STANDARD POWER SUPPLY
MODEL TPN1191A

MOTOROLA INC.
Communications
Sector

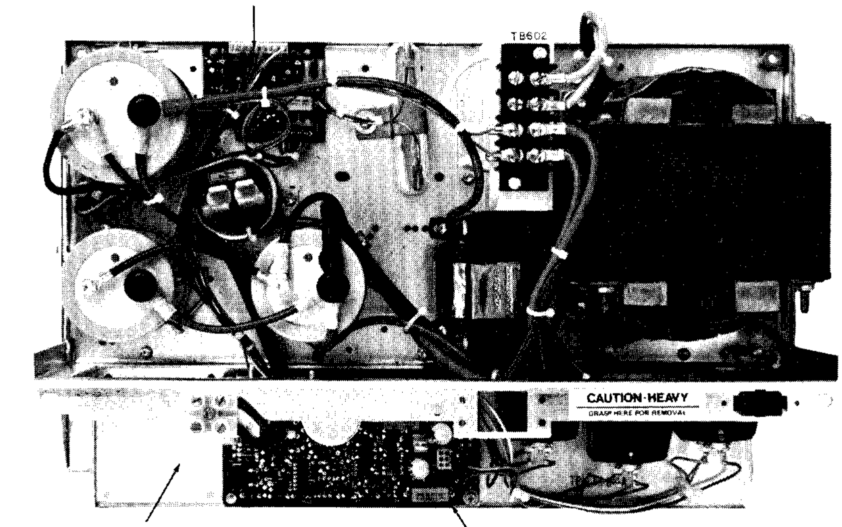


Figure 1. Model TPN1191A Standard Power Supply

1. DESCRIPTION
(Refer to Figure 1)

1.1 Model TPN1191A Standard Power Supply is a high efficiency, solid state, power source for operation of base and repeater radio stations. The power supply consists of three main sections: transformer/rectifier/filter, distribution board, and auxiliary regulator board. Refer to Table 1 for the power supply model complement.

1.2 The transformer has a primary winding, a high current secondary winding, and a resonant secondary winding. Under normal operations, the current in the resonant winding causes the transformer core to saturate, limiting the transformer output voltage. Rectifying and filtering the transformer output produces a stable direct current output.

1.3 The distribution board consists of four power supply fuses and circuitry for overvoltage protection. Transistorized circuitry senses a high dc voltage and adds loading for voltage reduction.

1.4 The auxiliary regulator board consists of two current limited linear series pass regulators. These regulators are set for 9.4 V and 13.9 V. The 9.4 V regulator draws power from the main ferroresonant supply output. The 13.9 V regulator draws full-wave rectified power directly from the ferroresonant transformer.

1.5 The features of this power supply include short circuit protection which is inherent in the ferroresonant power transformer, and overvoltage protection. Refer to Table 2 for performance specifications.

Table 1. Model Complement for TPN1191A Standard Power Supply

Kit	Sub-Kit	Description
TPN1189A		Auxiliary Regulator Chassis
	TRN5119A	Auxiliary Regulator Circuit Board
	TRN5297A	Hardware Kit
	TRN5299A	Chassis Kit
TPN6138B		Distribution Circuit Board
TRN5335A		Hardware, Interconnect
TRN5336A		Hardware, 500 W
TRN5452A		Hardware, Miscellaneous

2. THEORY OF OPERATION

2.1 TRN5336A STANDARD POWER SUPPLY

The TRN5336A Power Supply performs the conversion of ac line voltage to the dc voltages required by the radio. The supply consists of rectification, filtering, and regulation.

2.1.1 Rectification and Filtering

The secondary voltage of transformer T601 is rectified by CR601 and CR602. Ground connection for the diodes is provided through the heat sink to chassis. Output filtering is provided by the network of C602, C603, L601, and C604.

2.1.2 Regulation

Line and load regulation is provided by the ferroresonant action in the secondary resonant winding of the power transformer T601. The high voltage winding resonates with C601, causing the secondary to saturate and restrict the secondary output voltage.

2.2 TPN6138B DISTRIBUTION BOARD

The TPN6138B Distribution Board provides overcurrent and overvoltage protection for the power supply. Refer to the functional and schematic diagrams for circuit details. Secondary voltage fusing is provided by F602 thru F605. Overvoltage protection is provided by a surge protection circuit consisting of Q601 thru Q604. A surge in excess of 18 V causes VR601 to conduct. Forward bias current through R602 and base-emitter junction of Q604, turns on Q604. The other transistors turn on, and the chassis mounted R601 acts as a pull-down load for the line voltage surge.

Table 2. Performance Specifications

Operating Temperature	-30° to +80°C
Input Voltage	96-132 V; 60 Hz
Line Current*	8A max. at full rated power supply output

HIGH CURRENT OUTPUT

Steady State Output Voltage	13.1 to 16.3 V dc (36A to 2A)
Output Current	30.4A at 14.1 V
Load Transient	Shall not drop below 11.5 V for a 2A to 36A transient
Output Ripple	50 mV p-p 25°C to +80°C Derate to 100 mV p-p at -30°C

9.4 V OUTPUT

Output Voltage	9.4 V dc set nominal (9.1-9.7 adjustable)
Output Ripple	Less than 10 mV rms when installed in station
Line Regulation	Shall not change more than 50 mV over input range
Load Regulation	Shall not change more than 150 mV from no load to full load
Max. Output Current	1.1A at +80°C
Current Limit	2.3A typ at 25°C
Short Circuit Current	0.77 max @25°C

14 V OUTPUT

Output Voltage	13.9 set nominal (13.5-14.1 adjustable)
Output Ripple	Less than 10 mVrms when installed in station
Line Regulation	Shall not change more than 25 mV over input voltage
Load Regulation	Shall not change more than 175 mV from no load to full load
Max. Output Current	1.16A at +80°C
Current Limit	2.3A typ at 25°C
Short Circuit Current	0.77A max. @25°C

* When calculating primary power requirements do not use Line Current to calculate dissipated power. Use a power meter with provisions for nonunity Power Factor.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

2.3 TRN5119A AUXILIARY REGULATOR BOARD

The TRN5119A Auxiliary Regulator Board provides regulated 9.4 V and 14 V for the radio. The board circuitry consists of a reference voltage, 9.4 V and 14 V regulators, temperature compensated overcurrent amplifier, and a local control inhibit inverter.

