

Ratelco

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DC POWER SUPPLY

TYPE: PS-8

MODEL: 109-2046-BA

OPERATING AND SERVICE MANUAL

Ratelco Inc.

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OPERATION AND MAINTENANCE INSTRUCTIONS

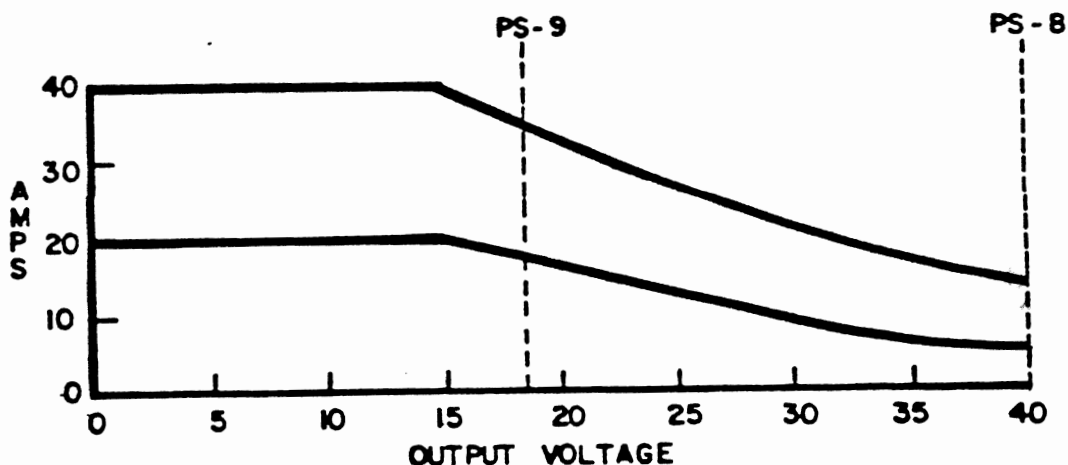
MODEL	TYPE	DESCRIPTION
106-2079-B	PS-9	1-18 VDC, 0-40 ADC Output
106-2046-B	PS-8	1-40 VDC, 0-40 ADC Output

1. INTRODUCTION

These power supplies are used for the testing of transistorized mobile and portable two-way radios with transmit currents up to 40 ADC. These units have precise voltage and current regulation up to the rated voltage and peak current of 40 ADC. Current-limiting is adjustable and precise from tenths of an amp to the rating of 40 ADC. They are equipped with removable control units containing volt and amp meters. The control unit may be mounted separately from the main power supply by using a Model 2098 Remote Cable Kit. In Addition, a 2099 Rack-Mount Kit allows mounting of the power supply in a 19 inch communications rack.

2. DESCRIPTION

The Type PS-8 and PS-9 power supplies are continuously variable in voltage and current. They will supply operating power within their current and voltage rating with a continuous power output of 300 watts and a 1 minute out of 5 minute intermittent power output of 600 watts. This limitation is depicted graphically below. The ripple content at 10 mVrms is low enough to be used with any communications equipment being tested.



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There are two control switches on the front of the unit; a standby switch on the control head and an ON-OFF switch which also functions as a range switch on the PS-8. The STANDBY switch allows the output voltage to be turned off at the control head without switching the AC power off. The main power switch need be used only to remove AC power and turn the fan off. This switch also selects the 1-15 VDC and 15-40 VDC ranges on the PS-8. The PS-8 can be operated at low power from 0-40 VDC on the high range position but it is recommended that whenever power output exceeds 200 watts under 15 VDC the range switch be switched to the 1-15 VDC range.

3. OPERATION

a. Voltage Control

When testing communications equipment, turn the STANDBY switch to the UP position and set the voltage control adjustment to the desired output voltage. When the test is complete, return the STANDBY switch to the "standby" or DOWN position.

b. Current Limiter Control

This control is used to limit the current to the equipment under test. The unit will hold the output current to within one ampere of the set limit. The current limiting level is set by turning the control in a counter-clockwise direction until the voltage starts to fall as indicated by the volt meter on the control head. If the equipment under test exceeds the preset current limit, the voltage will drop automatically, limiting the current output to the set limit.

c. Transistor Fail Protect Circuitry

These supplies have a circuit designed in which turns the SCR firing circuit off if a pass transistor should fail. This also restricts the 1-15 volt range on the PS-8 to 20 VDC maximum. The circuit also senses AC line voltage drop-outs and may cause the output voltage to go to zero on occasion. To restore output voltage switch the AC power switch off then back on.

WARNING

Improper field adjustment of the circuit board or replacement of components on the circuit board may cause this protection feature to become inoperative without other indication. See Troubleshooting Guide Paragraph 10.1 for adjustment and test procedures.

4. INSTALLATION

- a. Place the power supply in any convenient location which does not restrict the air vents.
 - b. Connect the power cord to a 120 VAC $\pm 10\%$ source.
 - c. Connect the equipment to be tested to the DC receptacles on the front panel with heavy wire. Number 10 is the minimum recommended wire size for most applications. NOTE: Be sure of proper polarity when making connections to the equipment (RED - Positive, BLACK - Negative).
5. Deviation of voltage and current may be encountered when the power supply is operated in high RF fields. Any RF radiator should be positioned at least 25 feet away from the supply or the supply shielded with a ground plane at transmitter ground potential.

6. GUARANTEED PERFORMANCE SPECIFICATIONS

	PS-8	PS-9
DC Voltage	1-15, 1-40 VDC	1-18 VDC
Metering Accuracy	$\pm 2\%$ of full scale	
Current Output	20 Amps Continuous	40 Amps Intermittent at 1-15 VDC
	300 Watts Continuous,	600 Watts Intermittent over 15 volts DC
Ripple Content	10 mVrms in continuous range	
Regulation	± 15 mV in continuous range, $\pm 1\%$ in intermittent range.	
Overall Dimensions	13 1/2" high, 8" wide, 15" deep	
Weight	41 Lbs net.	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

7. DATA INCLUDED

Model 106-2076-B Portable Supply Schematic Diagram
Model 106-2079-B Portable Supply Schematic Diagram

TROUBLE SHOOTING GUIDE TYPE PS-8 AND PS-9

NOTE

Unless otherwise noted, all voltages are given with the voltmeter connected to the positive DC Output jack. (The meter should have an input impedance of at least 20,000 ohm/volt)

1. NO DC OUTPUT

- 1.1 Remove all load from the DC output jacks; put the STANDBY switch in "standby" and observe the DC Voltmeter while turning the AC Power switch "on". If the voltmeter goes full scale and drifts down one of the pass-transistors or driver is shorted or leaky. The transistors should be checked and the bad one replaced with a new MATCHED transistor.
- 1.2 If the voltage remains low and does not jump up, put the STANDBY switch up and cycle the AC Power switch off and back on. If the DC voltmeter goes to full scale and drifts back then the 723 voltage regulator integrated circuit is defective.
- 1.3 If the DC voltmeter in either of the above steps goes full scale and remains there, readjust the SCR firing angle adjustment 2.5K trimmer. See Paragraph 10.1.

NOTE

At the time of manufacture the pass-transistors were installed in matched sets. They were selected for leakage and current sharing. If a single transistor must be replaced, request the transistor from RATELCO, Inc., giving the markings which were placed on the case with a marking pen during manufacture.

