

845A/845AB

High Impedence Voltmeter Null Detector

Instruction Manual

P/N 294173
November 1967



WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify the JOHN FLUKE MFG. CO., INC., or nearest Service facility, giving full details of the difficulty, and include the model number, type number, and serial number. On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"™ prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC. will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

CHANGE/ERRATA INFORMATION

ISSUE NO: 3 7/93

This change/errata contains information necessary to ensure the accuracy of the following manual:

MANUAL

Title: 845A & 845AB
Print Date: Nov. 1967
Rev.- Date: ---

C/E PAGE EFFECTIVITY

Page No.	Print Date
1	2/90
2	2/90
3	2/90
4	2/90
5	2/90
6	2/90
7	2/90
8	2/90
9	2/90
10	2/90

NOTE

A major circuit modification has been made to the Fluke Model 845AB. This change entails the complete redesign of the Photo Modulator, previously based on photo-conductive resistors. The new circuit now employs optically-isolated Bilateral Analog FETs, and is fabricated on an additional circuit board.

Updates to the relevant sections of this manual are now in process and will be available for shipment approximately December 1993. This manual is completely accurate with regard to specifications and operating instructions. The circuit modifications are totally internal and are completely transparent to the user.

If you have any questions regarding repair and/or service of your 845AB please contact your nearest Fluke Service Center (see the list attached to this change/errata.)

CHANGE #1 - 6282

On page 1-1,

Change paragraph 1-2,

FROM: ...the input impedance is 10 megohms...
TO: ...the input impedance is 1 megohms....

Under Paragraph 1-4, under INPUT RESISTANCE,

ADD:

10 Megohms on the 3 millivolt through 100 millivolt range

CHANGE: 10 Megohms on 100 millivolt range and below
TO: 1 Megohms on 1 millivolt range and below

On page 2-5,

Change paragraph 2-36,

FROM: In the 1 microvolt to 1 millivolt ranges, a 10...
TO: In the 1 microvolt to 1 millivolt ranges, a 1....

FROM:creased on these ranges by disconnecting the 10 megohm..
TO:creased on these ranges by disconnecting the 1 megohm...

FROM:Typical input resistances with the 10 megohm resistor...
TO:Typical input resistances with the 1 megohm resistor....

On page 3-2, change paragraph 3-14,

FROM: ...volt and below, a 10 megohm resistor, R104 is con-...
TO: ...volt and below, a 1 megohm resistor, R104 is con-....

On the functional schematic, change R104,

FROM: 10M
TO: 1M.

ERRATA #1

On page 3-1, change all occurrences,

FROM: "dc signal"
TO: "ac signal"

In Section 5, replace all the tables with the following:

Table 5-1. 845AB Final Assembly
(See Figure 5-1.)

REFERENCE DESIGNATOR		FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T E
-A>-NUMERICS----->	S-----DESCRIPTION-----	--NO--	-CODE-	-OR GENERIC TYPE-----		-E---
A	2					
		194548	89536	194548	1	
A	3					
		194399	89536	194399	1	
A	4					
		194555	89536	194555	1	
BT	1					
		256966	89536	256966	1	
C	4, 5					
		148387	09023	CD15FD102J0	2	
E	1					
		101055	79963	9.074.020,BR,ELEC-TIN	1	
E	2, 3					
		169409	79963	29A.120.016COPR,ELC-TN	2	
F	1					
		163030	71400	MDL-1-16 250V	1	
H	1					
		177022		COMMERCIAL	10	
H	2					
		176172		COMMERCIAL	12	
H	3					
		156364		COMMERCIAL	16	
H	4					
		114116		COMMERCIAL	6	
H	5					
		152173		COMMERCIAL	14	
H	8					
		114124		COMMERCIAL	4	
H	9					
		110270		COMMERCIAL	7	
H	10					
		152819		COMMERCIAL	6	
H	11					
		114991		COMMERCIAL	4	
H	12					
		111005		COMMERCIAL	2	
H	13					
		110312		COMMERCIAL	2	
H	14					
		178533		COMMERCIAL	8	
M	1					
		192294	1A791	502	1	
MP	1					
		117259	89536	117259	1	
MP	2					
		194506	89536	194506	1	
MP	3					
		455162	89536	455162	1	
MP	4					
		194282	89536	194282	1	
MP	5					
		455188	89536	455188	2	
MP	6					
		194308	89536	194308	2	
MP	7					
		194241	89536	194241	1	
MP	8					
		194258	89536	194258	1	
MP	9					
		194266	89536	194266	1	
MP	10					
		194274	89536	194274	1	
MP	11					
		196907	89536	196907	2	
MP	12					
		194365	89536	194365	1	
MP	13					
		171876	89536	171876	4	
MP	14					
		100065	88786	505	1	
MP	15					
		153155	55566	1124-.156-A-22	4	
MP	16					
		341339	89536	341339	1	
MP	17					
		434183	89536	434183	1	
MP	18					
		341396	89536	341396	2	
MP	19					
		193557	89536	193557	1	
MP	20					
		103309	83478	9102-W	4	
MP	21					
		104638	06383	SSC2S-S10	1	
MP	22					
		103838	89536	103838	1	
MP	23					
		203299	89536	203299	1	
MP	24					
		215210	55566	1122-6-A-22	4	
MP	25					
		455352	89536	455352	1	
MP	26					
		455170	89536	455170	2	
MP	27					
		166280	12136	919-415-173	1	
MP	28					
		284323	89536	284323	4	
TM	1					
		294173	89536	294173	1	
W	1					
		284174	70903	17239	1	
XF	1					
		160846	75915	342004	1	

An * in 'S' column indicates a static-sensitive part.

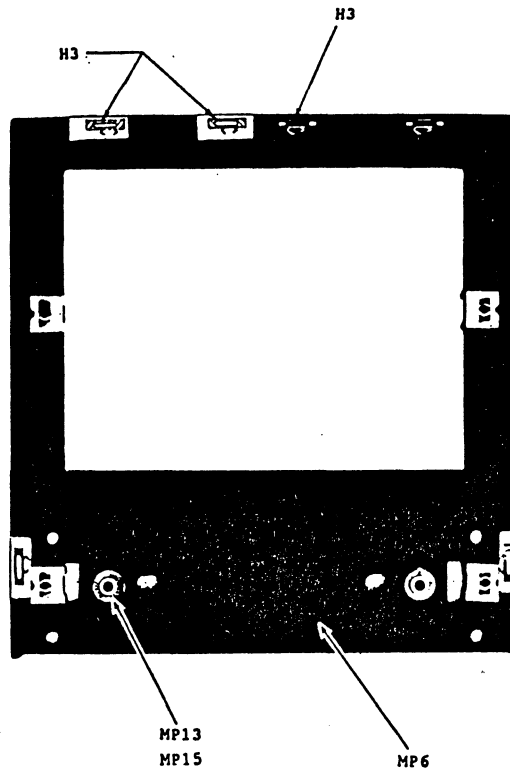
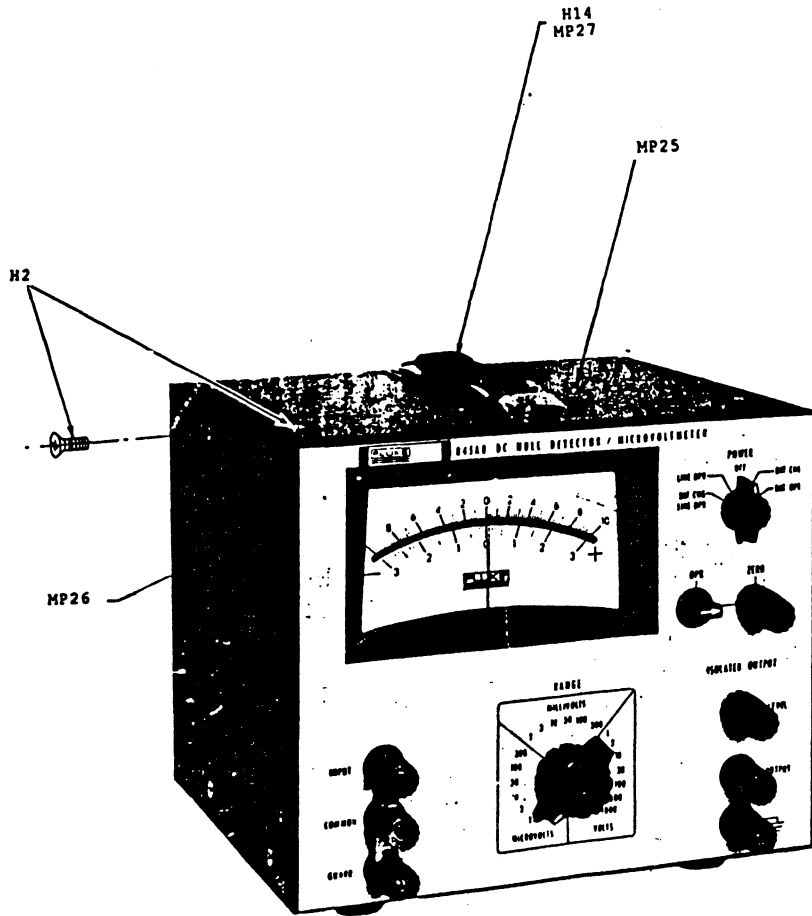


Figure 5-1. 845AB Final Assembly

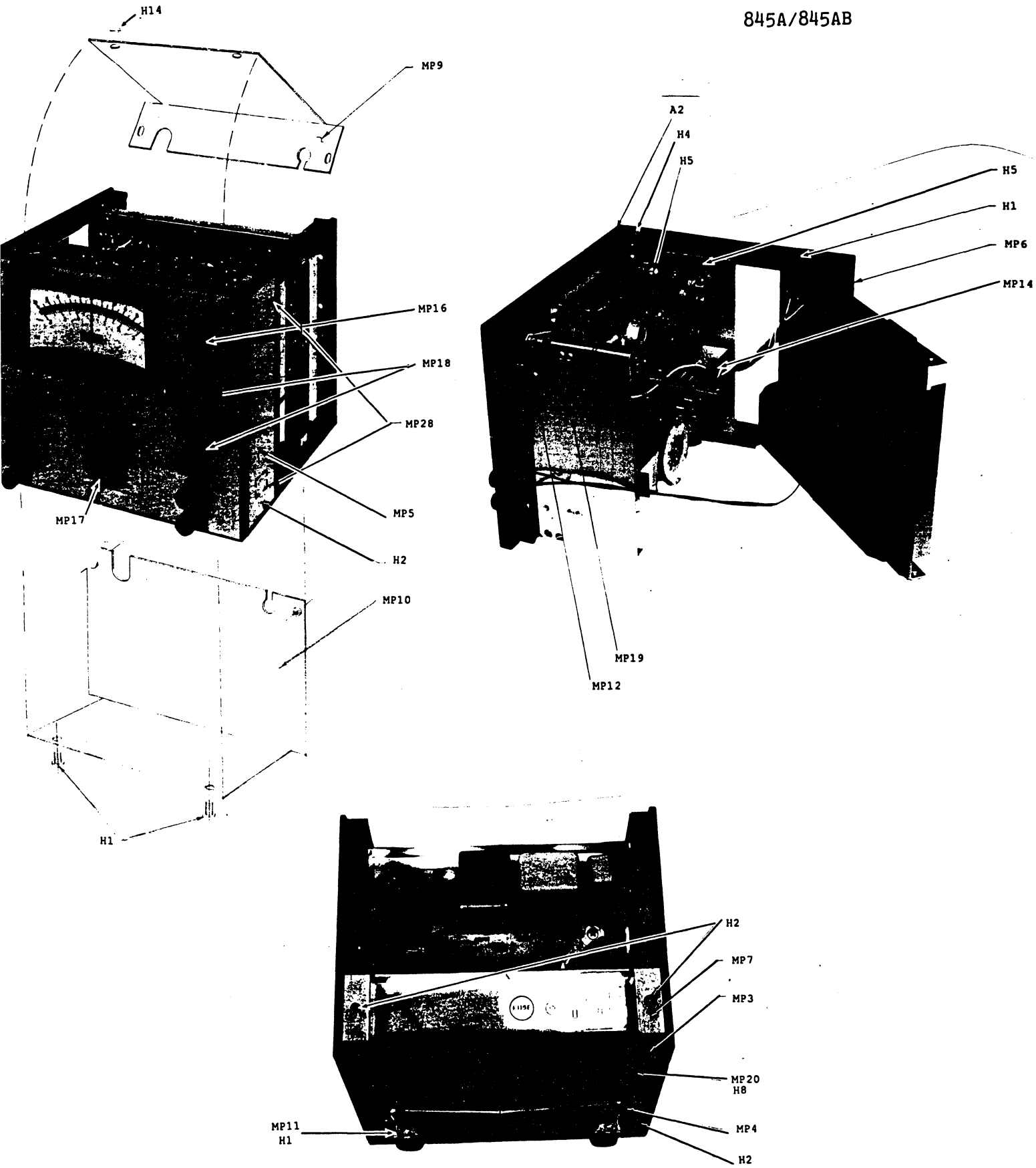
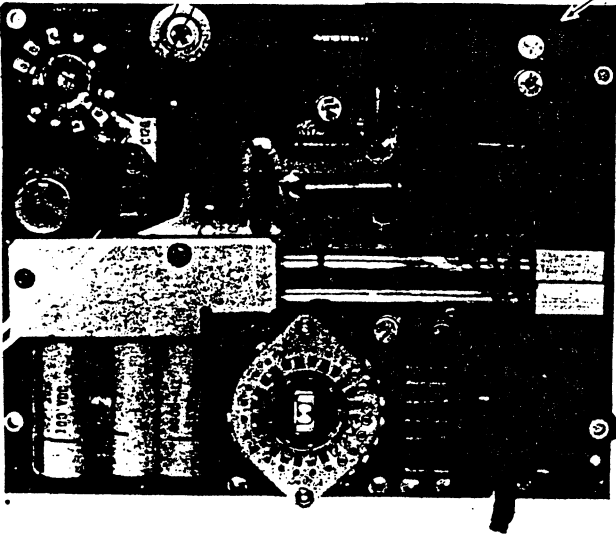
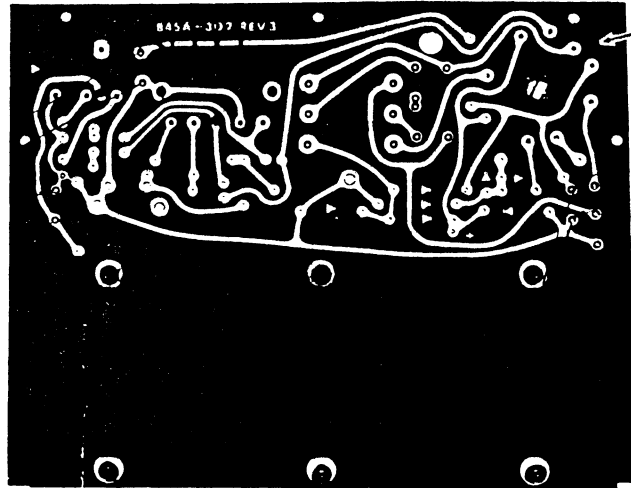


Figure 5-1. 845AB Final Assembly (cont.)

A3



A4



H5
H9
H0

E1

E2
E3
H13

MP21
H9

M1

MP8

H12
MP24

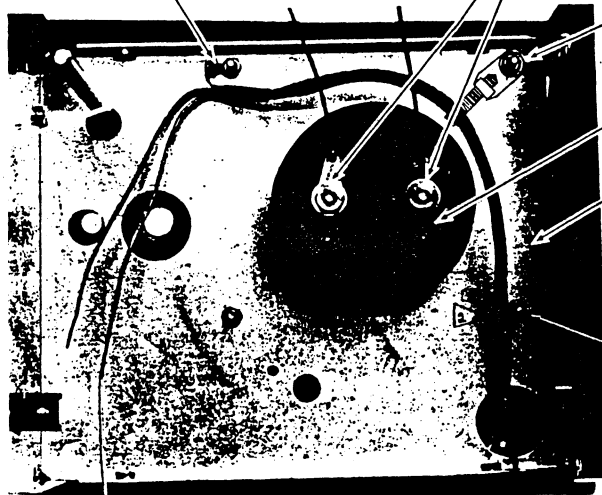


Figure 5-1. 845AB Final Assembly (cont.)

Table 5-2. A2 Front Panel Assembly
(See Figure 5-2.)

REFERENCE DESIGNATOR	QUANTITY	DESCRIPTION	FLUKE STOCK NO	MFRS SPLY CODE	MANUFACTURERS PART NUMBER OR GENERIC TYPE	TOT QTY	N O T
-A>-NUMERICS-->	S	-----	--NO--	-CODE-	-----	----	-E--
C 1		CAP, POLYES, 0.047UF, +-20%, 1200V	182683	84411	663UW.47320%1200V	1	
C 2		CAP, POLYST, 0.047UF, +-20%, 1200V	190561	84411	1263UW.04720%1200V	1	
C 3		CAP, AL, 10UF, +50-10%, 25V	170266	62643	SM25 T-100	1	
E 1		JUMPER, LINK, BINDING POST	190728	83330	21171	1	
E 2- 6	*	TERM, RING .120 & .187, SOLDR	169409	79963	29A.120.016COPR, ELC-TN	5	
H 1		NUT, MACH, HEX, STL, 3/8-32	110510		COMMERCIAL	1	
H 2		WASHER, LOCK, INTRNL, STEEL, 0.387 ID	129957		COMMERCIAL	1	
H 3		WASHER, LOCK, INTRNL, STEEL, #10	110312		COMMERCIAL	9	
H 4		SCREW, MACH, PH, P, STL, 4-40X0.500	152132		COMMERCIAL	2	
H 5		WASHER, LOCK, INTRNL, STEEL, #4	110403		COMMERCIAL	2	
J 1, 2		ASSY, RED 10-32 BINDING POST CU	794438	89536	794438	2	
J 3, 5		ASSY, BLK 10-32 BINDING POST BR	794412	89536	794412	2	
J 4		ASSY, RED 10-32 BINDING POST BR	794404	89536	794404	1	
MP 1		CASTING FINISHED,	194217	89536	194217	1	
MP 2		PANEL SCREENED	455121	89536	455121	1	
MP 3		SWITCH, PART, INDEX, ROTARY	193565	29238	4-8243-348	1	
MP 4		BUSHING, SNAP-IN, NYLON, 0.251 ID	160499	96881	7-4L2-FF	1	
MP 5		NAMEPLATE, .250X1.3, SERIAL NUMBER	393975	89536	393975	1	
MP 6		BUSHING, SWITCH, LEXAN, 0.435 ID	193540	20584	193540	1	
MP 7		SPACER	127761	89536	127761	2	
R 1		RES, VAR, CP, 10K, +-30%, 0.25W	192344	12697	CM46140	1	
R 2		RES, CC, 4.7K, +-10%, 0.5W	108381	01121	EB4721	1	
W 1		CORD, LINE INPUT CABLE,	195917	89536	195917	1	

An * in 'S' column indicates a static-sensitive part.