2.3.1 Reference Voltage

The operational amplifiers on the circuit board requires a stable reference voltage. This reference voltage is produced in two stages of circuitry. The first stage consists of VR4 and R40 which are connected to J1-1 and main 13.8 V. Diode VR4 regulates at 9.6 V. The second stage which operates from this 9.6 V is temperature compensated and consists of VR1, CR2, and R39. The resultant 6.5 V reference is feed to each of the operational amplifiers.

2.3.2 9.4 V Regulator

2.3.2.1 The 9.4 V regulator is a series pass type circuit using a PNP transistor (Q6). A PNP type transistor can provide voltage regulation with as little as 0.7 V differential between collector and emitter. This means that the input voltage can go as low as 10.4 V, and the circuitry will still maintain voltage regulation. The voltage regulator circuitry provides output voltage adjustment, correction for changes of input voltage and load and overcurrent protection.

2.3.2.2 The 9.4 V regulator output voltage (J5-6) is set by the 9.4 V VOLTAGE ADJUST potentiometer, R35. The voltage from R35 goes to U1A-2 and is compared to U1A-3, the reference voltage input. The differential voltage appears at U1A-1. For example, if U1A-2 becomes less positive, the output at U1A-1 becomes more positive, causing Q7 to conduct harder. Increased collector current at Q7 causes increased baseemitter current at Q6. As a result, Q6 conducts harder, with a resultant higher (more positive) regulated output voltage at J5-6.

2.3.2.3 The circuitry described in the previous paragraph is a negative feedback loop. It maintains a constant output voltage for changes in load or input voltage. The feedback loop has typically 40 dB of gain at dc to give a load/line regulation of ±0.1 V dc maximum from no load to full load. As an example, for an increase in load current, the regulator output voltage would normally decrease. The reduced output voltage is sensed at U1A-2, which is now less positive than U1A-3, the reference voltage. U1A-1 goes more positive and drives Q7 into further conduction. An increase in collector current of Q7 causes increased conduction of Q6 which returns the regulated output voltage to normal. A decrease in load current causes the opposite action.

2.3.2.4 The overcurrent protection circuitry is of the current foldback type. As the load increases beyond the knee, the output voltage and current decrease simultaneously to a final short circuit current of 0.77 amp maximum. The current is sensed across R20. When this voltage exceeds about 0.3 volts (representing a load current of about 2.3 amps), Q8 is forward biased and starts to conduct. Its collector goes positive, causing Q9 to conduct thru R23 and R25. Q9 conducting lowers the voltage at R28 (VREF). As the voltage on U1A-3 lowers, it causes the voltage on U1A-1 to go lower, forcing Q7 and Q6 to conduct less. As a result, the output voltage (9.4 V regulated) decreases. As output current increases, Q8 and Q9 conduct harder resulting in higher Q6 impedance. This action continues until the output voltage decreases to about 6.5 V. At this point, CR10 becomes forward biased, and the emitter current of Q10 increases. This results in an increased voltage across R21. This will forward bias Q8 harder. As a result less output current can be drawn under a short circuit condition. This is desirable because the power dissipated in Q6 is now reduced.

2.3.3 14 V Regulator

2.3.3.1 The 14 V regulator is a series pass type circuit using PNP transistors (Q1 and Q11). A PNP type transistor can provide voltage regulation with as little as 0.7 V differential between collector and emitter. This means that the input voltage can go as low as 14.7 V, and the circuitry will still maintain voltage regulation. The voltage regulator circuitry provides output voltage adjustment, correction for changes of input voltage and load current, and overcurrent protection.

2.3.3.2 The input filter circuitry provides power to the 14 V regulator. CR1 and CR15 rectify ac to dc (26-34 V). Resistors R47 and R48 limit the surge and reduce the ripple current filter capacitor C1.

2.3.3.3 The 14 V regulated (J5-2) is set by the 14 V VOLTAGE ADJUST potentiometer, R7. The voltage from R7 goes to U1C-9 and is compared to U1C-10, the reference voltage input. The differential voltage appears at U1C-8. For example, if U1C-9 becomes less positive, the output at U1C-8 becomes more positive, causing Q2 to conduct harder. Increased collector current at Q2 causes increased base-emitter current at Q1 and Q11. As a result Q1 and Q11 conduct harder, with a resultant higher (more positive) regulated output voltage at J5-2.

2.3.3.4 The circuitry described in the previous paragraph is a negative feedback loop. It maintains a constant output voltage for changes in load or input voltages. The feedback loop has typically 40 dB of gain at dc to give a load/line regulation of ±0.1 V dc maximum from no load to full load. As an example, for an increase in load current, the regulator output voltage would normally decrease. The reduced output voltage is sensed at U1C-9, which is now less positive than U1C-10, the reference voltage input. U1C-8 goes more positive and drives Q2 into further conduction. An increase in collector current of Q2 causes increased conduction of Q1 and Q11. The regulator output returns to normal. A decrease in load current causes the opposite action.

2.3.3.5 The overcurrent protection circuitry is of the current foldback type. As the load increases beyond the knee, the output voltage and current decrease simultaneously to a final short circuit current of 0.77 ampere maximum. The current is sensed across R10. When this voltage exceeds about 0.3 volts (representing a load current of about 2.3 amperes), Q3 is forward biased and starts to conduct. Its collector goes positive, causing Q4 to conduct through R13 and R14. Q4 conducting lowers the voltage at R9 (V REF). As the voltage on U1C-10 lowers, it causes the voltage on U1C-8 to go lower forcing Q2, Q1, and Q11 to conduct less. As a result, the output voltage (14 V regulated) decreases. As output current increases, Q3 and Q4 conduct harder, resulting in higher Q1 and Q11 impedance. This action continues until the output voltage decreases to about 6.5 V. At this point, CR5 becomes forward biased, and the emitter current of Q5 increases. This results in an increased voltage across R11. This will forward bias Q3 harder. As a result less output current can be drawn under a short circuit condition. This is desirable because the power dissipated in Q1 and Q11 is now reduced.