2. REDUCED CURRENT OUTPUT CAPACITY

- 2.1 Check the voltage between the pass-transistor heatsink and the positive output jack with the unit under 5-10 Amp load. This voltage should be greater than 10 volts, if not, check the SCR firing circuit or SCR's for an inoperative SCR.

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2.2 With a 5-20 amp load at any convenient voltage, measure the emitter voltage at each of the pass-transistors (TP22-25). The emitter pin is the pin with two power resistors connected to it. The four emitter voltages should read within 50 mV of each other. If not, replace the transistor(s) with the low voltage at the emitter. The transistors are in matched sets so they must be matched when replacing them. See note under Paragraph 1.3.

2.3 Check the current limiter adjustment and circuit.

3. POOR REGULATION

3.1 With the voltage control turned down, check the voltage across the pass-transistors (TP26). If the voltage at TP26 varies with load more than a volt or so, check the -55 and -58 trimmers for intermittent contact at the wiper. This is evidenced by poor regulation and a possible maximum output current of 5 to 20 amps.

3.2 See Paragraph 2.

4. EXCESSIVE RIPPLE

4.1 When the output current is being limited by the current limiter, the ripple content of the output will increase slightly. If the current limiter is not in operation and there is greater than 10 mVrms ripple in the output, measure the voltage across the pass transistors with the load connected.

4.2 See Paragraph 2.1.

5. AC INPUT FUSE BLOWS WHENEVER THE UNIT IS TURNED ON

5.1 Check SCR's for short circuit. If SCR's are shorted, replaced SCR(s) and pulse transformer (-87). Also check the unijunction transistor for defect.

6. REGULATOR CIRCUIT

6.1 TP11 and 16 should be approximately 3.3 volts, with the STANDBY switch out of "standby" and the output voltage greater than 2.0 volts, there should be less than .01 volts difference between TP16 and TP11. If TP16 has a higher voltage than TP11, then TP9 should be less than 1.0 volts, if not, replace the 723 voltage regulator IC. If TP11 is greater than TP16, TP9 should be greater than 1.0 volts.

7. CURRENT LIMITER

- 7.1 The 741 (-85) IC is the primary current limiting element. The voltage between pins 3 (TP7) and 2 (TP5) is compared and the difference amplified. If pin 3 is more positive than pin 2 the output voltage at pin 6 should be high (greater than 5 volts) and the current limiter not operating. If the voltage at pin 3 is more negative than the voltage at pin 2, then the output voltage on pin 6 will be less than 3 volts and the current limiter in operation.

8. AMMETER ADJUSTMENTS

- 8.1 For best results two ammeters are necessary, a 0-50 and a 0-5 ammeter. The adjustment trimmer for the power supply ammeter is mounted on the circuit board attached to the rear of the voltmeter in the control head. There are two trimmers in the Type PS-8, one for the ammeter and one for the 0-40 VDC range adjustment of the voltmeter. The PS-9 has a single single adjustment for the ammeter.
- 8.2 Apply a substantial load (20 amps or greater) through an external ammeter to the 40 amp jacks and adjust the current trimmer until both ammeters agree. The 0-4 amp range is adjusted by changing the length of the nichrome wire between the small and large positive DC jacks. After adjusting the power supply ammeter, connect a load drawing up to 4 amps to the small banana jacks and adjust the length of the nichrome wire resistor until the internal and external ammeters agree.

WARNING

The fuseholder has 115 VAC applied to it even when with the AC power switch turned off. To prevent shock hazard, remove the cord from the power receptical before attempting to adjust the nichrome wire resistor. Also make absolutely certain that the nichrome resistor has at least 1/2 " clearance surrounding it.

9. FIRING CIRCUIT

- 9.1 Position the STANDBY switch to the "up" (power on) position, the current limiter to the extreme clockwise (40 amp) position and the voltage control knob to 1 volt.
- 9.2 If the voltage at TP26 is close to 0 volts, check paragraph 1. If no discrepancy is found, put an oscilloscope across the 15 ohm resistor in the gate circuit of the SCR. Turn the unit off then back on to see if there is a gate pulse to the SCR at the moment the unit is switched on.

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To fire the SCR a gate pulse of greater than 3.0 volts is required. If there is no pulse, check TP21 with the scope probe for a wave form as given in FIG 1E. If the voltage at TP26 is close to 0 the waveform at TP21 will consist of only 2 to 4 pulses each time the unit is turned on.

- 9.3 If the pulse at the gates exceed 3.0 volts but the SCR does not fire, check the SCR's.

10. CIRCUIT BOARD ADJUSTMENT

Readjustment of the circuit board trimmers should be necessary only after replacing a defective component.

CAUTION

Maladjustment of the adjustment trimmers may cause damage to the power supply or invalidate some of the failure protection circuitry. For this reason the trimmers have been sealed at the factory and breaking the seal without approval of the factory may be cause to void the warranty.

The following tools be available while adjusting the circuit board trimmers.

1. DC voltmeter with reading accuracy of ± 0.2 VDC and VAC
2. Oscilloscope with $\pm 3\%$ calibration on vertical and horizontal axes. Adjustable triggering on vertical signal.
3. Variable AC power source with output range of 0-140 VAC, 10 AAC.

10.1 Firing Circuit Adjustment

- 10.1.1 Trimmers (-55) and (-58) are used to adjust the firing circuit. The voltage at TP26 is controlled by trimmer (-58) and the firing angle limit is controlled by trimmer (-55).

- 10.1.2 Set the AC input voltage to 120 VAC ± 2.0 VAC. Monitor TP26 with a voltmeter and connect an oscilloscope between the positive DC output jack and TP3. The voltage at TP26 should not exceed 11.5 volts when the SCR's are firing. It may be noted that there are excursions of voltage at times but the SCR's should have ceased firing and the voltage will drift down until the SCR's fire again.

- 10.1.3 Remove all load from the unit and turn the voltage control knob to its extreme counter-clockwise position. By incrementally adjusting trimmers (-55) and (-58), the voltmeter should fluctuate between 10.5 and 11.5 volts. The oscilloscope waveform will appear as in Fig 1a, possibly with only 2 or 3 firings per second. If the waveform appears as in Fig 1b there will be poor regulation at outputs of 14-18 VDC and 40 Amps.
- 10.1.4 On the PS-8 turn the voltage control to 40 VDC and apply a 15 ADC load. The voltage at TP26 should be 8.5 VDC $\pm$ 0.5 VDC and the firing stable. For this check the PS-9 should be adjusted to 15 VDC and 40 ADC load.
- 10.1.5 On the PS-8 set the power switch to the low range and adjust the output voltage to 15 VDC. On the PS-9 leave the voltage setting at 15VDC. Apply the 40 Amp load to the output while continuing to monitor the voltage at TP26. Gradually lower the AC input voltage to 110 VAC. At this point the voltage at TP26 should be 8.2 VDC $\pm$ 0.3 VDC. Lowering the AC input voltage to 109 VAC should shut down the SCR firing circuit. Gradually increase the AC voltage to 140 VAC. The firing circuit should not restart. The only way to restart the supply is to cycle the AC power switch to the off then on position.

