298			0.90	1.5	V	I_C=1.5A V_{CE}=4V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*					
2N 5294			0.15	1	V	I_C=0.5A I_B=0.05A
2N 5296			0.20	1	V	I_C= 1 A I_B=0.1 A
2N 5298			0.30	1	V	I_C=1.5A I_B=0.15A
D.C. Current Gain 2N 5294	H_{FE} *	30		120		I_C=0.5A V_{CE}=4V
2N 5296		30		120		I_C= 1 A V_{CE}=4V
2N 5298		20		80		I_C=1.5A V_{CE}=4V
Current Gain-Bandwidth Product	f_T	0.8			MHz	I_C=0.2A V_{CE}=4V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

2N5368 through 2N5375

COMPLEMENTARY SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

COMPLEMENTARY SILICON GENERAL PURPOSE AMPLIFIERS AND SWITCHES

THE ABOVE TYPES ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE AMPLIFIERS AND MEDIUM SPEED SWITCHING APPLICATIONS.

CASE TO-92F

CEB

ABSOLUTE MAXIMUM RATINGS		2N5368(NPN) 2N5369(NPN) 2N5370(NPN)	2N5372(PNP) 2N5373(PNP) 2N5374(PNP)	2N5371(NPN) 2N5375(PNP)
Collector-Base Voltage	V_{CBO}	60V	60V	40V
Collector-Emitter Voltage	V_{CEO}	30V	30V	30V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V
Collector Current	I_C	500mA	500mA	500mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}		500mW ** derate 4mW/°C above 25°C	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 150°C	

** 360mW in JEDEC registration.

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	↑			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	Note 1			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	↓			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}					
2N5368,69,70				50	nA	V_{CB}=40V I_E=0
2N5372,73,74				50	nA	V_{CB}=40V I_E=0
2N5371,75				50	nA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			50	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.18	0.3	V	I_C=150mA I_B=15mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		0.84	1.3	V	I_C=150mA I_B=15mA
Base-Emitter Voltage	V_{BE} *		0.8	1.2	V	I_C=150mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T					
2N5368 thru' 2N5371		250	370		MHz	I_C=20mA V_{CE}=10V
2N5372 thru' 2N5375		150	270		MHz	I_C=20mA V_{CE}=10V
Collector-Base Capacitance	Ccb					
2N5368 thru' 2N5371				8	pF	V_{CB}=10V I_E=0
2N5372 thru' 2N5375				10	pF	f=1MHz

Note 1 : Equal to the values of absolute maximum ratings.

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

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

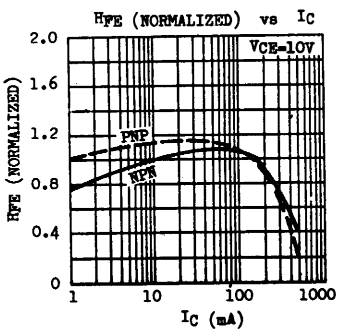
PARAMETER		SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Turn-On Time (Note 2)	2N5368 thru' 2N5371	t_{on}		40	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
	2N5372 thru' 2N5375			50	nS	I_C=150mA I_{B1}=15mA V_{CC}=30V
Turn-Off Time (Note 2)	2N5368,69	t_{off}		350	nS	I_C=150mA I_{B1}=-I_{B2}=15mA
	2N5370,71			400	nS	V_{CC}=30V
	2N5372,73			150	nS	I_C=150mA I_{B1}=-I_{B2}=15mA
	2N5374,75			175	nS	V_{CC}=6V

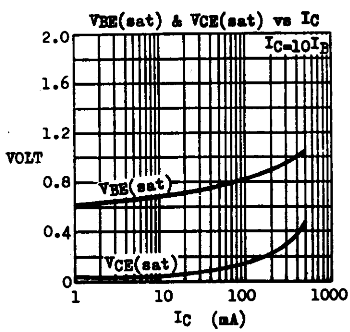
Note 2 : Test circuits referred to 2N2222/2N2907 data sheets.

D.C. CURRENT GAIN (H_{FE}) AT T_A=25°C V_{CE}=10V

	H_{FE} @ I_C=1mA		H_{FE} @ I_C=10mA		H_{FE} @ I_C=150mA	
	MIN	MAX	MIN	MAX	MIN	MAX
2N5368	20		40		60	200
2N5369	50		75		100	300
2N5370	75		150		200	600
2N5371	20		40		60	600
2N5372	20		30		40	120
2N5373	50		75		100	300
2N5374	100		150		200	400
2N5375	20		30		40	400

TYPICAL CHARACTERISTICS (T_A=25°C Pulse Test)





2N5400 2N5401 2N5550 2N5551

COMPLEMENTARY
SILICON GENERAL PURPOSE HIGH VOLTAGE TRANSISTORS

THE 2N5400, 2N5401 (PNP) AND 2N5550, 2N5551 (NPN) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS INTENDED FOR GENERAL PURPOSE HIGH VOLTAGE AMPLIFIER AND SWITCHING APPLICATIONS.

CASE TO-92A

EBC

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

		(PNP) 2N5400	(PNP) 2N5401	(NPN) 2N5550	(NPN) 2N5551
Collector-Base Voltage	V_{CBO}	130V	160V	160V	180V
Collector-Emitter Voltage	V_{CEO}	120V	150V	140V	160V
Emitter-Base Voltage	V_{EBO}	5V	5V	6V	6V
Collector Current	I_C	600mA			
Total Power Dissipation ($T_C \leq 25^oC$)	Ptot	1W derate 8mW/^oC above 25^oC			
($T_A \leq 25^oC$)		350mW derate 2.8mW/^oC above 25^oC			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^oC			

ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

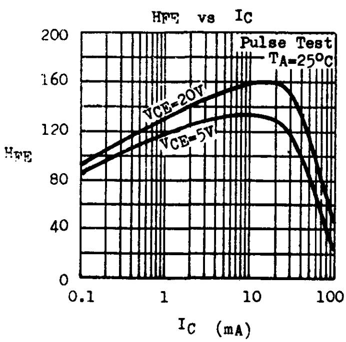
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1			I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	Note 1			I_C=1mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	Note 1			I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}				
2N5400, 5550			100	nA	V_{CB}=100V I_E=0
2N5401, 5551			50	nA	V_{CB}=120V I_E=0
Collector Cutoff Current	I_{CBO}				
2N5400, 5550			100	µA	V_{CB}=100V I_E=0 $T_A=100^oC$
2N5401, 5551			50	µA	V_{CB}=120V I_E=0 $T_A=100^oC$
Emitter Cutoff Current	I_{EBO}				
2N5400, 5401			50	nA	V_{EB}=3V I_C=0
2N5550, 5551			50	nA	V_{EB}=4V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$				
2N5400, 5401			0.2	V	I_C=10mA I_B=1mA
2N5550, 5551			0.15	V	I_C=10mA I_B=1mA

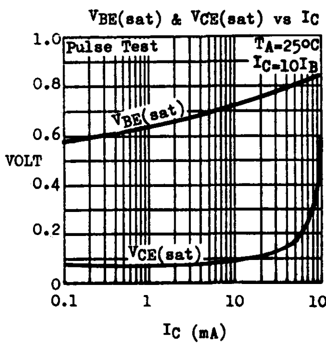
Note 1 : Equal to the values of absolute maximum ratings.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$					
2N5400, 5401				0.5	V	I_C=50mA I_B=5mA
2N5550				0.25	V	I_C=50mA I_B=5mA
2N5551				0.2	V	I_C=50mA I_B=5mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$					
All types				1	V	I_C=10mA I_B=1mA
2N5400, 5401				1	V	I_C=50mA I_B=5mA
2N5550				1.2	V	I_C=50mA I_B=5mA
2N5551				1	V	I_C=50mA I_B=5mA
Current Gain-Bandwidth Product	f_T					
2N5400		100	160	400	MHz	I_C=10mA V_{CE}=10V
2N5401, 5550, 5551		100	160	300	MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		4	6	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib					V_{EB}=0.5V I_C=0 f=1MHz
2N5550 only				30	pF	
2N5551 only				20	pF	
Noise Figure	NF					I_C=250μA V_{CE}=5V R_G=1KΩ f=10Hz-15KHz
2N5400, 5401, 5551 only				8	dB	
2N5550 only				10	dB	

D.C. AND SMALL SIGNAL CURRENT GAIN AT T_A=25°C

TYPE	H_{FE} @ I_C=1mA V_{CE}=5V		H_{FE} @ I_C=10mA V_{CE}=5V		H_{FE} @ I_C=50mA V_{CE}=5V		h_{fe} @ I_C=1mA V_{CE}=10V f=1kHz	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
2N5400	30		40	180	40		30	200
2N5401	50		60	240	50		40	200
2N5550	60		60	250	20		50	200
2N5551	80		80	250	30		50	200





2N5447 through 2N5450

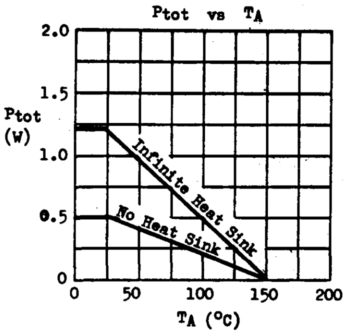
COMPLEMENTARY SILICON GENERAL PURPOSE AF TRANSISTORS

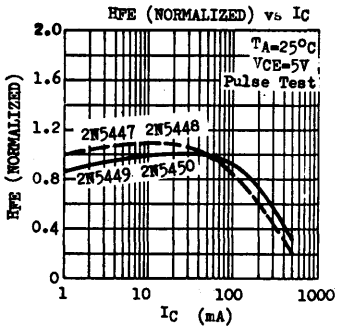
THE 2N5447, 2N5448, 2N5449, 2N5450 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR GENERAL PURPOSE MEDIUM POWER AMPLIFIER APPLICATIONS. THE 2N5447, 2N5448 ARE PNP AND ARE COMPLEMENTARY TO THE NPN 2N5449, 2N5450 RESPECTIVELY.

CASE TO-92F

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.		2N5447(PNP)	2N5448(PNP)	2N5449(NPN) 2N5450(NPN)
Collector-Base Voltage	V_{CBO}	40V	50V	50V
Collector-Emitter Voltage	V_{CEO}	25V	30V	30V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V
Collector Current	I_C	0.2A	0.2A	0.8A
Collector Peak Current ($t \leq 10mS$)	I_{CM}	0.6A	0.6A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}		1.2W	
($T_A \leq 25^oC$)			500mW **	
Operating Junction & Storage Temperature	T_j, T_{stg}		-55 to 150°C	

** 360mW in JEDEC registration.

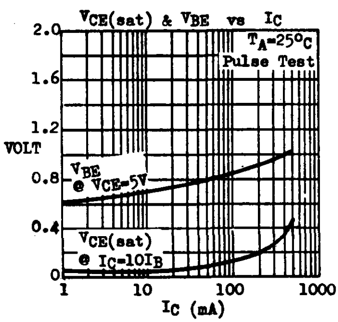


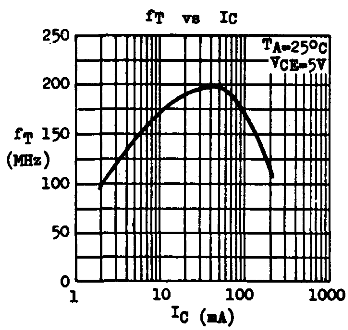


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
2N5447		40			V	
2N5448, 2N5449, 2N5450		50			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=10mA I_B=0
2N5447		25			V	
2N5448, 2N5449, 2N5450		30			V	
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*					
2N5447, 2N5448				0.25	V	I_C=50mA I_B=5mA
2N5449				0.6	V	I_C=100mA I_B=5mA
2N5450				0.8	V	I_C=100mA I_B=5mA
Base-Emitter Voltage	V_{BE} *					
2N5447, 2N5448		0.6		1.0	V	I_C=50mA V_{CE}=5V
2N5449, 2N5450		0.5		1.0	V	I_C=100mA V_{CE}=2V
D.C. Current Gain 2N5447	H_{FE} *	60		300		I_C=50mA V_{CE}=5V
2N5448		30		150		I_C=50mA V_{CE}=5V
2N5449		100		300		I_C=50mA V_{CE}=2V
2N5450		50		150		I_C=50mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T					
2N5447, 2N5448		100			MHz	I_C=50mA V_{CE}=5V
2N5449, 2N5450		100			MHz	I_C=50mA V_{CE}=2V
Collector-Base Capacitance	Cob			12	pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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2N5490 2N5492 2N5494 2N5496

NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS

THE 2N 5490, 2N 5492, 2N 5494 AND 2N 5496 ARE NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS DESIGNED FOR LOW SPEED SWITCHING AND AUDIO AMPLIFIER APPLICATIONS. THEY FEATURE LARGE SAFE OPERATING AREA.

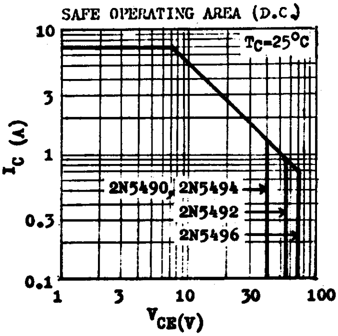
CASE TO-220B

BCE

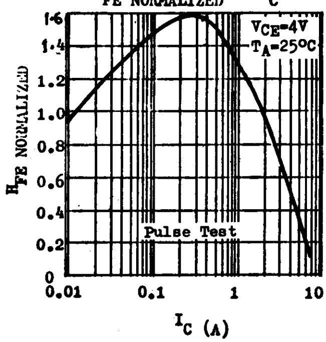
ABSOLUTE MAXIMUM RATINGS		2N5490/4	2N5492	2N5496
Collector-Base Voltage	V_{CBO}	60V	75V	90V
Collector-Emitter Voltage	V_{CEO}	40V	55V	70V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		7A	
Base Current	I_B		3A	
Total Power Dissipation @ $T_C \leq 25^\circ C$	P_{tot}		50W	
@ $T_A \leq 25^\circ C$			1.8W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	2.5°C/W	max.
Junction to Ambient	θ_{ja}	70°C/W	max.

SAFE OPERATING AREA (D.C.)



H_{FE} NORMALIZED vs I_C



ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage		LV_{CEO} *					I_C=0.1A I_B=0
	2N5490/4		40			V	
	2N5492		55			V	
	2N5496		70			V	
Collector-Emitter Breakdown Voltage		LV_{CER} *					I_C=0.1A R_{BE}=100Ω
	2N5490/4		50			V	
	2N5492		65			V	
	2N5496		80			V	
Collector-Emitter Breakdown Voltage		LV_{CEV} *					I_C=0.1A
	2N5490/4		60			V	V_{EB}=1.5V
	2N5492		75			V	
	2N5496		90			V	
Collector Cutoff Current	2N5490	I_{CER}			2	mA	V_{CE}=40V R_{BE}=100Ω
	2N5492				0.5	mA	V_{CE}=55V R_{BE}=100Ω
	2N5494				0.5	mA	V_{CE}=40V R_{BE}=100Ω
	2N5496				0.5	mA	V_{CE}=70V R_{BE}=100Ω
Collector Cutoff Current	2N5490	I_{CER}			5	mA	V_{CE}=40V R_{BE}=100Ω
@ T_C=150°C	2N5492				3.5	mA	V_{CE}=55V R_{BE}=100Ω
	2N5494				3.5	mA	V_{CE}=40V R_{BE}=100Ω
	2N5496				3.5	mA	V_{CE}=70V R_{BE}=100Ω
Collector Cutoff Current	2N5492	I_{CEV}			1	mA	V_{CE}=70V V_{EB}=1.5V
	2N5494				1	mA	V_{CE}=55V V_{EB}=1.5V
	2N5496				1	mA	V_{CE}=85V V_{EB}=1.5V
Collector Cutoff Current	2N5492	I_{CEV}			5	mA	V_{CE}=70V V_{EB}=1.5V
@ T_C=150°C	2N5494				5	mA	V_{CE}=55V V_{EB}=1.5V
	2N5496				5	mA	V_{CE}=85V V_{EB}=1.5V
Emitter Cutoff Current		I_{EBO}			1	mA	V_{EB}=5V I_C=0
Base-Emitter Voltage	2N5490	V_{BE} *		0.83	1.1	V	I_C=2A V_{CE}=4V
	2N5492			0.92	1.3	V	I_C=2.5A V_{CE}=4V
	2N5494			1.0	1.5	V	I_C=3A V_{CE}=4V
	2N5496			1.05	1.7	V	I_C=3.5A V_{CE}=4V
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$ *					
	2N5490			0.25	1	V	I_C=2A I_B=0.2A
	2N5492			0.3	1	V	I_C=2.5A I_B=0.25A
	2N5494			0.35	1	V	I_C=3A I_B=0.3A
	2N5496			0.4	1	V	I_C=3.5A I_B=0.35A
D.C. Current Gain	2N5490	H_{FE} *	20		100		I_C=2A V_{CE}=4V
	2N5492		20		100		I_C=2.5A V_{CE}=4V
	2N5494		20		100		I_C=3A V_{CE}=4V
	2N5496		20		100		I_C=3.5A V_{CE}=4V
Current Gain-Bandwidth Product		f_T	0.8			MHz	I_C=0.5A V_{CE}=4V

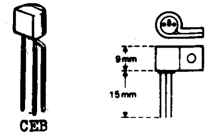
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

2N5810 through 2N5819

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

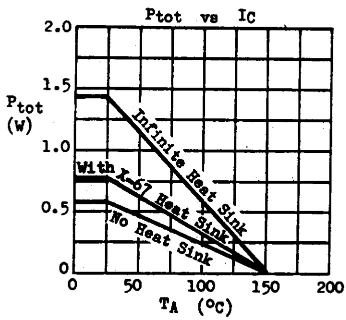
THE 2N5810 THROUGH 2N5819 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVERS AND OUTPUTS, AS WELL AS FOR UNIVERSAL APPLICATIONS. THEY ARE SUPPLIED IN TO-92F PLASTIC CASE WITH OPTIONAL X-67 HEAT SINK. THE 2N5810, 2, 4, 6, 8 ARE NPN AND ARE COMPLEMENTARY TO THE PNP 2N5811, 3, 5, 7, 9.