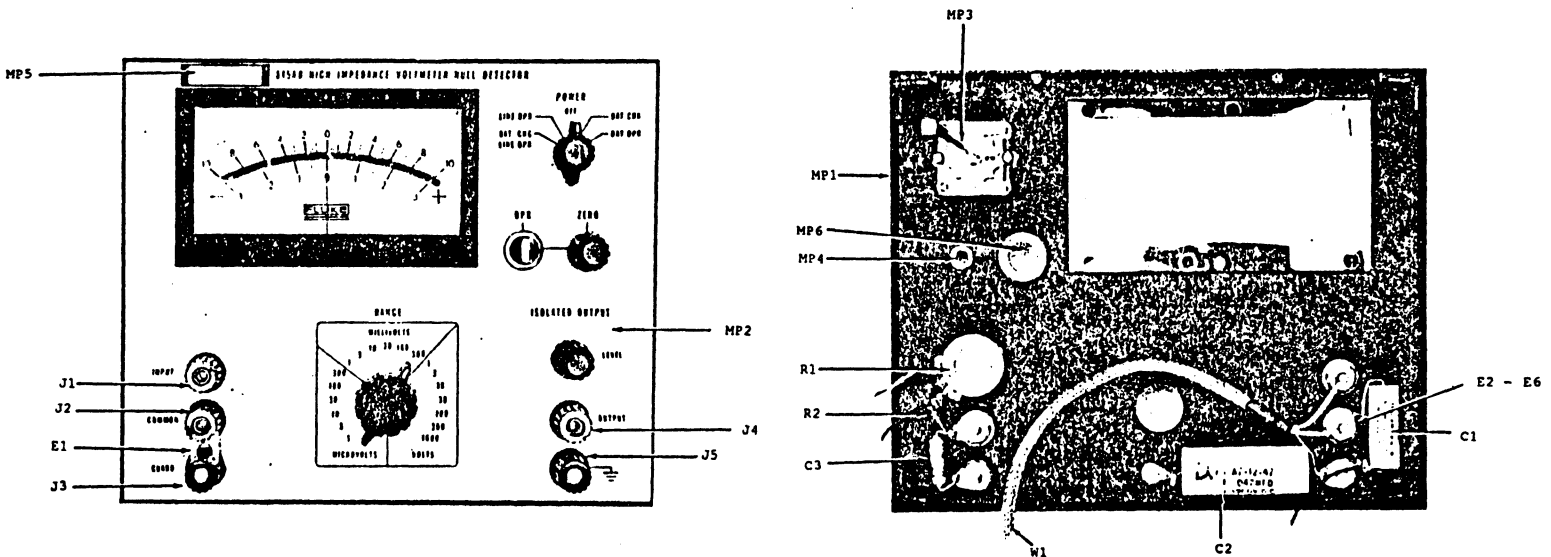


Figure 5-2. A2 Front Panel Assembly

Table 5-3. A3 Amplifier PCB Assembly
(See Figure 5-3.)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T
-A>-NUMERIC--> S	NO	CODE	-OR GENERIC TYPE	QTY	-E--
-----DESCRIPTION-----					
C 101-103	190553	84411	1263UW474 20% 120V	3	
C 104, 109, 115	271973	84411	X603.1-10-250V	3	
C 105, 108	105734	60705	562CX7WCK501AE301K	2	
C 106	166330	62643	SM6.3T-1500	1	
C 107	187765	62643	SM16T-331	1	
C 110, 112	170266	62643	SM25 T-100	2	
C 111	106054	56289	10304	1	
C 113	187773	62643	SM6.3T-470	1	
C 114	182782	56289	150D685X9035B3	1	
C 116	153056	56289	150D156X0020B3	1	
C 117, 118	168153	62643	SM25T-470	2	
C 119	194803	80031	719A1GG223L251SB	1	
C 120	150292	56289	30D150-10%-15V	1	
CR 101, 102	260554	14552	CD55105	2	
CR 104-107	112383	04713	1N5397	4	
CR 108	375477	09214	MPD200	1	
DS 101, 102	100347	53944	A9A-1	2	
FL 1	219535	25088	B62110-A503-0X025-C	1	
H 1	178533	COMMERCIAL		4	
H 2	110270	COMMERCIAL		1	
H 3	110601	COMMERCIAL		1	
H 4	111054	COMMERCIAL		3	
H 5	110692	COMMERCIAL		1	
H 6	152165	COMMERCIAL		1	
H 7	110569	COMMERCIAL		1	
MP 1	194316	89536	194316	1	
MP 2	167569	89536	167569	2	
MP 3	168047	9S171	3200180-3.50	2	
MP 4	171876	89536	171876	4	
MP 5	153155	55566	1124-.156-A-22	4	
MP 6	194076	89536	194076	2	
MP 7	656124	89536	656124	1	
Q 101	242065	04713	2N5089	1	
Q 102	168716	27014	ST07154	1	
Q 103, 107, 108	168708	09214	2N3391	3	
Q 104, 105	177105	27014	PN3565	2	
Q 106, 114	321398	04713	2N2945A	2	
Q 109, 110	169375	04713	MPS-3638	2	
Q 111	218081	04713	MPS-6520	1	
Q 112	229898	07263	MPS-6522	1	
Q 113	454843	04713	SP57940	1	
R 101-103, 105-109	227132	89536	227132	1	1
R 104	177188	64537	PME751004F T-1	1	
R 110	393397	64537	PME75150.5% T-9	4	
R 111, 120	148163	01121	CB4735	2	
R 112, 128, 130, 146	148189	01121	CB1045	4	
R 113	147983	01121	CB4715	1	
R 114	193946	89536	193946	1	
R 115	108407	01121	EB1251	1	
R 116	188433	01121	CB6845	1	
R 117	193086	12697	CM46141	1	
R 118	108142	01121	EB1061	1	
R 119	198390	01121	CB2255	1	
R 121	147868	01121	CB1035	1	
R 122, 150	148171	01121	CB6835	2	
R 123	188458	01121	CB8235	1	
R 124	147884	01121	CB2205	1	
R 125	147918	01121	CB685	1	
R 126	147959	01121	CB2215	1	
R 127, 133	148106	01121	CB1035	2	
R 129, 135, 148, 155, 156	148130	01121	CB2235	5	
R 131	147926	01121	CB1015	1	
R 132	188466	01121	CB3935	1	
R 134, 147	148114	01121	CB1535	2	
R 136	187930	91637	CMF651071F T-1	1	
R 137	187781	91637	CMF653161F T-1	1	

An * in 'S' column indicates a static-sensitive part.

Table 5-3. A3 Amplifier PCB Assembly (cont)

REFERENCE DESIGNATOR	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT	N O T
-A>-NUMERICS-----> S-----	DESCRIPTION-----	--NO--	-OR CODE-	GENERIC TYPE-----	QTY-- -E--
R 138-142	RES, ASSY BETA SET	194423	89536	194423	1 2
R 143-145	RES, CC, 150K, +-5%, 0.25W	182212	01121	CB1545	3
R 149	RES, CC, 3.9M, +-5%, 0.25W	188417	01121	CB3955	1
R 151	RES, VAR, WW, 2K, +-5%, 1.25W, PWB MTG	160705	71450	110-202-1.25W-5%	1
R 152	RES, MF, 7.5K, +-1%, 0.5W, 100PPM	192161	91637	CMF657501F T-1	1
R 153, 158, 159	RES, CC, 1K, +-5%, 0.25W	148023	01121	CB1025	3
R 154	RES, CC, 47K, +-5%, 0.5W	108738	01121	EB4735	1
R 157	RES, MF, 825, +-1%, 0.5W, 100PPM	155119	91637	CMF658250F T-1	1
S 101	SW, ROTARY RANGE, 845A-804	194589	89536	194589	1
S 102	SWITCH, WAFER, SPECIAL CUT	194027	29238	4-2512-665	1
S 103	SW, ROTARY ZERO, 845A-809	194936	89536	194936	1
V 101	PHOTOCELL PHOTOCELL ASMBLY,	194449	89536	194449	1
VR 103	* ZENER, UNCOMP, 10.0V, 10%, 12.5MA, 0.4W	113324	04713	1N961A	1
XQ 104-106, 109-	SOCKET, TRANS, T0-5	104315	95354	133-400-01	9
XQ 114		104315			

An * in 'S' column indicates a static-sensitive part.

NOTE 1 - These resistors are factory matched. If any replacement is required, an entire set, part number 227132, must be replaced.

NOTE 2 - These resistors are factory matched. If any replacement is required, an entire set, part number 194423, must be replaced.

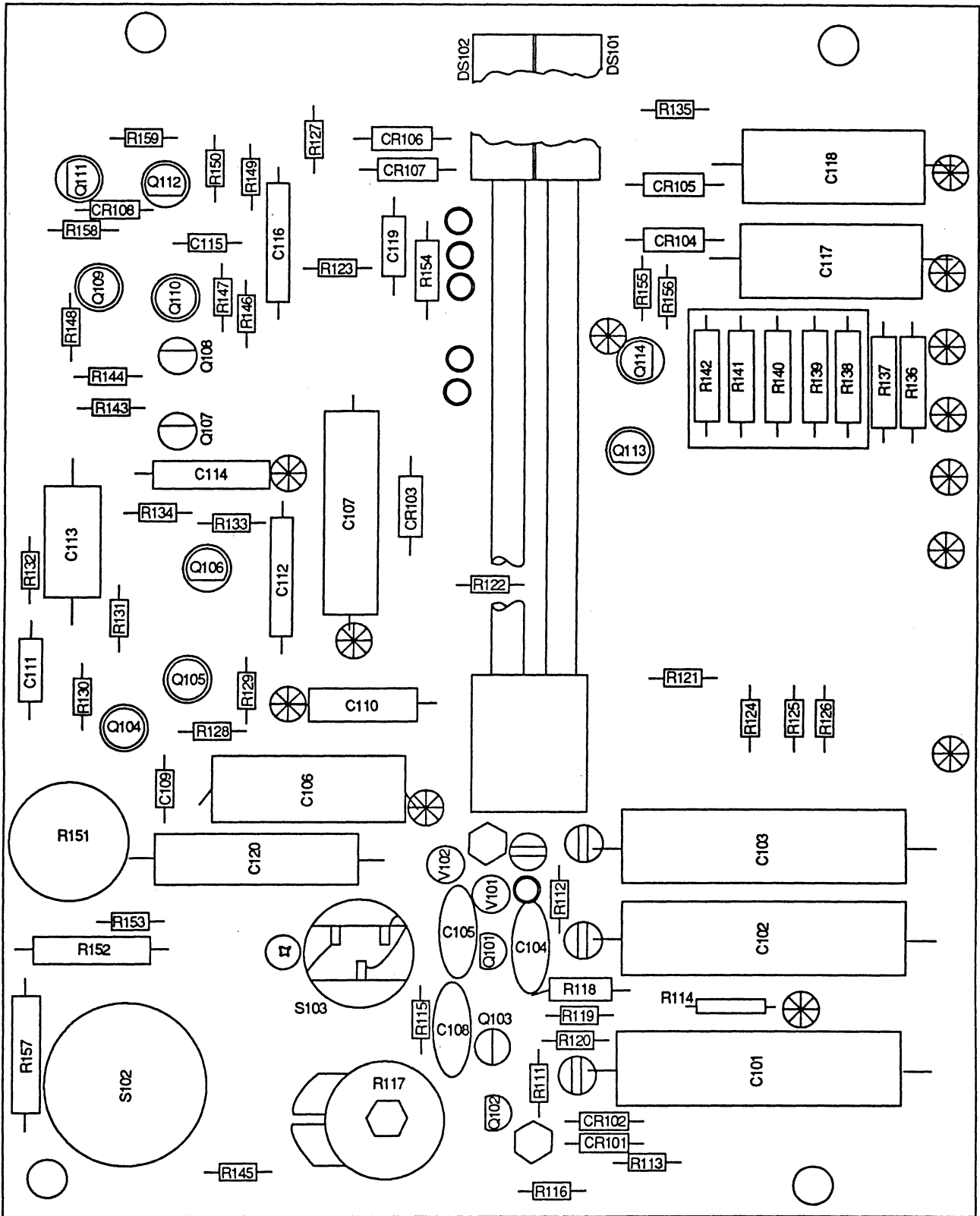


Figure 5-3. A3 Amplifier PCB Assembly

Table 5-4. A4 Power Supply PCB Assembly
(See Figure 5-4.)

REFERENCE DESIGNATOR	DESCRIPTION	FLUKE STOCK	MFRS SPLY	MANUFACTURERS PART NUMBER	TOT QTY	N O T
-A>-NUMERIC-->	S-----DESCRIPTION-----	--NO--	--CODE--	--OR GENERIC TYPE--	----	-E--
C 201	CAP,AL,470UF,+50-10%,25V	168153	62643	SM25T-470	1	
C 203	CAP,POLYES,1UF,+20%,200V	106450	12673	33M1004M-2	1	
C 204	CAP,AL,470UF,+50-10%,6.3V	187773	62643	SM6.3T-470	1	
CR 201-206	DIODE,SI,600 PIV,1.5 AMP	112383	04713	1N5397	6	
H 1	RIVET,S-TUB,OVAL,STL,.118,.218	103606	12014	R3647X7-32	8	
MP 1	METL,SHT REAR BULKHEAD	194357	89536	194357	1	
Q 201,202	* TRANSISTOR,SI,NPN,SELECTED,SMALL SIG	454843	04713	SPS7940	2	
Q 203,204	* TRANSISTOR,SI,PNP,SMALL SIG,SELECTED	380394	56289	T-6506	2	
R 201	RES,CC,39,+10%,2W	144378	01121	HB3901	1	
R 202	RES,CC,150,+5%,1W	178566	01121	GB1515	1	
R 205	RES,MF,9.53K,+1%,0.5W,100PPM	159442	91637	CMF659531F T-1	1	
R 206	RES,VAR,WW,3K,+10%,1.25W	112458	11236	110-302-1.25-10%	1	
R 207,208	RES,CC,5.1K,+5%,0.5W	109108	01121	EB5125	2	
R 209,210	RES,CC,22K,+5%,0.25W	148130	01121	CB2235	2	
S 201	SWITCH,WAFER,SPECIAL CUT	194019	29238	4-2435-469	1	
T 201	XFORMER POWER	192724	89536	192724	1	
T 202	XFORMER DRIVER	192708	89536	192708	1	
T 203	XFORMER ISOLATION	192716	89536	192716	1	
XQ 201-204	SOCKET,TRANS,T0-5	104315	95354	133-400-01	4	

An * in 'S' column indicates a static-sensitive part.

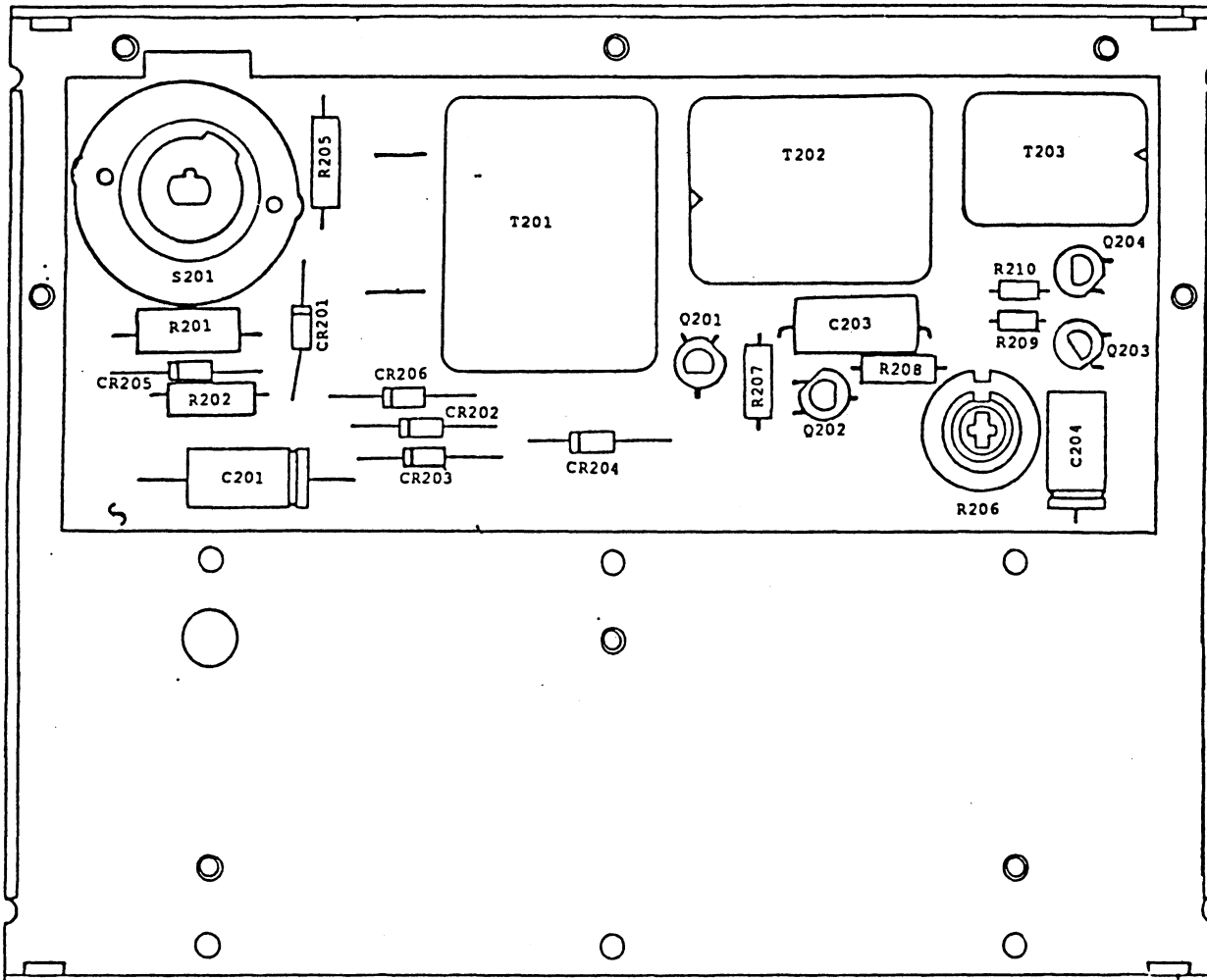


Figure 5-4. A4 Power Supply PCB Assembly

SERVICE CENTERS

USA

California

Fluke Technical Center
46610 Landing Parkway
Fremont, CA 94538
TEL: (510) 651-5112
FAX: (510) 651-4962

Fluke Technical Center
16715 Von Karman Avenue
Suite 110
Irvine, CA 92714
TEL: (714) 863-9031
FAX: (714) 863-1723

Florida

Fluke Technical Center
550 S. North Lake Blvd.
Altamonte Springs, FL 32701-5227
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FAX: (407) 331-3366

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Fluke Technical Center
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Palatine, IL 60067
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FAX: (708) 705-9989

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Fluke Technical Center
W. 75 Century Rd
or P.O. Box 930
Paramus, N.J. 07652
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FAX: (201) 599-2093

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Fluke Technical Center
2104 Hutton Drive
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Carrollton, TX 75006
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FAX: (214) 406-1072

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John Fluke Mfg. Co., Inc.
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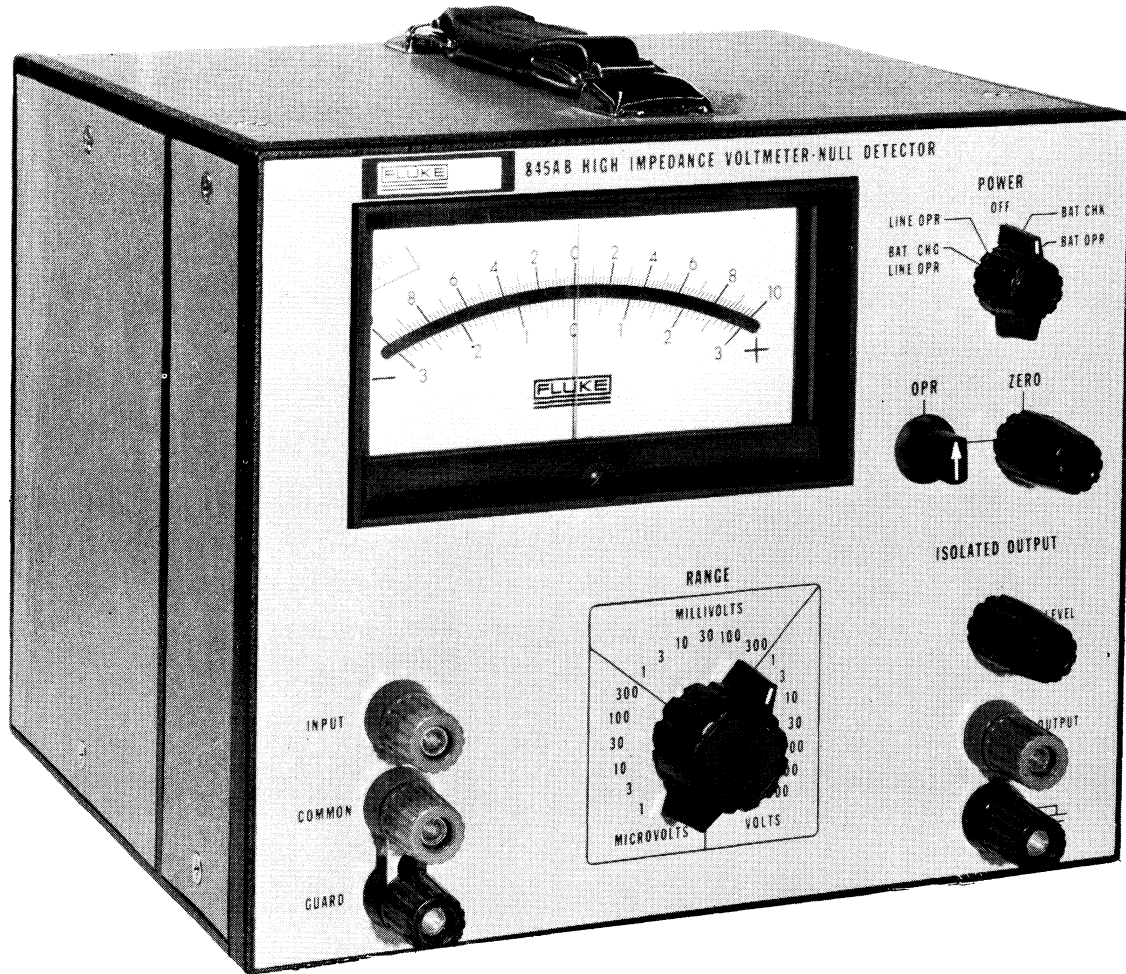
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MODEL 845AB HIGH IMPEDANCE VOLTMETER-NUL DETECTOR

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SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. The Fluke Model 845 High Impedance Voltmeter-Null Detector allows measurement of dc voltages from one microvolt to 1000 volts dc in 19 ranges. When used as a null detector on the 100 millivolt range and below, the input impedance is 10 megohms. A linear recorder output allows the instrument to be used for production testing and also as a dc amplifier with a maximum gain of 120 db.