NOTE

Please observe the intermittent rating of the power supply while making this adjustment as permanent damage to the unit may result if the ratings are exceeded.

10.2 Voltage Adjustment

- 10.2.1 The output voltage range is adjusted with trimmer (-63). The upper voltage limit adjustment is made by turning the 2.5k (-72) trimmer until the desired voltage is reached with voltage control fully clockwise.

10.3 Current Limiter Adjustment

- 10.3.1 After performing the ammeter checks in para. 8., the power supply ammeter may be used to set the current limiter. Connect a load capable of drawing at least 4.5 amps across the small output jacks. Turn the current limiter control to the 0 amp position and the voltage control clockwise. (Do not exceed 5 amps.) Turn the 5k (-71) fully counter-clockwise. Adjust the 1k (-72) trimmer until the ammeter reads .1 amp. Turn the current limit control fully clockwise. Rotate the 5k (-71) trimmer clockwise until the ammeter reads 4.2 amps. Turn the current limiter control to zero; the current should not exceed 100 mA.

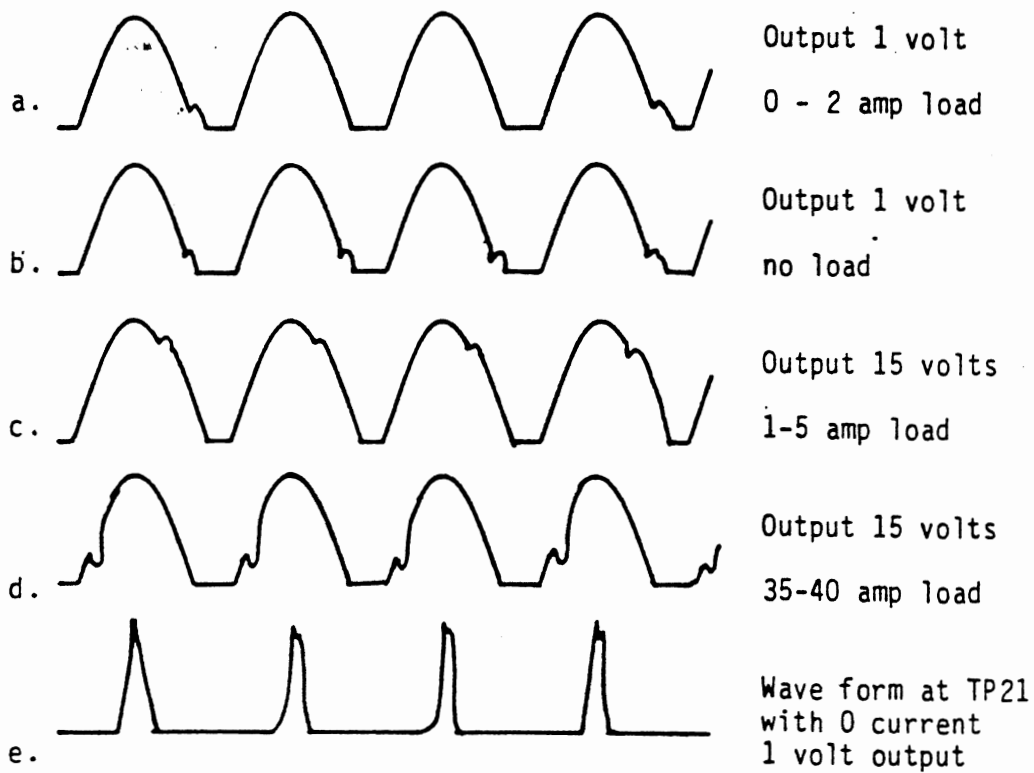


FIG. 1.

11. VOLTAGES AT VOLTAGE TEST POINT

Measured with STANDBY switch up and with voltage and current limiter adjustment controls in mid range.

NOTE

All voltages are given with the voltmeter negative connected to the positive output (red) jack. The internal resistance of the meter must be at least 20,000 Ω/V .

<u>Test Point</u>	<u>Voltage</u>	<u>Possible Malfunction</u>
TP-1	0.1 to 0.4 VDC	
TP-2	10 to 20 VDC	Paragraph 10.1
TP-3	32 - 35 VDC	
TP-4	18V $\pm 10\%$	
TP-5	3.5V $\pm 10\%$	Paragraph 7.1
TP-7	3.5V $\pm 10\%$	Paragraph 7.1
TP-8	1.0 - 2.0	
TP-9	1.0 - 5.0	
TP-10	8.0 - 11.0 VDC	Paragraph 1
TP-11	3.0 - 3.5 VDC	Paragraphs 6.1, 7.1
TP-12	Depends on output voltage $+2.5$ to -25.0	
TP-13	3.5V $\pm 10\%$	Paragraph 7.1
TP-14	0 - 0.4 VDC	
TP-15	7.0 $\pm 5\%$	IC (-51)
TP-16	3.0 - 3.5	Paragraph 6.1
TP-17	10.0 - 18.0 Volts	Standby Switch out of STANDBY
TP-18	Same as T-17	Standby Switch out of STANDBY
TP-19	2.5 - 3.3 VDC	
TP-20	18 to 24VDC	
TP-21	2.0 - 7.0	Paragraph 10.1
TP-22 thru TP-25	0.0 to 0.4 depending on output current	
TP-26	7.0 to 11.0 Volts	Paragraph 1

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SINGLE LEVEL BILL OF MATERIALS

1

ASSEMBLY: 109-2046-BA
DESC: PS-8, PAR SUPPLY: 40V 40A, 120VAC 60HZ
REF COMPONENT DESCRIPTION

UMG #: 109-2046-BA
DESCRIPTION

QTY UM

052-1000-36	CABLE: 6 PR 22 GA, BELDEN A747; 36 INC	1.0	EA
202-2727-00	ENCL: METER HEAD PS-8/9	1.0	EA
202-2728-00	ENCL: PS 8/9, 14: TOP AND BACK	1.0	EA
202-2729-00	ENCL: PS 8/9, FRONT & BOTTOM	1.0	EA
202-2730-00	ENCL: SIDE PS-8/9 CKT BD SIDE	1.0	EA
202-2731-00	ENCL: STDF PS-8/9 BLANK	1.0	EA
207-2704-00	HEAT SINK, PS-8/9 RUTIM	1.0	EA
207-2705-00	HEAT SINK, PS-8/9 TOP	1.0	EA
207-2706-00	HEAT SINK, 900-7, 2 TO-3	1.0	EA
207-2707-00	HEAT SINK, 900-7, 3 TO-3	1.0	EA
208-2841-00	BRACKET, PS-8 FAN	1.0	EA
208-2842-00	BRACKET, PS-8 FAN NOTCHED	1.0	EA
208-2935-00	BRKT, ANGLE: CARD EDGE 492812 SEASTRO	2.0	EA
208-2935-00	BRKT, ANGLE: CARD EDGE 492812 SEASTRO	2.0	EA
210-8035-01	STUD: BRASS, 5/16-18 X 2" FT, DRILLE	1.0	EA
211-0503-00	NUT: STL. HEX, JAM 5/16-18	8.0	EA
211-1502-00	NUT: HEX BRASS, 5/16-18	2.0	EA
211-2500-00	NUT: BRASS, WING, 5/16-18	2.0	EA
212-0100-00	WASHER, FLAT STL: 1/4, 3/4 OD	4.0	EA
212-0505-00	LOCH WASHER, STL SHKPF: 5/16" INT. TO	2.0	EA
212-5000-00	WASHER, NYLON: WECKESSER NWB-3753	4.0	EA
212-5055-00	WASHER, NYLON: WECKESSER NWB-3753	2.0	EA
212-5500-00	WASHER, NYLON: SW-10 #10	4.0	EA
212-5510-03	WASHER, NYLON SHOULDER, .323 X .750	2.0	EA
213-0100-00	SPACER: HEX BRASS, 6-32 X .5 2322	2.0	EA
213-1500-00	SPACER, NYLON: 1/4" WECKESSER SP-102	4.0	EA
216-2000-00	STRATIN RFLTER: LINE COND SR6P3-4 WEC	1.0	EA
216-7000-00	CABLE CLAMP: WECKESSER WC-56	1.0	EA
216-7200-00	CABLE CLAMP: NYLON, MOLDED BLK. 11/	1.0	EA
218-3510-00	WEATHER STRIP: .125 X .5 X 25 FT, SS	2.2	FT
225-2712-00	LABEL: PS-8 MAIN 120VAC 60HZ	1.0	EA
225-2712-01	LABEL, PS-8 CONTL HD	1.0	EA