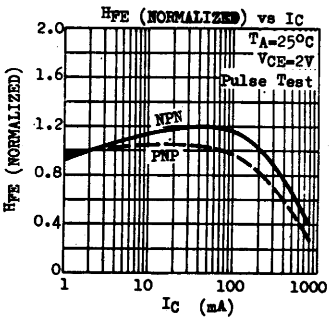
CASE TO-92F LEAD PREFORMED | WITH X-67 HEAT SINK



ABSOLUTE MAXIMUM RATINGS (For p-n-p devices, voltage and current values are negative.)		2N5810, 2(NPN) 2N5811, 3(PNP)	2N5814, 6, 8(NPN) 2N5815, 7, 9(PNP)
Collector-Base Voltage	V_{CBO}	35V	50V
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	35V	50V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	25V	40V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	0.75A	
Collector Peak Current (t≤10mS)	I_{CM}	1.5A	
Total Power Dissipation @ T_C≤25°C	P_{tot}	1.4W	
With X-67 Heat Sink @ T_A≤25°C		800mW	
No Heat Sink @ T_A<25°C		625mW **	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

** 500mW in JEDEC registration.

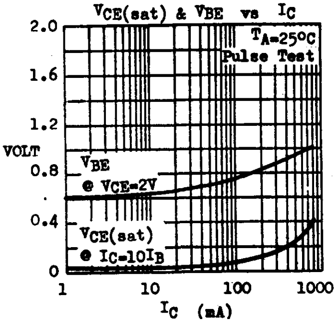


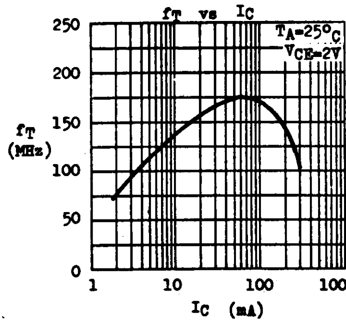


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N5810 thru' 2N5819 MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CES}				I_C=0.01mA V_{BE}=0
2N5810, 1, 2, 3		35		V	
2N5814, 5, 6, 7, 8, 9		50		V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *				I_C=10mA I_B=0
2N5810, 1, 2, 3		25		V	
2N5814, 5, 6, 7, 8, 9		40		V	
Collector Cutoff Current	I_{CBO}		100	nA	V_{CB}=25V I_E=0
			15	µA	V_{CB}=25V I_E=0 T_A=100°C
Emitter Cutoff Current	I_{EBO}		10	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.75	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$*		1.2	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *	0.6	1.1	V	I_C=500mA V_{CE}=2V
D.C. Current Gain	H_{FE} *				I_C=2mA V_{CE}=2V
2N5810, 1		60	200		
2N5812, 3		150	500		
2N5814, 5		60	120		
2N5816, 7		100	200		
2N5818, 9		150	300		
D.C. Current Gain	H_{FE} *				I_C=500mA V_{CE}=2V
2N5810, 1		45			
2N5812, 3		60			
2N5814, 5		20			
2N5816, 7		25			
2N5818, 9		25			
Current Gain-Bandwidth Product	f_T				I_C=50mA V_{CE}=2V
2N5810, 1, 4, 5		100		MHz	
2N5816, 7		120		MHz	
2N5812, 3, 8, 9		135		MHz	
Collector-Base Capacitance	Cob		15	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Cib		55	pF	V_{EB}=0.5V I_C=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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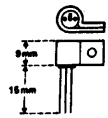
2N5820 through 2N5823

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

THE 2N5820 THROUGH 2N5823 ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF DRIVERS AND OUTPUTS, AS WELL AS FOR UNIVERSAL APPLICATIONS. THEY ARE SUPPLIED IN TO-92F PLASTIC CASE WITH OPTIONAL X-67 HEAT SINK. THE 2N5820, 2N5822 ARE NPN AND ARE COMPLEMENTARY TO THE PNP 2N5821, 2N5823.

CASE TO-92F

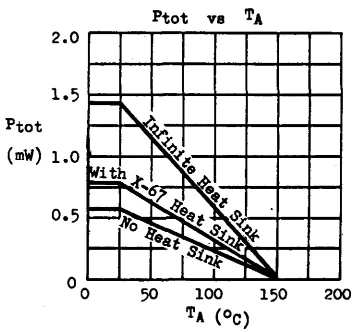
X-67 Heat Sink

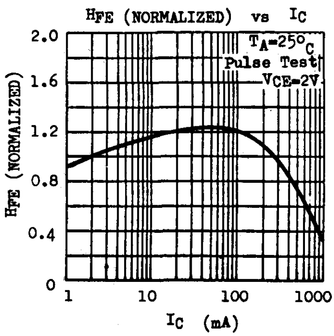


ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		2N5820,2(NPN) 2N5821,3(PNP)
Collector-Base Voltage	V_{CBO}	70V
Collector-Emitter Voltage (V_{BE}=0)	V_{CES}	70V
Collector-Emitter Voltage (I_B=0)	V_{CEO}	60V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	1A **
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	1.4W **
With X-67 Heat Sink ($T_A \leq 25°C$)		800mW**
No Heat Sink ($T_A \leq 25°C$)		625mW**
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

** This exceeds JEDEC registered value.

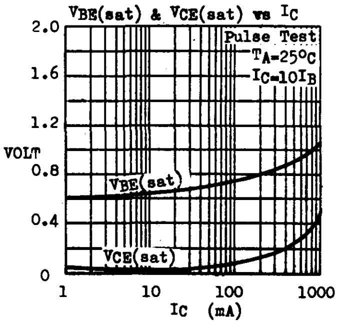


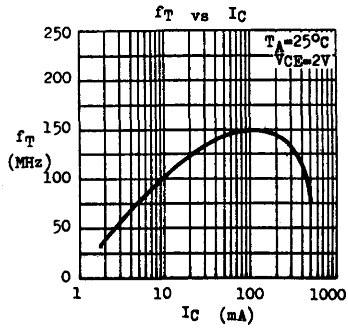


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	BV_{CES}	70			V	I_C=0.01mA V_{BE}=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	60			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=25V I_E=0
				15	μA	V_{CB}=25V I_E=0 T_A=100°C
Emitter Cutoff Current	I_{EBO}			10	μA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.25	0.75	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		0.9	1.2	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *	0.6	0.85	1.1	V	I_C=500mA V_{CE}=2V
D.C. Current Gain	H_{FE} *					
2N5820, 2N5821		60		120		I_C=2mA V_{CE}=2V
2N5822, 2N5823		100		200		I_C=2mA V_{CE}=2V
2N5820, 2N5821		20				I_C=500mA V_{CE}=2V
2N5822, 2N5823		25				I_C=500mA V_{CE}=2V
Collector-Base Capacitance	Ccb			15	pF	V_{CB}=10V I_E=0 f=1MHz
Current Gain-Bandwidth Product	f_T		140		MHz	I_C=50mA V_{CE}=2V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





2N5824 through 2N5828

NPN SILICON AF SMALL SIGNAL TRANSISTORS

THE 2N5824 THROUGH 2N5828 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIERS AND DIRECT COUPLED CIRCUITS.

CASE TO-92F

CEB

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	50V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	100mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	360mW derate 2.88mW/^{o}C above 25^{o}C
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150^{o}C

ELECTRICAL CHARACTERISTICS (T_A=25^{o}C unless otherwise noted)

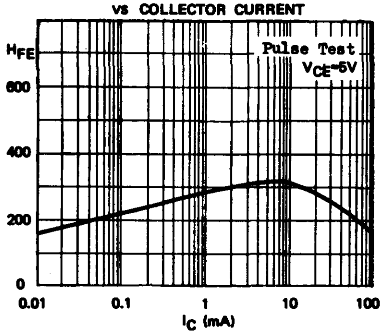
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	40			V	I_C=10mA (Pulsed) I_B=0
Collector Cutoff Current	I_{CBO}			50 10	nA µA	V_{CB}=40V I_E=0 V_{CB}=40V I_E=0 T_A=100^{o}C
Emitter Cutoff Current	I_{EBO}			50	nA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$		0.07	0.125	V	I_C=10mA I_B=1mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$		0.7	0.78	V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}	0.5	0.65	0.9	V	I_C=2mA V_{CE}=10V
Current Gain-Bandwidth Product 2N5824,5,6 2N5827,8	f_T	 90 90		 250 350	 MHz MHz	 I_C=2mA V_{CE}=10V I_C=2mA V_{CE}=10V
Collector-Base Capacitance	Ccb		1.9	4	pF	V_{CB}=10V I_E=0 f=1MHz
Feedback Time Constant 2N5824 2N5825,6 2N5827,8	$C_cr_{bb'}$		 65 80 100		 pS pS pS	I_C=2mA V_{CE}=10V f=31.8MHz

D.C. AND SMALL SIGNAL CURRENT GAIN (H_{FE}, h_{fe}) AT T_A=25°C

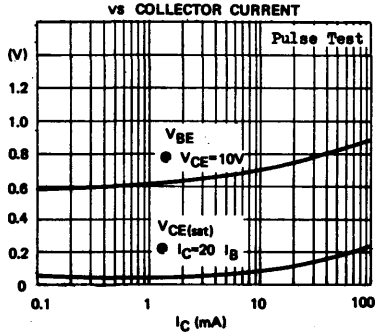
TYPE	H_{FE} @ I_C=2mA V_{CE}=5V MIN	MAX	h_{fe} @ I_C=2mA V_{CE}=5V f=1KHz MIN	MAX
2N5824	60	120	60	180
2N5825	100	200	100	300
2N5826	150	300	150	450
2N5827	250	500	250	750
2N5828	400	800	400	1200

TYPICAL CHARACTERISTICS AT T_A=25°C

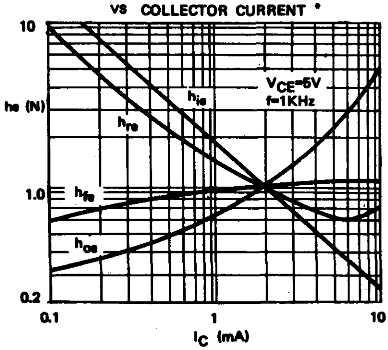
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



VBE AND VCE(sat)
vs COLLECTOR CURRENT



h–PARAMETERS (NORMALIZED)
vs COLLECTOR CURRENT *



*Typical values at I_C=2mA V_{CE}=5V	
H_{FE}(D.C.)	300
h_{ie}(1KHz)	4.5Kohms
h_{fe}(1KHz)	330
h_{re}(1KHz)	2×10^{-4}
h_{oe}(1KHz)	30μmhos

2N6027 2N6028

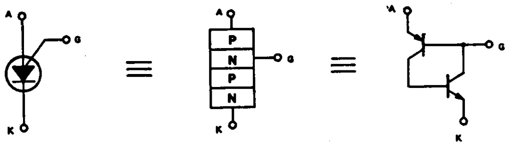
PROGRAMMABLE UNIJUNCTION TRANSISTORS

The Micro Electronics Programmable Unijunction Transistor (PUT) is a three-terminal planar passivated PNPN device in TO-92 package. The terminals are designated as anode, gate and cathode.

The 2N 6027 and 2N 6028 offer outstanding circuit design flexibility. External resistors can be selected to meet designers' needs in programming the unijunction characteristics such as η, R_{BB}, I_P and I_V.

The 2N 6028 is designed for long interval timers and other applications requiring low peak point current. The 2N 6027 is designed for general use where the low peak point current of the 2N 6028 is not essential.

For further information, refer to Application Notes Nos. 143, 144 and 158.



FEATURES

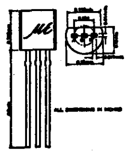
- PROGRAMMABLE η; R_{BB}; I_P; I_V
- LOW LEAKAGE CURRENT
- LOW PEAK POINT CURRENT
- LOW FORWARD VOLTAGE
- HIGH PULSE OUTPUT VOLTAGE
- LOW COST

APPLICATIONS

- OSCILLATORS AND TIMERS
- TRIGGER DEVICES
- LATCHING SWITCHES
- PULSE SHAPING CIRCUITS
- SENSING CIRCUITS

PACKAGE

TO-92



AGK

ABSOLUTE MAXIMUM RATINGS

Voltage	
Gate-Cathode Forward Voltage	+40 V
Gate-Cathode Reverse Voltage	−5 V
Gate-Anode Reverse Voltage	+40 V
Anode-Cathode Voltage	±40 V
Current	
DC Forward Anode Current*	150 mA
Peak Forward Anode Current, Repetitive (100 μsec pulse width, 1% duty cycle)	1 A
(20 μsec pulse width, 1% duty cycle)	2 A
Current	
Peak Forward Anode Current, Non-repetitive (10 μsec pulse)	5 A
DC Gate Current	±20 mA
Capacitive Discharge Energy†	250 μJ
Power	
Total Average Power*	300 mW
Temperature	
Operating Ambient* Temperature Range	−50°C to +100°C

*Derate currents and powers 1%/°C above 25°C

†$E = \frac{1}{2} CV^2$ capacitor discharge energy with no current limiting

ELECTRICAL CHARACTERISTICS AT $T_A = 25°C$ (unless otherwise specified)

CHARACTERISTICS	SYMBOL	FIG. NO.	2N6027 Min.	2N6027 Max.	2N6028 Min.	2N6028 Max.	UNITS	TEST CONDITIONS
Peak Point Current	I_P	1		2		.15	μA	V_S = 10 Volts R_G = 1 MΩ
				5		1.0	μA	V_S = 10 Volts R_G = 10 KΩ
Offset Voltage	V_T	1	.2	1.6	.2	.6	Volts	V_S = 10 Volts R_G = 1 MΩ
			.2	.6	.2	.6	Volts	V_S = 10 Volts R_G = 10 KΩ
Valley Current	I_V	1		50		25	μA	V_S = 10 Volts R_G = 1 MΩ
			70		25		μA	V_S = 10 Volts R_G = 10 KΩ
Gate-Anode Leakage Current	I_{GAO}	2		10		10	nA	V_S = 40 Volts, T_A=25°C
				100		100	nA	T_A=75°C
Gate - Cathode Leakage Current	I_{GKS}	3		100		100	nA	V_S = 40 Volts, V_A = 0
Forward Voltage	V_F	1		1.5		1.5	Volts	I_F = 50 mA
Pulse Output Voltage	V_O	4	6		6		Volts	
Pulse Voltage Rate of Rise	t_r	4		80		80	nsec.	

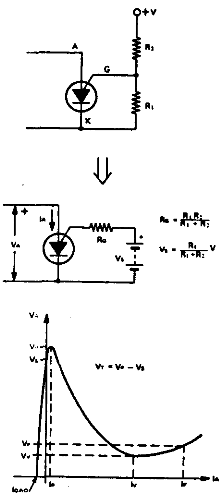


Figure 1

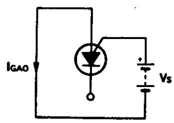


Figure 2

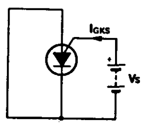


Figure 3

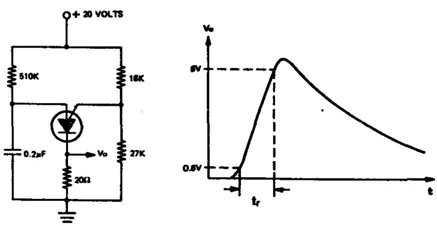
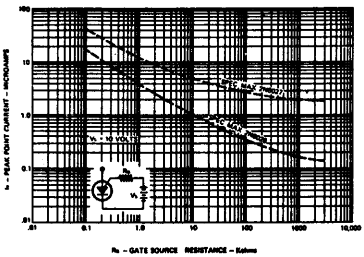
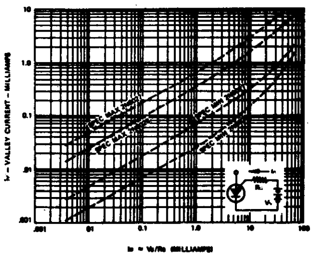


Figure 4

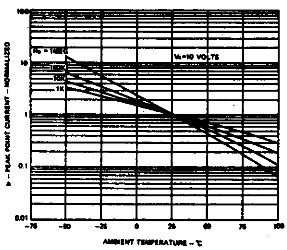
TYPICAL CHARACTERISTICS AT $T_A = 25°C$ (unless otherwise specified)



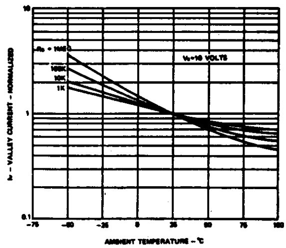
I_P VS GATE SOURCE RESISTANCE



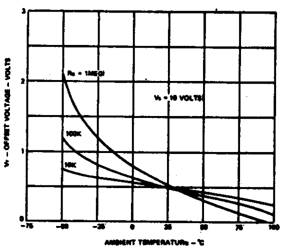
I_V VS "ON STATE" GATE CURRENT



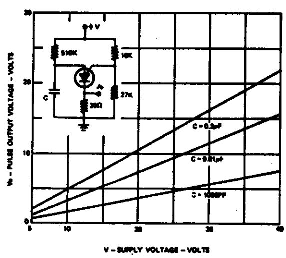
I_P VS TEMPERATURE AND R_G



I_V VS TEMPERATURE AND R_G



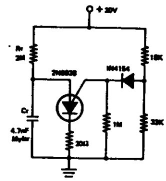
V_T VS TEMPERATURE AND R_G



PULSE OUTPUT VOLTAGE

APPLICATIONS

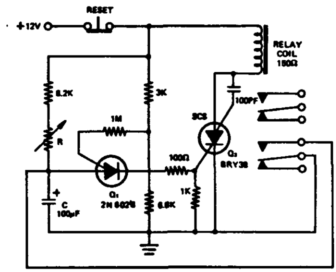
Precision Relaxation Oscillator



The use of the diode 1N4154 and 1 meg resistor at the gate gives low peak point current, therefore reducing the shunting effect of the PUT on C_T during the charging period. The diode also temperature compensates V_{AG} which drifts at about −2.5mV per °C.