2.3.4 Temperature Compensated Overcurrent Amplifier

The temperature compensated overcurrent amplifier (U1D) compensates the knee of the 9.4 V and 14 V overcurrent detect circuits (Q3 and Q8). Compensation allows operation from -30°C to +80°C without major degradation in available output current. Compensation begins at diodes CR13 and CR14. These diodes are temperature sensitive, having a voltage decrease of about 2 mV from an increase of each degree centigrade. A temperature increase makes U1D-14 less positive. Both Q5 and Q10 reduce collector current with a reduction in voltage drop across R11 and R21. The reduced bias voltage developed across these resistors counteracts the effects of high ambient temperatures on Q3 and Q8.

2.3.5 Local Control Inhibit Inverter

The local control inhibit inverter (U1B) is used to turn off the 9.4 V and 14 V voltage regulators externally for local control operation. When used, jumper JU2 is removed, and J5-5 is connected to ground through the normally closed contacts of a switch. Opening the switch contacts causes U1B-7 to go high. Both Q4 and Q9 are driven into saturation. U1C-8 and U1A-1 are pulled low which cuts off Q6, Q1, and Q11.

3. REGULATED OUTPUT VOLTAGE ADJUSTMENT PROCEDURE

The regulated output voltages can be adjusted with the auxiliary regulator board in the radio or on the service bench. If adjusted on the test bench, the regulator must be supplied 14 V at J1-1 and +28 V at J1-6 or J1-7. The outputs must be loaded to 1.1 ampere each.

Step 1. Measure the regulated output voltages at TP101 (9.4 V) and TP111 (14 V).

Step 2. Set R35 for 9.4 V ±0.1 V.

Step 3. Set R7 for 13.9 V ±0.1 V.

4. MAINTENANCE

4.1 INTRODUCTION

Maintenance and repairs of this power supply demands a thorough understanding of its operation. Refer to the Power Supply Theory of Operation for this information.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is necessary for efficient, accurate servicing in the event that maintenance is required.

- 3-1/2 digit DVM (Motorola Model R1001A or equivalent).
- DC current meter (50 amperes)
- Load resistor (variable from 0 ohms to 15 ohms, and capable of carrying 50 amperes).
- Variable voltage ac line transformer (0-130 volts).
- Oscilloscope.
- Bench service cord consisting of:

Qty.	Part No.	Description
1	15-83183N01	Housing
2	39-83145N01	Contact
1	39-83145N02	Contact
1	30-865903	Cord

4.3 AUXILIARY REGULATOR CHASSIS REMOVAL
(Refer to Figure 2)

The circuitry on the auxiliary regulator chassis can be serviced without removing the entire power supply. The auxiliary chassis below the main chassis can be disconnected and removed separately.

Step 1. Disconnect P1 and P5.

Step 2. Remove the three screws holding the auxiliary chassis to the main chassis. Use a magnetic screwdriver.

Step 3. Lift the auxiliary regulator chassis out of the cabinet.

Step 4. Remove circuit board(s) by compressing the plastic locking tabs.

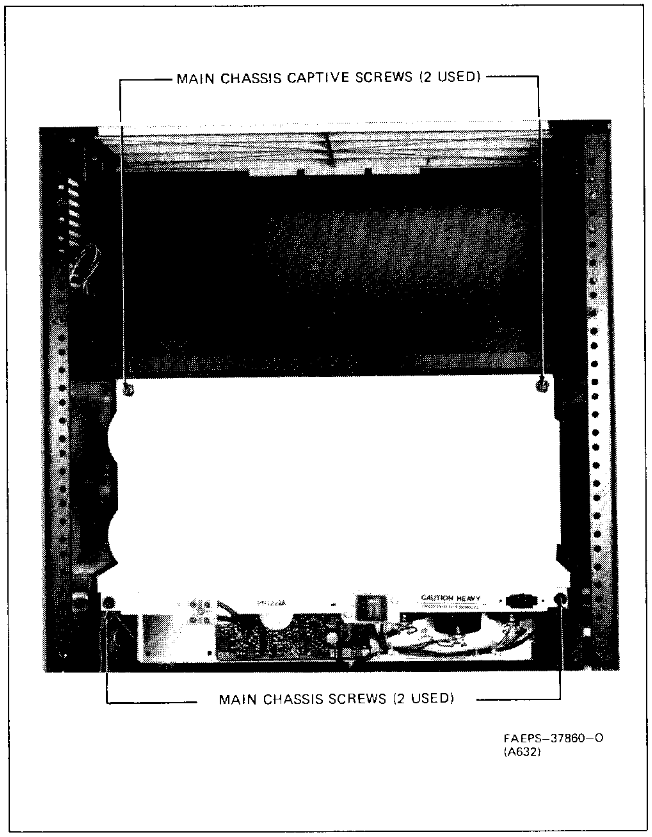


Figure 2. Power Supply Mounting Hardware

4.4 POWER SUPPLY REMOVAL

(Refer to Figures 2 thru 5)

WARNING
The power supply is unexpectedly heavy, and balances sharply to the right. Follow the removal instructions carefully.

Step 1. Disconnect P5 and P103 (for battery power supply). Open tie wraps and reposition cable.

Step 2. Remove MAIN CHASSIS SCREWS and loosen MAIN CHASSIS CAPTIVE SCREWS. Remove the two shipping screws (Motorola Part No. 3-83498N08) and washers (Motorola Part No. 4-135873) located under the main chassis side rails. These screws need not be replaced when re-installing the power supply unless the station is to be shipped to another location. Retain the screws for further shipping needs.

Step 3. Slide power supply chassis toward you until chassis is flush with cabinet as shown in Figure 3.