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SINGLE LFVFL BILL OF MATERIALS

2

ASSEMBLY : 109-2046-BA
 DESC : PS-8, PNR SUPPLY
 REF COMPONENT

UMG # : 109-2046-BA
 40V 40A, 120VAC 60HZ
 DESCRIPTION

EFF : 12-16-83

QTY UM

229-0300-00	FEET: RUBBER 2194 SMITH SCREW-UN	2194	4.0 EA
237-0500-00	KNOB, BLANK: 76F2R3	76F2R3	1.0 EA
237-0600-00	ELECTIPUNIC HDWK	76F2B3	1.0 EA
240-1300-00	SW, 106GLE: 4PUT CNTR	7FF2B3	1.0 EA
250-0100-00	TERM STRIP: R13	IM250-73	1.0 EA
250-0900-00	TERM STRIP: 1087	1POS	2.0 EA
250-1000-00	SMITH KEYSIONE	804	3.0 EA
253-0120-00	LUG: SMITH CU	1087	1.0 EA
253-0301-00	LUG: 16-14WR, IIN, RNG, 312 ST. B	5400-5	4.0 EA
253-0401-00	LUG: 12-10WR, IIN, RNG, 312 ST. B	R 4125	3.0 EA
265-8000-00	KEY, POLARIZING: EDAC	R 3459	1.0 EA
350-2046-R	WIPE BUNDLE: FUR PS-8	307-240-31A	1.0 EA
400-0190-00	CAP, FYD CER: 0.05MFD	307-240-31B	1.0 EA
581-0010-00	DIODE, IN1186	500V	2.0 EA
610-0200-00	RES., VAR TRIM: 6800	UHMS FLAT MTG	1.0 EA
655-0510-00	RES., FXD COMP: 22K OHM	PT15LD-6.8K	1.0 EA
143-2045-A	XFMR, PMR: PS-8/9	300W/600W INT	1.0 EA
255-4400-00	LAMP NFUN: 125V WHITE	50,000 HRS	1.0 EA
-101	METER DC AMPS: 0-50AMP	50MV BLK 2025	1.0 EA
-102	CIRCUIT BOARD: PS-8/9	METER	1.0 EA
-11	SW, THERMAL: 105/112	DEGREE, N.O.	1.0 EA
-115	RES., FYD COMP: 100 OHM	10% 1W	1.0 EA
-12	FUSE: 15A 250V	MDA	1.0 EA
-13	FUSE HOLDER: HKP	PANFL MTG	1.0 EA
		BUSSMANN.	

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SINGLE LEVEL BILL OF MATERIALS

3

ASSEMBLY : 109-2046-BA
DESC : PS-8, PWR SUPPLY
REF COMPONENT

DWG # : 109-2046-BA
40V 40A, 120VAC 60HZ
DESCRIPTION

EFF : 12-16-83

QTY UM

-16	263-0100-00	RINDING POST, 899-102 RED SMITH H.H. SMITH 899-102 RED	1.0 EA
-17	263-0110-00	RINDING POST, 899-103 BLK SMITH H.H. SMITH CU. 899-103	1.0 EA
-20	252-0020-00	BARRIER BLOCK: 3 PUS 20 AMP 699-3K1 KULKA 699-3K1	1.0 EA
-21	670-0290-00	RES., FXD WM: 0.1 OHM 5W PW5	8.0 EA
-22	695-0500-00	RES., NICHROME: 18GA 6"	1.0 EA
-23	667-0060-00	RES., FXD WM: 1 OHM 10X 1W	4.0 EA
-24	655-0210-00	RES., FXD COMP: 100 OHM 10X 0.5W IRW BWH JANRCR20G101KS	1.0 EA
-25,26	400-0160-00	CAP., FXD CER: 2X.01MFD 1.4KV SPRG CFKA-MITE CORP. 565CBA142AX103MA04	2.0 EA
-26	400-0160-00	CAP., FXD CFR: 2X.01MFD 1.4KV SPRG SPRAGUE 1251-2S10 (OBSOLETE)	1.0 EA
-27	440-2800-00	CAP., FXD ELCTLT: 470MFD 63V STEMENS B 41010 470MFD/63V PANASONIC ECE-B1JV471S PACCOM EH 470/63	1.0 EA
-28	675-0150-00	RES., FXD WM: 500 OHM 10W CLAPUSAT VPR-10F-500 MALLORY 1HJ500	2.0 EA
-29	208-1080-00	BRACKET, CAP: VR12B 3.0" MALLOR MALLORY VR12B	1.0 EA
-3	576-0100-00	DINDE RECT: 1N4006 1A 800V MOTOROLA 1N4006 FSC 1N4006 ITT 104006	2.0 EA
-32	205-0040-00	HANDLE, CABINET CHROME AMERUCK AMERUCK AMERUCK #CM-459-26	2.0 EA
-39	265-0010-00	CUNN., PCR: 10 PIN SLDR EYE, 307-010-5 EDAC 307-010-501-104	1.0 EA
-4	595-1000-01	SCR: 40C108 TESTED FOR PS8-9 307-015- CUNN., PCR: 15 PIN SLDR EYE, 307-015-104	2.0 EA
-40	265-0020-00	EDAC 307-015-501-104	1.0 EA
-41	213-1600-00	SPACER, NYLON: BLIND TOGGLE NUT 106 WAKEFIELD 106	4.0 EA
-44	655-0080-00	RES., FXD WM: 15 OHM 10X 0.5W AAVU ENGRING AAVU 106	2.0 EA
-45	450-1400-00	CAP., FXD ELCTLT: 35,000MFD 50VDC MALLORY CGS353U050X4C3PH	1.0 EA
-47	680-0060-00	RES., FXD WM: 250 OHM 20W CLAPUSAT VPR20H-250	1.0 EA
-48	310-2150-01	CIRCUIT BOARD: PS-8/9 CONTNOL	1.0 EA
-6	540-0800-01	TRANSISTOR: 2N6254 CHECKED	5.0 EA
-7	151-0010-00	FAN BLADE: 2C953 DAYTON	1.0 EA
-8	060-0200-00	PWR CURD: 16/3 W/GROUND 2C953 MILLER MILLER 04946	1.0 EA