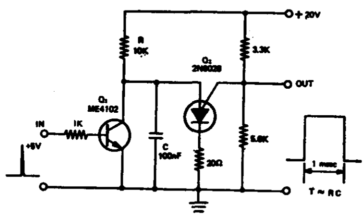
The circuit oscillates at 100Hz which is kept within 1% from −30°C to 75°C.

Ten-minute Time Delay Relay



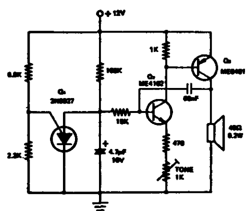
The PUT uses high gate source resistance (1M-ohms) and draws negligible current from the RC network during the delay time. When the SCS is triggered by the PUT, the relay is energized. C is short-circuited by a pair of relay contacts. This condition ensures that accurate timing is repeatable because C is always charged from zero volt after the circuit is reset. Time delay is approximately 10 minutes at R = 4.7 M-ohms.

Monostable Multivibrator



The PUT is normally ON. A positive pulse at the input turns Q_1 on, C is discharged rapidly through the saturation resistance of the collector-emitter junction. The PUT becomes OFF. At the removal of the input pulse, Q_1 is cut off. C is charged through R towards +20V. When the peak point voltage is reached, Q_2 fires and returns to the latching state again due to the large holding current through R.

Warble Alarm Circuit

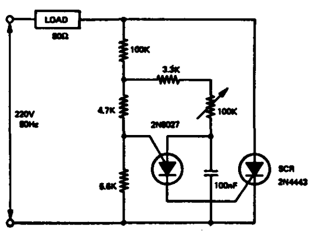


This alarm can be easily heard in noisy background. Q_2 and Q_3 forms a tone generator in which the fundamental frequency is modulated by the sawtooth output of Q_1.

Tone frequency ≈ (500-800)Hz

Sawtooth frequency ≈ 2.5Hz

SCR Phase Control



The conduction angle of the SCR is controlled by the PUT oscillator which is synchronized from the a.c. line. This ensures that the SCR is triggered at the same point on the a.c. cycle each time.

The conduction angle of the SCR can be varied from 30° to 160° by using the 100 k-ohm variable resistor.

2N6111 2N6109 2N6107

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

THE 2N 6111, 2N 6109 AND 2N 6107 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6111, 2N 6109 AND 2N 6107 ARE COMPLEMENTARY TO 2N 6288, 2N 6290 AND 2N 6292 RESPECTIVELY.

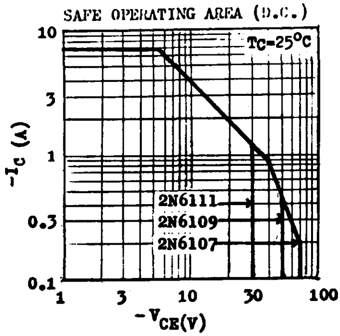
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6111	2N 6109	2N 6107
Collector-Base Voltage	$-V_{CBO}$	40V	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	30V	50V	70V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		7A	
Base Current	$-I_B$		3A	
Total Power Dissipation @ $T_C \leq 25°C$	P_{tot}		40W	
@ $T_A \leq 25°C$			1.8W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

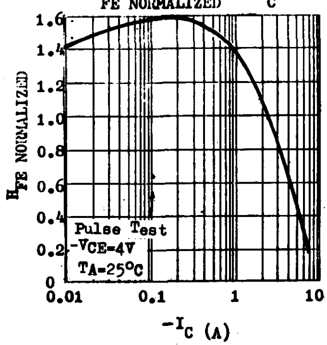
THERMAL RESISTANCE

Junction to Case θ_{jc} 3.12°C/W max.

SAFE OPERATING AREA (D.C.)



H_{FE} NORMALIZED vs I_C



ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=0.1A I_B=0
2N 6111		30			V	
2N 6109		50			V	
2N 6107		70			V	
Collector-Emitter Breakdown Voltage	$-LV_{CER}$ *					$-I_C$=0.1A R_{BE}=100Ω
2N 6111		40			V	
2N 6109		60			V	
2N 6107		80			V	
Collector-Emitter Cutoff Current	$-I_{CEO}$					
2N 6111				1	mA	$-V_{CE}$=20V I_B=0
2N 6109				1	mA	$-V_{CE}$=40V I_B=0
2N 6107				1	mA	$-V_{CE}$=60V I_B=0
Collector-Emitter Cutoff Current	$-I_{CER}$					
2N 6111				0.1	mA	$-V_{CE}$=35V R_{BE}=100Ω
2N 6109				0.1	mA	$-V_{CE}$=55V R_{BE}=100Ω
2N 6107				0.1	mA	$-V_{CE}$=75V R_{BE}=100Ω
2N 6111				2	mA	$-V_{CE}$=30V R_{BE}=100Ω T_C=150°C
2N 6109				2	mA	$-V_{CE}$=50V R_{BE}=100Ω T_C=150°C
2N 6107				2	mA	$-V_{CE}$=70V R_{BE}=100Ω T_C=150°C
Collector-Emitter Cutoff Current	$-I_{CEV}$					
2N 6111				0.1	mA	$-V_{CE}$=37.5V $-V_{EB}$=1.5V
2N 6109				0.1	mA	$-V_{CE}$=56V $-V_{EB}$=1.5V
2N 6107				0.1	mA	$-V_{CE}$=75V $-V_{EB}$=1.5V
2N 6111				2	mA	$-V_{CE}$=30V $-V_{EB}$=1.5V T_C=150°C
2N 6109				2	mA	$-V_{CE}$=50V $-V_{EB}$=1.5V T_C=150°C
2N 6107				2	mA	$-V_{CE}$=70V $-V_{EB}$=1.5V T_C=150°C
Emitter-Base Cutoff Current	$-I_{EBO}$			1	mA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$ *					
2N 6111			0.35	1	V	$-I_C$=3A $-I_B$=0.3A
2N 6109			0.3	1	V	$-I_C$=2.5A $-I_B$=0.25A
2N 6107			0.3	1	V	$-I_C$=2A $-I_B$=0.2A
All types				3.5	V	$-I_C$=7A $-I_B$=3A
Base-Emitter Voltage 2N 6111	$-V_{BE}$ *		1.05	1.5	V	$-I_C$=3A $-V_{CE}$=4V
2N 6109			0.97	1.5	V	$-I_C$=2.5A $-V_{CE}$=4V
2N 6107			0.93	1.5	V	$-I_C$=2A $-V_{CE}$=4V
All types				3	V	$-I_C$=7A $-V_{CE}$=4V
D.C. Current Gain 2N 6111	H_{FE} *	30		150		$-I_C$=3A $-V_{CE}$=4V
2N 6109		30		150		$-I_C$=2.5A $-V_{CE}$=4V
2N 6107		30		150		$-I_C$=2A $-V_{CE}$=4V
All types		2.3				$-I_C$=7A $-V_{CE}$=4V
Current Gain-Bandwidth Product	f_T	10			MHz	$-I_C$=0.5A $-V_{CE}$=4V
Collector-Base Capacitance	Cob			250	pF	$-V_{CB}$=10V I_E=0 f=1MHz
Small Signal Current Gain	h_{fe}	20				$-I_C$=0.5A $-V_{CE}$=4V f=50KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

2N6121 2N6122 2N6123

NPN SILICION EPITAXIAL BASE POWER TRANSISTORS

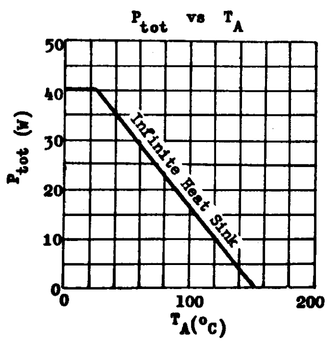
THE 2N 6121, 2N 6122 AND 2N 6123 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6121, 2N 6122, 2N 6123 ARE COMPLEMENTARY TO 2N 6124, 2N 6125, 2N 6126 RESPECTIVELY.

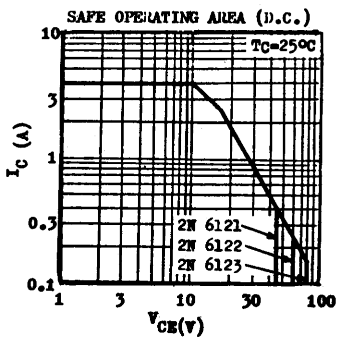
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6121	2N 6122	2N 6123
Collector-Base Voltage	V_{CBO}	45V	60V	80V
Collector-Emitter Voltage	V_{CEO}	45V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		4A	
Base Current	I_B		1A	
Total Power Dissipation ($T_C \leq 25^{\circ}C$)	P_{tot}		40W	
Junction Temperature	T_j		$150^{\circ}C$	
Storage Temperature Range	Tstg		-55 to $+150^{\circ}C$	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	$3.12^{\circ}C/W$ max.

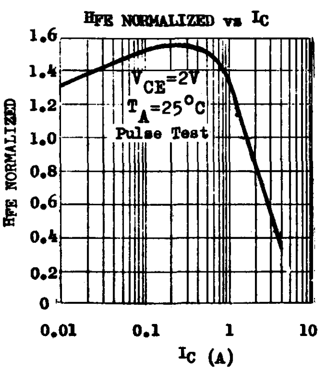


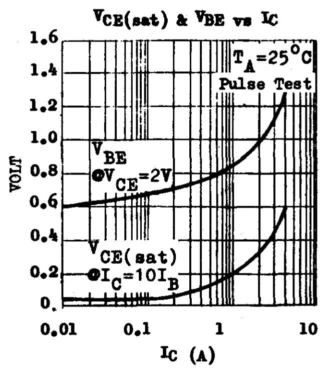


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=0.1A I_B=0
2N 6121		45			V	
2N 6122		60			V	
2N 6123		80			V	
Collector-Base Cutoff Current	I_{CBO}			0.1	mA	V_{CB}=V_{CBO} I_E=0
Collector-Emitter Cutoff Current	I_{CEO}			1	mA	V_{CE}=V_{CEO} I_B=0
Collector-Emitter Cutoff Current	I_{CEV}			0.1	mA	V_{CE}=V_{CEO} V_{EB}=1.5V
				2	mA	V_{CE}=V_{CEO} V_{EB}=1.5V T_C=125°C
Emitter-Base Cutoff Current	I_{EBO}			1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.28	0.6	V	I_C=1.5A I_B=0.15A
				1.4	V	I_C=4A I_B=1A
Base-Emitter Voltage	V_{BE} *		0.87	1.2	V	I_C=1.5A V_{CE}=2V
D.C. Current Gain 2N 6121,6122	H_{FE} *	25		100		I_C=1.5A V_{CE}=2V
2N 6123		20		80		I_C=1.5A V_{CE}=2V
2N 6121,6122	H_{FE} *	10				I_C=4A V_{CE}=2V
2N 6123		7				I_C=4A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	2.5			MHz	I_C=1A V_{CE}=4V
Small Signal Current Gain	h_{fe}	25				I_C=0.1A V_{CE}=2V f=1KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





12.77.8700E

2N6124 2N6125 2N6126

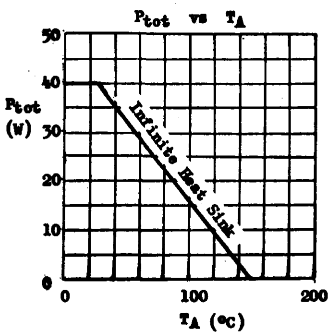
PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

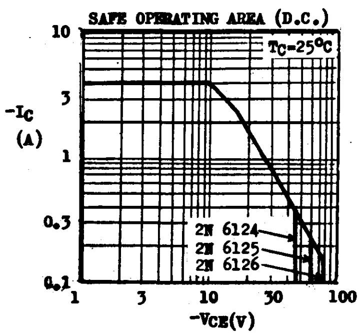
THE 2N 6124, 2N 6125 AND 2N 6126 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6124, 2N 6125, 2N 6126 ARE COMPLEMENTARY TO 2N 6121, 2N 6122, 2N 6123 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6124	2N 6125	2N 6126
Collector-Base Voltage	$-V_{CBO}$	45V	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	45V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		4A	
Base Current	$-I_B$		1A	
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}		40W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	3.12°C/W	max.

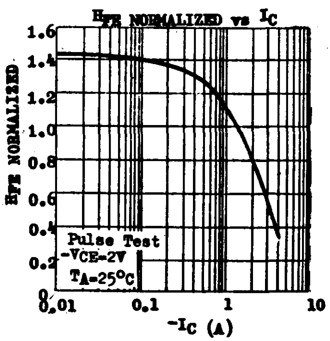


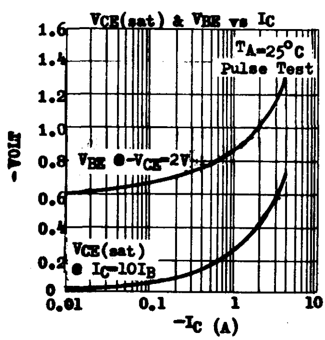


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=0.1A I_B=0
2N 6124		45			V	
2N 6125		60			V	
2N 6126		80			V	
Collector-Base Cutoff Current	$-I_{CBO}$			0.1	mA	V_{CB}=V_{CBO} I_E=0
Collector-Emitter Cutoff Current	$-I_{CEO}$			1	mA	V_{CE}=V_{CEO} I_B=0
Collector-Emitter Cutoff Current	$-I_{CEV}$			0.1	mA	V_{CE}=V_{CEO} $-V_{EB}$=1.5V
				2	mA	V_{CE}=V_{CEO} $-V_{EB}$=1.5V T_C=125°C
Emitter-Base Cutoff Current	$-I_{EBO}$			1	mA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE}(sat)$ *		0.33	0.6	V	$-I_C$=1.5A $-I_B$=0.15A
				1.4	V	$-I_C$=4A $-I_B$=1A
Base-Emitter Voltage	$-V_{BE}$ *		0.9	1.2	V	$-I_C$=1.5A $-V_{CE}$=2V
D.C. Current Gain	H_{FE} *					
2N 6124, 2N 6125		25		100		$-I_C$=1.5A $-V_{CE}$=2V
2N 6126		20		80		$-I_C$=1.5A $-V_{CE}$=2V
2N 6124, 2N 6125	H_{FE} *	10				$-I_C$=4A $-V_{CE}$=2V
2N 6126		7				$-I_C$=4A $-V_{CE}$=2V
Current Gain-Bandwidth Product	f_T	2.5			MHz	$-I_C$=1A $-V_{CE}$=4V
Small Signal Current Gain	h_{fe}	25				$-I_C$=0.1A $-V_{CE}$=2V f=1kHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





12.77.0870E

2N6129 2N6130 2N6131

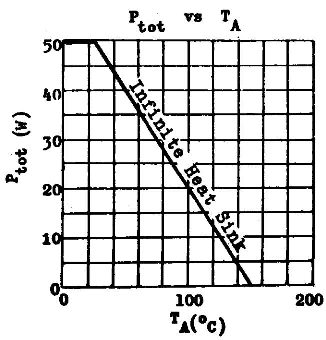
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

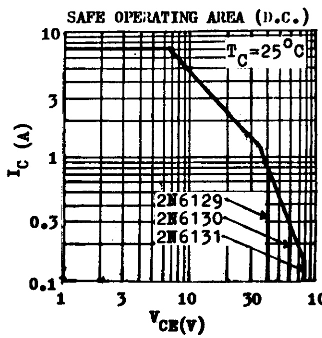
THE 2N 6129, 2N 6130 AND 2N 6131 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6129, 2N 6130, 2N 6131 ARE COMPLEMENTARY TO 2N 6132, 2N 6133, 2N 6134 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6129	2N 6130	2N 6131
Collector-Base Voltage	V_{CBO}	40V	60V	80V
Collector-Emitter Voltage	V_{CEO}	40V	60V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		7A	
Base Current	I_B		3A	
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}		50W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	Tstg		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	2.5°C/W	max.