1-3. The instrument consists of the line powered Model 845A, and the line-battery-powered Model 845AB. The instruments are half-rack in size, and are equipped with resilient feet and a tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side in a standard 19 inch rack by means of metal handle rack adapter kit 881A-103.

1-4. ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE RANGE

1 microvolt to 1000 volt dc end scale in nineteen ranges, using X1 and X3 progression.

INPUT RESISTANCE

100 megohms on 300 millivolt range and above.
10 megohms on 100 millivolt range and below.

ACCURACY

±(2% end scale + 0.1 microvolt).

MAXIMUM METER NOISE (Input Shorted)

<u>RANGE</u>	<u>NOISE (peak-to-peak)</u>
1 microvolt	0.20 microvolt
3 microvolt	0.25 microvolt
10 microvolt - 1000 volt	0.30 microvolt

METER RESPONSE TIME (to 90% of reading)

<u>RANGE</u>	<u>TIME</u>
1 microvolt	5 seconds
3 microvolt	3 seconds
10 microvolt - 1000 volt	1-1/2 seconds

INPUT ISOLATION

Better than 10¹² ohms at less than 50% relative humidity and 25° C regardless of line, chassis, or recorder grounding. Better than 10¹⁰ ohms up to 80% relative humidity and 35° C. With driven guard, isolation improves by at least one order of magnitude up to 10¹³ ohms. Any input terminal may be floated 1100 volts off chassis ground.

DC COMMON MODE REJECTION

Better than 160 db, input short-circuited,
80% relative humidity.
Better than 140 db, open-circuited,
50% relative humidity.
Better than 120 db, open-circuited,
80% relative humidity.

AC COMMON MODE REJECTION (below 100 kHz)

100 volts rms or 120 db greater than end scale, whichever is less, will effect reading less than 2% of end scale. Input open-circuited.

AC NORMAL MODE REJECTION (60 Hz and above)

AC voltages 60 db above end scale will effect reading less than 2% of end scale. Maximum ac voltage not to exceed 750 volts rms.

RECORDER OUTPUT

0-1 volt, one side at chassis ground; linear to 0.5% of end scale. Source impedance, 5k to 7.5k. Response time is approximately half that of the meter, therefore noise may exceed meter noise by 6 db.

STABILITY OF ZERO

Better than 0.15 microvolt/hour.
Better than 0.3 microvolt/day.

TEMPERATURE COEFFICIENT OF ZERO

Less than 0.1 microvolt/°C from 15° C to 35° C.
Less than 0.2 microvolt/°C from 0° C to 50° C.

ZERO CONTROL RANGE

±5 microvolt minimum.

OVERLOAD PROTECTION

Up to 1100 volts dc may be applied on any range. Typical recovery time is 4 seconds.

INPUT POWER**Model 845A**

115/230 volts ac $\pm 10\%$, 50 to 440 Hz, approximately 3 watts.

Model 845AB

Rechargeable battery or 115/230 volts ac $\pm 10\%$, 50 to 440 Hz, approximately 6 watts during recharge (40 hours operation on full charge, batteries trickle-charged while instrument operates from line power).

1-5. ENVIRONMENTAL SPECIFICATIONS**OPERATING TEMPERATURE RANGE**

Within all specifications from 15°C to 35°C.

Within all specifications from 0°C to 50°C except:

Maximum noise and meter response time - derated by a factor of two.

DC Common Mode Rejection - derated by 20 db.

STORAGE TEMPERATURE RANGE

Model 845A -40°C to +70°C.

Model 845AB -40°C to +60°C.

RELATIVE HUMIDITY RANGE

0 to 80%.

SHOCK

Meets hammer blow requirements of MIL-T-945A and MIL-S-901B.

VIBRATION

Meets 10 Hz to 55 Hz tests of MIL-T-945A.

1-6 MECHANICAL SPECIFICATIONS**MOUNTING**

Resilient feet provide for bench and portable use. For side-by-side EIA rack mounting of two units, add Adapter Kit 881A-103 (includes handle-brackets and key plate). For EIA rack mounting of a single unit, add Adapter Kit 881A-102.

WEIGHT

Model 845A 9 pounds.

Model 845AB 10-1/4 pounds.

SIZE

8 inches high by 8-1/2 inches wide by 9 inches deep.

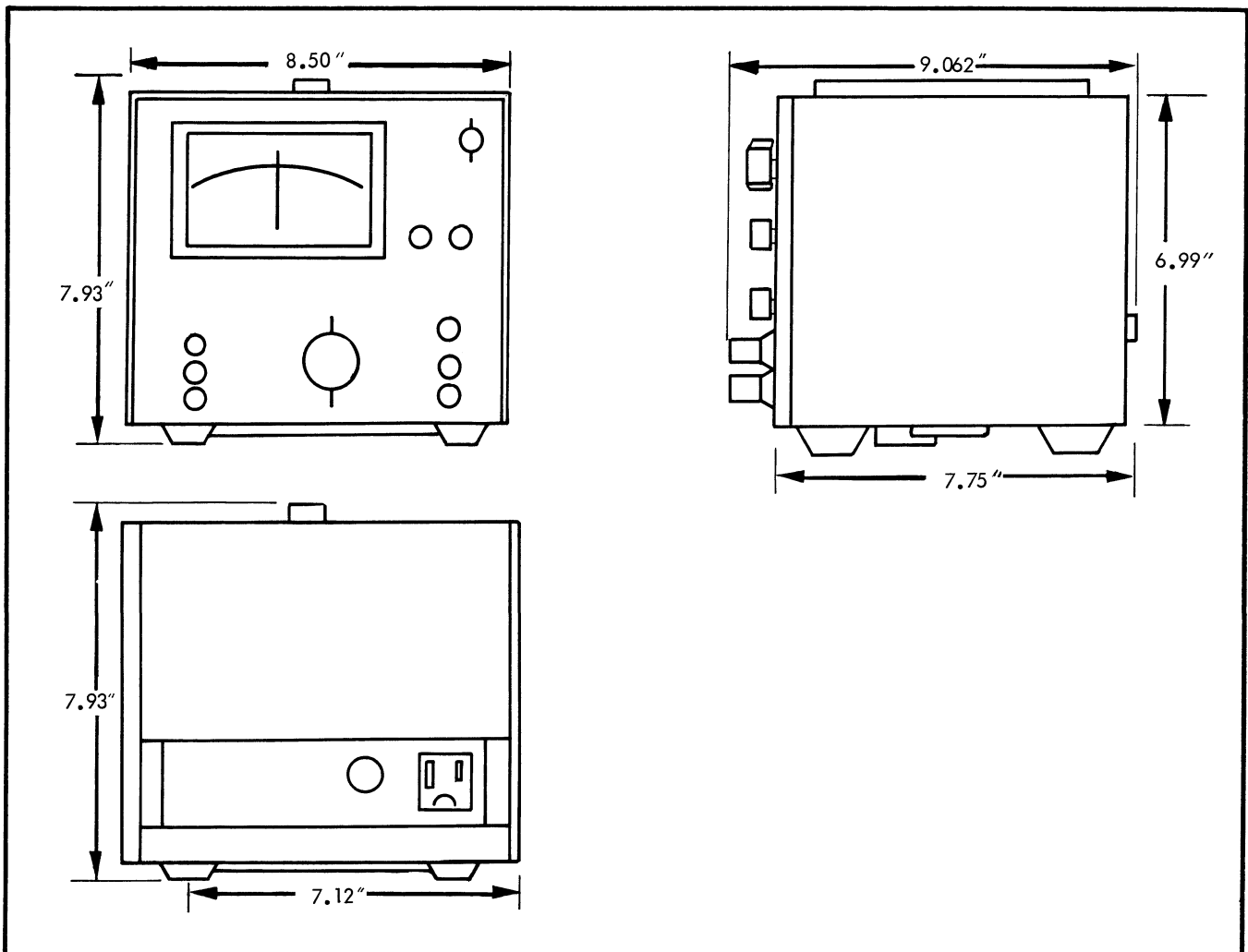


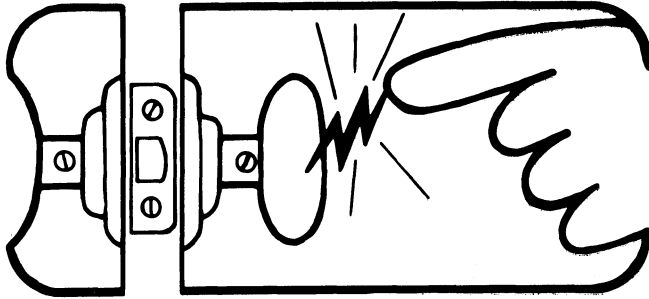
Figure 1-1. MODEL 845 OUTLINE DRAWING



static awareness



A Message From
John Fluke Mfg. Co., Inc.



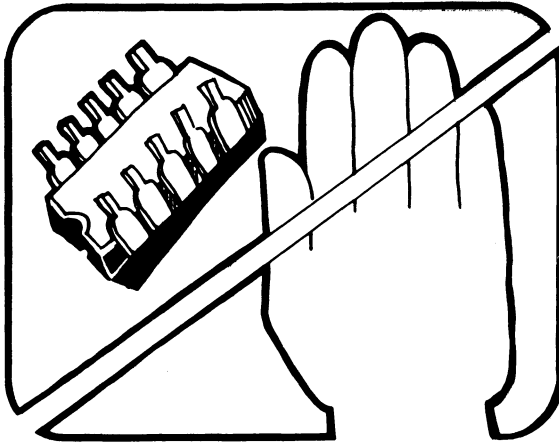
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

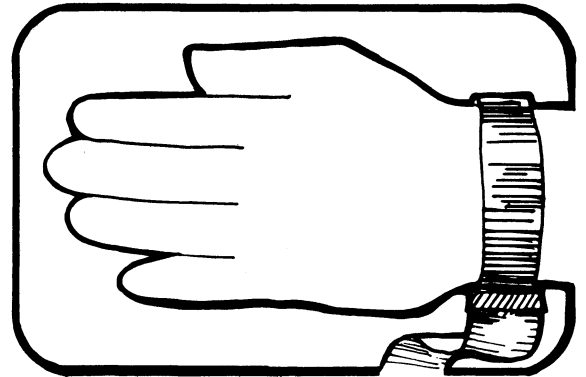
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol



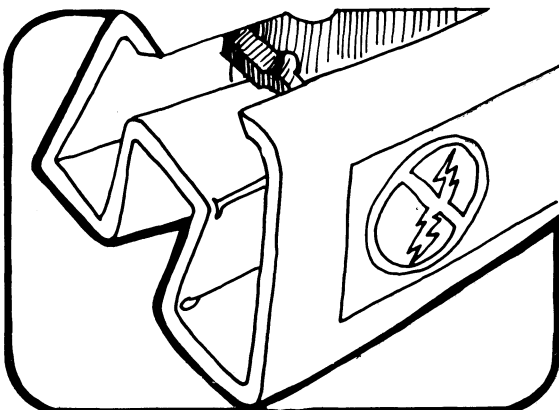
The following practices should be followed to minimize damage to S.S. devices.



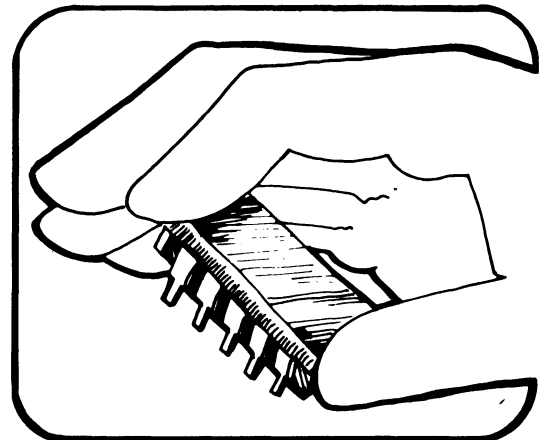
1. MINIMIZE HANDLING



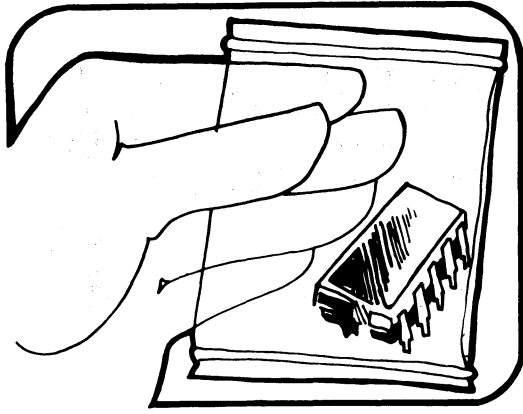
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



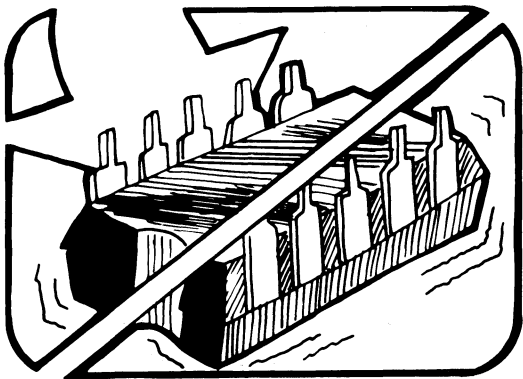
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



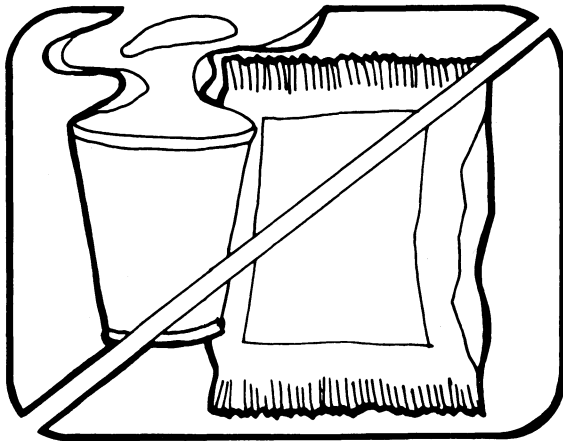
4. HANDLE S.S. DEVICES BY THE BODY



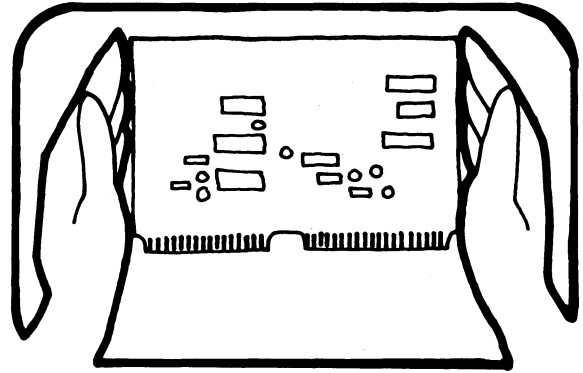
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT



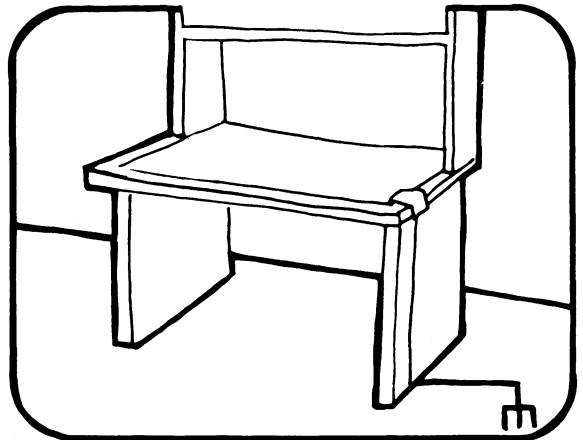
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



- 9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
- 10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
- 11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

A complete line of static shielding bags and accessories is available from Fluke Parts Department, Telephone 800-526-4731 or write to:

JOHN FLUKE MFG. CO., INC.
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 9028 EVERGREEN WAY
 EVERETT, WA 98204

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SECTION II

OPERATING INSTRUCTIONS

2-1. INTRODUCTION

2-2. This section of the manual contains information necessary to operate the Model 845 High Impedance Voltmeter-Null Detector. Should any difficulties be encountered during operation of your instrument, feel free to contact your nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co. Inc.

2-3. CONTROLS, TERMINALS, AND INDICATOR

2-4. The location and function of the front-panel controls are described in Figure 2-1. Detailed operating descriptions are given in the following paragraphs.

2-5. PRELIMINARY OPERATION

2-6. Connect the Model 845 line plug to a 115 volt ac power outlet or to 230 volts ac, if the instrument is so wired. If your instrument is a Model 845A, proceed with steps a and b. If your instrument is a Model 845AB, check the batteries as outlined in paragraph 2-7. Upon completion of a satisfactory battery check, proceed with steps c and d.

WARNING!

The round pin on the polarized three-prong plug connects the instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact outlet. For personnel safety, connect the short lead from the adapter to a high-quality earth ground.

- a. Place the Model 845A controls as follows:

POWER	ON
RANGE	10 MICROVOLTS
OPR	ZERO

- b. Adjust the ZERO control for an initial zero meter deflection. Place the RANGE switch to the 1 MICROVOLT RANGE and re-zero with the ZERO control.

- c. Place the Model 845AB controls as follows:

POWER	LINE OPR or BAT OPR
RANGE	10 MICROVOLTS
OPR	ZERO

- d. Adjust the ZERO control for an initial zero meter deflection. Place the RANGE switch to the 1 MICROVOLT RANGE and re-zero with the ZERO control.

2-7. MODEL 845AB BATTERY CHECK

2-8. The Model 845AB batteries must be in the proper charge state for the instrument to operate properly in the BAT OPR mode. To check the batteries proceed as follows:

- a. Place the POWER switch to BAT CHK position.
- b. The Model 845AB meter needle should deflect within the BATTERY OK region. If the meter needle does not stay within the BATTERY OK region for at least 10 seconds, charge the batteries as indicated in paragraph 2-9. If the batteries are adequately charged, refer to paragraph 2-5.

2-9. MODEL 845AB BATTERY CHARGING

2-10. If the Model 845AB is left in the BAT OPR mode for an extended period of time, the batteries will become discharged. If the batteries are fully discharged, the instrument will not operate properly in the LINE OPR mode until the battery voltage can be brought up to 3/4 of full voltage. This will require about 15 minutes of charging. To charge the Model 845AB batteries proceed as follows:

- a. Connect the line plug to a 115 volt ac power outlet or to 230 volts ac, if the instrument is so wired.
- b. Place the POWER switch to BAT-CHG LINE OPR. After 16 hours the batteries will be fully charged and capable of operating the instrument for at least 40 hours.

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. The Model 845 High Impedance Voltmeter-Null Detector theory of operation is contained in this section of the manual. A block diagram is illustrated in Figure 3-1, and a functional schematic diagram is located at the end of Section V. The block diagram and functional schematic diagram are to be used as an aid in understanding circuit theory, and in troubleshooting.

3-3. BLOCK DIAGRAM ANALYSIS

3-4. The Model 845 is a photo-chopper stabilized amplifier with the overall gain of the amplifier being precisely controlled by negative feedback. The instrument's main circuits are an input range divider, a photocell modulator, an ac amplifier, a synchronous demodulator, a dc amplifier, a meter, an isolation converter, a neon drive, a neon drive, an 84 Hz multivibrator, a supply rectifier, and a rectifier filter.

3-5. The input range divider provides a fixed input impedance to signals of less than 1 millivolt and allows reduction of input signals above 1 millivolt. Photo-choppers modulate the input signal to the ac amplifier at 84 Hz. The drive signal for the photo modulator is provided by the neon drive which is composed of neon lamps driven alternately at 84 Hz by the 84 Hz multivibrator. The 84 Hz signal provides the Model 845 with an operating frequency asynchronous with the power line

frequency and power line harmonics. The 84 Hz multivibrator also drives the following circuits; (1) the supply rectifiers which provide operating voltages for the amplifiers, (2) the isolation converter which provides the isolated recorder output, (3) the synchronous demodulator which demodulates the amplified dc signal. The entire amplifier and the secondaries of both transformers are surrounded by a guard shield which permits the use of external guard voltages.

3-6. The ac amplifier is a high impedance amplifier whose gain is controlled by the resistance selected by the RANGE control. The amplified dc signal is then detected by the synchronous demodulator.