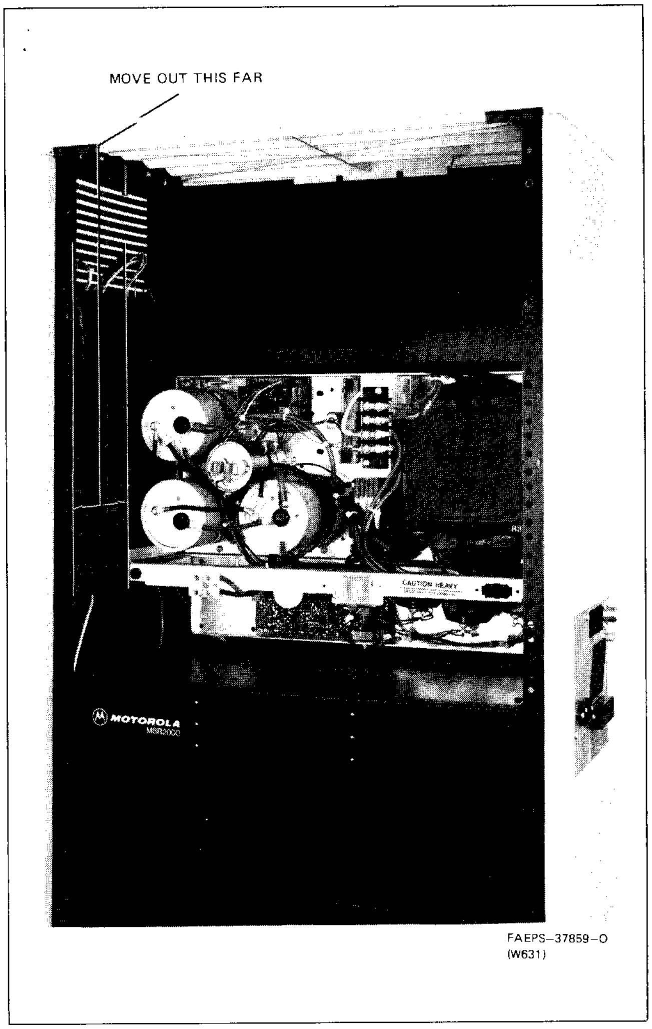


Figure 3. Power Supply Chassis Travel Distance

WARNING
Do not allow chassis to slide freely beyond front of cabinet: Cabinet rail support ends abruptly.

Step 4. Grip the main chassis with the right hand as shown in Figure 4. Find a comfortable grip around the flattened parts of the metal. Adjacent parts have sharp edges.

Step 5. Plant your feet firmly with good balance to receive a heavy weight.

Step 6. Slide the power supply toward you. Slightly tilt the chassis toward you and reach the left hand over the top to balance the chassis on the cabinet rails. Press the chassis firmly against the rails or the chassis will suddenly slide out of the cabinet. See Figure 5.

Figure 4. Properly Gripped Chassis

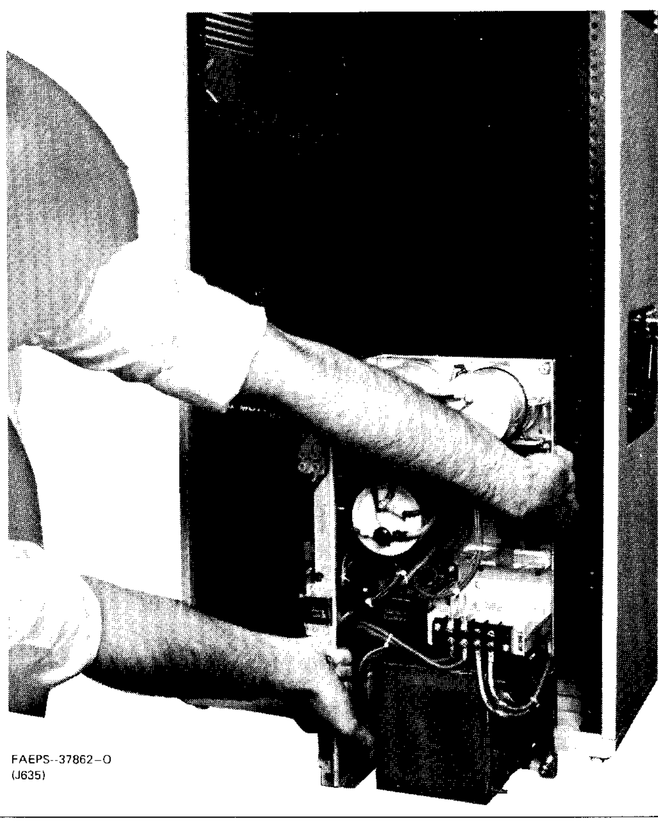


Figure 5. Power Supply Removed From Cabinet

Step 7. Reposition the left hand from balancing the chassis to a firm grip.

Step 8. Brace your body to receive a heavy weight, and lift the power supply chassis free of the cabinet.

Table 3. Troubleshooting Chart

Symptom	Corrective Action
A. No output voltage	1) Check primary line connection to supply. 2) Check transformer secondary voltage at TB601. 3) Check power rectifiers CR601 and CR602.
B. No regulated output voltages	1) Check for approximately 14 volts at J1-1. If no voltage, check fuse F603. 2) Check for approximately 6.5 volts at TP105, 6.5 V REF. If no voltage, check CR2 and VR1. 3) Check for grounded CR4 and CR8, REGULATOR INHIBIT lead. 4) Check for defective U1B. 5) Check for defective U1D.
C. 9.4 V regulated output: OK. No 14 V regulated output.	1) Check fuses F605 and F604. 2) Check Q3 and Q4. TP105 should be 6.5 volts. 3) Check U1C. 4) Check Q2 for open circuit. 5) Check Q1 and Q11 for open circuit. 6) Check VR2 for short. 7) Check for short circuit at J5-2.
D. 14 V regulated output: OK. No 9.4 V regulated output	1) Check Q8 and Q9. TP104 should be 6.5 volts. 2) Check U1A. 3) Check Q7 for open circuit. 4) Check Q6 for open circuit. 5) Check VR3 for short circuit. 6) Check for short circuit at J5-6.
E. Regulators cannot supply full rated current of 1.1A (output drops more than 1 volt.)	1) Check U1D, Q3, Q4, Q8 and Q9.
F. Regulators short circuit current greater than 0.8A, and possibly input fuse blowing.	1) Overcurrent detect circuits defective. Check U1D, Q3, Q4, Q8 and Q9. 2) Check CR5 and CR10.
G. Regulated output voltages cannot be adjusted to 9.4 ±0.1 V and 13.9 ± 0.1 V.	1) Check 6.5 V REF. It should be 6.5 ±0.2 volts. If not, check CR2, VR1, and VR4. 2) Check regulator feedback loop: U1A, Q7, and Q6; U1C, Q2, Q1 and Q11. 3) Check for high leakage Q2 and Q7.
H. High ac ripple voltage on 14 V regulated output: greater than 10 mV at 1.5A.	1) Check filter capacitor C1 for low capacity or leakage. Ripple voltage at TP100 is greater than 4 V peak-to-peak. 2) Check U1C for low loop gain: less than 20 dB.