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SINGLE LEVEL BILL OF MATERIALS

4

ASSEMBLY : 109-2046-BA

OWG #: 109-2046-BA

EFF: 12-16-83

DESC : PS-8, PWR SUPPLY

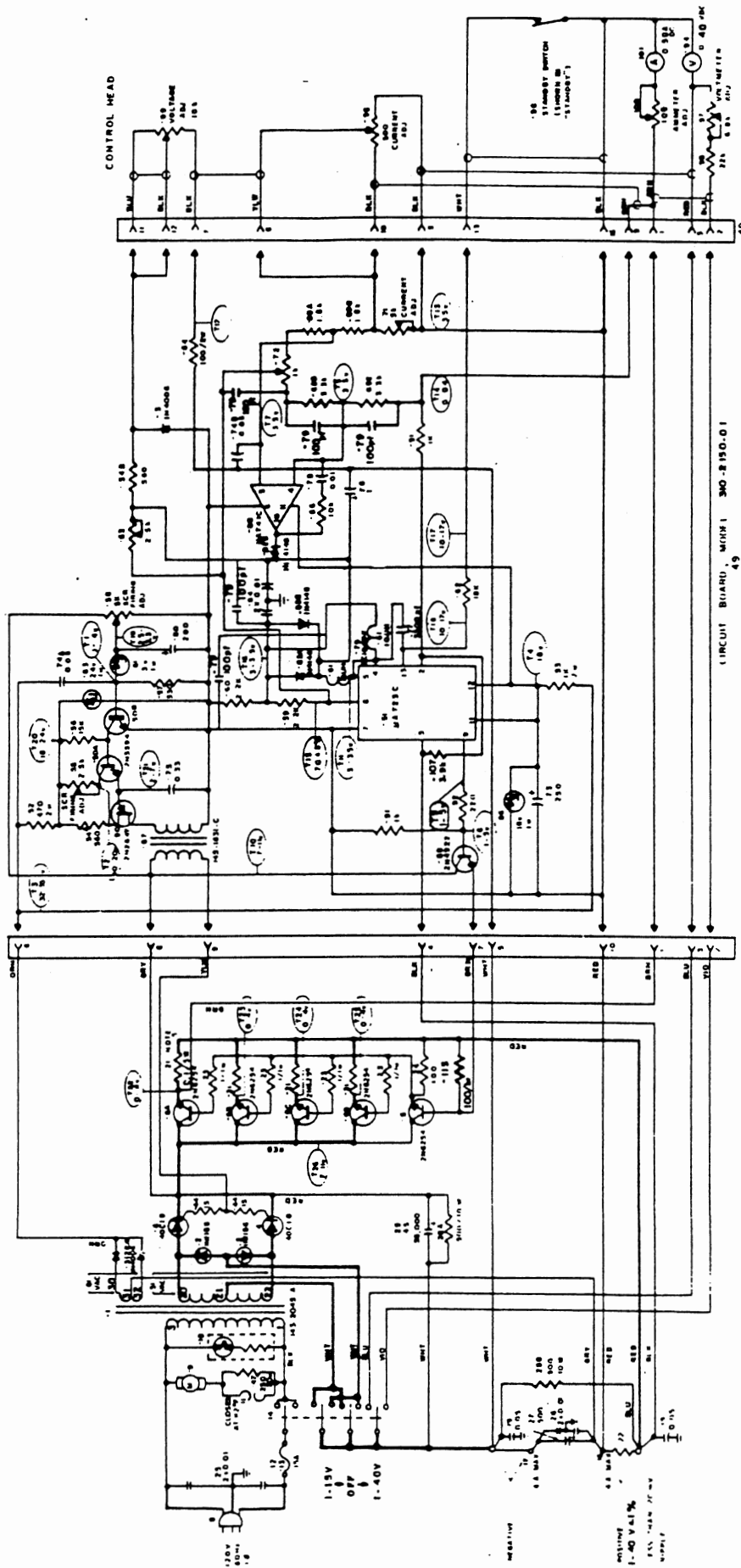
40V 40A, 120VAC 60HZ

REF COMPONENT

DESCRIPTION

QTY UM

-9	151-0020-00	FAN MOTOR: 3M603	DAYTON	1.0 EA
-94	344-0010-00	METER, DC VOLTS: 0-15/0-40	3M603	1.0 EA
-95	625-0300-00	RES., VAR POT: 500 OHM 4W WITH SHAF	CM42430	1.0 EA
-96	240-0A00-00	SW, LOGGLE: SPST 2FA53-73	2FA53-73	1.0 EA
-99	620-0400-00	RES., VAR POT: 10K OHM 0.5W	A47-10K-S	1.0 EA



NOTES: 1) VOLTAGES ARE GIVEN IN VDC ± 5% UNLESS NOTED
 2) VALUE MAY VARY
 3) RESISTOR VALUES ARE GIVEN IN OHMS AND ARE
 1/2 WATT 5% CAPACITOR VALUES ARE GIVEN
 IN MFD, UNLESS NOTED
 4) TEST VOLTAGES ARE MEASURED WITH RESPECT
 TO GND OUTPUT JAIL
 5) MAXIMUM 2% IN TWO RESISTORS IN PARALLEL

PART NO.		NAME	
109-2048-9A		DC POWER SUPPLY	
SHEET 1 OF 1		P 5 - 8	
DATE 8-12-83		FOR	
DRAWN BY 10/12		P.D.	
SCALE		NO.	
DATE		DATE	