3-7. Demodulation of the output signal of the ac amplifier is accomplished by a synchronous demodulator. The synchronous demodulator is driven by the 84 Hz reference signal and detects the amplified dc signal. The detected dc signal is then amplified by a dc amplifier whose gain is controlled by fixed feedback. The output signal of the dc amplifier drives the meter which indicates the polarity and magnitude of the measured voltage, and the isolation converter which drives the isolated recorder output. This same dc signal is also fed back to the input of the ac amplifier to control overall amplifier gain. The feedback ratio is determined by the setting of the RANGE control and allows overall amplifier gain to be precisely controlled.

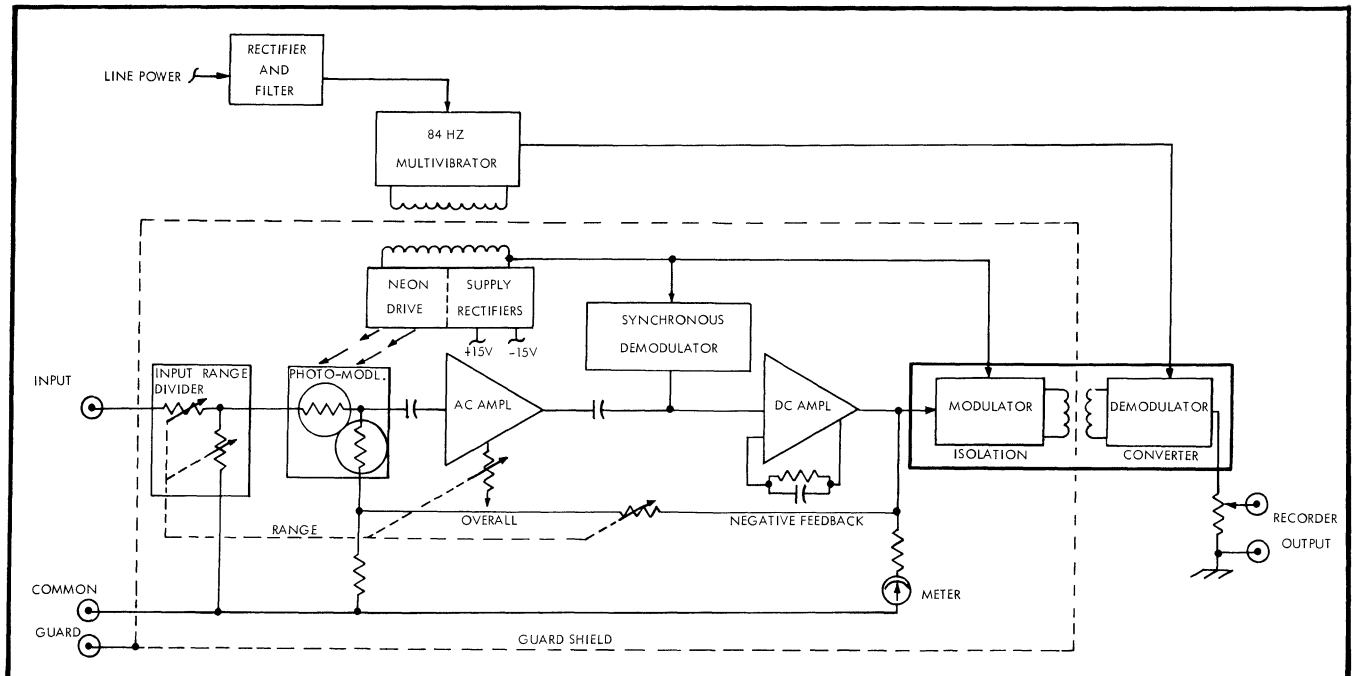


Figure 3-1. MODEL 845 BLOCK DIAGRAM

- c. Place the jumpers removed in step b across the 230V labeled terminals, refer to Figure 4-3 for location, and solder the connections.
- d. Replace the top-back dust cover and install a 3AG 1/32 ampere fuse in place of F1.

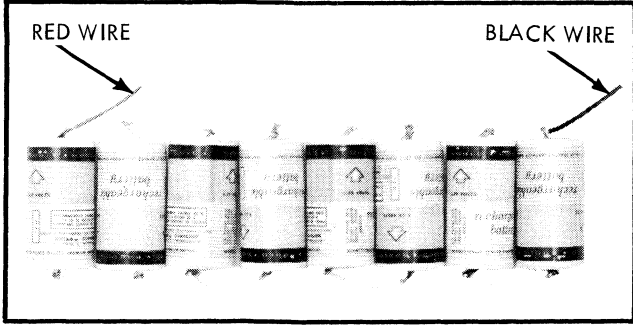


Figure 4-2. BATTERY POLARITY CONNECTIONS

4-11. DISASSEMBLY INSTRUCTION

4-12. The following procedure can be used to gain access to the inside of the Model 845:

- a. Remove the top-back cover by removing four screws that fasten it to side castings. This allows access to the parts on the power supply board (parts with 200 series reference designations.)
- b. Remove the bottom cover by removing two screws that fasten it to side castings. This allows access to capacitors C1 and C2 on the front panel.
- c. Remove the large side cover on both sides of instrument by removing two screws that fasten each of them to side castings.
- d. Remove the top cover of the guard chassis by removing four screws; two screws on the top of the guard and two on the back. This allows access to the dc amplifier Q107 through Q112, and the last two stages of the ac amplifier, Q104 through Q106. The instrument will still operate properly with the top of guard chassis removed. When the instrument is turned on, a red neon glow from the two lucite rods on the amplifier board is an indication that the photo-modulator drive circuit is working.
- e. Remove the bottom-back cover of guard chassis by removing two screws on bottom. This allows access to; the input divider R101 to R110, the +15 and -15 volt dc supply filter capacitors C117 and C118, and the recorder output modulator Q113 and Q114. The instrument will still operate but will have a meter offset, especially with high source impedances.
- f. Remove the screw that fastens the right side casting to the front panel at the top of the instrument.
- g. Remove the small right side cover by removing the two screws that attach it to the chassis.

- h. Loosen the four screws located below the removed small right side cover, by two turns only.

CAUTION!

Avoid touching polyethelene grommets. Contamination will cause excessive electrical leakage.

- i. Remove the top and bottom screws that fasten the right side casting to the power supply board bracket.
- j. Loosen the top and bottom screws that fasten the left side casting to the power supply board bracket by two turns.
- k. Take off the power plug bracket at the rear of the instrument by removing two screws that fasten it to the side castings.
- l. Pull the rear of the right side casting out far enough to swing the power supply board bracket out from the back of the instrument. This will allow access to the entire component side of the amplifier board.
- m. Remove the input shield located at the end of the Lucite rods by removing the two attaching screws. This will allow access to the first three amplifier stages Q101 to Q103, and the chopper drive photocells V101 and V102.
- n. If it is necessary to gain access to the land side of amplifier board, proceed as follows:
 - (1) Place the RANGE control to 1 MICROVOLTS and loosen the RANGE switch set screw that points toward the bottom of the instrument.
 - (2) Place the RANGE switch to 1000 VOLTS and loosen the other set screw that now points down, and take off the RANGE knob.

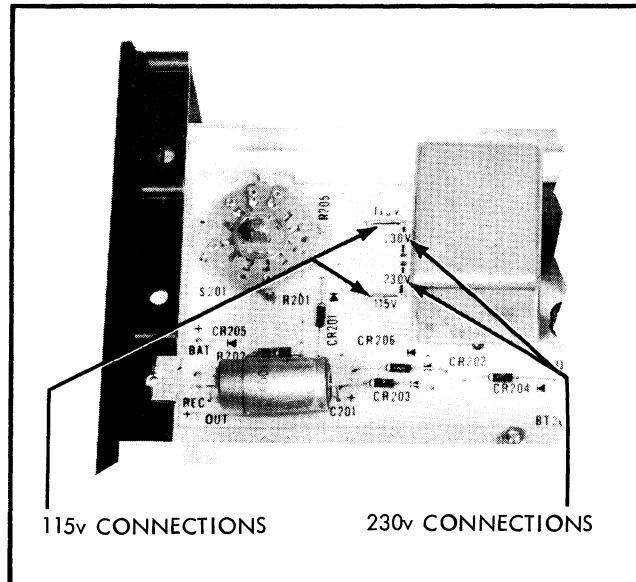


Figure 4-3. T201 115/230 VOLT AC POWER TERMINALS

- (3) Loosen the set screw on the ZERO control shaft coupler where it connects to the potentiometer.
- (4) Using a 1/2" socket wrench, remove the nut that holds the range switch to the guard chassis.
- (5) Remove the four screws that hold the amplifier board to the guard chassis.
- (6) Slide the amplifier board toward the rear of the instrument. This will allow access to the land side of the amplifier board.

4-13. CORRECTIVE MAINTENANCE

4-14. TROUBLESHOOTING

4-15. The purpose of troubleshooting is to locate and replace as quickly as possible any malfunctioning com-

ponent or components that are causing improper operation. The causes and remedies of the more common troubles that may occur are listed in the troubleshooting chart, Figure 4-4. Waveforms useful for troubleshooting are given in Figures 4-5 through 4-10. A complete understanding of the theory of operation and familiarity with the schematic diagram is the best way to locate and correct the cause of any malfunction.

4-16. VISUAL INSPECTION

4-17. Troubles may sometimes be located by a thorough visual inspection. This may be accomplished by looking for the following symptoms:

- a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in paragraph 4-18.
- b. Scorched or burned parts. Damage of this type is usually caused by other defective components. Determine the cause of damage before replacing the components.

SYMPTOM	PROBABLE CAUSE	FAULT ISOLATION PROCEDURE
Blows fuses	Short circuit across secondary of T201 Shorted turn in T201 Defective CR201 through CR206	Test for short circuit between pins 3 and 6. Unsolder R202 in secondary of T201. A shorted turn will require almost as much current as normal operation. Measure voltage of C201. Should be 10.5 volts. If near zero, replace CR201 thru CR206, as necessary.
Photo Modulator inoperative (Neon lights out)	Low battery voltage Defective Q201 or Q202 Open winding on T202, or open C203 No drive to neon lamps DS101 and DS102	Charge batteries. If voltage of C201 is less than 7 volts, and batteries are charged, replace Q201 and/or Q202. Waveform on TP10 should agree with Figure 4-5. If square wave is absent, T202 or C203 is defective. A square wave of over 200 volts peak-to-peak should be present between pin 9 of T202 and the GUARD terminal. If not, T202 may be defective.
Meter movement inoperative	Dead meter Defective auxiliary supply	Check meter with an ohmmeter. Panel meter should peg. (Model 845AB in LINE OPR, line cord disconnected). Test points 3 and 4 voltage is near zero, check the associated diode and capacitor. If both voltages are zero, T202 is defective.

Figure 4-4. TROUBLESHOOTING CHART (Sheet 1 of 2)

5-7. LIST OF ABBREVIATIONS

ac	alternating current	mw	milliwatt
Al	Aluminum	na	nanoampere
amp	ampere	nsec	nanosecond
assy	assembly	nv	nanovolt
cap	capacitor	Ω	ohm
car flm	carbon film	ppm	parts per million
C	centigrade	piv	peak inverse voltage
cer	ceramic	p-p	peak to peak
comp	composition	pf	picofarad
conn	connector	plstc	plastic
db	decibel	p	pole
dc	direct current	pos	position
dpdt	double-pole, double-throw	P/C	printed circuit
dpst	double-pole, single-throw	rf	radio frequency
elect	electrolytic	rfi	radio frequency interference
F	fahrenheit	res	resistor
Ge	germanium	rms	root mean square
gmv	guaranteed minimum value	rtry	rotary
h	henry	sec	second
Hz	hertz	sect	section
hf	high frequency	S/N	serial number
IC	integrated circuit	Si	silicon
if	intermediate frequency	scr	silcon controlled rectifier
k	kilohm	spdt	single-pole, double-throw
kHz	kilohertz	spst	single-pole, single-throw
kv	kilovolt	sw	switch
lf	low frequency	Ta	tantalum
MHz	megahertz	tstr	transistor
M	megohm	tvm	transistor voltmeter
met flm	metal film	uhf	ultr high frequency
ua	microampere	vtvm	vacuum tube voltmeter
uf	microfarad	var	variable
uh	microhenry	vhf	very high frequency
usec	microsecond	vlf	very low frequency
uv	microvolt	v	volt
ma	milliampere	va	voltampere
mh	millihenry	vac	volts, alternating current
m	milliohms	vdc	volts, direct current
msec	millisecond	w	watt
mv	millivolt	ww	wire wound

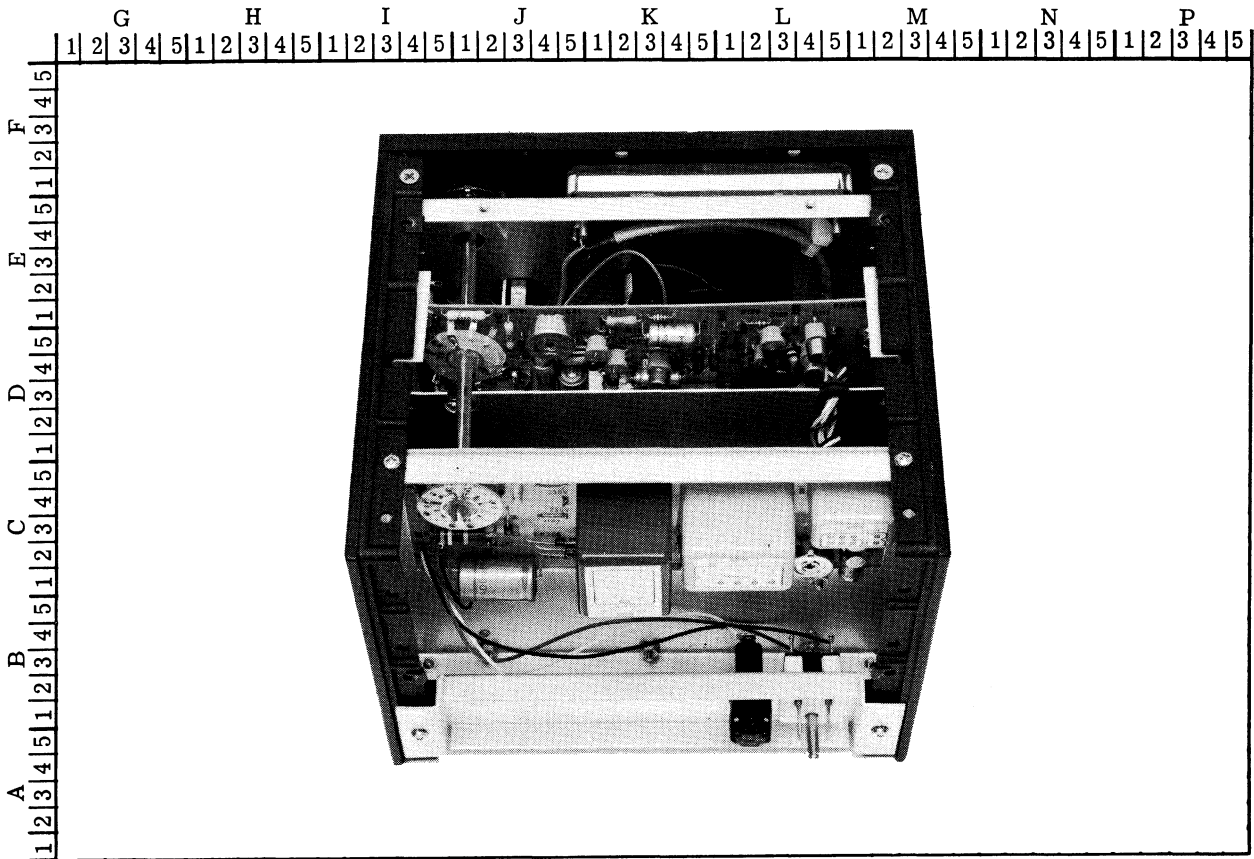


Figure 5-1. FINAL ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		FINAL ASSEMBLY - Figure 5 - 1 Line-powered model Battery/line-powered model	845A 845AB					
A1	D3-M3	Chassis Assembly (See Figure 5-2)						
A2	F1-J4	Front Panel Assembly (See Figure 5-3)						
A3	D5-L1	Amplifier P/C Assembly (See Figure 5-4)	1702-194399 (845A-401)	89536	1702-194399	1		
A4	C4-J4	Power Supply P/C Assembly (See Figure 5-5) Model 845A	1702-194407 (845A-402)	89536	1702-194407	1		
		Model 845AB	1702-194555 (845AB-402)	89536	1702-194555	1		

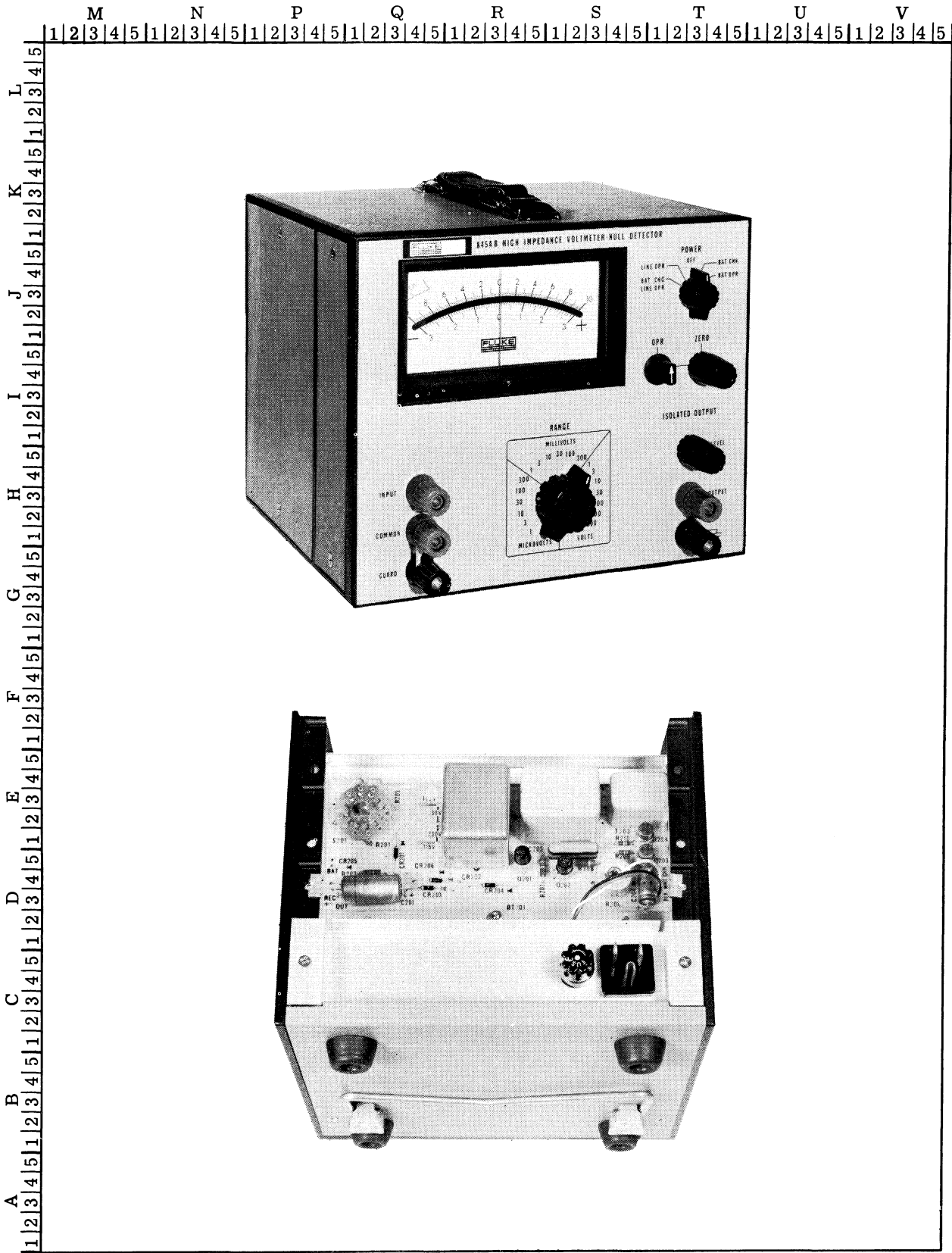


Figure 5-2. CHASSIS ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A1		CHASSIS ASSEMBLY - Figure 5 - 2						
BT201		Battery, 1.2v, Ni-Cad, (not illustrated)	4002-160390	05397	C1. 2J	8		
C4, C5		Cap, mica, 0.001 uf $\pm 5\%$, 500v (not illustrated)	1504-148387	88419	CD19F102J	2		B
F1		Fuse, Type MDL, slow blow, 1/16 amp, 250v (for 115v operation) (not illustrated)	5101-163030	71400	Type MDL	1	5	
F1		Fuse, Type MDL, slow blow, 1/32 amp, 250v (for 230v operation) (not illustrated)	5101-163022	71400	Type MDL	1	5	
P1	C5-S5	Connector, male, 3 prong chassis mount	2109-160275	73586	M-1548-GS	1		
XBT201		Holder, battery (not illustrated)	3155-194530	89536	3155-194530	1		
XF1	C5-S2	Holder, fuse	2102-160846	75915	342004	1		
		Coupler, 1/4 to 1/4 (not illustrated)	2402-104505	89536	2402-104505	1		
		Coupler, 1/8 to 1/4 (not illustrated)	2402-193557	89536	2402-193557	1		
	C1-R3	Cover, bottom	3156-194233	89536	3156-194233	1		
	I2-P2	Cover, side Cover, side (not illustrated)	3156-194290 3156-194290	89536 89536	3156-194290 3156-194290	2		REF
	I2-P5	Cover, side front Cover, side front (not illustrated)	3156-162164 3156-162164	89536 89536	3156-162164 3156-162164	2		REF
	K2-Q2	Cover, top	3156-194225	89536	3156-194225	1		
	B5-Q1	Foot, rubber	2819-103309	77969	9102-W	4		
	B1-Q2	Foot, rubber	2819-103309	77969	9102-W			REF
	B5-S5	Foot, rubber	2819-103309	77969	9102-W			REF
	B1-S4	Foot, rubber	2819-103309	77969	9102-W			REF
	K3-R2	Handle, black vinyl	2404-166280	12136	919-415-173	1		
		Line cord (not illustrated)	6005-161638	91934	107-1, SVT	1		
		Shaft, zero (not illustrated)	3156-194365	89536	3156-194365	1		
		Shaft, range switch (not illustrated)	2814-203299	89536	2814-203299	1		
	B3-R3	Tilt stand	3156-194282	89536	3156-194282	1		