parts list

TRN5299A Chassis PL-8013-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
Q1,6,11	48-869672	PNP; type M9672
		connector:
P3	15-83498F39	HOUSING, 3 position (WHT)
P4	15-83498F40	HOUSING, 3 position (RED)
P7	15-83498F39	HOUSING, 3 position (WHT)
		mechanical parts
	3-136143	SCREW, tapping: 8-32 x 1/4"; 6 used
	43-83561N01	STANDOFF, twist lock; 2 used
	3-136850	SCREW, tapping: 6-32 x 1/2"; 6 used
	9-82973A01	SOCKET, transistor; 3 used
	14-865854	INSULATOR; 3 used
	26-82979N01	HEAT SINK; 3 used
	29-83499F01	TERMINAL; 9 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN5297A Hardware Kit
TRN5298A Hardware Kit PL-8014-O

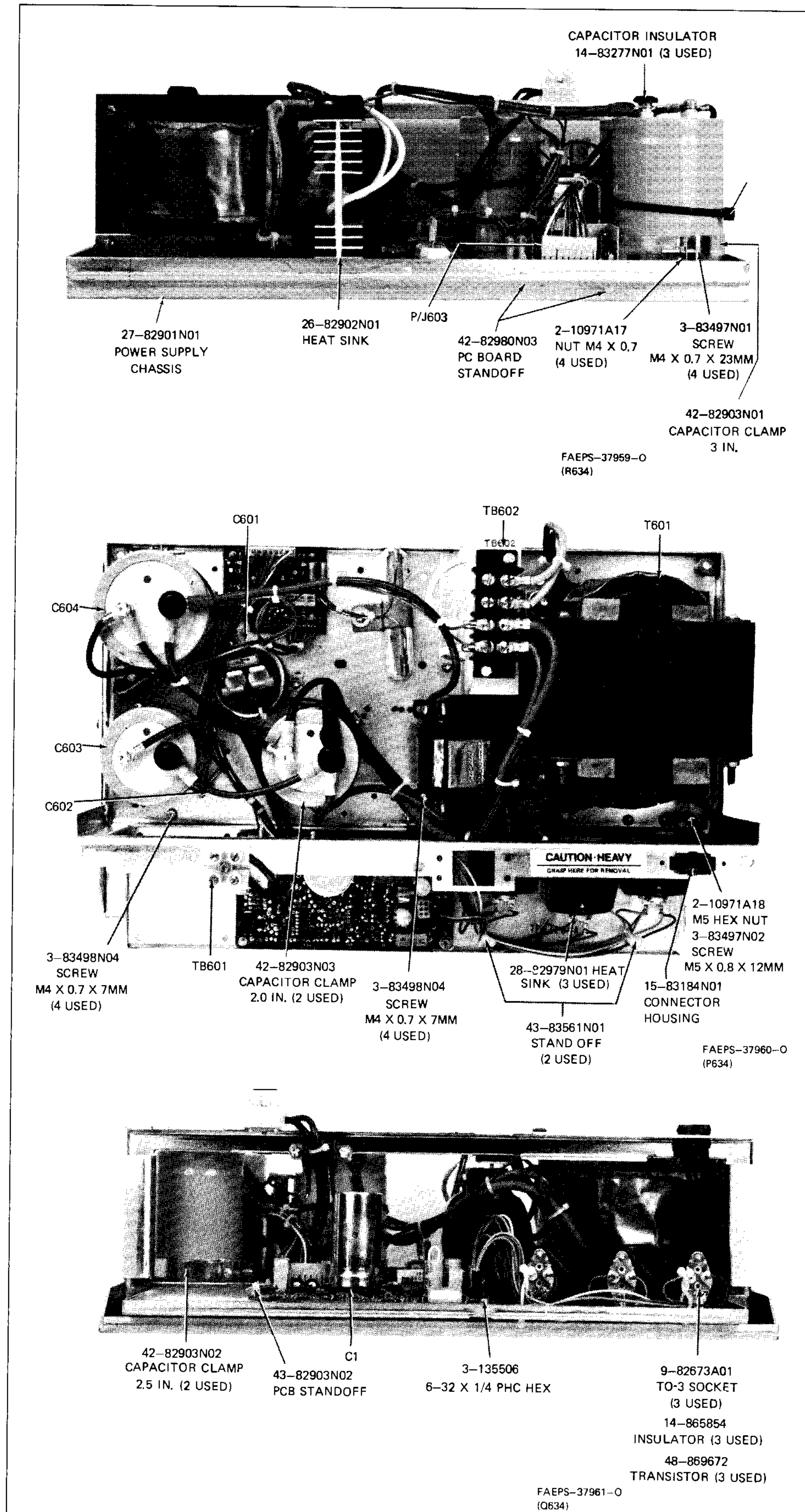
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P6,101	15-83498F38	HOUSING, 2 position
		mechanical parts
	3-134185	SCREW, tapping: 6-32 x 1/4"
	43-82980N01	STANDOFF; 3 used TRN5297A; 5 used TRN5298A
	43-82980N02	STANDOFF, spacer; 2 used TRN5298A
	43-83561N01	STANDOFF, twist lock; 2 used
	1-80754D87	Assembly Wire and Lug includes: (p/o TRN5297A)
	29-83499F01	TERMINAL; 2 used
	1-80754D97	Assembly Wire and Lug includes: (p/o TRN5298A)
	29-83499F01	TERMINAL; 2 used
	1-80754D98	Assembly Wire and Lug includes: (p/o TRN5298A)
	29-83499F01	TERMINAL; 2 used
	42-10217A02	STRAP, ties