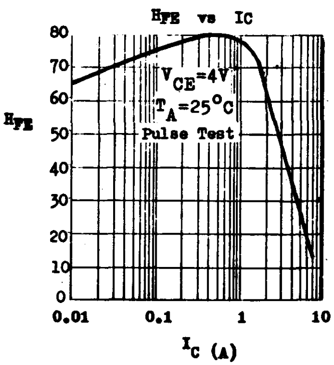


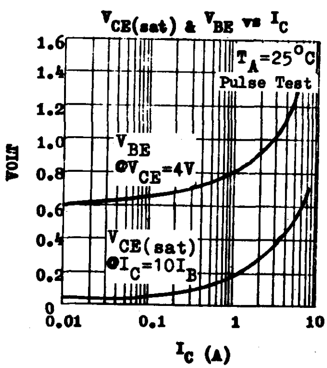


ELECTRICAL CHARACTERISTICS ($T_A=25°C$ unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *					$I_C=0.1A$ $I_B=0$
2N 6129		40			V	
2N 6130		60			V	
2N 6131		80			V	
Collector-Base Cutoff Current	I_{CBO}			0.1	mA	$V_{CB}=V_{CBO}$ $I_E=0$
Collector-Emitter Cutoff Current	I_{CEO}			2	mA	$V_{CE}=V_{CEO}$ $I_B=0$
Collector-Emitter Cutoff Current	I_{CEV}			2	mA	$V_{CE}=V_{CEO}$ $V_{EB}=1.5V$ $T_C=125°C$
Emitter-Base Cutoff Current	I_{EBO}			1	mA	$V_{EB}=5V$ $I_C=0$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *					$I_C=7A$ $I_B=3A$
2N 6129, 2N 6130				1.4	V	
2N 6131				2.0	V	
Base-Emitter Voltage	V_{BE} *		0.95	2.0	V	$I_C=2.5A$ $V_{CE}=4V$
D.C. Current Gain All types	H_{FE} *	20		100		$I_C=2.5A$ $V_{CE}=4V$
2N 6129, 2N 6130		7				$I_C=7A$ $V_{CE}=4V$
2N 6131		5				$I_C=7A$ $V_{CE}=4V$
Current Gain-Bandwidth Product	f_T	2.5			MHz	$I_C=1A$ $V_{CE}=4V$
Small Signal Current Gain	h_{fe}	25				$I_C=0.1A$ $V_{CE}=4V$ f=1KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





2N6132 2N6133 2N6134

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

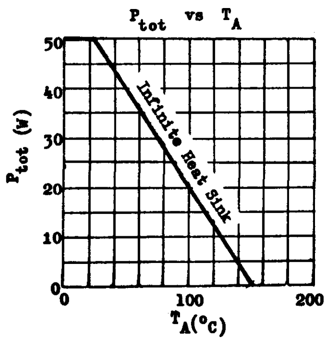
THE 2N 6132, 2N 6133 AND 2N 6134 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6132, 2N 6133 AND 2N 6134 ARE COMPLEMENTARY TO 2N 6129, 2N 6130 AND 2N 6131 RESPECTIVELY.

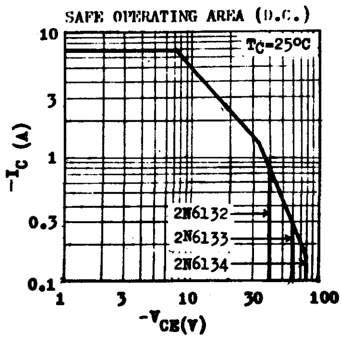
CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6132	2N 6133	2N 6134
Collector-Base Voltage	$-V_{CBO}$	40V	60V	80V
Collector-Emitter Voltage	$-V_{CEO}$	40V	60V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		7A	
Base Current	$-I_B$		3A	
Total Power Dissipation ($T_C \leqslant 25°C$)	P_{tot}		50W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE

Junction to Case	θ_{jc}	2.5°C/W	max.

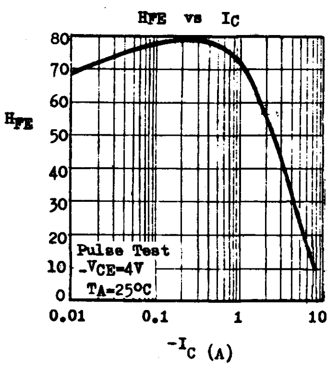


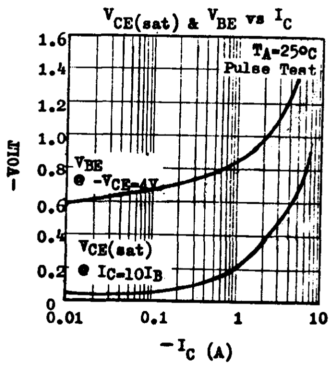


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=0.1A I_B=0
2N 6132		40			V	
2N 6133		60			V	
2N 6134		80			V	
Collector-Base Cutoff Current	$-I_{CBO}$			0.5	mA	V_{CB}=V_{CBO} I_E=0
Collector-Emitter Cutoff Current	$-I_{CEO}$			2	mA	V_{CE}=V_{CEO} I_B=0
Collector-Emitter Cutoff Current	$-I_{CEV}$			2	mA	V_{CE}=V_{CEO} $-V_{EB}$=1.5V T_C=125°C
Emitter-Base Cutoff Current	$-I_{EBO}$			1	mA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$ *					$-I_C$=7A $-I_B$=3A
2N 6132, 2N 6133				1.4	V	
2N 6134				1.8	V	
Base-Emitter Voltage	$-V_{BE}$ *		0.97	2	V	$-I_C$=2.5A $-V_{CE}$=4V
D.C. Current Gain All types	H_{FE} *	20		100		$-I_C$=2.5A $-V_{CE}$=4V
2N 6132, 2N 6133		7				$-I_C$=7A $-V_{CE}$=4V
2N 6134		5				$-I_C$=7A $-V_{CE}$=4V
Current Gain-Bandwidth Product	f_T	2.5			MHz	$-I_C$=1A $-V_{CE}$=4V
Small Signal Current Gain	hfe	25				$-I_C$=0.1A $-V_{CE}$=4V f=1KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





12.77.0850E

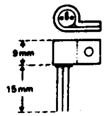
2N6218 through 2N6221

NPN SILICON GENERAL PURPOSE HIGH VOLTAGE TRANSISTORS

THE 2N6218 THROUGH 2N6221 ARE NPN SILICON PLANAR TRANSISTORS INTENDED FOR USE IN TV, NIXIE-NEON TUBE AND OTHER GENERAL HIGH VOLTAGE APPLICATIONS. THE DEVICES ARE SUPPLIED IN CASE TO-92F WITH OPTIONAL X-67 HEAT SINK.

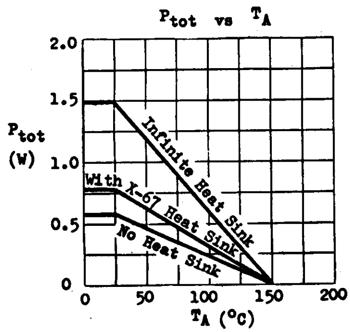
CASE TO-92F

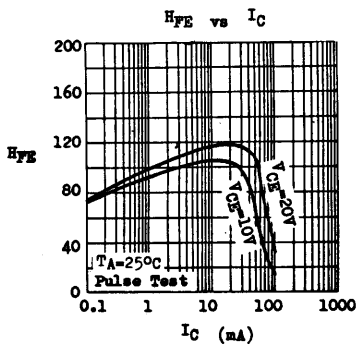
X-67 HEAT SINK



ABSOLUTE MAXIMUM RATINGS		2N6218	2N6219	2N6220	2N6221
Collector-Base Voltage	V_{CBO}	300V	250V	200V	150V
Collector-Emitter Voltage	V_{CEO}	300V	250V	200V	150V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V	5V
Collector Current	I_C	50mA			
Collector Peak Current	I_{CM}	100mA			
Total Power Dissipation @ $T_C \leq 25^oC$	P_{tot}	1.5W			
With X-67 Heat Sink @ $T_A \leq 25^oC$		800mW			
No Heat Sink @ $T_A \leq 25^oC$		625mW **			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C			

** 0.5W in JEDEC registration.

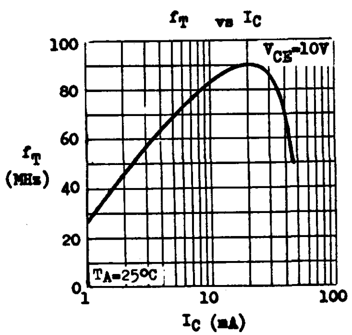


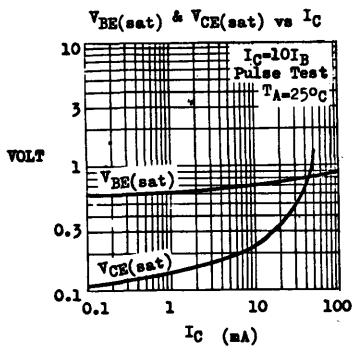


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	Note 1		V	I_C=10mA I_B=0 (Pulsed)
Emitter-Base Breakdown Voltage	BV_{EBO}	5		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}				
2N6218			0.5	μA	V_{CB}=250V I_E=0
2N6219			1	μA	V_{CB}=200V I_E=0
2N6220			1	μA	V_{CB}=150V I_E=0
2N6221			1	μA	V_{CB}=100V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$				
2N6218,9			1	V	I_C=10mA I_B=1mA
2N6220,1			2	V	I_C=20mA I_B=2mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$				
2N6218,9		0.6	0.75	V	I_C=10mA I_B=1mA
2N6220,1		0.65	0.85	V	I_C=20mA I_B=2mA
Base-Emitter Voltage	V_{BE}	0.55	0.75	V	I_C=20mA V_{CE}=10V
D.C. Current Gain	HFE	10			I_C=2mA V_{CE}=10V
		20			I_C=20mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	50		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Ccb		5	pF	V_{CB}=10V I_E=0 f=1MHz
Emitter-Base Capacitance	Ceb		70	pF	V_{EB}=0.5V I_C=0 f=1MHz
Small Signal Current Gain	h_{fe}	20	300		I_C=20mA V_{CE}=10V f=1kHz

Note 1 : equal to the values of V_{CBO} & V_{CEO} ratings.





2N6288 2N6290 2N6292

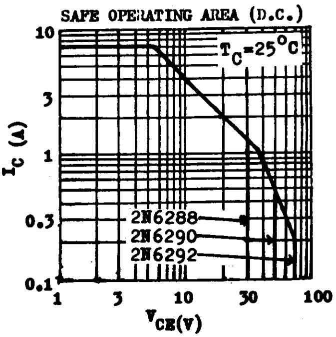
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

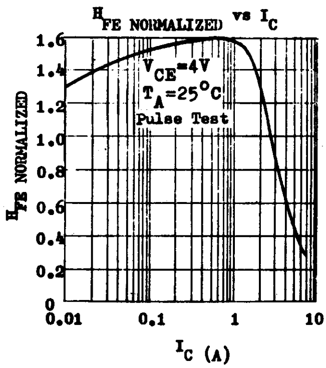
THE 2N 6288, 2N 6290 AND 2N 6292 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THE 2N 6288, 2N 6290, 2N 6292 ARE COMPLEMENTARY TO 2N 6111, 2N 6109, 2N 6107 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2N 6288	2N 6290	2N 6292
Collector-Base Voltage	V_{CBO}	40V	60V	80V
Collector-Emitter Voltage	V_{CEO}	30V	50V	70V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		7A	
Base Current	I_B		3A	
Total Power Dissipation	P_{tot}			
@ $T_C \leq 25^\circ C$			40W	
@ $T_A \leq 25^\circ C$			1.8W	
Junction Temperature	T_j		$150^\circ C$	
Storage Temperature Range	Tstg		-55 to $+150^\circ C$	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	$3.12^\circ C/W$	max.





ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}*					I_C=0.1A I_B=0
2N 6288		30			V	
2N 6290		50			V	
2N 6292		70			V	
Collector-Emitter Breakdown Voltage	LV_{CER}*					I_C=0.1A R_{BE}=100Ω
2N 6288		40			V	
2N 6290		60			V	
2N 6292		80			V	
Collector-Emitter Cutoff Current	I_{CEO}					
2N 6288				1	mA	V_{CE}=20V I_B=0
2N 6290				1	mA	V_{CE}=40V I_B=0
2N 6292				1	mA	V_{CE}=60V I_B=0
Collector-Emitter Cutoff Current	I_{CER}					
2N 6288				0.1	mA	V_{CE}=35V R_{BE}=100Ω
2N 6290				0.1	mA	V_{CE}=55V R_{BE}=100Ω
2N 6292				0.1	mA	V_{CE}=75V R_{BE}=100Ω
2N 6288				2	mA	V_{CE}=30V R_{BE}=100Ω T_C=150°C
2N 6290				2	mA	V_{CE}=50V R_{BE}=100Ω T_C=150°C
2N 6292				2	mA	V_{CE}=70V R_{BE}=100Ω T_C=150°C
Collector-Emitter Cutoff Current	I_{CEV}					
2N 6288				0.1	mA	V_{CE}=37.5V V_{EB}=1.5V
2N 6290				0.1	mA	V_{CE}=56V V_{EB}=1.5V
2N 6292				0.1	mA	V_{CE}=75V V_{EB}=1.5V
2N 6288				2	mA	V_{CE}=30V V_{EB}=1.5V T_C=150°C
2N 6290				2	mA	V_{CE}=50V V_{EB}=1.5V T_C=150°C
2N 6292				2	mA	V_{CE}=70V V_{EB}=1.5V T_C=150°C
Emitter-Base Cutoff Current	I_{EBO}			1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*					
2N 6288			0.35	1	V	I_C=3A I_B=0.3A
2N 6290			0.3	1	V	I_C=2.5A I_B=0.25A
2N 6292			0.3	1	V	I_C=2A I_B=0.2A
All types				3.5	V	I_C=7A I_B=3A
Base-Emitter Voltage 2N 6288	V_{BE} *		1	1.5	V	I_C=3A V_{CE}=4V
2N 6290			0.95	1.5	V	I_C=2.5A V_{CE}=4V
2N 6292			0.9	1.5	V	I_C=2A V_{CE}=4V
All types				3	V	I_C=7A V_{CE}=4V
D.C. Current Gain 2N 6288	H_{FE} *	30		150		I_C=3A V_{CE}=4V
2N 6290		30		150		I_C=2.5A V_{CE}=4V
2N 6292		30		150		I_C=2A V_{CE}=4V
All types		2.3				I_C=7A V_{CE}=4V
Current Gain-Bandwidth Product	f_T	4			MHz	I_C=0.5A V_{CE}=4V
Collector-Base Capacitance	Cob			250	pF	V_{CB}=10V I_E=0 f=1MHz
Small Signal Current Gain	h_{fe}	20				I_C=0.5A V_{CE}=4V f=50KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

12.77.8500E

2N6473 2N6474 2N6475 2N6476

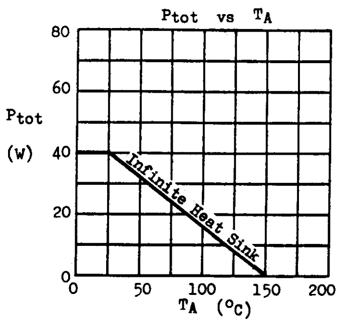
COMPLEMENTARY
SILICON EPITAXIAL BASE AF POWER TRANSISTORS

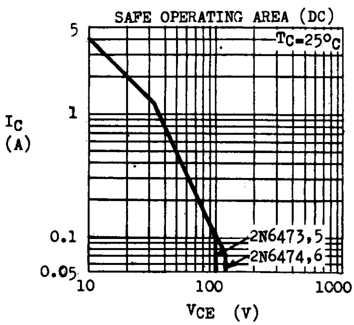
THE 2N6473, 2N6474 (NPN) AND 2N6475 2N6476 (PNP) ARE COMPLEMENTARY SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGN FOR SWITCHING, DRIVER AND OUTPUT STAGES IN AUDIO AMPLIFIERS. THEY FEATURE HIGH COLLECTOR-EMITTER BREAK-DOWN VOLTAGE.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.		2N6473(NPN) 2N6475(PNP)	2N6474(NPN) 2N6476(PNP)
Collector-Base Voltage	V_{CBO}	110V	130V
Collector-Emitter Voltage ($R_{BE} \leq 100\Omega$)	V_{CER}	110V	130V
Collector-Emitter Voltage ($I_B=0$)	V_{CEO}	100V	120V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	4A	4A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	40W	40W
($T_A \leq 25^oC$)		1.8W	1.8W
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C	

THERMAL RESISTANCE		
Junction to Case	θ_{jc}	3.13°C/W max.
Junction to Ambient	θ_{ja}	70°C/W max.