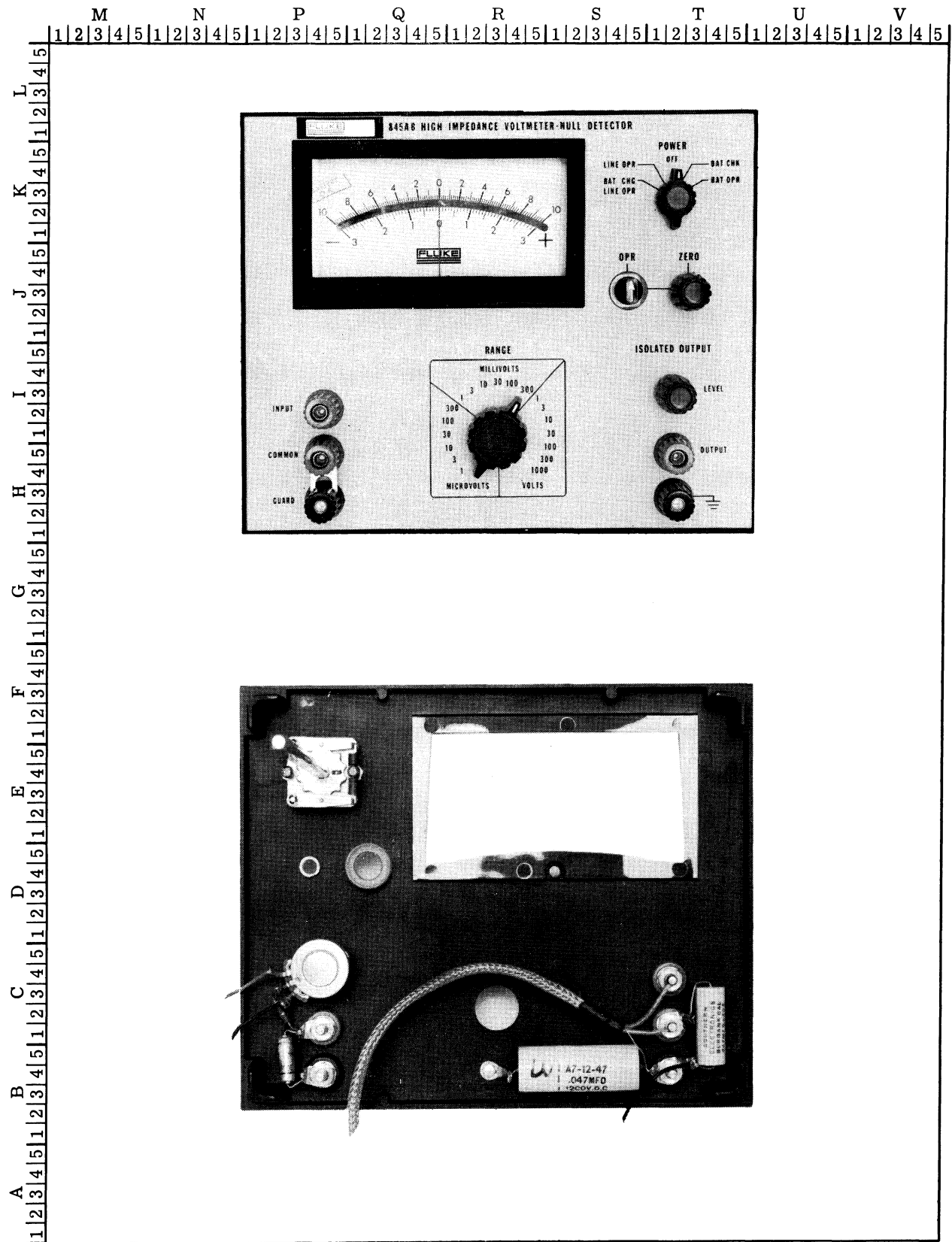


Figure 5-3. FRONT PANEL ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A?		FRONT PANEL ASSEMBLY Figure 5-3						
C1	C1-T4	Cap, mylar, 0.047 uf $\pm 20\%$, 1200v	1507-182683	72928	343-087M	1		
C2	B4-S3	Cap, poly, 0.047 uf $\pm 20\%$, 1200v	1507-190561	84411	JF-7	1		
C3	B5-P3	Cap, elect, 10 uf $+50/-10\%$, 25v	1502-170266	73445	C426ARF10	1	1	A
J1	I2-P4	Binding post, red	2811-149856	58474	BHB-10208-G22	2		
J2	H5-P4	Binding post, red	2811-149856	58474	BHB-10208-G22	REF		
J3	H2-P4	Binding post, black	2811-142984	58474	DF31BC	2		
J4	H5-T2	Binding post, red	2811-142976	58474	DF31RC	1		
J5	H3-T2	Binding post, black	2811-142984	58474	DF31BC	REF		
M1	K2-Q2	Meter, 100-0-100 ua, 650 Ω (845A only)	2901-192310	89536	2901-192310	1		
	K2-Q2	Meter, 100-0-100 ua, 650 Ω (845AB only)	2901-192294	89536	2901-192294	1		
R1	C4-P4	Res, var, comp, 10k $\pm 30\%$, 1/3w	4701-192344	71450	WF-45	1		
R2	C2-P2	Res, comp, 4.7k $\pm 10\%$, 1/2w	4704-108381	01121	EB4721	1		
S201	E3-P3	Switch, detent, dual index ball (845A only)	5108-193573	76854	Type F	1		
S201	E3-P3	Switch, detent, dual index ball (845AB only)	5108-193565	76854	Tyep F	1		
	I3-T2	Knob, LEVEL	2405-158949	89536	2405-158949	2		
	K3-T2	Knob, POWER	2405-158956	89536	2405-158956	1		
	I1-R3	Knob, RANGE	2405-170035	89536	2405-170035	1		
	J3-T3	Knob, ZERO	2405-158949	89536	2405-158949	REF		
	I5-P4	Panel, front (845A only)	1406-194209	89536	1406-194209	1		
	I5-P4	Panel, front (845AB only)	1406-194522	89536	1406-194522	1		
	H4-P5	Shorting link	2811-190728	24655	938LG	1		

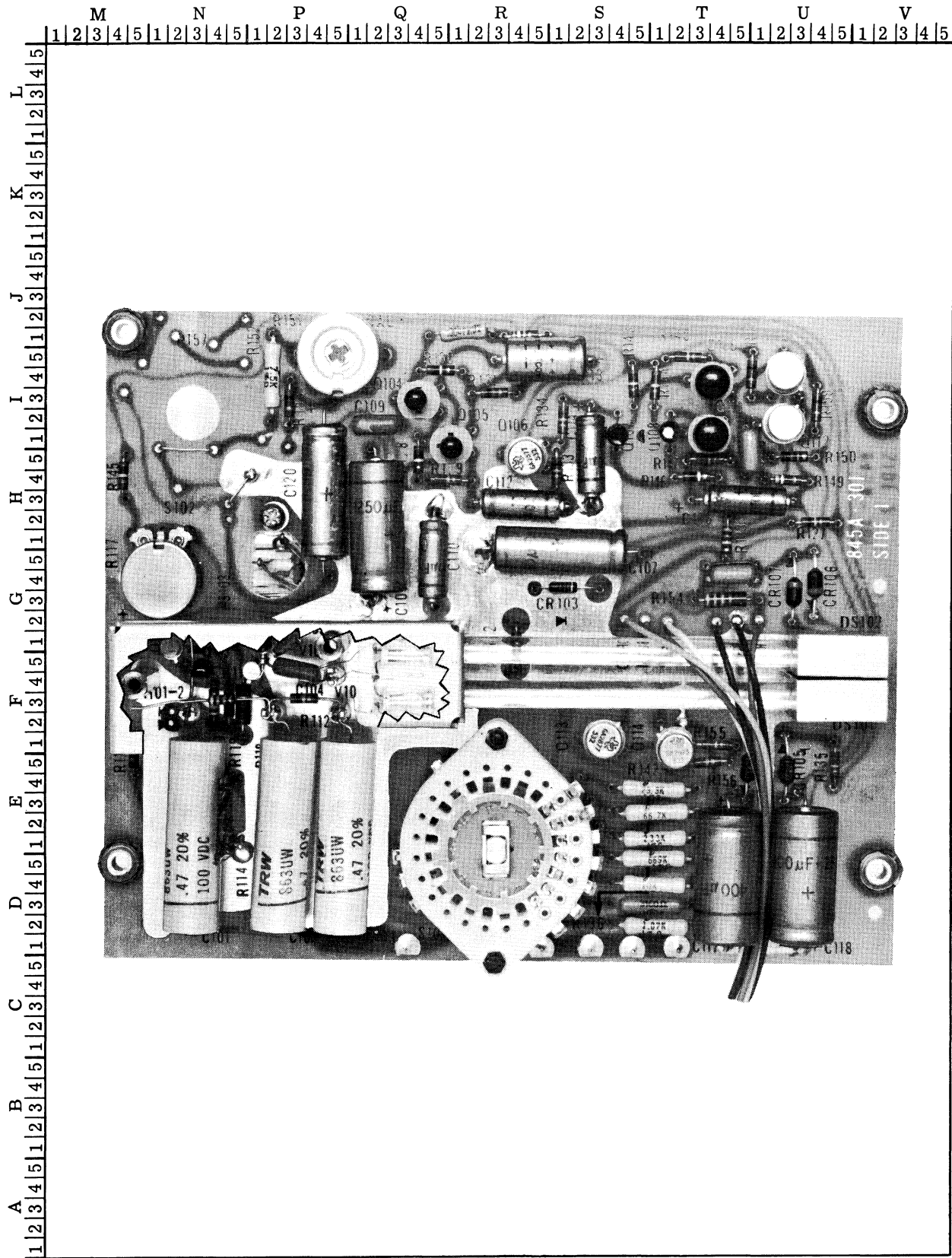


Figure 5-4. AMPLIFIER P/C ASSEMBLY (SHEET 1 OF 2)

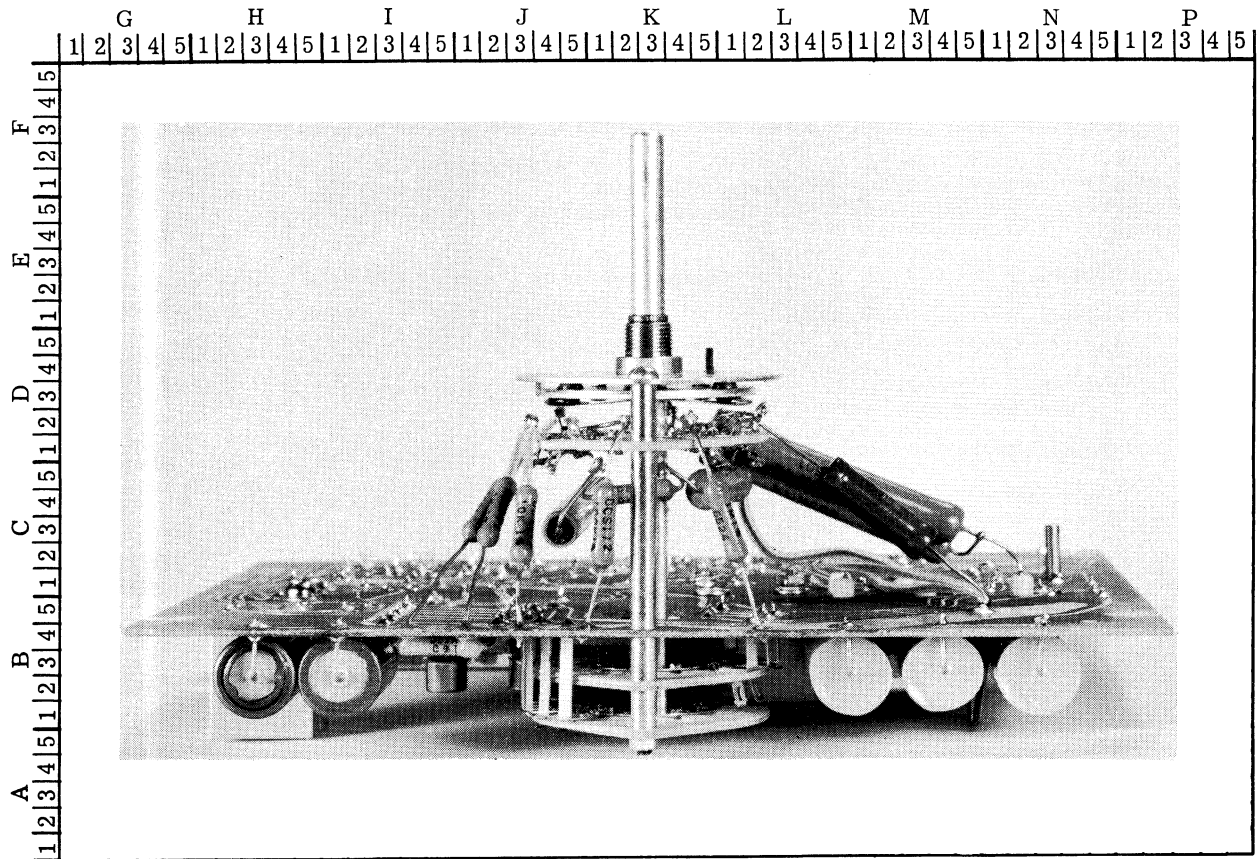














Figure 5-4. AMPLIFIER P/C ASSEMBLY (Sheet 2 of 2)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A3		AMPLIFIER P/C ASSEMBLY Figure 5-4	1702-194399 (845A-401)	89536	1702-194399	REF		
C101	E1-N3	Cap, plstc, 0.47 uf ±20%, 100v	1507-190553	84411	JF-36	3		
C102	E1-P2	Cap, plstc, 0.47 uf ±20%, 100v	1507-190553	84411	JF-36	REF		
C103	E1-P5	Cap, plstc, 0.47 uf ±20%, 100v	1507-190553	84411	JF-36	REF		
C104	F5-P3	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	3		
C105	G1-P3	Cap, cer, 300 pf ±10%, 500v	1501-105734	71590	BB60301KW7W	2		
C106	H1-Q2	Cap, elect, 1250 uf +50/-10%, 4v	1502-166330	73445	C437ARB1250	1	1	
C107	G5-S1	Cap, elect, 250 uf +50/-10%, 16	1502-187765	73445	C437ARE250	2	1	A
C108	G1-N4	Cap, cer, 300 pf ±10%, 500v (underneath cover)	1501-105734	71590	BB60301KW7W	REF		
C109	I2-Q2	Cap, plstc 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C110	G5-Q5	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	2	1	
C111	J1-R1	Cap, mylar, 0.0047 uf ±20%, 200v	1507-106054	72928	C472M	1		
C112	H3-R4	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C113	I5-S1	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARE400	2	1	
C114	H5-S3	Cap, Ta, 10 uf ±10%, 20v	1508-160259	05397	K10C20K	1		A
C114	H5-S3	Cap, Ta, 6.8 uf ±10%, 35v	1508-182782	88411	Type 901	1		B
C115	H5-U1	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100K	REF		
C116	H3-T5	Cap, Ta, 22 uf ±10%, 15v	1508-182816	05397	K22C15K	1		A
C116	H3-T5	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	1		B
C117	D5-T5	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	3	1	
C118	D5-U3	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C119	G4-T5	Cap, plstc, 0.22 uf ±20%, 230v	1507-194803	73445	C280AE/P220K	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
C120	H4-P4	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C437ARE250	REF		A
C120	H4-P4	Cap, elect, 150 uf +75/-10%, 15v	1502-150292	80183	TE 1163	1	1	B
CR101		Diode, C.D. Type CD12599 treated (not illustrated)	4802-180885	89536	4802-180885	2	1	
CR102		Diode, C.D. Type CD12599 treated (not illustrated)	4802-180885	89536	4802-180885	REF		
CR103	G4-S1	Diode, zener, 10v Type 1N961A	4803-113324	07910	1N961A	1	1	
CR104	E5-T5	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	8	2	
CR105	E5-U3	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR106	G4-U4	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR107	G3-U3	Diode, IRC, Type 4D4	4802-180240	81483	Type 4D4	REF		
DS101		Lamp, neon, NE-2U (not illustrated)	3902-162602	89730	NE-2U	2	5	
DS102		Lamp, neon, NE-2U (not illustrated)	3902-162602	89730	NE-2U	REF		
FL1	F5-P3	Bead, Ferrite choke	2503-219535	02214	56-060-85-3B	1		B
Q101	F5-P1	Tstr, selected Transatron Type ST-1750T	4805-194456	89536	4805-194456	1	1	
Q102	G1-N2	Tstr, selected Transatron Type ST-1750T	4805-198812	89536	4805-198812	1	1	
Q103	F5-N3	Tstr, Type 2N3391	4805-168708	89730	2N3391	3	1	
Q104	I3-Q4	Tstr, Type 2N3565	4805-177105	07263	2N3565	2	1	
Q105	I1-R1	Tstr, Type 2N3565	4805-177105	07263	2N3565	REF		
Q106	H5-R4	Tstr, T.I. Type GA2877	4805-182709	01295	GA2877	2	1	
Q107	I1-S4	Tstr, Type 2N3391	4805-168708	89730	2N3391	REF		
Q108	I1-T2	Tstr, Type 2N3391	4805-168708	89730	2N3391	REF		
Q109	I4-T4	Tstr, Motorola Type MPS3638	4805-169375	04713	MPS3638	2	1	
Q110	I1-T4	Tstr, Motorola Type MPS3638	4805-169375	04713	MPS3638	REF		
Q111	I4-U2	Tstr, Type 2N1304	4805-117127	01295	2N1304	1	1	
Q112	I2-U2	Tstr, Type 2N1305	4805-190298	95303	2N1305	1	1	
Q113	F1-S3	Tstr, T.I. Type GA2875	4805-182691	01295	GA2875	3	1	
Q114	F1-T2	Tstr, T.I. Type GA2877	4805-182709	01295	GA2877	REF		
R101	C5-L1	Res, car flm, matched set (sheet 2 of 2)						
R102	C4-K2	Res, car flm, 900k $\pm 1/2\%$, 1/2w (sheet 2 of 2)	4703-107391	19701	DC1/2A	1		
R103	C3-J5	Res, car flm, matched set (sheet 2 of 2)						
R104	C3-M2	Res, car flm, 10M $\pm 1/2\%$, 1w (sheet 2 of 2)	4703-107748	19701	DC1	1		
R105	C3-L1	Res, car flm, matched set (sheet 2 of 2)						
R106	C2-K1	Res, car flm, matched set (sheet 2 of 2)						
R107	C3-J3	Res, car flm, matched set (sheet 2 of 2)						
R108	C3-J2	Res, car flm, matched set (sheet 2 of 2)						
R109	C3-J1	Res, car flm, matched set (sheet 2 of 2)						
R110	C5-L3	Res, car flm, 300k $\pm 1\%$, 2w (sheet 2 of 2)	4703-107425	12400	Type C30	2		
R111	F3-N4	Res, comp, 47k $\pm 5\%$, 1/4w	4704-148163	01121	CB4735	2		
R112	F3-P3	Res, comp, 100k $\pm 5\%$, 1/4w	4704-148189	01121	CB1045	4		
R113	E5-M5	Res, comp, 470 Ω $\pm 5\%$, 1/4w	4704-147983	01121	CB4715	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R114	E1-N5	Res, ww, 10Ω ±1%, 1/2w	4707-193946	19429	4707-193946	1	1	
R115	G1-P1	Res, comp, 1.2M ±10%, 1/2w (underneath cover)	4704-108407	01121	EB1251	1		
R116	F3-M4	Res, comp, 680k ±5%, 1/4w (underneath cover)	4704-188433	01121	CB6845	1		
R117	G4-N1	Res, var, comp, 5M ±30%, 0.2w	4701-193086	71450	U-70	1		
R118	F3-P1	Res, comp, 10M ±10%, 1/2w	4704-108142	01121	EB1061	1		
R119	F3-N5	Res, comp, 2.2M ±10%, 1/4w	4704-198390	01121	CB2255	1		
R120	F2-N4	Res, comp 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R121	E4-R1	Res, comp, 10Ω ±5%, 1/4w (underneath switch wafers)	4704-147868	01121	CB1005	1		
R122	G1-R4	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	2		
R123	H1-T4	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	1		
R124	E2-Q5	Res, comp, 22Ω ±5%, 1/4w (underneath switch wafers)	4704-147884	01121	CB2205	1		
R125	E1-Q4	Res, comp, 68Ω ±5%, 1/4w (underneath switch wafers)	4704-147918	01121	CB6805	1		
R126	D5-Q4	Res, comp, 220Ω ±5%, 1/4w (underneath switch wafers)	4704-147959	01121	CB2215	1		
R127	H2-U4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	2		
R128	H5-Q4	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R129	H4-R1	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	7		
R130	I4-Q5	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R131	I3-R3	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	1		
R132	J1-R4	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	1		
R133	H5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R134	I2-S1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	2		
R135	E5-U5	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R136	D2-T1	Res, met flm, 1.07k ±1%, 1/2w	4705-187930	12400	Type CEC-TO	1		
R137	D3-T1	Res, met flm, 3.16k ±1%, 1/2w	4705-187781	12400	Type CEC-TO	1		
R138	D4-T1	Res, met flm, matched set						
R139	D5-T1	Res, met flm, matched set						
R140	E1-T1	Res, met flm, matched set						
R141	E2-T1	Res, met flm, matched set						
R142	E4-T1	Res, met flm, matched set						
R143	I4-S5	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	3		
R144	I4-T1	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	REF		
R145	H4-M4	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	REF		
R146	H4-T3	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R147	H5-T4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R148	I5-T3	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R149	H4-U3	Res, comp, 3.9M ±5%, 1/4w	4704-188417	01121	CB3955	1		
R150	H5-U3	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	REF		
R151	J1-P5	Res, var, ww, 2k ±5%, 1-1/4w	4702-160705	11237	Type 110	2		
R152	I4-P2	Res, met flm, 7.5k ±1%, 1/2w	4705-192161	12400	Type CEC-TO	1		
R153	I3-P3	Res, comp, 1k ±5%, 1/4w	4704-148073	01121	CB1025	3		
R154	G3-T4	Res, comp, 33k ±5%, 1/2w	4704-108761	01121	EB3335	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R155	F1-T4	Res, comp, 22k $\pm 5\%$, 1/4w	4704-148130	01121	CB2235	REF		
R156	E5-T4	Res, comp, 22k $\pm 5\%$, 1/4w	4704-148130	01121	CB2235	REF		
R157		Res, met film, 825 Ω $\pm 1\%$, 1/2w (not illustrated)	4705-155119	19701	MF7C-TO	1		
R158	I4-U1	Res, comp, 1k $\pm 5\%$, 1/4w	4704-148023	01121	CB1025	REF		
R159	I3-U4	Res, comp, 1k $\pm 5\%$, 1/4w	4704-148023	01121	CB1025	REF		
S101	D4-K3	Switch, rotary, 4p, 19 pos, 3 sect (sheet 2 of 2)	5105-194589	89536	5105-194589	1		
S102		Switch, section (not illustrated)	5107-194027	76854	Type FV	1		
S103	G5-P2	Switch, twist, spdt	5105-194936	89536	5105-194936	1		
V101, V102	F4-Q3	Photocell assembly	3700-194449	89536	3700-194449	1		
	J2-M4	Grommet, 3/8"	2807-171876	89536	2807-171876	4	1	
	E1-M4	Grommet, 3/8"	2807-171876	89536	2807-171876	REF		
	I3-V3	Grommet, 3/8"	2807-171876	89536	2807-171876	REF		
	D5-V3	Grommet, 3/8"	2807-171876	89536	2807-171876	REF		
	F3-S1	Rod, optical	3800-168047	89536	3800-168047	2		
	F5-S1	Rod, optical	3800-168047	89536	3800-168047	REF		