Rockwell INC
 640 PETERS AVE. SE
 ATLANTA, GA 30316

12/16/83

SINGLE LEVEL BILL OF MATERIALS

1

ASSEMBLY : 310-2150-01

DWG # : 310-2150-01

EFF : 12-16-83

DESC : CIRCUIT BOARD: PS-8/9 CONTROL

QTY UM

-108	655-0410-00	RES., FXD COMP: 5.9K OHM 10% 0.5W	JANRCR20G392KS	1.0 EA
-49	400-0180-00	CAP., FXD CER: 0.03MFD	1KV GP130 MAL	1.0 EA
-50	310-2150	PCR: PS-8/9 CONTROL F	R4	1.0 EA
-50	500-0200-00	TRANSISTOR: 2N3394, N	ST 0.1A 25V	2.0 EA
		NAT TUNAL	2N3394	
		GF	2N3394	
		SPRAGUE	2N3394	
-51	550-0400-00	INT CKT: 723 PRECISION REGULATOR, 14	CA723F OK LM723N	1.0 EA
-52	665-0130-00	RES., FXD COMP: 470 OHM, 10% 2W		1.0 EA
-53	665-0170-00	RES., FXD COMP: 1K OHM, 10% 2W		1.0 EA
-54	655-0300-00	RES., FXD COMP: 560 OHM, 10% 0.5W	JANRCR20G561KS	2.0 EA
-55	610-0150-00	RES., VAK TRIM: 2500	OHMS VERT MTG	1.0 EA
		MALLURY	MTC-252L1	
-56	655-0480-00	RES., FXD COMP: 15K OHM 10% 0.5W	PT15LR-2.5K	1.0 EA
-57	655-0270-00	RES., FXD COMP: 330 OHM 10% 0.5W	JANRCR20G153KS	1.0 EA
-58,-7	610-0180-00	RES., VAK TRIM: 5000	JANRCR20G331KS	2.0 EA
		MALLURY	UHMS FLAT MTG	
-59,-60	655-0370-00	RES., FXD COMP: 2.2K OHM 10% 0.5W	MTC53L4	2.0 EA
-61	146-0200-00	CHOKES: 10 UHY	PT15LD-5K	2.0 EA
-62	655-0490-00	RES., FXD COMP: 18K OHM 10% 0.5W	JANRCR20G222KS	2.0 EA
-63	610-0160-00	RES., VAK TRIM: 2500	17N100K	1.0 EA
		MALLURY	JANRCR20G183KS	1.0 EA
-64	665-0080-00	RES., FXD COMP: 100 OHM, 10% 0.5W	UHMS FLAT MYG	1.0 EA
-65	655-0390-00	RES., FXD COMP: 3.3K OHM, 10% 0.5W	MTC252L4	1.0 EA
-66	655-0460-00	RES., FXD COMP: 10K OHM 10% 0.5W	PT15LD-2.5K	1.0 EA
-67	576-0100-00	DIODE, RECT.: 1N4006 1A 800V	JANRCR20G103KS	1.0 EA
		MOTOKOLA	1N4006	
		FSC	1N4006	
-72	610-0140-00	RES., VAK TRIM: 1000	UHMS FLAT MTG	1.0 EA
		MALLURY	MTC 13L4	
-73	440-2400-00	CAP., FXD ELCTLT: 220MFD 25V	PT15LD-1K	2.0 EA
		PANASONIC	ECE-B1EV221S	
		STEMENS	B41283 220/25V	
-74	400-0190-00	CAP., FXD CER: 0.05MFD 500V	EH 220/25	1.0 EA
		PACUM	5HK-550	
		SPRAGUE	5GAS50	