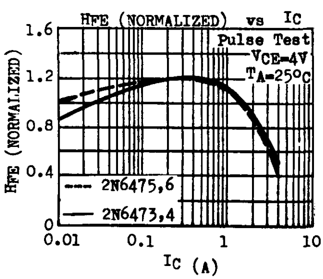


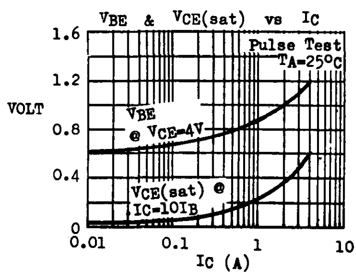


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	2N6473(NPN) 2N6475(PNP) MIN	MAX	2N6474(NPN) 2N6476(PNP) MIN	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CER}*	110		130		V	I_C=0.1A R_{BE}=100Ω
Collector-Emitter Breakdown Voltage	LV_{CEO}*	100		120		V	I_C=0.1A I_B=0
Collector Cutoff Current	I_{CER}		0.1			mA	V_{CE}=100V R_{BE}=100Ω
					0.1	mA	V_{CE}=120V R_{BE}=100Ω
Collector Cutoff Current (T_C=100°C)	I_{CER}		2			mA	V_{CE}=100V R_{BE}=100Ω
					2	mA	V_{CE}=120V R_{BE}=100Ω
Collector Cutoff Current	I_{CEV}		0.1			mA	V_{CE}=100V V_{EB}=1.5V
					0.1	mA	V_{CE}=120V V_{EB}=1.5V
Collector Cutoff Current (T_C=100°C)	I_{CEV}		2			mA	V_{CE}=100V V_{EB}=1.5V
					2	mA	V_{CE}=120V V_{EB}=1.5V
Collector Cutoff Current	I_{CEO}		1			mA	V_{CE}=50V I_B=0
					1	mA	V_{CE}=60V I_B=0
Emitter Cutoff Current	I_{EBO}		1		1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		1.2		1.2	V	I_C=1.5A I_B=0.15A
			2.5		2.5	V	I_C=4A I_B=2A
Base-Emitter Voltage	V_{BE}*		2		2	V	I_C=1.5A V_{CE}=4V
			3.5		3.5	V	I_C=4A V_{CE}=2.5V
D.C. Current Gain	H_{FE} *	15	150	15	150		I_C=1.5A V_{CE}=4V
		2		2			I_C=4A V_{CE}=2.5V
Current Gain-Bandwidth Product	f_T						I_C=0.5A V_{CE}=4V
2N6473,4 only		4		4		MHz	
2N6475,6 only		10		10		MHz	
Collector-Base Capacitance	Cob		250		250	pF	V_{CB}=10V I_E=0 f=1MHz
Small Signal Current Gain	hfe	20		20			I_C=0.5A V_{CE}=4V f=50KHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%





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2SA473 2SC1173

PNP NPN SILICON PLANAR EPITAXIAL POWER TRANSISTORS

THE 2SA 473 (PNP) AND 2SC 1173 (NPN) ARE SILICON PLANAR EPITAXIAL COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR 5-WATT AUDIO AMPLIFIER OUTPUT APPLICATIONS. THEY ARE ALSO SUITABLE FOR SWITCHING UP TO 3A COLLECTOR CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Base Voltage	V_{CBO}	30V
Collector-Emitter Voltage	V_{CEO}	30V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	3A
Collector Peak Current (t < 10mS)	I_{CM}	6A
Total Power Dissipation ($T_C \leq 25^\circ C$)	P_{tot}	10W
Junction Temperature	T_j	150°C
Storage Temperature Range	Tstg	-55 to + 150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

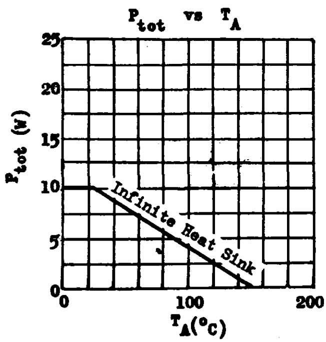
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS	
Collector-Base Breakdown Voltage	BV_{CBO}	30			V	I_C=0.1mA	I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	30			V	I_C=10mA	I_B=0
Collector Cutoff Current	I_{CBO}			1.0	μA	V_{CB}=20V	I_E=0
Emitter Cutoff Current	I_{EBO}			1.0	μA	V_{EB}=5V	I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *			0.8	V	I_C=2A	I_B=0.2A
Base-Emitter Voltage	V_{BE} *			1.0	V	I_C=0.5A	V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1 *	40		400		I_C=0.5A	V_{CE}=2V
	H_{FE} 2 *	25				I_C=2.5A	V_{CE}=2V
Current Gain-Bandwidth Product	f_T		100		MHz	I_C=0.1A	V_{CE}=10V

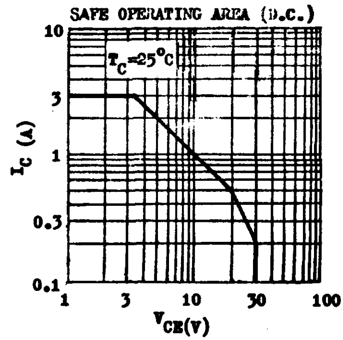
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

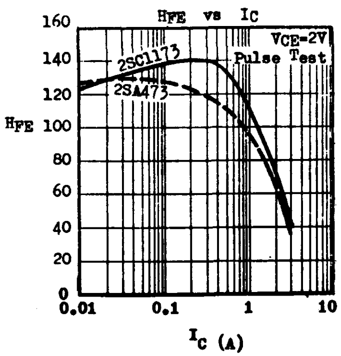
Note : H_{FE} is classified as follows. Group R : 40-80 Group O : 70-140 Group Y : 120-240 Group G : 200-400

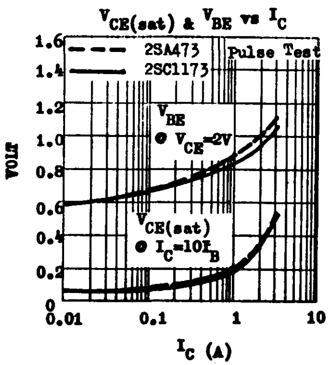
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2SA489 2SB604 2SB596

PNP SILICON EPITAXIAL BASE POWER TRANSISTORS

THE 2SA489, 2SB604, 2SB596 ARE PNP SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR 20 TO 25W AUDIO AMPLIFIER OUTPUTS AND SWITCHING APPLICATIONS UP TO 4A COLLECTOR CURRENT. THE 2SA489, 2SB604 AND 2SB596 ARE COMPLEMENTARY TO 2SC789, 2SD570 AND 2SD526 RESPECTIVELY.

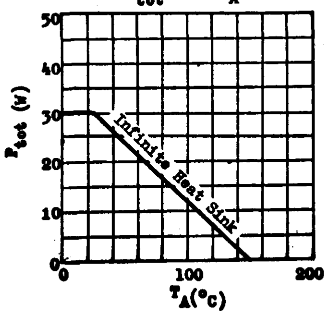
CASE TO-220B

BCE

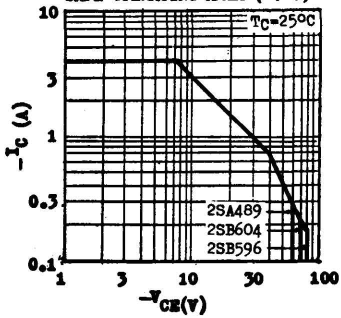
ABSOLUTE MAXIMUM RATINGS		2SA489	2SB604	2SB596
Collector-Base Voltage	$-V_{CBO}$	70V	70V	80V
Collector-Emitter Voltage	$-V_{CEO}$	60V	70V	80V
Emitter-Base Voltage	$-V_{EBO}$		5V	
Collector Current	$-I_C$		4A	
Collector Peak Current ($t \leq 10mS$)	$-I_{CM}$		8A	
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}		30W	
Junction Temperature	T_j		150°C	
Storage Temperature Range	T_{stg}		-55 to +150°C	

THERMAL RESISTANCE			
Junction to Case	Θ_{jc}	4.17°C/W	max.

P_{tot} vs T_A



SAFE OPERATING AREA (D.C.)

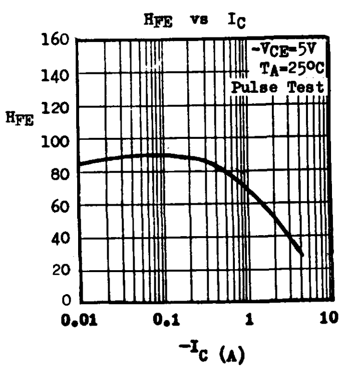


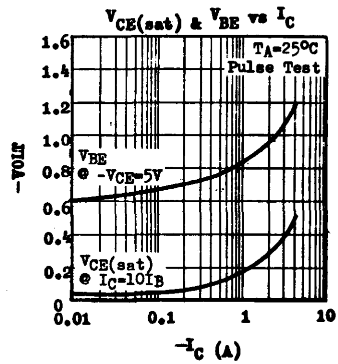
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	$-BV_{CBO}$					$-I_C$=0.1mA I_E=0
2SA489		70			V	
2SB604		70			V	
2SB596		80			V	
Collector-Emitter Breakdown Voltage	$-LV_{CEO}$ *					$-I_C$=100mA I_B=0
2SA489		60			V	
2SB604		70			V	
2SB596		80			V	
Collector Cutoff Current	$-I_{CBO}$					
2SA489				30	μA	$-V_{CB}$=50V I_E=0
2SB604				30	μA	$-V_{CB}$=50V I_E=0
2SB596				30	μA	$-V_{CB}$=80V I_E=0
Emitter Cutoff Current	$-I_{EBO}$			100	μA	$-V_{EB}$=5V I_C=0
Collector-Emitter Saturation Voltage	$-V_{CE(sat)}$ *		0.4	1.5	V	$-I_C$=3A $-I_B$=0.3A
Base-Emitter Voltage	$-V_{BE}$ *					
2SA489			1.0	1.5	V	$-I_C$=2.5A $-V_{CE}$=5V
2SB604			1.07	1.5	V	$-I_C$=3A $-V_{CE}$=5V
2SB596			1.07	1.5	V	$-I_C$=3A $-V_{CE}$=5V
D.C. Current Gain (note)	H_{FE} 1 *	40		240		$-I_C$=0.5A $-V_{CE}$=5V
	H_{FE} 2 *	15				$-I_C$=3A $-V_{CE}$=5V
Current Gain-Bandwidth Product	f_T	3			MHz	$-I_C$=0.5A $-V_{CE}$=5V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

note : H_{FE} 1 is classified as follows. Group R : 40-80 Group O : 70-140
Group Y : 120-240





2SA490 2SC790

PNP NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

THE 2SA490 (PNP) AND 2SC790 (NPN) ARE SILICON EPITAXIAL BASE COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR 10-WATT AUDIO AMPLIFIER OUTPUT APPLICATIONS. THEY ARE ALSO SUITABLE FOR SWITCHING UP TO 3A COLLECTOR CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Base Voltage	V_{CBO}	50V
Collector-Emitter Voltage	V_{CEO}	40V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	3A
Collector Peak Current ($t \leq 10mS$)	I_{CM}	6A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	25W
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	-55 to +150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

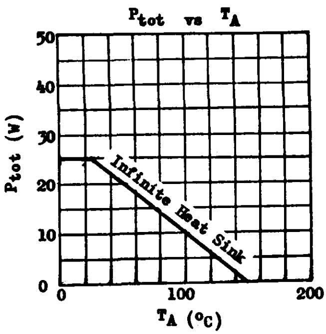
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50			V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	40			V	I_C=50mA I_B=0
Collector Cutoff Current	I_{CBO}			20	µA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			100	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.4	1.4	V	I_C=2A I_B=0.2A
Base-Emitter Voltage	V_{BE} *		1.0	1.8	V	I_C=2A V_{CE}=2V
D.C. Current Gain (note)	H_{FE} 1 *	40		240		I_C=0.5A V_{CE}=2V
	H_{FE} 2 *	13				I_C=2A V_{CE}=2V
Current Gain-Bandwidth Product	f_T	3			MHz	I_C=0.5A V_{CE}=2V

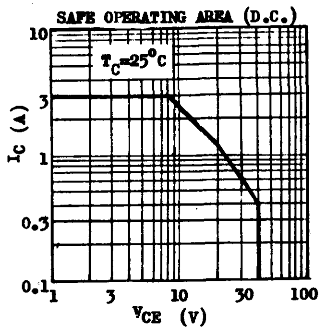
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

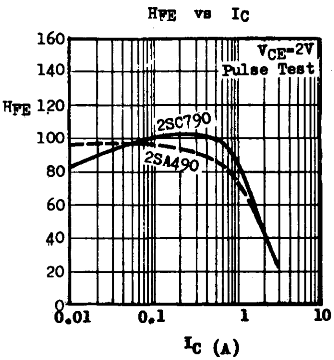
Note : $H_{FE\,1}$ is classified as follows : Group R : 40-80 Group O : 70-140
Group Y : 120-240

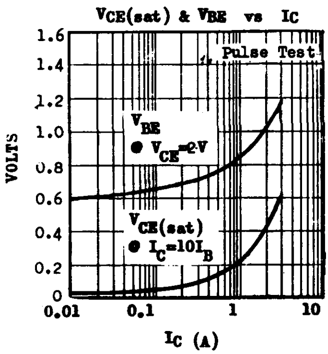
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2SA539 2SC815

COMPLEMENTARY SILICON GENERAL PURPOSE AF AMPLIFIERS

THE 2SA539 (PNP) ARE 2SC815 (NPN) ARE SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF AMPLIFIERS AND DRIVERS, AS WELL AS FOR UNIVERSAL SWITCHING APPLICATIONS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Base Voltage	V_{CBO}	60V
Collector-Emitter Voltage	V_{CEO}	45V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	200mA
Collector Peak Current	I_{CM}	500mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	250mW derate 2.5mW/^oC above 25^oC
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125^oC

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

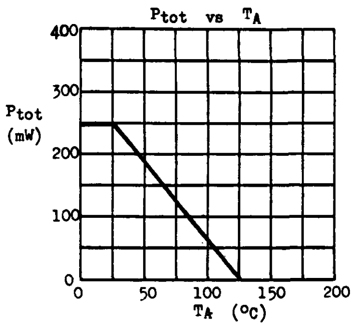
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO}*	45			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CBO}			0.1	μA	V_{CB}=45V I_E=0
Emitter Cutoff Current	I_{EBO}			0.1	μA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$*		0.18	0.5	V	I_C=150mA I_B=15mA
Base-Emitter Saturation Voltage	$V_{BE}(sat)$*		0.88	1.2	V	I_C=150mA I_B=15mA
Base-Emitter Voltage	V_{BE}	0.6	0.68	0.9	V	I_C=10mA V_{CE}=10V
D.C. Current Gain (Note 1)	HFE 1 *	50	120	232		I_C=50mA V_{CE}=1V
	HFE 2 *	30	100			I_C=150mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	100	160		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob					
2SC815			4.5	8	pF	V_{CB}=10V I_E=0
2SA539			5.5		pF	f=1MHz

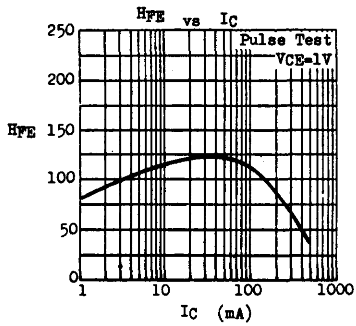
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

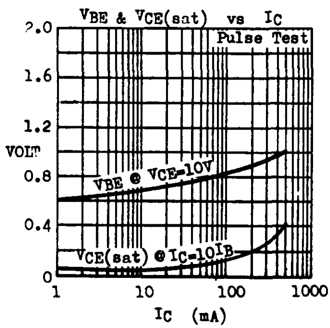
Note 1 : H_{FE} 1 is classified as follows.

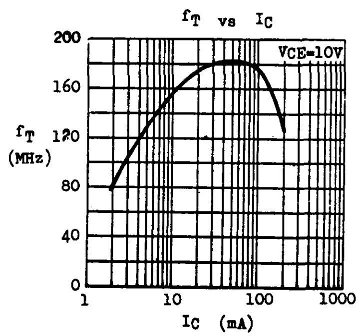
Group M : 50-94 Group L : 80-150 Group K : 125-232

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)









2SA564 2SA564A 2SC828 2SC828A

COMPLEMENTARY SILICON AF SMALL SIGNAL TRANSISTORS

THE 2SA564, 2SA564A (PNP) AND 2SC828, 2SC828A (NPN) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN AF SMALL SIGNAL AMPLIFIER STAGES AND DIRECT COUPLED CIRCUITS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		(PNP) 2SA564	(PNP) 2SA564A	(NPN) 2SC828	(NPN) 2SC828A
Collector-Base Voltage	V_{CBO}	25V	45V	30V	45V
Collector-Emitter Voltage	V_{CEO}	25V	45V	25V	45V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V	5V
Collector Current	I_C	50mA			
Collector Peak Current	I_{CM}	100mA			
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	250mW derate 2.5mW/^oC above 25^oC			
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125^oC			

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1			V	I_C=0.01mA I_E=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CEO}			10	µA	V_{CE}=V_{CEO} I_B=0
Collector Cutoff Current	I_{CBO}			1	µA	V_{CB}=10V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.15	0.4	V	I_C=50mA I_B=5mA
Base-Emitter Voltage	V_{BE}		0.68	0.8	V	I_C=10mA V_{CE}=5V
D.C. Current Gain (Note 2)	H_{FE}	65	300	700		I_C=2mA V_{CE}=5V
Current Gain-Bandwidth Product	f_T		150		MHz	I_C=2mA V_{CE}=10V
Collector-Base Capacitance	Cob					V_{CB}=10V I_E=0 f=1MHz
2SA564, 2SA564A			3.2		pF	
2SC828, 2SC828A			2.5		pF	
Noise Figure	NF		2		dB	I_C=0.2mA V_{CE}=5V R_G=2KΩ f=1kHz

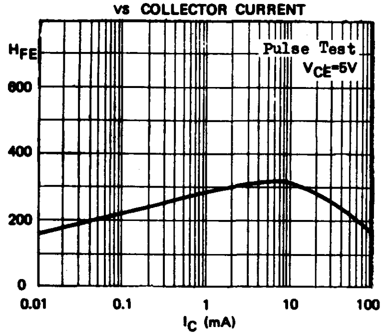
Note 1 : equal to the value of V_{CBO} rating.