These resistors are factory matched. If any replacement is required, an entire set, part number 4710-194415, must be ordered.



These resistors are factory matched. If any replacement is required, an entire set, part number 4710-194423, must be ordered.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A4		POWER SUPPLY P/C ASSEMBLY						
		Figure 5-5						
		Model 845A	1702-194407 (845A-402)	89536	1702-194407	REF		
		Model 845AB	1702-194555 (845AB-402)	89536	1702-194555	REF		
C201	G2-N5	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C203	H2-T1	Cap, plstc, 1 uf ±20%, 250v	1507-190330	73445	C280AE/P1M	1		
C204	G4-U3	Cap, elect, 400 uf +50/-10%, 4v	1502-187773	73445	C426ARE400	REF		
CR201	H2-P3	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR202	G3-Q1	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR203	G4-Q2	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR204	G4-R3	Diode, IRC Type 4D4	4802-180240	81483	Type 4D4	REF		
CR205	H1-N4	Diode, IRC Type 4D4 (845AB only)	4802-180240	81483	Type 4D4	2		
CR206	G5-Q1	Diode, IRC Type 4D4 (845AB only)	4802-180240	81483	Type 4D4	REF		
CR207		Diode, Type 1N961A (845A only) (not illustrated)	4803-113324	07910	1N961A	1	1	
Q201	H1-S1	Tstr, T.I. Type GA2817	4805-182600	01295	GA2817	2	1	
Q202	G5-S5	Tstr, T.I. Type GA2817	4805-182600	01295	GA2817	REF		
Q203	H2-U4	Tstr, T.I. Type GA2875	4805-182691	01295	GA2875	REF		
Q204	H4-U3	Tstr, T.I. Type GA2875	4805-182691	01295	GA2875	REF		
R201	H2-N4	Res, comp, 39Ω ±10%, 2w (845AB only)	4704-144378	01121	HB3901	1		
R202	G5-N5	Res, comp, 150Ω ±5%, 1w	4704-178566	01121	GB1515	1		
R205	I3-P4	Res, met flm, 9.53k ±1%, 1/2w (845AB only)	4705-159442	12400	Type CEC-TO	1		
R206	G4-T5	Res, var, ww, 2k ±5%, 1-1/4w	4702-160705	11237	Type 110	REF		
R207	H1-S3	Res, comp, 5.1k ±5%, 1/2w	4704-109108	01121	EB5125	2		
R208	H1-T2	Res, comp, 5.1k ±5%, 1/2w	4704-109108	01121	EB5125	REF		
R209	H3-U1	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R210	H4-U1	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
S201	H5-N3	Switch section (845A only)	5107-194035	76854	Type F	1		
S201	H5-N3	Switch section (845AB only)	5107-194019	76854	Type FE	1		
T201	H5-R1	Transformer, power	5600-192724	89536	5600-192724	1		
T202	I2-S4	Transformer, drive	5600-192708	89536	5600-192708	1		
T203	I3-U3	Transformer, isolation	5600-192716	89536	5600-192716	1		

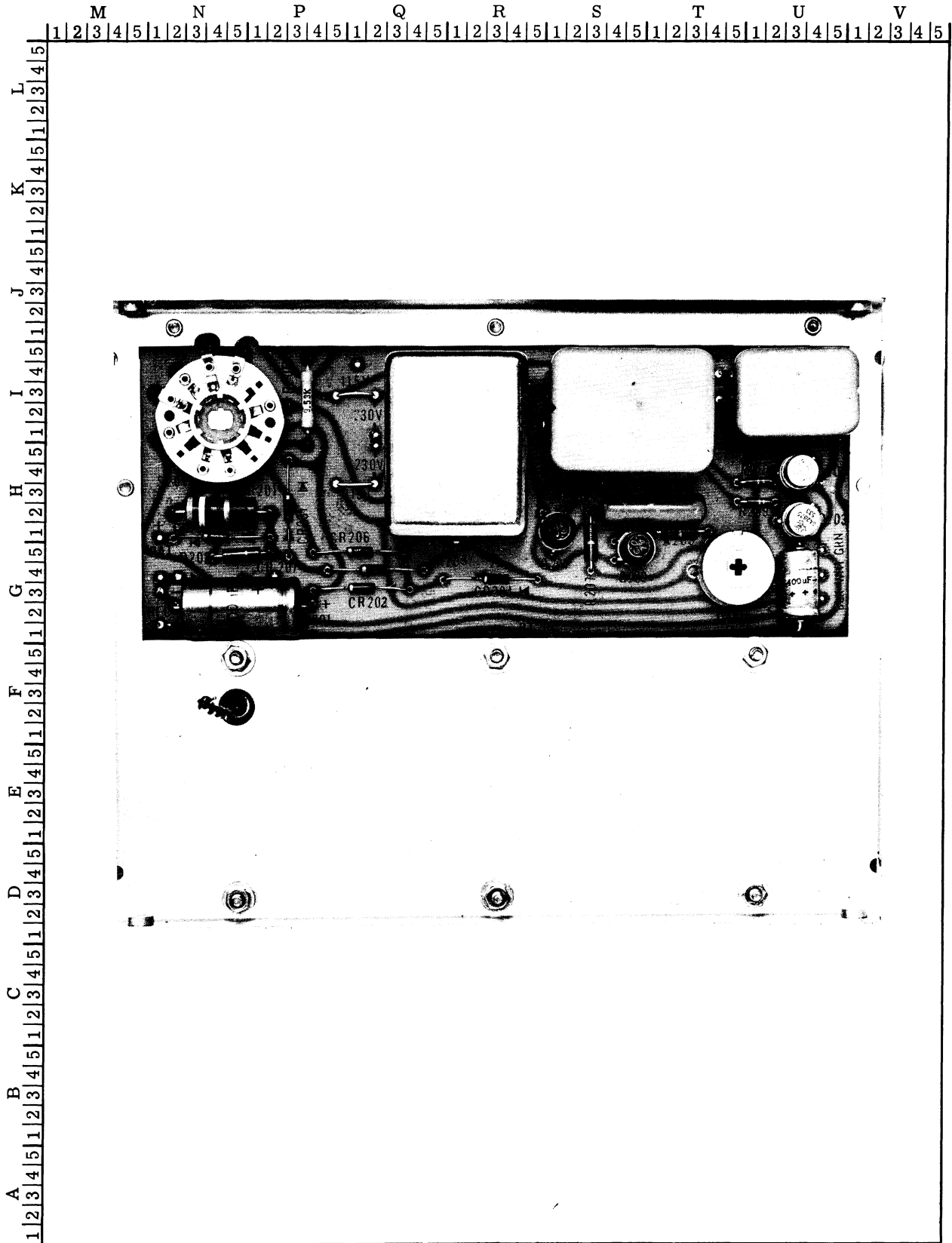


Figure 5-5. POWER SUPPLY P/C ASSEMBLY

5-8. SERIAL NUMBER EFFECTIVITY

5-9. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 845. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as required by instrument changes.

USE CODE	EFFECTIVITY
A	Model 845A and 845AB, serial number 123 to 1011.
B	Model 845A and 845AB, serial number 1012 and on.

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere	hf	high frequency	(+) or pos	positive
ac	alternating current	Hz	hertz	pot	potentiometer
af	audio frequency	IC	integrated circuit	p-p	peak-to-peak
a/d	analog-to-digital	if	intermediate frequency	ppm	parts per million
assy	assembly	in	inch(es)	PROM	programmable read-only memory
AWG	american wire gauge	intl	internal	psi	pound-force per square inch
B	bel	I/O	input/output	RAM	random-access memory
bcd	binary coded decimal	k	kilo (10 ³)	rf	radio frequency
°C	Celsius	kHz	kilohertz	rms	root mean square
cap	capacitor	kΩ	kilohm(s)	ROM	read-only memory
ccw	counterclockwise	kV	kilovolt(s)	s or sec	second (time)
cer	ceramic	lf	low frequency	scope	oscilloscope
cermet	ceramic to metal(seal)	LED	light-emitting diode	SH	shield
ckt	circuit	LSB	least significant bit	Si	silicon
cm	centimeter	LSD	least significant digit	serno	serial number
cmrr	common mode rejection ratio	M	mega (10 ⁶)	sr	shift register
comp	composition	m	milli (10 ⁻³)	Ta	tantalum
cont	continue	mA	milliamper(s)	tb	terminal board
crt	cathode-ray tube	max	maximum	tc	temperature coefficient or temperature compensating
cw	clockwise	mf	metal film	tcxo	temperature compensated crystal oscillator
d/a	digital-to-analog	MHz	megahertz	tp	test point
dac	digital-to-analog converter	min	minimum	u or μ	micro (10 ⁻⁶)
dB	decibel	mm	millimeter	uhf	ultra high frequency
dc	direct current	ms	millisecond	us or μs	microsecond(s) (10 ⁻⁶)
dmm	digital multimeter	MSB	most significant bit	uut	unit under test
dvm	digital voltmeter	MSD	most significant digit	V	volt
elect	electrolytic	MTBF	mean time between failures	v	voltage
ext	external	MTTR	mean time to repair	var	variable
F	farad	mV	millivolt(s)	vco	voltage controlled oscillator
°F	Fahrenheit	mv	multivibrator	vhf	very high frequency
FET	Field-effect transistor	MΩ	megohm(s)	vlf	very low frequency
ff	flip-flop	n	nano (10 ⁻⁹)	W	watt(s)
freq	frequency	na	not applicable	ww	wire wound
FSN	federal stock number	NC	normally closed	xfmr	transformer
g	gram	(-) or neg	negative	xstr	transistor
G	giga (10 ⁹)	NO	normally open	xtal	crystal
gd	guard	ns	nanosecond	xtlo	crystal oscillator
Ge	germanium	opnl ampl	operational amplifier	Ω	ohm(s)
GHz	gigahertz	p	pico (10 ⁻¹²)	μ	micro (10 ⁻⁶)
gmV	guaranteed minimum value	para	paragraph		
gnd	ground	pcb	printed circuit board		
H	henry	pF	picofarad		
hd	heavy duty	pn	part number		

Federal Supply Codes for Manufacturers

D9816 Westermann Wilhelm Augusta-Anlage Mannheim-Nackarau Gemany	02533 Leigh Instruments Ltd. Frequency Control Div. Don Mills, Ontario, Canada	04713 Motorola Inc. Semiconductor Group Phoenix, Arizona	06665 Precision Monolithics Sub of Boums Inc. Santa Clara, California
00199 Marcon Electronics Corp Kearny, New Jersey	02606 Fenwal Labs Division of Travenal Labs Morton Grove, Illinois	05236 Jonathan Mfg. Co. Fullerton, California	06666 General Devices Co. Inc. Indianapolis, Indiana
00213 Nytronics Comp. Group Inc. Darrlington, South Carolina	0266 Bunker Ramo-Eltra Corp. Amphenol NA Div. Broadview, Illinois	05245 Corcom Inc. Libertyville, Illinois	06739 Electron Corp. Littleton, Colorado
00327 Welwyn International Inc. Westlake, Ohio	02735 RCA-Solid State Div. Somerville, New Jersey	05276 ITT Pomona Electronics Div. Pomona, California	06743 Gould Inc. Foil Div. Eastlake, Ohio
00656 Aerovox Corp. New Bedford, Massachusetts	02799 Arco Electronics Inc. Chatsworth, California	05277 Westinghouse Elec. Corp. Semiconductor Div. Youngwood, Pennsylvania	06751 Components Inc. Semcor Div. Phoenix, Arizona
00686 Film Capacitors Inc. Passaic, New Jersey	03508 General Electric Co. Semiconductor Products & Batteries Auburn, New York	05397 Union Carbide Corp. Materials Systems Div. Cleveland, Ohio	06776 Robinson Nugent Inc. New Albany, Indiana
00779 AMP, Inc. Harrisburg, Pennsylvania	03797 Genisco Technology Corp. Eltronic Div. Rancho Dominguez, Calif.	05571 Sprague Electric Co. (Now 56289)	06915 Richco Plastic Co. Chicago, Illinois
01121 Allen Bradley Co. Milwaukee, Wisconsin	03877 Gilbert Engineering Co. Inc Incon Sub of Transiron Electronic Corp. Glendale, Arizona	05574 Viking Connectors Inc Sub of Criton Corp. Chatsworth, Calif.	06961 Vernitron Corp. Piezo Electric Div. Bedford, Ohio
01281 TRW Electronics & Defense Sector Lawndale, California	03888 KDI Electronics Inc. Pyrofilm Div. Whippany, New Jersey	05820 EG & G Wakefield Engineering Wakefield, Massachusetts	06980 Varian Associates Inc. Eimac Div. San Carlos, California
01295 Texas Instruments Inc. Semiconductor Group Dallas, Texas	03911 Clairex Corp. Clairex Electronics Div. Mount Vernon, New York	05972 Loctite Corp. Newington, Connecticut	07047 Ross Milton Co., The Southampton, Penna.
01537 Motorola Communications & Electronics Inc. Franklin Park, Illinois	03980 Muirhead Inc. Mountainside, New Jersey	06001 General Electric Co. Electric Capacitor Product Section Columbia, S. Carolina	07138 Westinghouse Electric Corp. Industrial & Government Tube Div. Horseheads, New York
01686 RCL Electronics/Shallcross Inc. Electro Components Div. Manchester, New Hampshire	04009 Cooper Industries, Inc. Arrow Hart Div. Hartford, Connecticut	06141 Fairchild Weston Systems Inc. Data Systems Div. Sarasota, Florida	07233 Benchmark Technology Inc. City of Industry, Calif.
01884 Sprague Electric Co. (Now 56289)	04217 Essex International Inc. Wire & Cable Div. Anaheim, California	06192 La Deau Mfg. Co. Glendale, California	07239 Biddle Instruments Blue Bell, Penna.
01961 Varian Associates Inc. Pulse Engineering Div. Convoy, Connecticut	04221 Midland-Ross Corp. Midtex Div. N. Mankato, Minnesota	06229 Electrovert Inc. Elmsford, New York	07256 Silicon Transistor Corp. Sub of BBF Inc. Chelmsford, Massachusetts
02111 Spectrol Electronics Corp. City of Industry, California	04222 AVX Corp. AVX Ceramics Div. Myrtle Beach, S. Carolina	06383 Panduit Corp. Tinley Park, Illinois	07261 Avnet Corp. Culver City, California
02114 Amperex Electronic Corp. Ferrox Cube Div. Saugerties, New York	04423 Telonic Berkley Inc. Laguna Beach, California	06473 Bunker Ramo Corp. Amphenol NA Div. SAMS Operation Chatsworth, California	07263 Fairchild Camera & Instrument Semiconductor Div. Mountain View, California
02131 General Instrument Corp. Government Systems Div. Westwood, Massachusetts	04423 Telonic Berkley Inc. Laguna Beach, California	06555 Beede Electrical Instrument Penacook, New Hampshire	07344 Bircher Co. Inc., The Rochester, New York
02395 Sonar Radio Corp. Hollywood, Florida			

Federal Supply Codes for Manufacturers (cont)