TRN5335A Interconnect Hardware Kit PL-8015-D

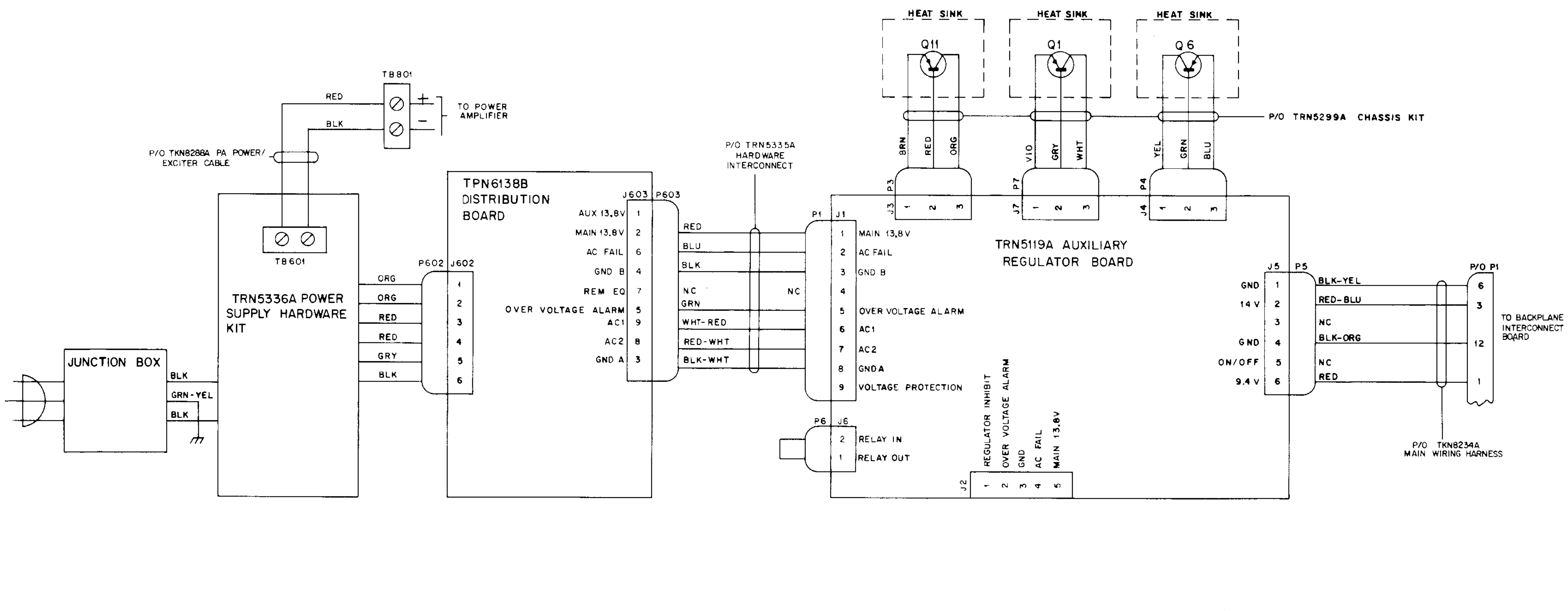
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P1,603	15-83498F45	HOUSING, 9 position
		resistor, fixed: ± 5%; 50 W: unless otherwise stated
R610	17-83389G03	10
		mechanical parts
	1-80762D67	RESISTOR, assembly
	3-10943M25	SCREW, tapping; M4 x 7 x 20mm; 2 used
	3-83498N04	SCREW, tapping: M4 x.7 x 7mm; 3 used
	42-10217A02	STRAP, tie; 2 used
	29-83499F01	TERMINAL; 14 used
	29-83113N01	TERMINAL, right angle
	29-83113N03	TERMINAL, right angle
	46-84549F01	PLUG, polarizing; 2 used
	4-7651	WASHER, lock, #8
	29-82907N07	TERMINAL, ring

TRN5452A Miscellaneous Power Supply Hardware Kit PL-8269-B

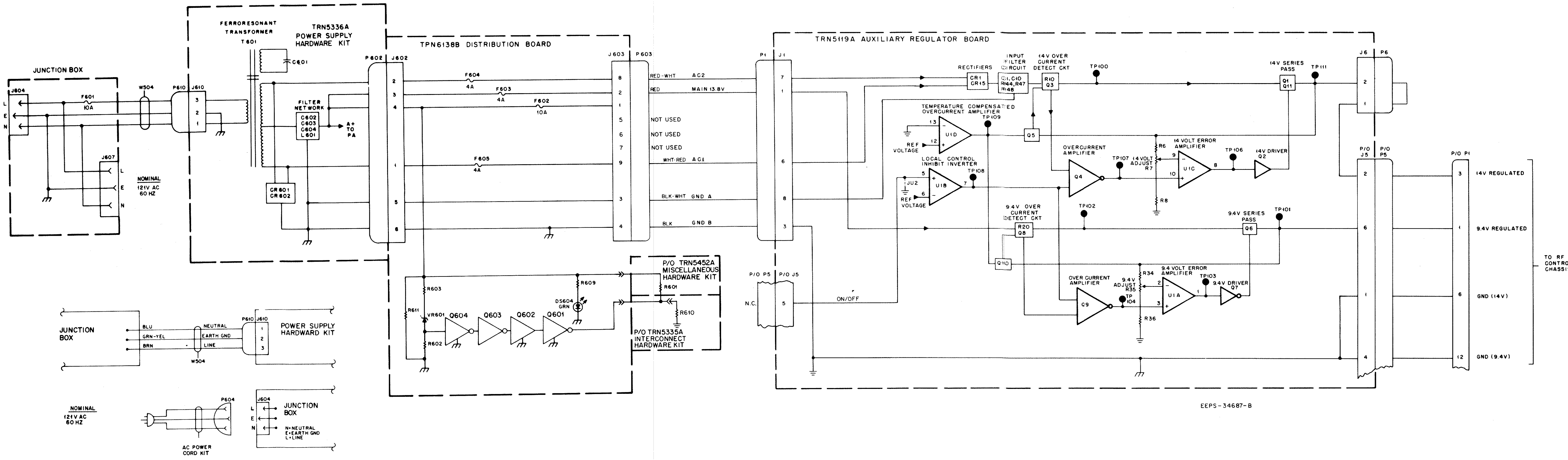
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor, fixed:
R601	17-82177B65	10 ± 10%; 50 W
		non-referenced items
	1-80766D10	ASSEMBLY, resistor cable; includes:
	29-83113N01	TERMINAL, right angle; 4 used
	2-10971A17	NUT, hex; M4 × 0.7mm
	3-83497N05	SCREW, machine; M4 × 10mm
	4-7633	WASHER, flat
	4-7651	LOCKWASHER, internal; #8
	43-82980N03	STANDOFF, support; 4 used