12/16/83

SINGLE LEVEL BILL OF MATERIALS

2

ASSEMBLY : 310-2150-01 DWG #: 310-2150-01
 DESC : CIRCUIT BOARD:PS-8/9 CONTROL
 REF COMPONENT DESCRIPTION

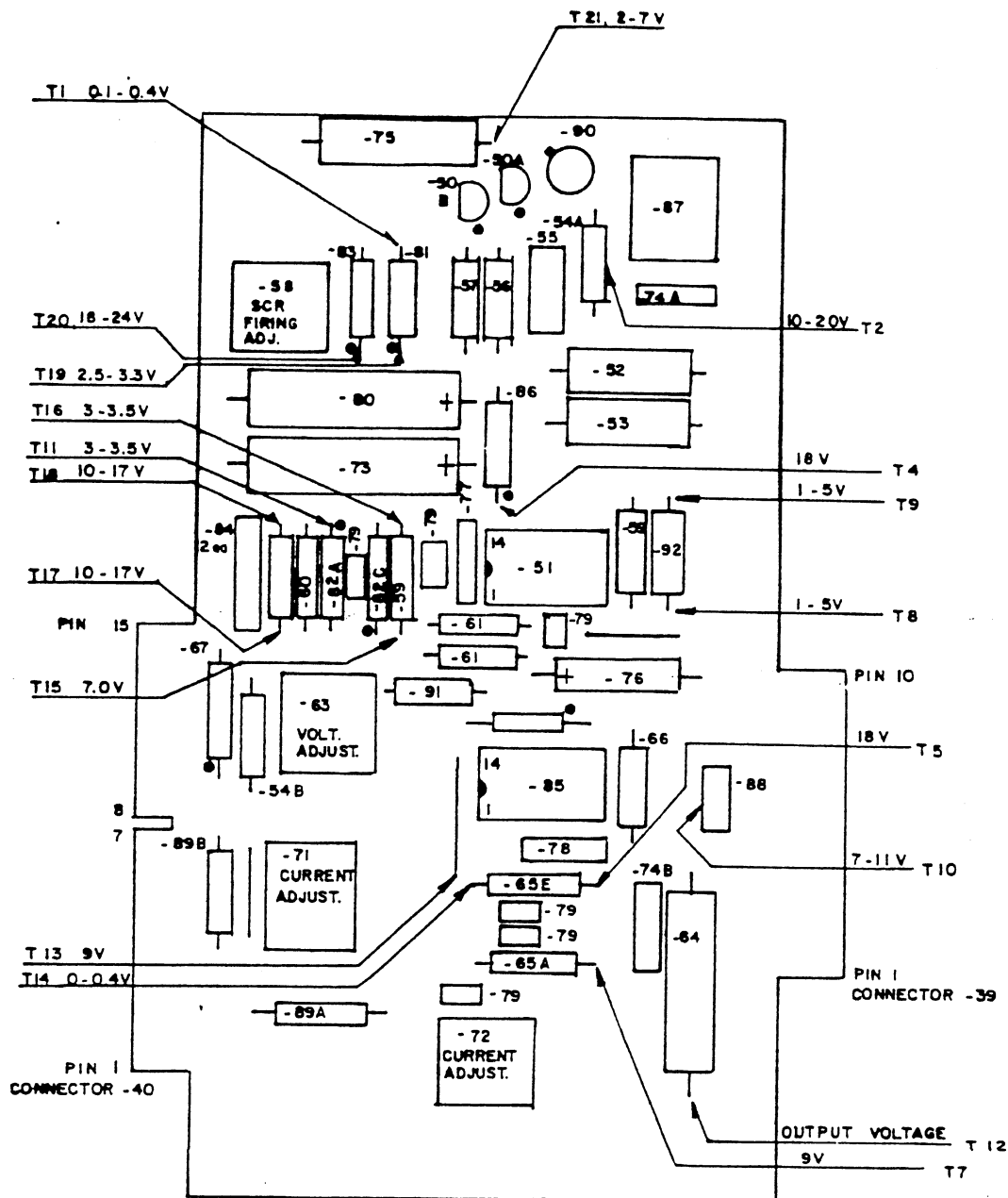
EFF :12-16-83

QTY UM

-75	430-0190-00	CAP.,FOL-MYLAR: 0.33MFD, 10% 50V, T MALLORY EWF 05033	1.0 EA
-76	440-0100-00	CAP.,FXD ELCTLT: IMFD 63V ECER1HV010S PANASONIC PACCOM EH 1/50	1.0 EA
-77	400-0120-00	STEMENS B41313 1/100V CAP.,FXD CFR:330MMFD MALLORY CCU-332G ARC GP233	1.0 EA
-78,83	400-0150-00	ARC CAP.,FXD CER:0.01MFD SPRAGUE 14KV SPRG 125L-S10 (OBSOLETE) CERA-MITE 125L-S10	3.0 EA
-79	400-0030-00	CAP.,FXD CER:100MMFD MALLORY 1KV GP310 MAL GP 310 KCK HP60SHY5P101K	6.0 EA
-81	571-0100-00	DIODE ZENER:3.3V 1W ARC CCU-101 IN4728A	1.0 EA
-82	575-0500-00	DIODE,FAST:1N4148 .5W 75V 4NS IN4148 UNITHRODE IN4148 FAIRCHILD TEXAS INST IN4148	3.0 EA
-83	571-0900-00	DIODE 7ENER:24V 1W IN4749A IN4749A	1.0 EA
-85	552-0700-00	INT CKT,AMP:741C RPIN OP AMP IN4749A FSC 741TC	1.0 EA
-86	571-0800-00	DIODE 7ENER:18V 1W IN4746A IN4746A	1.0 EA
-87	145-1631-C	XFMK,PULSE: SCR FIRING 1:1 RATEL PRND. CU. 145-1631-C KATELCU 145-1631-C	1.0 EA
-88	500-0800-00	TRANSISTOR:2N4922, N MOTOROLA 2N4922 NATTIONAL	1.0 EA
-89	655-0360-00	RES.,FXD COMP: 1.8K OHM 10% 0.5W SGS 2N4922	2.0 EA
-90	530-0300-00	TRANSISTOR,UJT:2N2647 TRW 2N2647	1.0 EA
-91	655-0330-00	RES.,FXD COMP: 1K OHM 10% 0.5W MOTOROLA JANRCR20G102KS	2.0 EA
-92	655-0250-00	RES.,FXD COMP: 220 OHM 10% 0.5W TRW JANRCR20G221KS	1.0 EA
-93	260-1002-00	SOCKET,IC: 8 PIN DIP, ROBINSON NUGENT AMP SPECIAL IND. BURNING ICN 083-S3T 640463-3 DILR6P-10R	1.0 EA
-93	260-1003-00	SOCKET,IC:14PIN ICN-143531 R-N AMP ROBINSON-NUGENT 640357-3 ICN-14353T CR914-01	1.0 EA

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED



NOTE VOLTAGES ARE GIVEN IN VDC
± 10% UNLESS NOTED.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

FRACTIONS DECIMALS ANGLES
= .XX =
= .XXX =

MATERIAL

FINISH

CONTRACT NO.

APPROVALS

DATE

DRAWN

PKD

10-28-83

CHECKED

ISSUED

Ratelco INC

1260 MERCER STREET
SEATTLE, WA 98109

CIRCUIT BOARD LAYOUT
COMPONENT SIDE

SIZE

A

FSCM NO.

DWG. NO.

310-2150-01

REV.

DO NOT SCALE DRAWING

SCALE

NONE

SHEET 1 OF 1

Ratelco

NO HASSLE LIMITED WARRANTY POLICY

Ratelco, Inc. warrants each product it manufactures, when properly applied and operated within specified conditions, against defects due to faulty materials or workmanship until 90 days after the unit is activated or 6 months after shipment, whichever occurs first. If, during this period the product is found to be defective, Ratelco shall provide all material and labor necessary to repair or replace the product. In addition, Ratelco will repair or replace any parts discovered by buyer to be defective within one year from the date of shipment (two years on FF, FC, FR, FS & FT battery chargers), provided Buyer promptly notifies Ratelco of the defect. If Ratelco determines that a defect may be remedied by a replacement of a defective part, replacement parts will normally be shipped via surface freight within 24 hours of Ratelco's receipt of notice of the defect. Equipment required to be repaired or replaced must be returned to the factory for repair or replacement and must be shipped freight prepaid. Equipment repaired under warranty will be returned via surface freight at no charge. Ratelco products repaired or replaced pursuant to this warranty shall be warranted for the unexpired portion of the warranty applying to the original date of sale.

Excepted from this warranty is equipment which has been abused or operated outside the limits of its electrical or environmental specifications. When equipment failure or field tests suggest that equipment may be defective, whether in or out of the warranty period, a full report of the difficulty should be telephoned to the Customer Service Department at the number listed below. Upon receipt of this report, the Customer Service Department will provide the appropriate assistance.

Ratelco will not be liable for any associated costs or losses incurred by the user, installing contractor, or wholesaler as a direct or indirect result of defects or of the replacement of defective, in-warranty material unless prior approval has been granted by Ratelco.

Any technical advice furnished before or after delivery in regard to use or application of Ratelco's equipment is furnished without charge and on the basis that it represents Ratelco's best judgment under the circumstances, but will not relieve the recipient from the terms of the warranty in case of negligent application of the equipment.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, (EXCEPT TITLE) INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER OBLIGATION OR LIABILITY ON THE PART OF RATELCO. The sole and exclusive remedy for breach of any warranty, expressed or implied, concerning Ratelco hereunder shall be the repair or replacement of defective equipment, components, or parts; or, at Ratelco's option, refund of the purchase price or substitution with a new replacement product. RATELCO SHALL IN NO WAY BE RESPONSIBLE FOR CONSEQUENTIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER RESULTING FROM THE BREACH OF ANY WARRANTY, EXPRESSED OR IMPLIED.

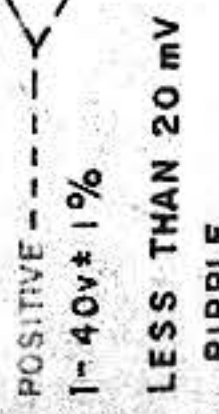
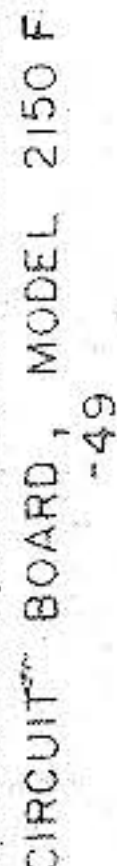
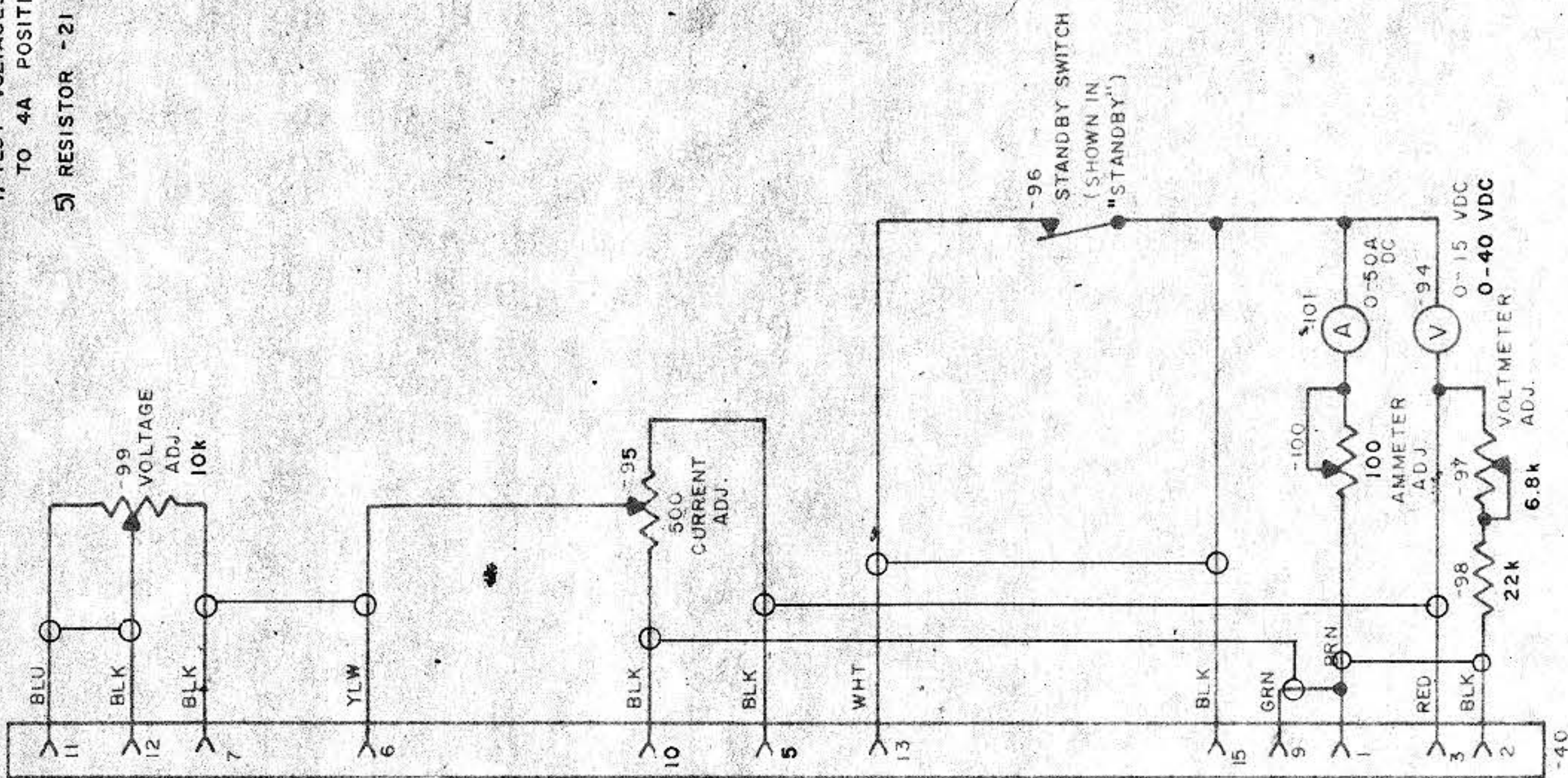
Ratelco shall provide no material, labor or other remedy for any breach of warranty hereunder with respect to any product for which Ratelco has not received full payment.