07557 Campion Co. Inc. Philadelphia, Penna.	09423 Scientific Components Inc. Santa Barbara, California	11711 General Instrument Corp. Rectifier Div. Hicksville, New York	12954 Microsemi Corp. Components Group Scottsdale, Arizona
07597 Burdny Corp. Tape/Cable Div. Rochester, New York	09579 CTS of Canada, Ltd Streetsville, Ontario	11726 Qualidyne Corp. Santa Clara, California	12969 Unitrode Corp. Lexington, Massachusetts
07716 TRW Inc. (Can use 11502) IRC Fixed Resistors/ Burlington Burlington, Iowa	09922 Burdny Corp. Norwalk, Connecticut	12014 Chicago Rivet & Machine Co. Naperville, Illinois	13050 Potter Co. Wesson, Mississippi
07792 Lerma Engineering Corp. Northampton, Massachusetts	09969 Dale Electronics Inc. Yankton, South Dakota	12040 National Semiconductor Corp. Danbury, Connecticut	13103 Thermalloy Co., Inc. Dallas, Texas
07810 Bock Corp. Madison, Wisconsin	09975 Burroughs Corp. Electronics Components Detroit, Michigan	12060 Diodes Inc. Northridge, California	13327 Solitron Devices Inc. Tappan, New York
07933 Raytheon Co. Semiconductor Div. Mountain View, Calif.	10059 Barker Engineering Corp. Kenilworth, New Jersey	12136 PHC Industries Inc. Formerly Philadelphia Handle Co. Camden, New Jersey	13511 Bunker-Ramo Corp. Amphenol Cadre Div. Los Gatos, California
08235 Industro Transistor Corp. Long Island City, New York	10389 Illinois Tool Works Inc. Licon Div. Chicago, Illinois	12300 AMF Canada Ltd. Potter-Brumfield Guelph, Ontario, Canada	13606 Sprague Electric Co. (Use 56289)
08261 Spectra-Strip An Eltra Co. Garden Grove, Calif.	10582 CTS of Asheville Skyland, N. Carolina	12323 Practical Automation Inc. Shelton, Connecticut	13689 SPS Technologies Inc. Hatfield, Pennsylvania
08530 Reliance Mica Corp. Brooklyn, New York	11236 CTS Corp. Beme Div. Berne, Indiana	12327 Freeway Corp. Cleveland, Ohio	13919 Burr-Brown Research Corp. Tucson, Arizona
08718 ITT Cannon Electric Phoenix Div. Phoenix, Arizona	11237 CTS Corp of California Paso Robles Div. Paso Robles, California	12443 Budd Co.,The Plastics Products Div. Phoenixville, Pennsylvania	14099 Semtech Corp. Newbury Park, California
08806 General Electric Co. Miniature Lamp Products Cleveland, Ohio	11295 ECM Motor Co. Schaumburg, Illinois	12581 Hitachi Metals International Ltd. Hitachi Magna-Lock Div. Big Rapids, Missouri	14140 McGray-Edison Co. Commercial Development Div. Manchester, New Hampshire
08863 Nylomatic Fallsington, Penna.	11358 Columbia Broadcasting System CBS Electronic Div. Newburyport, Massachusetts	12615 US Terminals Inc. Cincinnati, Ohio	14193 Cal-R-Inc. Santa Monica, California
08988 Skottie Electronics Inc. Archbald, Pennsylvania	11403 Vacuum Can Co. Best Coffee Maker Div. Chicago, Illinois	12617 Hamlin Inc. Lake Mills, Wisconsin	14298 American Components Inc. an Insilco Co. RPC Div. Conshohocken, Pennsylvania
09021 Airco Inc. Airco Electronics Bradford, Penna.	11502 TRW Inc. TRW Resistive Products Div. Boone, North Carolina	12697 Clarostat Mfg. Co. Inc. Dover, New Hampshire	14298 ACIC Inc. Sub of Insilco Corp. Research Triangle Park, NC
09023 Cornell-Dublier Electronics Fuquay-Varina, N. Carolina	11503 Keystone Columbia Inc. Freemont, Indiana	12749 James Electronic Inc. Chicago, Illinois	14329 Wells Electronics Inc. South Bend, Indiana
09214 General Electric Co. Semiconductor Products Dept. Auburn, New York	11532 Teledyne Relays Teledyne Industries Inc. Hawthorne, California	12856 MicroMetals Inc. Anaheim, California	14482 Watkins-Johnson Co. Palo Alto, California
09353 C and K Components Inc. Newton, Massachusetts		12881 Metex Corp. Edison, New Jersey	14552 Microsemi Corp. Santa Ana, California
		12895 Cleveland Electric Motor Co. Cleveland, Ohio	14655 Cornell-Dublier Electronics Div. of Federal Pacific Electric Co. Govt Cont Dept. Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

14704 Crydom Controls (Division of Int Rectifier) El Segundo, California	16733 Cablewave Systems Inc. North Haven, Connecticut	18927 GTE Products Corp. Precision Material Products Business Parts Div. Titusville, Pennsylvania	23936 William J. Purdy Co. Pamotor Div. Burlingame, California
14752 Electro Cube Inc. San Gabriel, California	16742 Paramount Plastics Fabricators Inc. Downey, California	19315 Bendix Corp., The Navigation & Control Group Terboro, New Jersey	24347 Penn Engineering Co. S. El Monte, California
14936 General Instrument Corp. Discrete Semi Conductor Div. Hicksville, New York	16758 General Motors Corp. Delco Electronics Div. Kokomo, Indiana	19451 Perine Machinery & Supply Co.. Kent, Washington	24355 Analog Devices Inc. Norwood, Massachusetts
14949 Trompeter Electronics Chatsworth, California	17069 Circuit Structures Lab Burbank, California	19613 Minnesota Mining & Mfg. Co. Textool Products Dept. Electronic Product Div. Irving, Texas	24444 General Semiconductor Industries, Inc. Tempe, Arizona
15412 Amtron Midlothian, Illinois	17117 Electronic Molding Corp. Woonsocket, Rhode Island	19647 Caddock Electronics Inc. Riverside, California	24655 Genrad Inc. Concord, Massachusetts
15542 Scientific Components Corp. Mini-Circuits Laboratory Div. Brooklyn, New York	17338 High Pressure Eng. Co. Inc. Oklahoma City, Oklahoma	19701 Mepco/Centralab Inc. A N. American Philips Co. Mineral Wells, Texas	24759 Lenox-Fugle Electronics Inc. South Plainfield, New Jersey
15636 Elec-Trol Inc. Saugus, California	17545 Atlantic Semiconductors Inc. Asbury Park, New Jersey	20584 Enochs Mfg. Inc. Indianapolis, Indiana	24796 AMF Inc. Potter & Brumfield Div. San Juan Capistrano, Calif.
15782 Bausch & Lomb Inc. Graphics & Control Div. Austin, Texas	17745 Angstrohm Precision, Inc. Hagerstown, Maryland	20891 Cosar Corp. Dallas, Texas	24931 Specialty Connector Co. Greenwood, Indiana
15801 Fenwal Electronics Inc. Div. of Kidde Inc. Framingham, Massachusetts	17856 Siliconix Inc. Santa Clara, California	21317 Electronics Applications Co. El Monte, California	25088 Siemen Corp. Isilen, New Jersey
15818 Teledyne Inc. Co. Teledyne Semiconductor Div. Mountain View, California	18178 E G & Gvactee Inc. St. Louis, Missouri	21604 Buckeye Stamping Co. Columbus, Ohio	25099 Cascade Gasket Kent, Washington
15849 Useco Inc. (Now 88245)	18324 Signetics Corp. Sacramento, California	21845 Solitron Devices Inc. Semiconductor Group Rivera Beach, Florida	25403 Amperex Electronic Corp. Semiconductor & Micro-Circuit Div. Slatersville, Rhode Island
15898 International Business Machines Corp. Essex Junction, Vermont	18520 Sharp Electronics Corp. Paramus, New Jersey	22526 DuPont, El DeNemours & Co. Inc. DuPont Connector Systems Advanced Products Div. New Cumberland, Pennsylvania	25706 Dabum Electronic & Cable Corp. Norwood, New Jersey
16245 Conap Inc. Olean, New York	18542 Wabash Inc. Wabash Relay & Electronics Div. Wabash, Indiana	22767 ITT Semiconductors Palo Alto, California	26269 Frequency Sources Inc. Sources Div. Chelmsford, Massachusetts
16258 Space-Lok Inc. Burbank, California	18565 Chomerics Inc. Woburn, Massachusetts	22784 Palmer Inc. Cleveland, Ohio	26806 American Zettler Inc. Irvine, California
16352 Codi Corp. Linden, New Jersey	18612 Vishay Intertechnology Inc. Vishay Resistor Products Group Malvern, Pennsylvania	23050 Product Comp. Corp. Mount Vernon, New York	27014 National Semiconductor Corp. Santa Clara, California
16469 MCL Inc. LaGrange, Illinois	18632 Norton-Chemplast Santa Monica, California	23732 Tracor Applied Sciences Inc. Rockville, Maryland	27167 Coming Glass Works Coming Electronics Wilmington, North Carolina
16473 Cambridge Scientific Industries Div. of Chemed Corp. Cambridge, Maryland	18677 Scanbe Mfg. Co. Div. of Zero Corp. El Monte, California	23880 Stanford Applied Engineering Santa Clara, California	27264 Molex Inc. Lisle, Illinois
	18736 Voltronics Corp. East Hanover, New Jersey		27440 Industrial Screw Products Los Angeles, California

Federal Supply Codes for Manufacturers (cont)

27745 Associated Spring Barnes Group Inc. Syracuse, New York	30800 General Instrument Corp. Capacitor Div. Hicksville, New York	33297 NEC Electronics USA Inc. Electronic Arrays Inc. Div. Mountain View, California	49956 Raytheon Company Executive Offices Lexington, Massachusetts
27956 Relcom (Now 14482)	31019 Solid State Scientific Inc. Willow Grove, Pennsylvania	33919 Nortek Inc. Cranston, Rhode Island	50088 Thomson Components-Mostek Corp. Carrollton, Texas
28198 Positronic Industries Springfield, Missouri	31091 Alpha Industries Inc. Microelectronics Div. Hatfield, Pennsylvania	34333 Silicon General Inc. Garden Grove, California	50120 Eagle-Picher Industries Inc. Electronics Div. Colorado Springs, Colorado
28213 Minnesota Mining & Mfg. Co. Consumer Products Div. 3M Center Saint Paul, Minnesota	31323 Metro Supply Company Sacramento, California	34225 Advanced Micro Devices Sunnyvale, California	50157 Midwest Components Inc. Muskegon, Mississippi
28425 Serv-O-Link Euless, Texas	31448 Army Safeguard Logistics Command Huntsville, Alabama	34359 Minnesota Mining & Mfg. Co. Commercial Office Supply Div. Saint Paul, Minnesota	50541 Hypertronics Corp. Hudson, Massachusetts
28478 Deltrol Corporation Deltrol Controls Div. Milwaukee, Wisconsin	31746 Cannon Electric Woodbury, Tennessee	34371 Harris Corp. Harris Semiconductor Products Group Melbourne, Florida	50579 Litronix Inc. Cupertino, California
28480 Hewlett Packard Co. Corporate HQ Palo Alto, California	31827 Budwig Ramona, California	34649 Intel Corp. Santa Clara, California	51167 Aries Electronics Inc. Frenchtown, New Jersey
28484 Emerson Electric Co. Gearmaster Div. McHenry, Illinois	31918 ITT-Schadow Eden Prairie, Minnesota	34802 Electromotive Inc. Kenilworth, New Jersey	51372 Verbatim Corp. Sunnyvale, California
28520 Heyco Molded Products Kenilworth, New Jersey	32293 Intersil Cupertino, California	34848 Hartwell Special Products Placentia, California	51406 Murata Erie, No. America Inc. (Also see 72982) Marietta, Georgia
29083 Monsanto Co. Santa Clara, California	32539 Mura Corp. Westbury, Long Island, N.Y.	35009 Renfrew Electric Co. Ltd. IRC Div. Toronto, Ontario, Canada	51499 Amtron Corp. Boston, Massachusetts
29604 Stackpole Components Co. Raleigh, North Carolina	32559 Bivar Santa Ana, California	36665 Mitel Corp. Kanata, Ontario, Canada	51605 CODI Semiconductor Inc. Kenilworth, New Jersey
29907 Omega Engineering Inc. Stamford, Connecticut	32767 Griffith Plastics Corp. Burlingame, California	37942 Mallory Capacitor Corp. Sub of Emhart Industries Indianapolis, Indiana	51642 Centre Engineering Inc. State College, Pennsylvania
30035 Jolo Industries Inc. Garden Grove, California	32879 Advanced Mechanical Components Northridge, California	39003 Maxim Industries Middleboro, Massachusetts	51791 Statek Corp. Orange, California
30146 Symbex Corp. Painesville, Ohio	32897 Murata Erie North America Inc. Carlisle Operations Carlisle, Pennsylvania	40402 Roderstein Electronics Inc. Statesville, North Carolina	51984 NEC America Inc. Falls Church, Virginia
30148 AB Enterprise Inc. Ahoskie, North Carolina	32997 Bourns Inc. Trimpot Div. Riverside, California	42498 National Radio Melrose, Massachusetts	52063 Exar Integrated Systems Sunnyvale, California
30161 Aavid Engineering Inc. Laconia, New Hampshire	33096 Colorado Crystal Corp. Loveland, Colorado	43543 Nytronics Inc.(Now 53342)	52072 Circuit Assembly Corp. Irvine, California
30315 Itron Corp. San Diego, California	33173 General Electric Co. Owensboro, Kentucky	44655 Ohmite Mfg. Co. Skokie, Illinois	52152 Minnesota Mining & Mfg. Saint Paul, Minnesota
30323 Illinois Tool Works Inc. Chicago, Illinois	33246 Epoxy Technology Inc. Billerica, Massachusetts	49671 RCA Corp. New York, New York	52333 API Electronics Haugpaug, Long Island, New York

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52361 Communication Systems Piscataway, New Jersey	54590 RCA Corp. Electronic Components Div. Cherry Hill, New Jersey	58104 Simco Atlanta, Georgia	64155 Linear Technology Milpitas, California
52525 Space-Lok Inc. Lerco Div. Burbank, California	55026 American Gage & Machine Co. Simpson Electric Co. Div. Elgin, Illinois	58474 Superior Electric Co. Bristol, Connecticut	64834 West M G Co. San Francisco, Calif.
52531 Hitachi Magnetics Edmore, Missouri	55112 Plessey Capacitors Inc. (Now 60935)	59124 KOA-Speer Electronics Inc. Bradford, Pennsylvania	65092 Sangamo Weston Inc. Weston Instruments Div. Newark, New Jersey
52745 Timco Los Angeles, California	55261 LSI Computer Systems Inc. Melville, New York	59640 Supertex Inc. Sunnyvale, California	65940 Rohm Corp & Whatney Irvine, California
52763 Stettner-Electronics Inc. Chattanooga, Tennessee	55285 Beroquist Co. Minneapolis, Minnesota	59660 Tusonix Inc. Tucson, Arizona	65964 Evox Inc. Bannockburn, Illinois
52769 Sprague-Goodman Electronics Inc. Garden City Park, New York	55576 Synertek Santa Clara, California	59730 Thomas and Betts Corp. Iowa City, Iowa	66150 Entron Inc. Winslow Teltronics Div. Glendale, New York
52771 Moniterm Corp. Amatrom Div. Santa Clara, California	55680 Michicon/America/Corp. Schaumburg, Illinois	59831 Semtronics Corp. Watchung, New Jersey	66608 Bering Industries Fremont, California
52840 Western Digital Corp. Costa Mesa, California	56282 Utek Systems Inc. Olathe, Kansas	60395 Xicor Inc. Milpitas, California	70290 Almetal Universal Joint Co. Cleveland, Ohio
53021 Sangamo Weston Inc. (See 06141)	56289 Sprague Electric Co. North Adams, Massachusetts	60399 Torin Engineered Blowers Div. of Clevepak Corp. Torrington, Connecticut	70485 Atlantic India Rubber Works Inc. Chicago, Illinois
53217 Technical Wire Products Inc. Santa Barbara, California	56365 Square D Co. Corporate Offices Palatine, Illinois	60705 Cera-Mite Corp. (formerly Sprague) Grafton, Wisconsin	70563 Amperite Company Union City, New Jersey
53342 Opt Industries Inc. Phillipsburg, New Jersey	56375 DAL Industries Inc. Wescorp Div. Mountain View, California	60935 Westlake Capacitor Inc. Tantalum Div. Greencastle, Indiana	70903 Belden Corp. Geneva, Illinois
53944 Glow-Lite Pauls Valley, Oklahoma	56481 Shugart Associates Sub of Xerox Corp. Sunnyvale, California	61804 M/A Corn Inc. Burlington, Massachusetts	71002 Bimbach Co. Inc. Farmingdale, New York
54294 Shallcross Inc. Smithfield, North Carolina	56708 Zilog Inc. Campbell, California	61857 SAN-O Industrial Corp. Bohemia, Long Island, NY	71034 Bliley Electric Co. Erie, Pennsylvania
54453 Sullins Electronic Corp. San Marcos, California	56856 Vamistor Corp. of Tennessee Sevierville, Tennessee	61935 Schurter Inc. Petaluma, California	71183 Westinghouse Electric Corp. Bryant Div. Bridgeport, Connecticut
54473 Matsushita Electric Corp. (Panasonic) Secaucus, New Jersey	56880 Magnetics Inc. Baltimore, Maryland	62351 Apple Rubber Lancaster, New York	71400 Bussman Manufacturing Div. McGraw-Edison Co. St. Louis, Missouri
54583 TDK Garden City, New York	57026 Endicott Coil Co. Inc. Binghamton, New York	62793 Lear Siegler Inc. Energy Products Div. Santa Ana, California	71450 CTS Corp. Elkhart, Indiana
54869 Piher International Corp. Arlington Heights, Illinois	57053 Gates Energy Products Denver, Ohio	63743 Ward Leonard Electric Co. Inc. Mount Vernon, New York	71468 ITT Cannon Div. of ITT Fountain Valley, California
54937 DeYoung Mfg. Bellevue, Washington	58014 Hitachi Magnalock Corp. (Now 12581)	64154 Lamb Industries Portland, Oregon	71482 General Instrument Corp. Clare Div. Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

71590 Mepco/Centralab A North American Philips Co. Fort Dodge, Iowa	73445 Amperex Electronic Corp. Hicksville, New York	75378 CTS Knights Inc. Sandwich, Illinois	79727 C - W Industries Southampton, Pennsylvania
71707 Coto Corp. Providence, Rhode Island	73559 Carlingswitch Inc. Hartford, Connecticut	75382 Kulka Electric Corp. (Now 83330) Mount Vernon, New York	79963 Zierick Mfg. Corp. Mount Kisco, New York
71744 General Instrument Corp. Lamp Div/Worldwide Chicago, Illinois	73586 Circle F Industries Trenton, New Jersey	75915 Tracor Littlefuse Des Plaines, Illinois	80009 Tektronix Beaverton, Oregon
71785 TRW Inc. Cinch Connector Div. Elk Grove Village, Illinois	73734 Federal Screw Products Inc. Chicago, Illinois	76854 Oak Switch Systems Inc. Crystal Lake, Illinois	80031 Mepco/Electra Inc. Morristown, New Jersey
71984 Dow Corning Corp. Midland, Michigan	73743 Fischer Special Mfg. Co. Cold Spring, Kentucky	77122 TRW Assemblies & Fasteners Group Fastener Div. Moutainside, New Jersey	80032 Ford Aerospace & Communications Corp. Western Development Laboratories Div. Palo Alto, California
72005 AMAX Specialty Metals Corp. Newark, New Jersey	73893 Microdot Mt. Clemens, Mississippi	77342 AMF Inc. Potter & Brunfield Div. Princeton, Indiana	80145 LFE Corp. Process Control Div. Clinton, Ohio
72136 Electro Motive Mfg. Corp. Florence, South Carolina	73899 JFD Electronic Components Div. of Murata Erie Oceanside, New York	77542 Ray-O-Vac Corp Madison, Wisconsin	80183 Sprague Products (Now 56289)
72228 AMCA International Corp. Continental Screw Div. New Bedford, Massachusetts	73905 FL Industries Inc. San Jose, California	77638 General Instrument Corp. Rectifier Div. Brooklyn, New York	80294 Boums Instruments Inc. Riverside, California
72259 Nytronics Inc. New York, New York	73949 Guardian Electric Mfg. Co. Chicago, Illinois	77900 Shakeproof Lock Washer Co. (Now 78189)	80583 Hammerlund Mfg. Co. Inc. Paramus, New Jersey
72619 Amperex Electronic Corp. Dialight Div. Brooklyn, New York	74199 Quam Nichols Co. Chicago, Illinois	77969 Rubbercraft Corp. of CA Ltd. Torrance, California	80640 Computer Products Inc. Stevens-Arnold Div. South Boston, Mass.
72653 G C Electronics Co. Div. of Hydrometals Inc. Rockford, Illinois	74217 Radio Switch Co. Marlboro, New Jersey	78189 Illinois Tool Works Inc. Shakeproof Div. Elgin, Illinois	81073 Grayhill Inc. La Grange, Illinois
72794 Dzus Fastner Co. Inc. West Islip, New York	74306 Piezo Crystal Co. Div. of PPA Industries Inc. Carlisle, Pennsylvania	78277 Sigma Instruments Inc. South Braintree, Mass.	81312 Litton Systems Inc. Winchester Electronics Div. Watertown, Connecticut
72928 Gulton Industries Inc. Gudeman Div. Chicago, Illinois	74542 Hoyt Elect.Instr. Works Inc. Penacook, New Hampshire	78290 Struthers Dunn Inc. Pitman, New Jersey	81439 Therm-O-Disc Inc. Mansfield, Ohio
72982 Murata Erie N. America Inc. Erie, Pennsylvania	74840 Illinois Capacitor Inc. Lincolnwood, Illinois	78553 Eaton Corp. Engineered Fastener Div. Cleveland, Ohio	81483 International Rectifier Corp. Los Angeles, California
73138 Beckman Industrial corp. Helipot Div. Fullerton, California	74970 Johnson EF Co. Waseca, Minnesota	78592 Stoeger Industries South Hackensack, New Jersey	81590 Korry Electronics Inc. Seattle, Washington
73168 Fenwal Inc. Ashland, Massachusetts	75042 TRW Inc. IRC Fixed Resistors Philadelphia, Pennsylvania	79136 Waldes Kohinoor Inc. Long Island City, New York	81741 Chicago Lock Co. Chicago, Illinois
73293 Hughes Aircraft Co. Electron Dynamics Div. Torrance, California	75297 Litton Systems Kester Solder Div. Chicago, Illinois	79497 Western Rubber Co. Goshen, Indiana	82227 Airtax Corp. Cheshire Div. Cheshire, Connecticut
	75376 Kurz-Kasch Inc. Dayton, Ohio		82240 Simmons Fastner Corp. Albany, New York