Note 2 : H_{FE} is classified as follows.

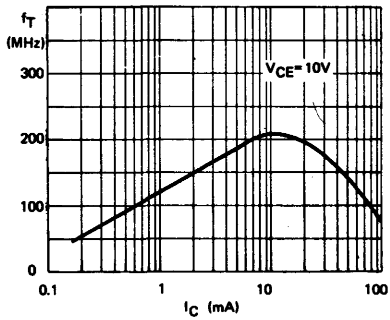
Group O : 65-130　Group P : 90-180　Group Q : 130-260
Group R : 180-360　Group S : 260-520　Group T : 360-700

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

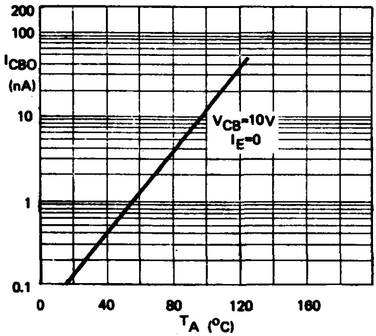
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



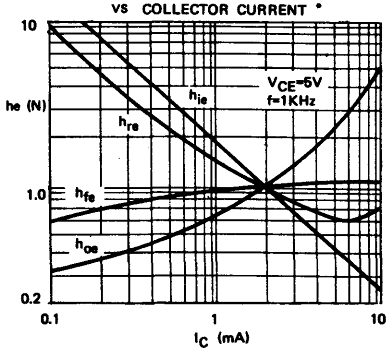
CURRENT GAIN – BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



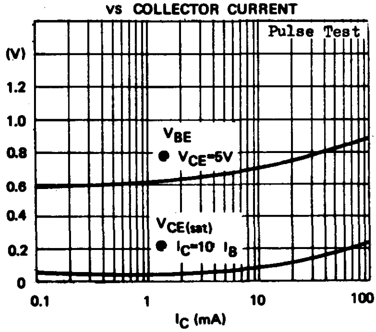
COLLECTOR CUTOFF CURRENT
vs AMBIENT TEMPERATURE



h–PARAMETERS (NORMALIZED)
vs COLLECTOR CURRENT *



V_{BE} AND $V_{CE(sat)}$
vs COLLECTOR CURRENT



*Typical values at I_C=2mA V_{CE}=5V	
H_{FE}(D.C.)	300
h_{ie}(1KHz)	4.5Kohms
h_{fe}(1KHz)	330
h_{re}(1KHz)	2×10^{-4}
h_{oe}(1KHz)	30μmhos

2.78.0430B.4300B

2SA666 2SC644

COMPLEMENTARY SILICON AF LOW NOISE SMALL SIGNAL TRANSISTORS

THE 2SA666 (PNP) AND 2SC644 (NPN) ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF LOW NOISE PREAMPLIFIER APPLICATIONS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

		2SA666(PNP)	2SC644(NPN)
Collector-Base Voltage	V_{CBO}	25V	30V
Collector-Emitter Voltage	V_{CEO}	25V	25V
Emitter-Base Voltage	V_{EBO}	5V	5V
Collector Current	I_C	50mA	
Collector Peak Current	I_{CM}	100mA	
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	250mW derate 2.5mW/^oC above 25^oC	
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125^oC	

ELECTRICAL CHARACTERISTICS (T_A=25^oC unless otherwise noted)

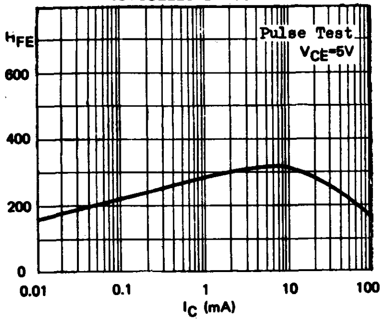
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.01mA I_E=0
2SA666		25			V	
2SC644		30			V	
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CEO}			10	μA	V_{CE}=25V I_B=0
Collector Cutoff Current	I_{CBO}			1	μA	V_{CB}=10V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.15	0.4	V	I_C=50mA I_B=5mA
Base-Emitter Voltage	V_{BE}		0.68	0.8	V	I_C=10mA V_{CE}=5V
D.C. Current Gain (Note 1)	H_{FE}	130	300	700		I_C=2mA V_{CE}=5V
Noise Figure	NF					I_C=0.2mA V_{CE}=5V
2SA666 only				16	dB	(R_G=50KΩ f=100Hz)
2SC644 only				5	dB	(R_G=2KΩ f=100Hz)
2SC644 only				3	dB	(R_G=2KΩ f=1kHz)

Note 1 : H_{FE} is classified as follows.

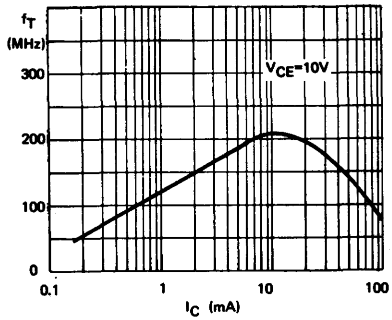
GROUP Q : 130-260 GROUP R : 180-360 GROUP S : 260-520 GROUP T : 360-700

TYPICAL CHARACTERISTICS (T_A=25°C UNLESS OTHERWISE SPECIFIED)

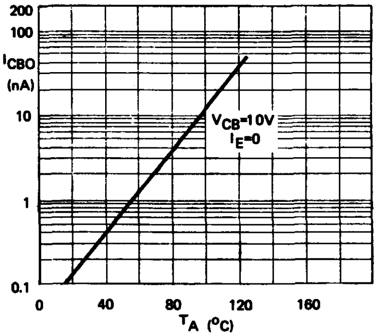
D.C. CURRENT GAIN
vs COLLECTOR CURRENT



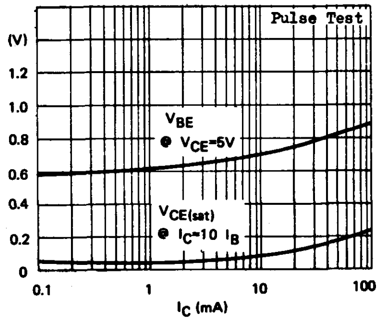
CURRENT GAIN – BANDWIDTH PRODUCT
vs COLLECTOR CURRENT



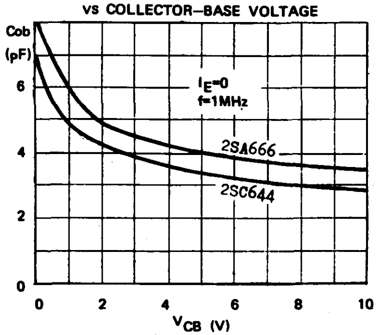
COLLECTOR CUTOFF CURRENT
vs AMBIENT TEMPERATURE



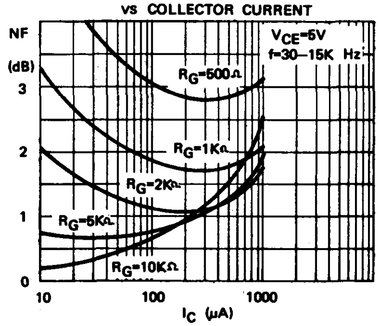
VBE AND VCE(sat)
vs COLLECTOR CURRENT



COLLECTOR–BASE CAPACITANCE
vs COLLECTOR–BASE VOLTAGE



BROAD BAND NOISE FIGURE
vs COLLECTOR CURRENT



2SA671 2SC1061

PNP NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

THE 2SA671 (PNP) AND 2SC1061 (NPN) ARE SILICON EPITAXIAL BASE COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR 15-WATT AUDIO AMPLIFIER OUTPUT APPLICATIONS. THEY ARE ALSO SUITABLE FOR SWITCHING UP TO 3A COLLECTOR CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Base Voltage	V_{CBO}	50V
Collector-Emitter Voltage	V_{CEO}	50V
Emitter-Base Voltage	V_{EBO}	4V
Collector Current	I_C	3A
Collector Peak Current ($t \leq 10mS$)	I_{CM}	6A
Total Power Dissipation ($T_C \leq 25^oC$)	P_{tot}	25W
Junction Temperature	T_j	150^{o}C
Storage Temperature Range	T_{stg}	-55 to +150^{o}C

ELECTRICAL CHARACTERISTICS ($T_A=25^oC$ unless otherwise noted)

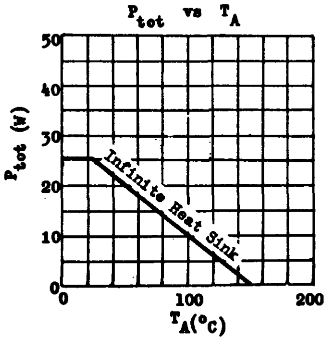
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	50			V	$I_C=0.1mA$ $I_E=0$
Collector-Emitter Breakdown Voltage	LV_{CEO} *	50			V	$I_C=50mA$ $I_B=0$
Collector Cutoff Current	I_{CBO}			100	μA	$V_{CB}=50V$ $I_E=0$
Emitter Cutoff Current	I_{EBO}			100	μA	$V_{EB}=4V$ $I_C=0$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.35	1	V	$I_C=2A$ $I_B=0.2A$
Base-Emitter Voltage	V_{BE} *		0.83	1.5	V	$I_C=1A$ $V_{CE}=4V$
D.C. Current Gain (Note)	H_{FE} 1 *	35		320		$I_C=1A$ $V_{CE}=4V$
	H_{FE} 2 *	35				$I_C=0.1A$ $V_{CE}=4V$
Current Gain-Bandwidth Product	f_T	3			MHz	$I_C=0.5A$ $V_{CE}=4V$

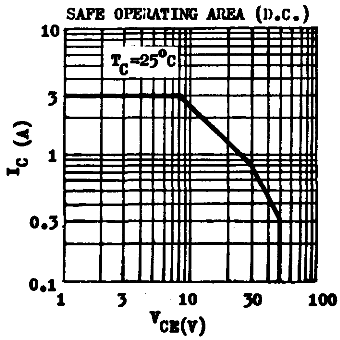
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

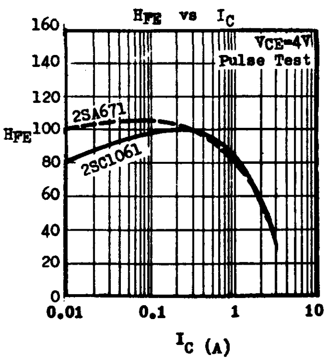
Note : H_{FE} 1 is classified as follows. Group A : 35-70 Group B : 60-120 Group C : 100-200 Group D : 160-320

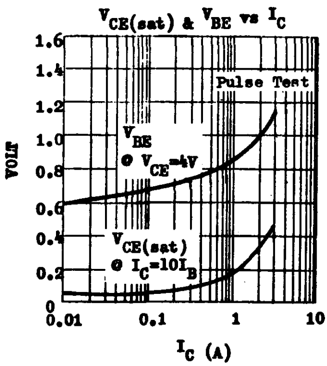
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2SA719, 720 730, 731 2SC1317, 1318, 1346, 1347

COMPLEMENTARY SILICON AF MEDIUM POWER TRANSISTORS

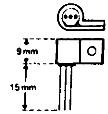
THE ABOVE TYPES ARE COMPLEMENTARY SILICON PLANAR EPITAXIAL TRANSISTORS FOR AF MEDIUM POWER AMPLIFIER & SWITCHING APPLICATIONS. THE 2SA719, 2SC1317 ARE SPECIALLY RECOMMENDED FOR 1W OTL OUTPUT STAGE.

CASE TO-92B

ECB

2SA719,720
2SC1317,1318

WITH X-67 HEAT SINK



2SA730,731
2SC1346,1347

ABSOLUTE MAXIMUM RATINGS

		(PNP) 2SA719 / (NPN) 2SC1317	2SA720 / 2SC1318	2SA730 / 2SC1346	2SA731 / 2SC1347
Collector-Base Voltage	V_{CBO}	30V	60V	30V	60V
Collector-Emitter Voltage	V_{CEO}	25V	50V	25V	50V
Emitter-Base Voltage	V_{EBO}	5V	5V	5V	5V
Collector Current	I_C	0.5A	0.5A	0.5A	0.5A
Collector Peak Current	I_{CM}	1A	1A	1A	1A
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	0.4W	0.4W	0.6W	0.6W
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C			

ELECTRICAL CHARACTERISTICS (T_A=25°C)

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

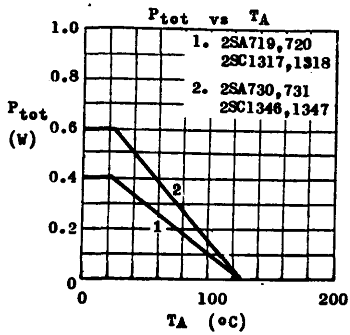
PARAMETER	SYMBOL	2SA TYPES MIN	TYP	MAX	2SC TYPES MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	Note 1			Note 1			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	BV_{CEO}*	Note 1			Note 1			V	I_C=10mA I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	Note 1			Note 1			V	I_E=0.01mA I_C=0
Collector Cutoff Current	I_{CBO}			0.1			0.1	μA	V_{CB}=20V I_E=0
Collector-Emitter Saturation Voltage	V_{CE}(sat)*		0.25	0.6		0.25	0.6	V	I_C=500mA I_B=50mA
Base-Emitter Saturation Voltage	V_{BE}(sat)*		0.93	1.5		0.91	1.5	V	I_C=500mA I_B=50mA
D.C. Current Gain (Note 2)	h_{FE} 1 *	60	180	340	60	180	340		I_C=150mA V_{CE}=10V
	h_{FE} 2 *	40			40				I_C=500mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T		160			200		MHz	I_C=50mA V_{CE}=10V
Output Capacitance	C_{ob}		12	15		8	15	pF	V_{CB}=10V I_E=0 f=1MHz

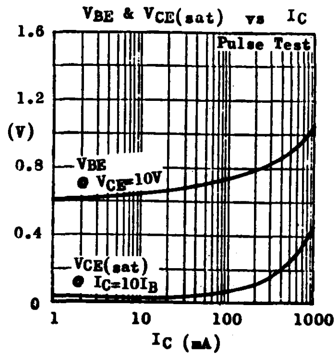
Note 1 : equal to the values of absolute maximum ratings.
Note 2 : h_{FE} 1 is classified as follows : Group P : 60-120 Group Q : 85-170
Group R : 120-240 Group S : 170-340

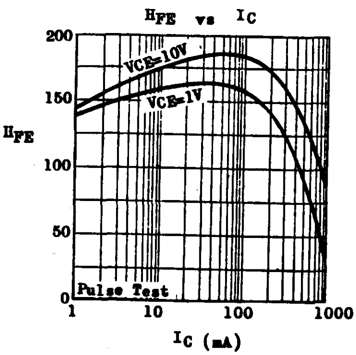
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

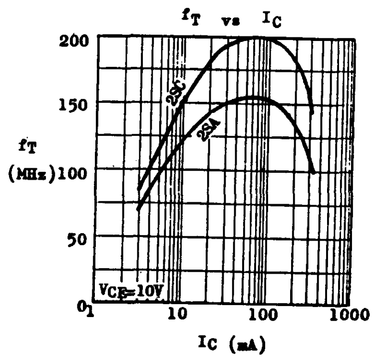
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2SA816 2SC1626

PNP NPN SILICON PLANAR EPITAXIAL POWER TRANSISTORS

THE 2SA816 (PNP) AND 2SC1626 (NPN) ARE SILICON PLANAR EPITAXIAL COMPLEMENTARY PAIR SPECIALLY DESIGNED FOR THE DRIVER STAGES OF 30-50W HI-FI AMPLIFIERS. THEY ARE ALSO SUITABLE FOR MEDIUM SPEED SWITCHING UP TO 2A PEAK CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS

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

Collector-Base Voltage	V_{CBO}	80V
Collector-Emitter Voltage	V_{CEO}	80V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	750mA
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}	2A
Total Power Dissipation @ $T_C \leqslant 25°C$	P_{tot}	10W
@ $T_A \leqslant 25°C$		1.5W
Junction Temperature	T_j	150°C
Storage Temperature Range	T_{stg}	-55 to +150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

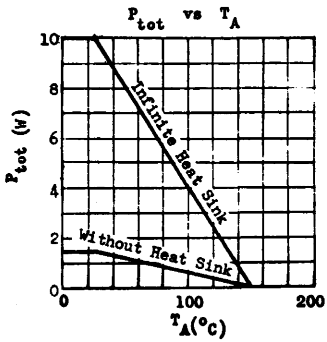
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	80			V	I_C=0.1mA I_B=0
Collector-Emitter Breakdown Voltage	LV_{CEO} *	80			V	I_C=10mA I_B=0
Collector Cutoff Current	I_{CBO}			0.5	µA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}			1	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$ *			0.5	V	I_C=500mA I_B=50mA
Base-Emitter Voltage	V_{BE} *			1	V	I_C=500mA V_{CE}=2V
D.C. Current Gain (Note)	H_{FE} 1 *	70		240		I_C=150mA V_{CE}=2V
	H_{FE} 2 *	40				I_C=500mA V_{CE}=2V
Current Gain-Bandwidth Product	f_T	50	100		MHz	I_C=150mA V_{CE}=2V
Collector-Base Capacitance 2SA816	Cob		20		pF	V_{CB}=10V I_E=0
2SC1626			13		pF	f=1MHz

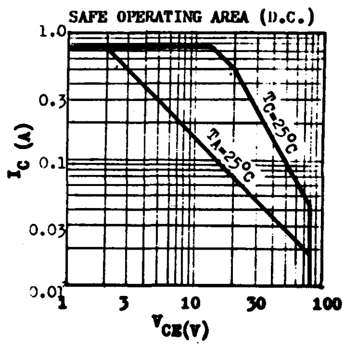
*Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

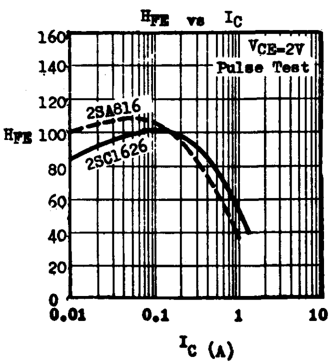
note : H_{FE} 1 is classified as follows, Group O : 70-140, Group Y : 120-240

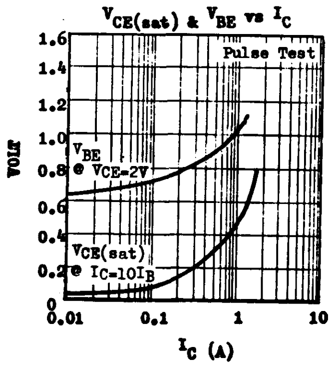
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)









2SA817 2SC1627

COMPLEMENTARY SILICON AF LARGE SIGNAL TRANSISTORS

THE 2SA817 (PNP) AND 2SC1627 (NPN) ARE SILICON PLANAR EPITAXIAL TRANSISTORS DESIGNED FOR AF LARGE SIGNAL AMPLIFIERS. THEY ARE SPECIALLY SUITED FOR THE DRIVER STAGES OF 30W AMPLIFIERS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative.