810-1086.1
(Replaces 810-186.1)
EFFECTIVE: 10-1-86

Ratelco Inc.
POWER SYSTEMS DIVISION
1260 Mercer St.
Seattle, WA 98109-5500

4) TEST VOLTAGES ARE MEASURED WITH RESPECT TO TO 4A POSITIVE OUTPUT JACK.

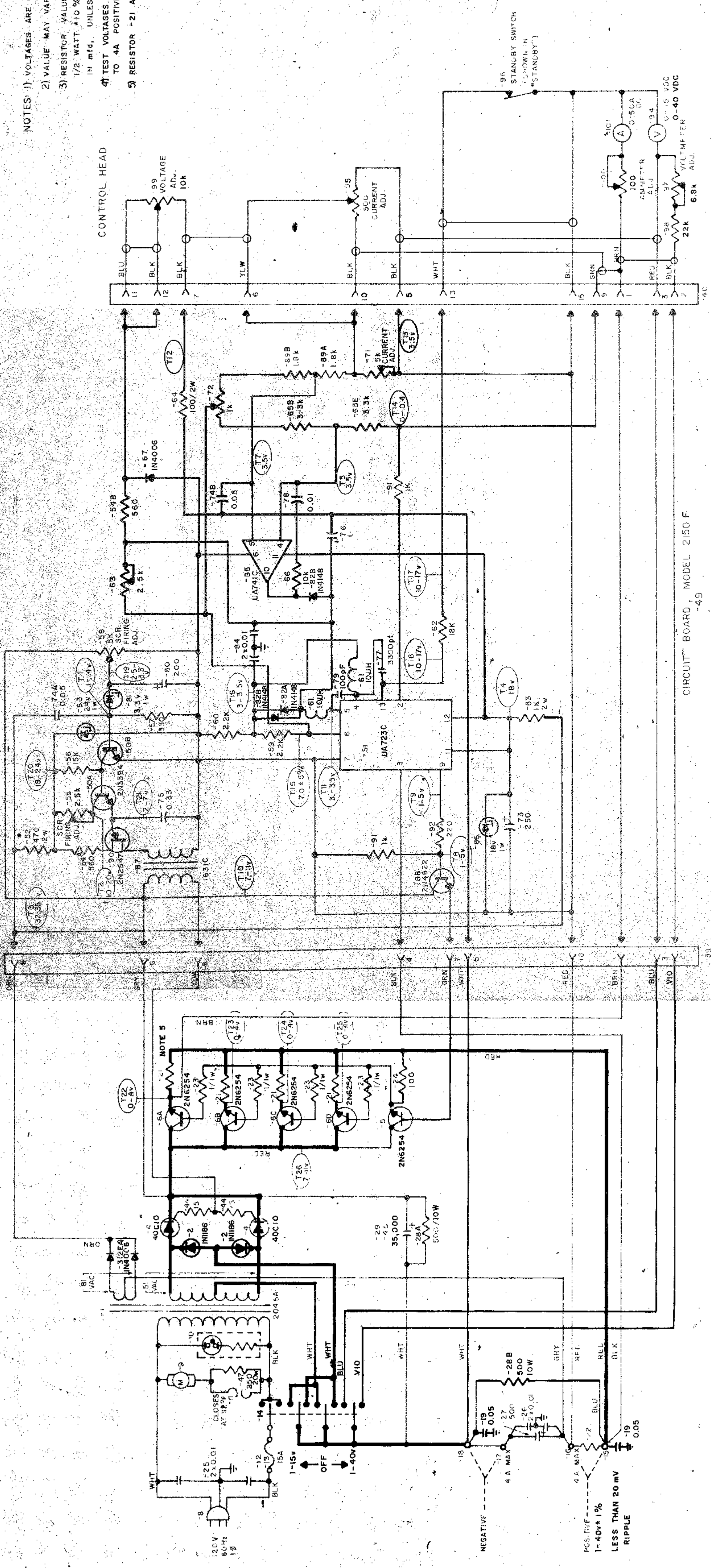
5) RESISTOR -21 ARE TWO RESISTORS IN PARALLEL.



Pateco

- NOTES: 1) VOLTAGES ARE GIVEN IN VDC $\pm 10\%$ UNLESS NOTED
 2) VALUE MAY VARY
 3) RESISTOR VALUES ARE GIVEN IN OHMS AND ARE 1/2 WATT $\pm 10\%$, CAPACITOR VALUES ARE GIVEN IN mfd, UNLESS NOTED
 4) TEST VOLTAGES ARE MEASURED WITH RESPECT TO TO 4A POSITIVE OUTPUT JACK.
 5) RESISTOR -21 ARE TWO RESISTORS IN PARALLEL.

CONTROL HEAD



CIRCUIT BOARD, MODEL 2150 F

PART NO.	2046B	NAME	DC POWER SUPPLY
SHEET	7	TYPE	PS-8
DATE	10-7-70	DRAWN	CHECKED
BY		SCALE	NONE
REV		DATE	

610 PONTIUS AVE. NO. SEATTLE, WASH. 98109