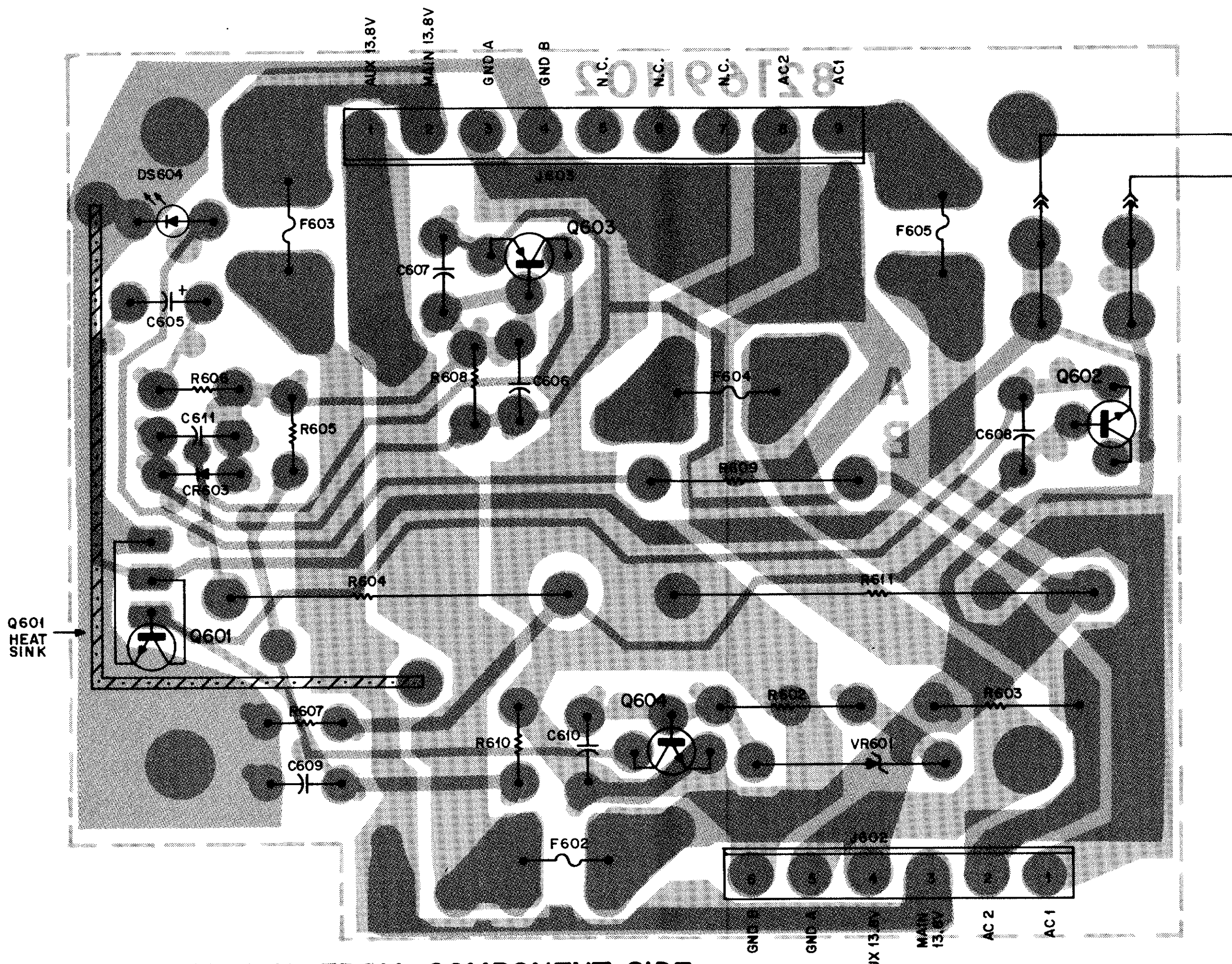
CABLE INTERCONNECT WIRING DIAGRAM



STANDARD POWER SUPPLY FUNCTIONAL BLOCK DIAGRAM
MODEL TPN1191A



STANDARD POWER SUPPLY
MODEL TPN1191A



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE BD-CEPS-35439-0
SOLDER SIDE BD-CEPS-35440-0
OL-CEPS-35441-0