Federal Supply Codes for Manufacturers (cont)

82305 Palmer Electronics Corp. South Gate, California	84171 Arco Electronics Commack, New York	89536 John Fluke Mfg. Co., Inc. Everett, Washington	91802 Industrial Devices Inc. Edgewater, New Jersey
82389 Switchcraft Inc. Sub of Raytheon Co. Chicago, Illinois	84411 American Shizuki TRW Capacitors Div. Ogallala, Nebraska	89597 Fredericks Co. Huntingdon Valley, Penna.	91833 Keystone Electronics Corp. New York, New York
82415 Airpax Corp Frederick Div. Frederick, Maryland	84613 FIC Corp. Rockville, Maryland	89709 Bunker Ramo-Eltra Corp. Amphenol Div. Broadview, Illinois	91836 King's Electronics Co. Inc. Tuckahoe, New York
82872 Roanwell Corp. New York, New York	84682 Essex Group Inc. Peabody, Massachusetts	89730 General Electric Lamp Div. Newark, New Jersey	91929 Honeywell Inc. Micro Switch Div. Freeport, Illinois
82877 Rotron Inc. Custom Div. Woodstock, New York	85367 Bearing Distributing Co. San Francisco, California	90201 Mallory Capacitor Co. Sub of Emhart Industries Inc. Indianapolis, Indiana	91934 Miller Electric Co. Woonsocket, Rhode Island
82879 ITT Royal Electric Div. Pawtucket, Rhode Island	85372 Bearing Sales Co. Los Angeles, California	90215 Best Stamp & Mfg. Co. Kansas City, Missouri	91984 Maida Development Co. Hampton, Virginia
83003 Varo Inc. Garland, Texas	85480 W. H. Brady Co. Industrial Product Milwaukee, Wisconsin	90303 Duracell Inc. Technical Sales & Marketing Bethel, Connecticut	91985 Norwalk Valve Co. S. Norwalk, Connecticut
83014 Hartwell Corp. Placentia, California	85932 Electro Film Inc. Valencia, California	91094 Essex Group Inc. Suflex/IWP Div. Newmarket, New Hampshire	92914 Alpha Wire Corp. Elizabeth, New Jersey
83055 Signalite Fuse Co. (Now 71744)	86577 Precision Metal Products Co. Peabody, Massachusetts	91247 Illinois Transformer Co. Chicago, Illinois	93332 Sylvania Electric Products Semiconductor Products Div. Wobum, Massachusetts
83058 TRW Assemblies & Fasteners Group Fasteners Div. Cambridge, Massachusetts	86684 Radio Corp. of America (Now 54590)	91293 Johanson Mfg. Co. Boonton, New Jersey	94144 Raytheon Co. Microwave & Power Tube Div. Quincy, Massachusetts
83259 Parker-Hannifin Corp. O-Seal Div. Culver City, California	86928 Seastrom Mfg. Co. Inc. Glendale, California	91462 Alpha Industries Inc. Logansport, Indiana	94222 Southco Inc. Concordville, Pennsylvania
83298 Bendix Corp. Electric & Fluid Power Div. Eatonville, New Jersey	87034 Illuminated Products Inc. (Now 76854)	91502 Associated Machine Santa Clara, California	94988 Wagner Electric Corp. Sub of McGraw-Edison Co. Whippany, New Jersey
83315 Hubbell Corp. Mundelein, Illinois	88219 GNB Inc. Industrial Battery Div. Langhorne, Pennsylvania	91506 Augat Inc. Attleboro, Massachusetts	95146 Alco Electronic Products Inc. Switch Div. North Andover, Massachusetts
83330 Kulka Smith Inc. A North American Philips Co. Manasquan, New Jersey	88245 Winchester Electronics Litton Systems-Usecos Div. Van Nuys, California	91507 Froeliger Machine Tool Co. Stockton, California	95263 Leecraft Mfg. Co. Long Island City, New York
83478 Rubbercraft Corp. of America West Haven, Connecticut	88486 Triangle PWC Inc. Jewitt City, Connecticut	91637 Dale Electronics Inc. Columbus, Nebraska	95275 Vitramon Inc. Bridgeport, Connecticut
83553 Associated Spring Bames Group Gardena, California	88690 Essex Group Inc. Wire Assembly Div. Dearborn, Michigan	91662 Elco Corp. A Gulf Western Mfg. Co. Connector Div. Huntingdon, Pennsylvania	95303 RCA Corp. Receiving Tube Div. Cincinnati, Ohio
83740 Union Carbide Corp. Battery Products Div. Danbury, Connecticut	89020 Amerace Corp. Buchanan Crimptool Products Div. Union, New Jersey	91737 ITT Cannon/Gremar (Now 08718)	95348 Gordo's Corp. Bloomfield, New Jersey
	89265 Potter-Brumfield (See 77342)		95354 Methode Mfg. Corp. Rolling Meadows, Illinois

Federal Supply Codes for Manufacturers (cont)

95573
Campion Laboratories Inc.
Detroit, Michigan

95712
Bendix Corp.
Electrical Comp. Div.
Franklin, Indiana

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Fernando, California

96853
Gulton Industries Inc.
Measurement & Controls Div.
Manchester, New Hampshire

96881
Thomson Industries Inc.
Port Washington, New York

97525
EECO Inc.
Santa Ana, California

97540
Whitehall Electronics Corp.
Master Mobile Mounts Div.
Fort Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, New Jersey

97966
CBS
Electronic Div.
Danvers, Massachusetts

98094
Machlett Laboratories Inc.
Santa Barbara, California

98159
Rubber-Teck Inc.
Gardena, California

98278
Malco A Microdot Co.
South Pasadena, California

98291
Selectro Corp.
BICC Electronics
Trumbull, Connecticut

98372
Royal Industries Inc.(Now 62793)

98388
Lear Siegler Inc.
Accurate Products Div.
San Deigo, California

99120
Plastic Capacitors Inc.
Chicago, Illinois

99217
Bell Industries Inc.
Elect. Distributor Div.
Sunnyvale, California

99378
ATLEE of Delaware Inc.
N. Andover, Massachusetts

99392
Mepco/Electra Inc.
Roxboro Div.
Roxboro, North Carolina

99515
Electron Products Inc.
Div. of American Capacitors
Duarte, California

99779
Bunker Ramo- Eltra Corp.
Barnes Div.
Lansdown, Pennsylvania

99800
American Precision Industries
Delevan Div.
East Aurora, New York

99942
Mepco/Centralab
A North American Philips Co.
Milwaukee, Wisconsin

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FAX: (965) 245218

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Tlx: 35000 phtc nl
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TLX: (799) BU 2265 RANKOC

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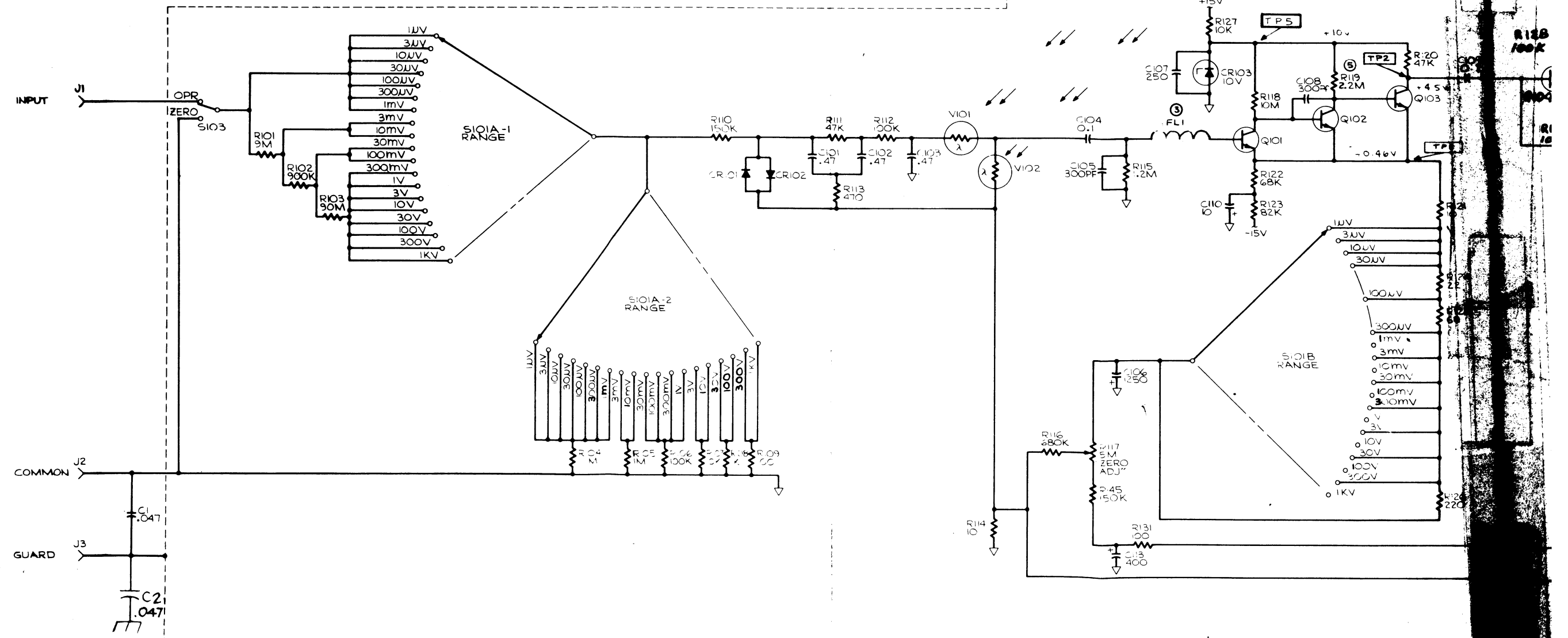
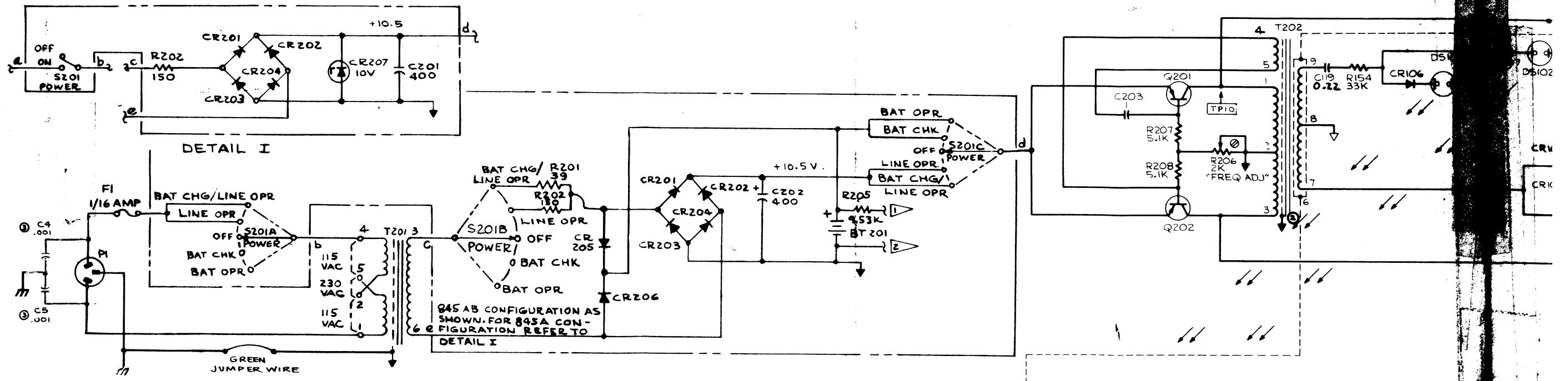
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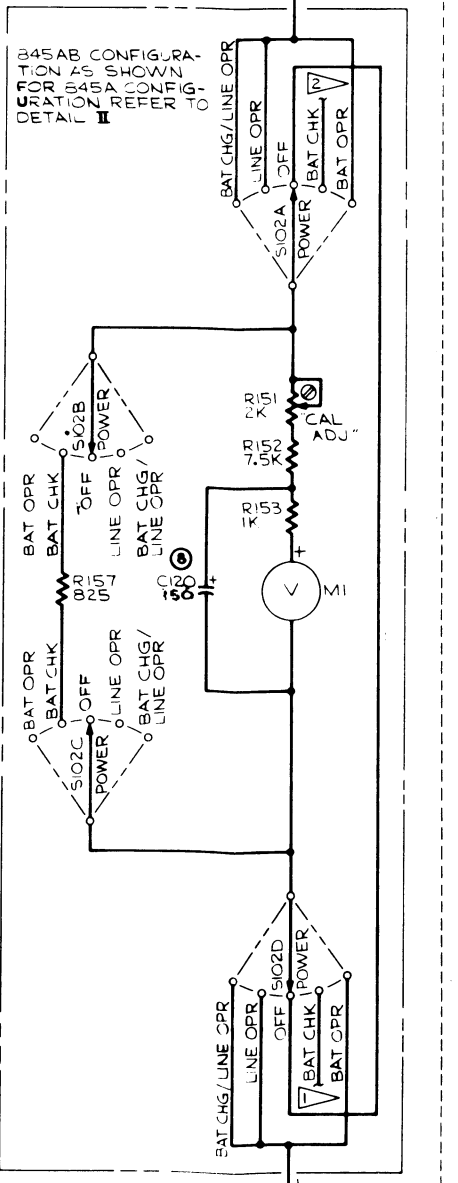
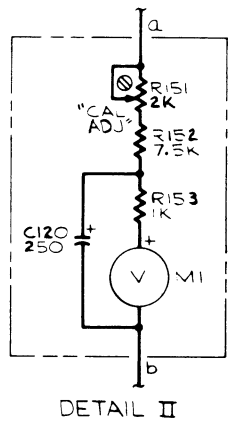
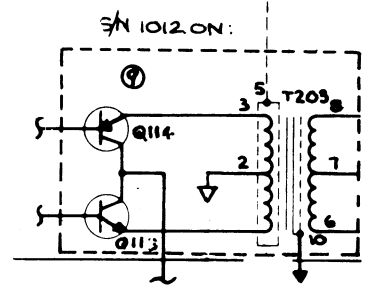
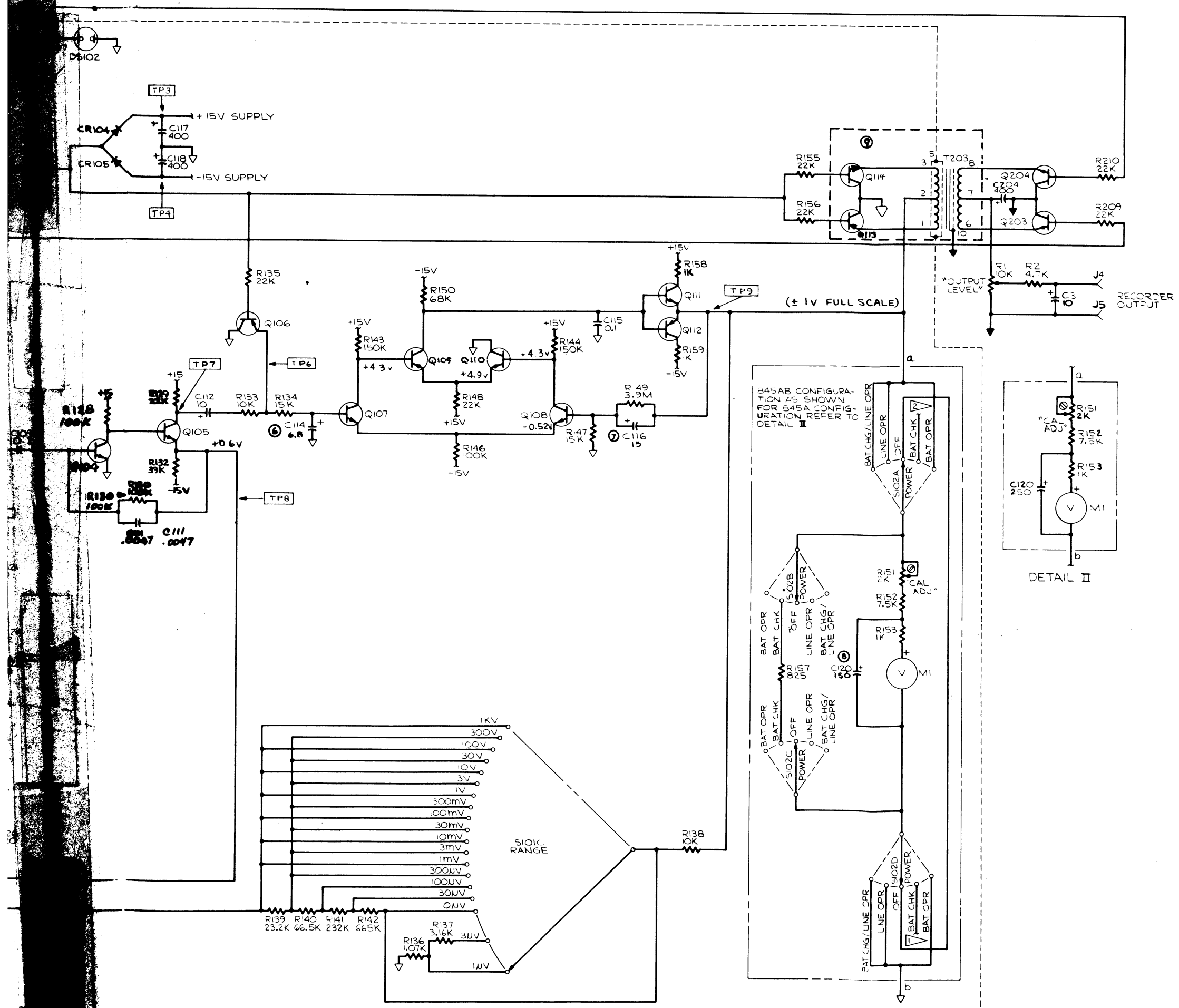
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- NOTES:
- ① ALL FLAGNOTES WITH THE SAME NUMBER ARE CONNECTED.
 - ② INDICATES POWER SUPPLY COMMON.
 - ③ INDICATES NULL DETECTOR COMMON.
 - ④ INDICATES CHASSIS GROUND.
 - ⑤ INDICATES INTERNAL ADJUSTMENT.
- UNLESS OTHERWISE INDICATED RESISTANCE IS IN OHMS AND CAPACITANCE IS IN MICROFARADS.
- CHANGES:
- ① FOR SER. NOS. 123 THRU 370: PREVIOUS TITLE WAS: "NULL DETECTOR / MICROVOLTMMETER"
 - ② TRANSFORMER CORE CONNECTION DELETED AT SN 1012 AND ON.
 - ③ C4, C5, AND FL1 ADDED AT SN 1012 AND ON.
 - ④ R119 WAS 1.2M FROM SN 123 TO 1011.
 - ⑤ C114 WAS 10 OF FROM SN 123 TO 1011.
 - ⑥ C116 WAS 22 OF FROM SN 123 TO 1011.
 - ⑦ C120 WAS 250 OF FROM SN 123 TO 1011.
 - ⑧ Q113 WAS 4K FROM SN 123 TO 1011. Q114 WAS 1K FROM SN 123 TO 1011.

FUNCTIONAL SCHEMATIC

① HIGH IMPEDANCE
VOLTMETER / NULL DETECTOR

MODEL 845A & 845AB

MODEL 845A & 845AB SER. NO. 123 & ON

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