Collector-Base Voltage	V_{CBO}	80V
Collector-Emitter Voltage	V_{CEO}	80V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	300mA
Collector Peak Current	I_{CM}	1A
Total Power Dissipation ($T_C \leq 25°C$)	P_{tot}	1.3W
($T_A \leq 25°C$)		0.6W
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 150°C

ELECTRICAL CHARACTERISTICS ($T_A=25°C$)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Emitter Breakdown Voltage	LV_{CEO} *	80			V	$I_C=5mA$ $I_B=0$
Collector Cutoff Current	I_{CBO}			0.1	µA	$V_{CB}=50V$ $I_E=0$
Emitter Cutoff Current	I_{EBO}			0.1	µA	$V_{EB}=5V$ $I_C=0$
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*		0.15	0.4	V	$I_C=200mA$ $I_B=20mA$
Base-Emitter Voltage	V_{BE} *	0.55	0.65	0.8	V	$I_C=5mA$ $V_{CE}=2V$
D.C. Current Gain (Note)	h_{FE} 1 *	70		240		$I_C=50mA$ $V_{CE}=2V$
	h_{FE} 2 *	40				$I_C=200mA$ $V_{CE}=2V$
Current Gain-Bandwidth Product	f_T		100		MHz	$I_C=10mA$ $V_{CE}=10V$
Output Capacitance	C_{ob}					
2SA817			17		pF	$V_{CB}=10V$ $I_E=0$ f=1MHz
2SC1627			10		pF	$V_{CB}=10V$ $I_E=0$ f=1MHz

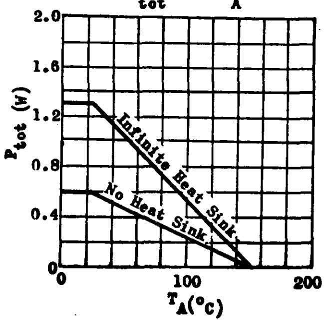
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

Note : h_{FE} 1 is classified as follows.
GROUP O : 70-140 GROUP Y : 120-240

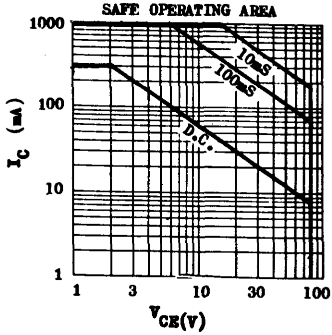
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)

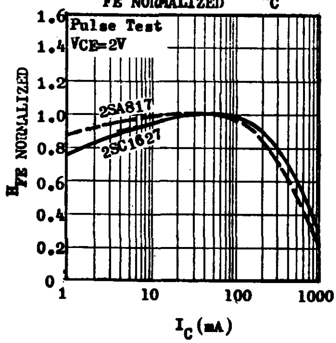
P_{tot} vs T_A



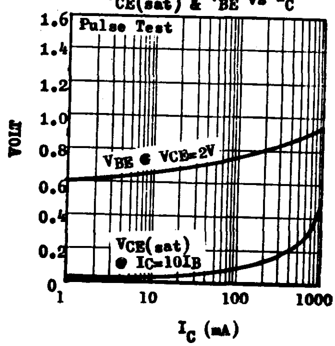
SAFE OPERATING AREA



H_{FE} NORMALIZED vs I_C



$V_{CE(sat)}$ & V_{BE} vs I_C



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2SB512 2SB512A 2SD365 2SD365A

PNP NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

THE 2SB512, 2SB512A (PNP) AND 2SD365, 2SD365A (NPN) ARE SILICON PLANAR EPITAXIAL BASE POWER TRANSISTORS OF COMPLEMENTARY CHARACTERISTICS. THEY ARE INTENDED FOR 10 TO 20W AUDIO AMPLIFIER OUTPUTS AND SWITCHING APPLICATIONS UP TO 3A COLLECTOR CURRENT.

CASE TO-220B

BCE

ABSOLUTE MAXIMUM RATINGS For p-n-p devices, voltage and current values are negative

		2SB512 (PNP) 2SD365 (NPN)	2SB512A (PNP) 2SD365A (NPN)
Collector-Base Voltage	V_{CBO}	60V	80V
Collector-Emitter Voltage	V_{CEO}	60V	80V
Emitter-Base Voltage	V_{EBO}	5V	
Collector Current	I_C	3A	
Collector Peak Current (t ≤10mS)	I_{CM}	6A	
Total Power Dissipation ($T_C \leq 25°C$)	Ptot	25W	
Junction Temperature	T_j	150°C	
Storage Temperature Range	Tstg	-55 to +150°C	

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
2SB512, 2SD365		60			V	
2SB512A, 2SD365A		80			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=100mA I_B=0
2SB512, 2SD365		60			V	
2SB512A, 2SD365A		80			V	
Collector Cutoff Current	I_{CBO}			30	μA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			1	mA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.28	1	V	I_C=2A I_B=0.4A
Base-Emitter Voltage	V_{BE} *		0.83	1.4	V	I_C=1A V_{CE}=3V
D.C. Current Gain (note)	H_{FE} 1 *	30		160		I_C=1A V_{CE}=3V
	H_{FE} 2 *	40				I_C=0.1A V_{CE}=3V
Current Gain-Bandwidth Product	f_T	3			MHz	I_C=0.2A V_{CE}=10V

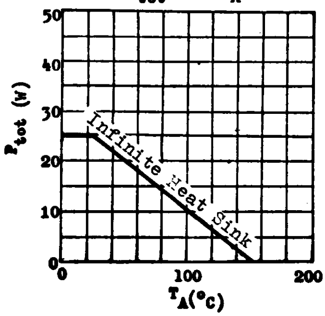
* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

note : H_{FE} 1 is classified as follows. Group Q : 30-60 Group P : 50-100 Group O : 80-160

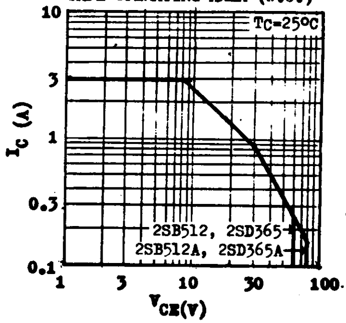
TYPICAL CHARACTERISTICS

(T_A=25°C unless otherwise noted)

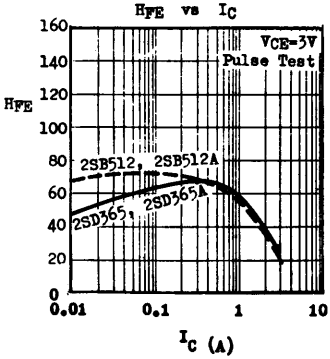
P_{tot} vs T_A



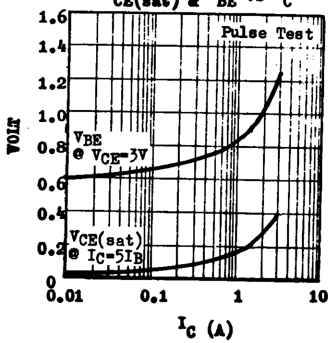
SAFE OPERATING AREA (D.C.)



H_{FE} vs I_C



$V_{CE(sat)}$ & V_{BE} vs I_C



2SC789 2SD570 2SD526

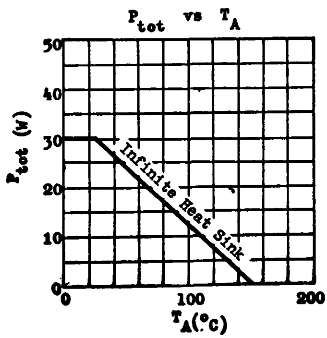
NPN SILICON EPITAXIAL BASE POWER TRANSISTORS

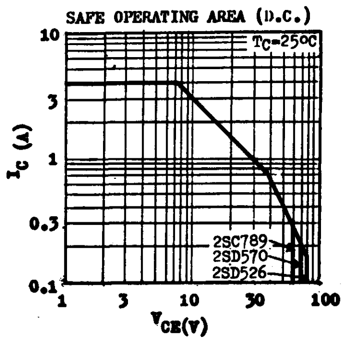
THE 2SC789, 2SD570, 2SD526 ARE NPN SILICON EPITAXIAL BASE POWER TRANSISTORS DESIGNED FOR 20 TO 25W AUDIO AMPLIFIER OUTPUTS AND SWITCHING APPLICATIONS UP TO 4A COLLECTOR CURRENT. THE 2SC789, 2SD570 AND 2SD526 ARE COMPLEMENTARY TO 2SA489, 2SB604 AND 2SB596 RESPECTIVELY.

CASE TO-220B

ABSOLUTE MAXIMUM RATINGS		2SC789	2SD570	2SD526
Collector-Base Voltage	V_{CBO}	70V	70V	80V
Collector-Emitter Voltage	V_{CEO}	60V	70V	80V
Emitter-Base Voltage	V_{EBO}		5V	
Collector Current	I_C		4A	
Collector Peak Current ($t \leqslant 10mS$)	I_{CM}		8A	
Total Power Dissipation ($T_C \leqslant 25^oC$)	P_{tot}		30W	
Junction Temperature	T_j		150^oC	
Storage Temperature Range	T_{stg}		-55 to $+150^oC$	

THERMAL RESISTANCE			
Junction to Case	θ_{jc}	$4.17^oC/W$	max.



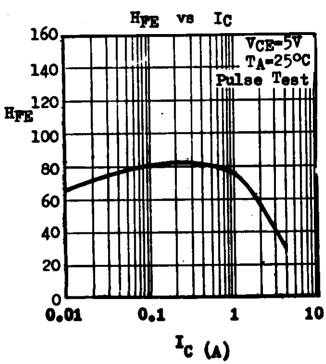


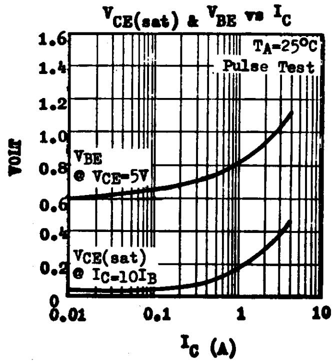
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=0.1mA I_E=0
2SC789		70			V	
2SD570		70			V	
2SD526		80			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=100mA I_B=0
2SC789		60			V	
2SD570		70			V	
2SD526		80			V	
Collector Cutoff Current	I_{CBO}					
2SC789				30	µA	V_{CB}=50V I_E=0
2SD570				30	µA	V_{CB}=50V I_E=0
2SD526				30	µA	V_{CB}=80V I_E=0
Emitter Cutoff Current	I_{EBO}			100	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ *		0.4	1.5	V	I_C=3A I_B=0.3A
Base-Emitter Voltage	V_{BE} *					
2SC789			1.0	1.5	V	I_C=2.5A V_{CE}=5V
2SD570			1.03	1.5	V	I_C=3A V_{CE}=5V
2SD526			1.03	1.5	V	I_C=3A V_{CE}=5V
D.C. Current Gain (note)	H_{FE} 1 *	40		240		I_C=0.5A V_{CE}=5V
	H_{FE} 2 *	15				I_C=3A V_{CE}=5V
Current Gain-Bandwidth Product	f_T	3			MHz	I_C=0.5A V_{CE}=5V

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%

note : H_{FE} 1 is classified as follows . Group R : 40-80 Group O : 70-140
Group Y : 120-240





12.77.8500E

2SC829

NPN SILICON RF SMALL SIGNAL TRANSISTOR

THE 2SC829 IS AN NPN SILICON PLANAR EPITAXIAL TRANSISTOR FOR RF SMALL SIGNAL APPLICATIONS SUCH AS RF, OSC, MIXER AND IF STAGES IN FM/AM RADIO SETS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	30V
Collector-Emitter Voltage	V_{CEO}	20V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	30mA
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	250mW derate 2.5mW/°C above 25°C
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C

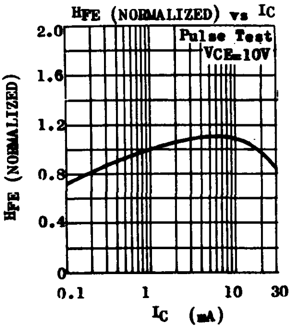
ELECTRICAL CHARACTERISTICS ($T_A=25°C$)

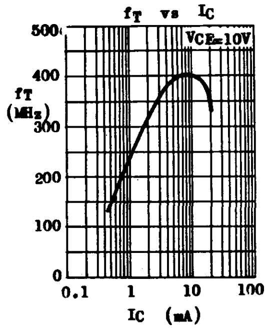
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	30			V	I_C=0.01mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	20			V	I_C=2mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	5			V	I_E=0.01mA I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.1		V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}		0.68		V	I_C=1mA V_{CE}=10V
D.C. Current Gain	H_{FE} *	40		250		I_C=1mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	150	230		MHz	I_C=1mA V_{CE}=10V
Feedback Capacitance (Common Emitter)	Cre		1.3	1.6	pF	I_C=1mA V_{CE}=10V f=10.7MHz
Feedback Impedance (Common Base)	$\lvert Z_{rb} \rvert$			60	Ω	$-I_E$=1mA V_{CB}=10V

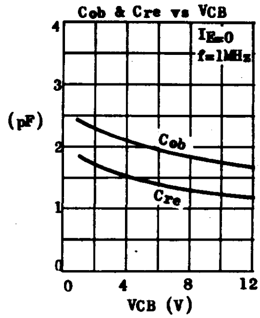
* H_{FE} is classified as follows.

GROUP A : 40-100 GROUP B : 70-160 GROUP C : 110-250

TYPICAL CHARACTERISTICS AT T_A=25°C

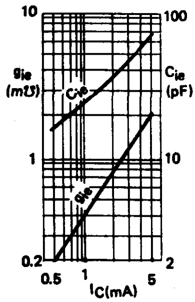


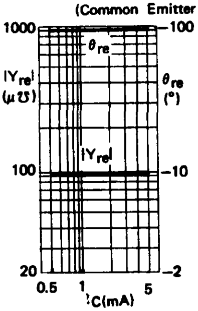


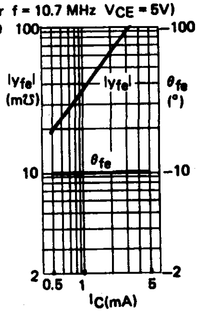


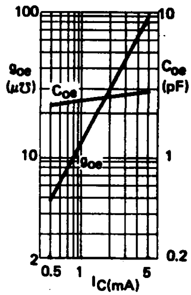
TYPICAL y-PARAMETERS AT T_A=25°C

(Common Emitter f = 10.7 MHz V_{CE} = 5V)









2SC838 2SC839

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE 2SC838, 2SC839 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR RF SMALL SIGNAL APPLICATIONS. THEY ARE SPECIALLY SUITED FOR RF AMPLIFIER, OSCILLATOR, MIXER, AND IF AMPLIFIER IN FM/AM RADIO SETS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	50V
Collector-Emitter Voltage	V_{CEO}	25V
Emitter-Base Voltage	V_{EBO}	5V
Collector Current	I_C	50mA
Total Power Dissipation ($T_A \leq 25°C$)	P_{tot}	250mW derate 2.5mW/°C above 25°C
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125°C

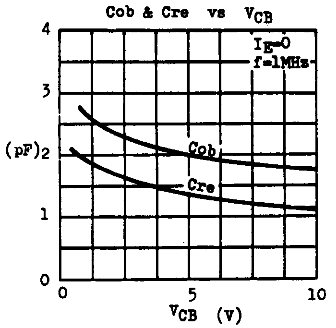
ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

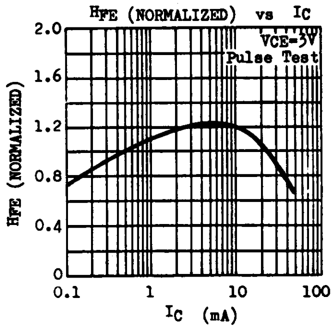
PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector Cutoff Current	I_{CBO}			100	nA	V_{CB}=15V I_E=0
Emitter Cutoff Current	I_{EBO}			100	nA	V_{EB}=3V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		0.1	0.3	V	I_C=10mA I_B=1mA
Base-Emitter Voltage	V_{BE}		0.67		V	I_C=1mA V_{CE}=6V
D.C. Current Gain (Note 1)	H_{FE}	30		180		I_C=0.5mA V_{CE}=3V
Current Gain-Bandwidth Product	f_T	150	250		MHz	I_C=1mA V_{CE}=6V
Collector-Base Capacitance	Cob		1.9	2.5	pF	V_{CB}=6V I_E=0 f=1MHz
Feedback Capacitance	Cre		1.3	1.8	pF	V_{CB}=6V I_E=0 f=1MHz
Feedback Time Constant	$C_c r_{bb'}$		25	59	pS	I_C=10mA V_{CE}=6V f=31.8MHz
Noise Figure 2SC839 only	NF		2.5	4	dB	I_C=0.5mA V_{CE}=6V R_G=500Ω f=1MHz

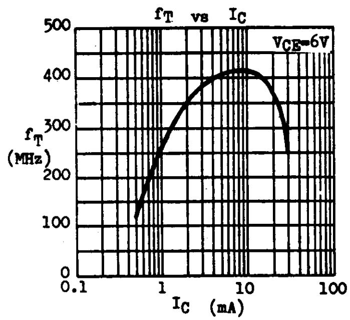
Note 1 : H_{FE} is classified as follow.

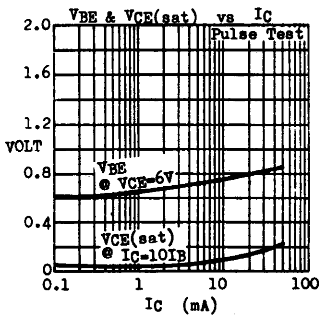
Group J : 30-80 Group H : 60-120 Group F : 90-180

TYPICAL CHARACTERISTICS AT TA=25°C









2SC922 2SC1047

NPN SILICON RF SMALL SIGNAL TRANSISTORS

THE 2SC922, 2SC1047 ARE NPN SILICON PLANAR EPITAXIAL TRANSISTORS FOR USE IN RF AND CONVERTER STAGES IN FM/AM RADIO SETS.

CASE TO-92B

ECB

ABSOLUTE MAXIMUM RATINGS		2SC922	2SC1047
Collector-Base Voltage	V_{CBO}	30V	30V
Collector-Emitter Voltage	V_{CEO}	20V	20V
Emitter-Base Voltage	V_{EBO}	5V	3V
Collector Current	I_C	20mA	15mA
Total Power Dissipation ($T_A \leq 25^oC$)	P_{tot}	250mW	150mW
Operating Junction & Storage Temperature	T_j, T_{stg}	-55 to 125oC	

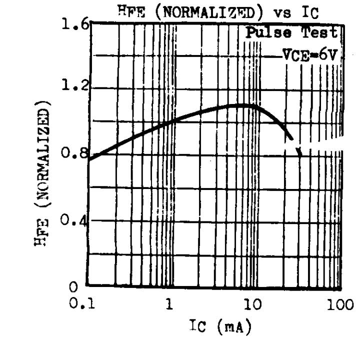
ELECTRICAL CHARACTERISTICS (T_A=25°C)

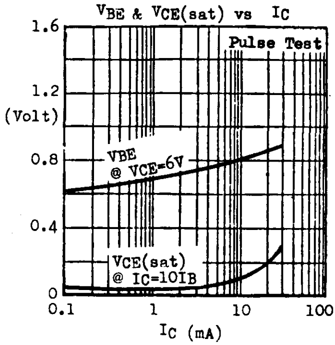
PARAMETER	SYMBOL	2SC922 MIN	2SC922 MAX	2SC1047 MIN	2SC1047 MAX	UNIT	TEST CONDITIONS
Collector Cutoff Current	I_{CBO}		0.1			μA	V_{CB}=20V I_E=0
					10	μA	V_{CB}=30V I_E=0
Emitter Cutoff Current	I_{EBO}		0.1		10	μA	V_{EB}=3V I_C=0
D.C. Current Gain (Note)	H_{FE}	40	180	40	160		I_C=1mA V_{CE}=6V
Current Gain-Bandwidth Product	f_T	400		450		MHz	I_C=1mA V_{CE}=6V
Feedback Capacitance	Cre		1.2			pF	V_{CB}=10V I_E=0 f=1MHz
					1.0	pF	V_{CE}=6V I_C=1mA f=10.7MHz
Collector-Base Time Constant	Ccrbb'		22			pS	I_C=1mA V_{CE}=6V f=31.8MHz
Power Gain	Gpe	20		20		dB	I_C=1mA V_{CE}=6V f=100MHz
Noise Figure	NF		5		5	dB	I_C=1mA V_{CE}=6V R_G=50Ω f=100MHz

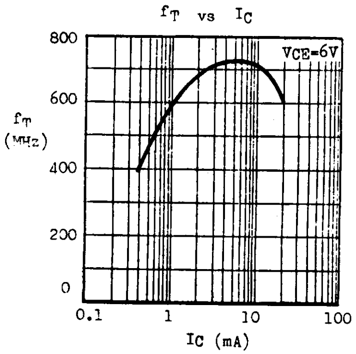
Note : The H_{FE} of 2SC922 is classified as follows — GROUP M : 40-80 GROUP L : 60-120
GROUP K : 90-180

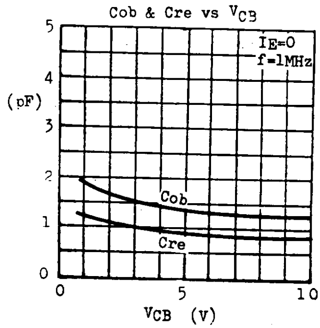
The H_{FE} of 2SC1047 is classified as follows — GROUP B : 40-110 GROUP C : 65-160

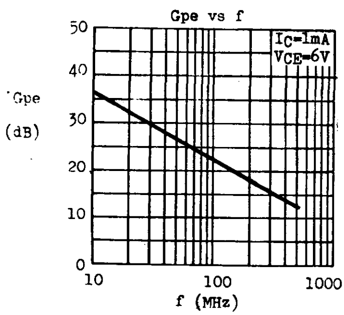
TYPICAL CHARACTERISTICS AT TA=25°C

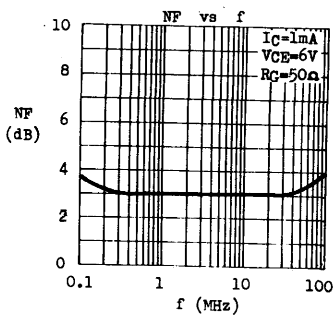












2SC1048

NPN SILICON HIGH VOLTAGE VIDEO AMPLIFIER

THE 2SC1048 IS AN NPN SILICON PLANAR TRANSISTOR DESIGNED FOR VIDEO AMPLIFIERS IN TELEVISION RECEIVERS AS WELL AS FOR HIGH VOLTAGE SWITCHING UP TO 100mA CURRENT.

CASE TO-39

C E B

ABSOLUTE MAXIMUM RATINGS

Collector-Base Voltage	V_{CBO}	200V
Collector-Emitter Voltage	V_{CEO}	200V
Emitter-Base Voltage	V_{EBO}	6V
Collector Current	I_C	50mA
Collector Peak Current	I_{CM}	100mA
Total Power Dissipation ($T_C \leq 25°C$)	Ptot	4W
($T_A \leq 25°C$)		600mW
Operating Junction & Storage Temperature	Tj, T_{stg}	-55 to 150°C

ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

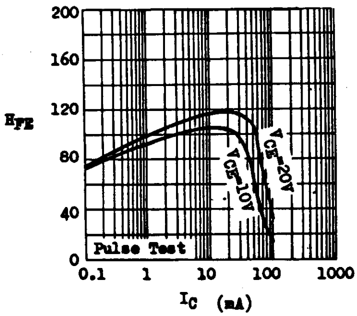
PARAMETER	SYMBOL	MIN	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}	200		V	I_C=0.1mA I_E=0
Collector-Emitter Breakdown Voltage	LV_{CEO}	200		V	I_C=3mA (Pulsed) I_B=0
Emitter-Base Breakdown Voltage	BV_{EBO}	6		V	I_E=0.1mA I_C=0
Collector Cutoff Current	I_{CBO}		10	µA	V_{CB}=100V I_E=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$		1.3	V	I_C=25mA I_B=2.5mA
D.C. Current Gain	H_{FE} *	40	200		IC=25mA V_{CE}=10V
Current Gain-Bandwidth Product	f_T	40		MHz	I_C=10mA V_{CE}=10V
Collector-Base Capacitance	Cob		4.2	pF	V_{CB}=10V IE=0 f=1MHz

* H_{FE} is classified as follows.

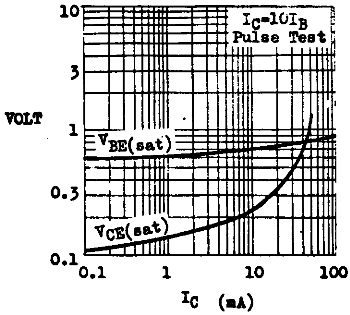
Group C : 40-80 Group D : 60-120 Group E : 100-200

TYPICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

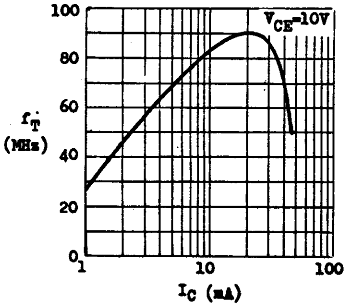
H_{FE} vs I_C



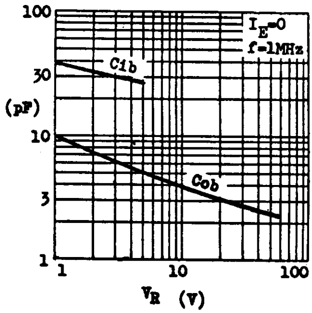
$V_{BE}(sat)$ & $V_{CE}(sat)$ vs I_C



f_T vs I_C



C_{ib} & C_{ob} vs V_R



2SD234 2SD235

NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS

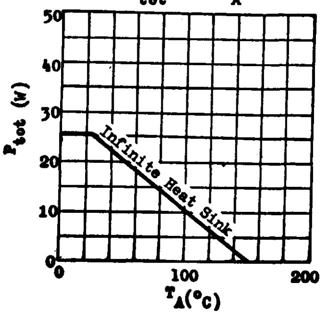
THE 2SD 234, 2SD 235 ARE NPN SILICON SINGLE DIFFUSED MESA POWER TRANSISTORS DESIGNED FOR LOW SPEED SWITCHING AND AUDIO POWER AMPLIFIER APPLICATIONS. THEY FEATURE LARGE SAFE OPERATING AREA.

CASE TO-220B

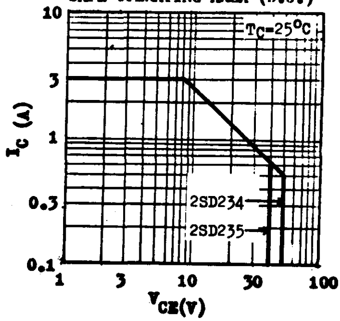
ABSOLUTE MAXIMUM RATINGS			2SD 234	2SD 235
Collector-Base Voltage		V_{CBO}	60V	50V
Collector-Emitter Voltage		V_{CEO}	50V	40V
Emitter-Base Voltage		V_{EBO}	10V	
Collector Current		I_C	3A	
Total Power Dissipation	@ $T_C \leq 25^oC$	P_{tot}	25W	
	@ $T_A \leq 25^oC$		1.5W	
Junction Temperature		T_j	150°C	
Storage Temperature Range		T_{stg}	-55 to +150°C	

THERMAL RESISTANCE		
Junction to Case	Θ_{jc}	5°C/W max.
Junction to Ambient	Θ_{ja}	83°C/W max.

P_{tot} vs T_A



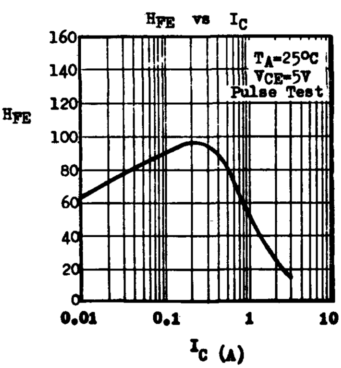
SAFE OPERATING AREA (D.C.)

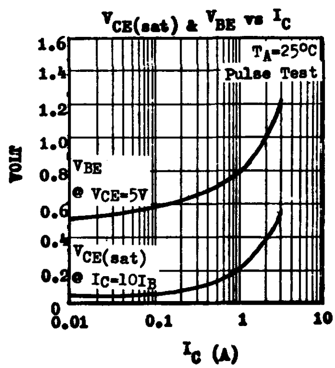


ELECTRICAL CHARACTERISTICS (T_A=25°C unless otherwise noted)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITIONS
Collector-Base Breakdown Voltage	BV_{CBO}					I_C=10mA I_E=0
2SD 234		60			V	
2SD 235		50			V	
Collector-Emitter Breakdown Voltage	LV_{CEO} *					I_C=100mA I_B=0
2SD 234		50			V	
2SD 235		40			V	
Emitter-Base Breakdown Voltage	BV_{EBO}	10			V	I_E=10mA I_C=0
Collector Cutoff Current	I_{CBO}			100	µA	V_{CB}=20V I_E=0
Emitter Cutoff Current	I_{EBO}			100	µA	V_{EB}=5V I_C=0
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$*					
2SD 234			0.5	1.2	V	I_C=3A I_B=0.3A
2SD 235			0.23	1	V	I_C=1A I_B=0.05A
Base-Emitter Voltage	V_{BE} *		0.68	0.9	V	I_C=0.5A V_{CE}=5V
D.C. Current Gain	H_{FE} 1 *	40		240		I_C=0.5A V_{CE}=5V
D.C. Current Gain	H_{FE} 2 *					
2SD 234		15				I_C=2.5A V_{CE}=5V
2SD 235		20				I_C=1A V_{CE}=5V
Current Gain-Bandwidth Product	f_T	0.8	1.5		MHz	I_E=0.2A V_{CE}=5V
Collector-Base Capacitance	Cob		250		pF	V_{CB}=10V I_E=0 f=1MHz

* Pulse Test : Pulse Width=0.3mS, Duty Cycle=1%



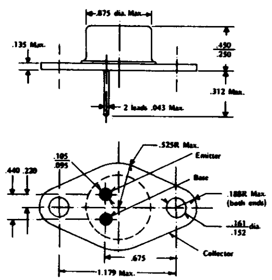


12.77.MA

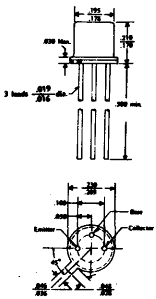
MECHANICAL OUTLINES

(All dimensions in inches unless otherwise noted)

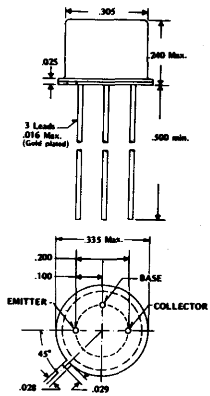
T0-3



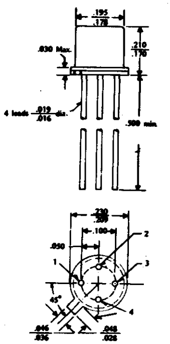
T0-18



T0-39



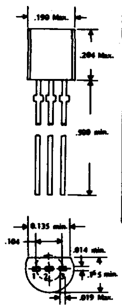
T0-72



JFET
1 – S
2 – D
3 – G
4 – Case

SCS
1 – K
2 – Gk
3 – Ga (Case)
4 – A

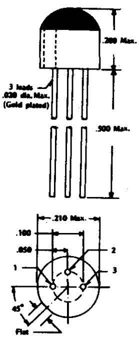
T0-92



Lead Code	123
T0-92A	EBC
T0-92B	ECB
*T0-92E	CEB
*T0-92F	CBE
T0-92DA	SGD
T0-92DD	DSG
*T0-92DE	GSD

*Leads pre-formed to T0-106 spacings.

T0-106

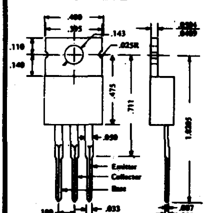


NPN, PNP
1 – E
2 – B
3 – C

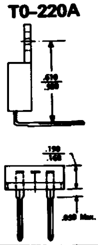
JFET
1 – S
2 – D
3 – G

PUT
1 – K
2 – G
3 – A

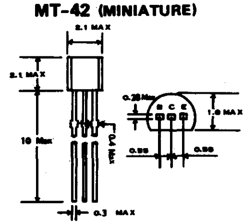
T0-220B



T0-220A



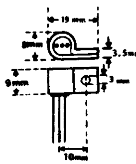
MT-42 (MINIATURE)



ALL DIMENSIONS IN MM

X-67 HEAT SINK

mounted to T0-92



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