TRANSISTOR BASE DETAILS

Q602, Q603, Q604 | Q601
SHOWN FROM LEAD END

parts list

TPN6138B Power Supply Distribution Board PL-8265-B

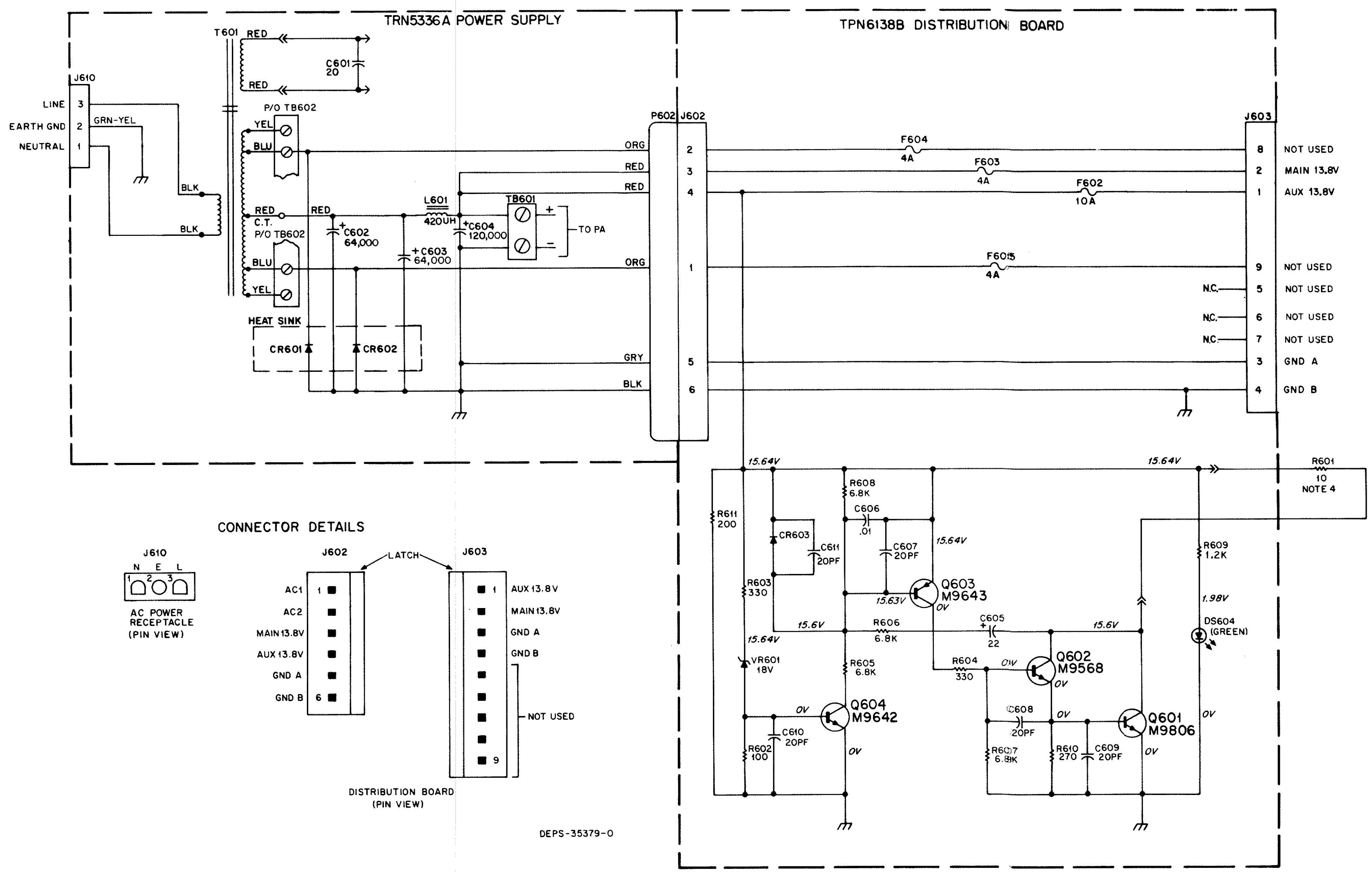
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C605	23-11019A27	22 uF ±20%; 25 V
C606	8-11017B08	.01 uF ±10%; 50 V
C607 thru 611	21-11014H32	20 pF ±5%; 100 V
		diode: (see note)
CR603	48-11034D01	silicon
		light emitting diode:
DS604	48-84404E04	green
		fuse:
F602	65-139767	10 amp; 32 V
F603, 604, 605	65-82859N01	4 amp; 32 V
		connector, plug:
J602	28-82984N06	male; 6 contact
J603	28-82984N14	male; 9 contact
		transistor: (see note)
Q601	48-869806	NPN; type M9806
Q602	48-869568	NPN; type M9568
Q603	48-869643	PNP; type M9643
Q604	48-869642	NPN; type M9642
		resistor, fixed ±5%: 1/4 W: unless otherwise stated
R602	6-11009E25	100
R603	6-11009E37	330
R604	6-127A37	330; 2 W
R605 thru 608	6-11009E69	6.8k
R609	6-125C51	1.2k, ±10%; 1/2 W
R610	6-11009E35	270
R611	17-82177B08	200; ±10%, 5 W
		voltage regulator:
VR601	48-83461E18	Zener; 18 V
	mechanical parts	
	29-82906N01	TERMINAL, fuse; 8 used
	2-10971A16	NUT, machine: M3 x 0.5mm
	3-83497N04	SCREW, machine; M3 × 0.5 × 8mm
	4-84180C01	WASHER, shoulder
	14-83820M02	INSULATOR, thermoconductive
	29-10231A10	LUG, terminal; 2 used
	26-84012N01	SHIELD, amplifier
	15-84576N01	HOUSING, fuse clip; 4 used

TRN5336A Power Supply Hardware Kit (500 W) PL-8020-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C601	8-82682N01	20 uF ±6%; 330 V
C602,603	23-82681N01	64,000 uF +75-7%; 20 V
C604	23-82681N02	120,000 uF +75-10%; 20 V
		diode: (see note)
CR601,602	48-82732C09	silicon
		connector, receptacle:
P602	9-83360N01	female; 6 contact
		coil:
L601	25-82686N01	choke; 420 uH
		transformer:
T601	25-82253N01	power: 500 W; 60 Hz
		terminal, board:
TB601	31-83576K02	2-terminals
	mechanical parts	
	2-10971A17	NUT, machine: M4 x 0.7 hex; 4 used
	2-10971A18	NUT, machine: M5 x 0.8 hex; 2 used
	3-10907A55	SCREW, machine: M6 x 1 x 25mm; 4 used
	3-83497N01	SCREW, machine: M4 x 0.7 x 25mm; 4 used
	3-83497N02	SCREW, terminal; M5 x 0.8 x 12mm; 8 used
	3-83498N04	SCREW, tapping: M4 x 0.7 x 7mm; 18 used
	3-83498N06	SCREW, tapping: M4 x 0.7 x 16mm; 3 used
	3-83678N02	SCREW, tapping; M3 x 0.5 x 5mm
	4-7651	LOCKWASHER, #8 internal; 12 used
	4-83499N01	WASHER, insulator; 3 used
	4-7658	LOCKWASHER, #10 internal; 25 used
	5-82904N01	GROMMET; 4 used
	14-83277N01	INSULATOR, lug; 3 used
	14-84088N01	INSULATOR, cap terminals; 2 used
	14-84548A01	INSULATOR, washer; 2 used
	26-82902N01	HEAT SINK
	29-82607B09	LUG, ring tongue; 2 used
	29-82607B05	LUG, ring tongue; 4 used
	29-82907N05	TERMINAL, ring (YEL) 6 used
	29-82907N07	TERMINAL, ring; (RED) 2 used
	29-83113N01	TERMINAL, right angle; 6 used
	29-83137N01	TERMINAL, splice; 2 used
	39-83146N01	CONTACT, socket
	42-85238	CLAMP, cable; 2 used
	42-10217A02	STRAP, tie; .091 x 3.62; 16 used
	42-35424B03	STRAP, tie: .094 x 14; 3 used
	42-82903N01	CLAMP, cap; 2"
	42-82903N02	CLAMP, cap: 2 1/2"; 2 used
	42-82903N03	CLAMP, cap; 3"
	29-82907N06	TERMINAL, ring (BLU)
	54-83971N01	LABEL; 2 used
	54-84046N01	LABEL
	75-83056P01	PAD, snap-on
	31-811350	TERMINAL, board; 4 terminal

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN5336A Standard Power Supply Hardware Kit,
and TRN6138B Distribution Board
Schematic Diagram, Circuit Board Details,
and Parts Lists
Motorola No. ***PEPS-34737-D***
(Sheet 1 of 2)
9/30/85-UP



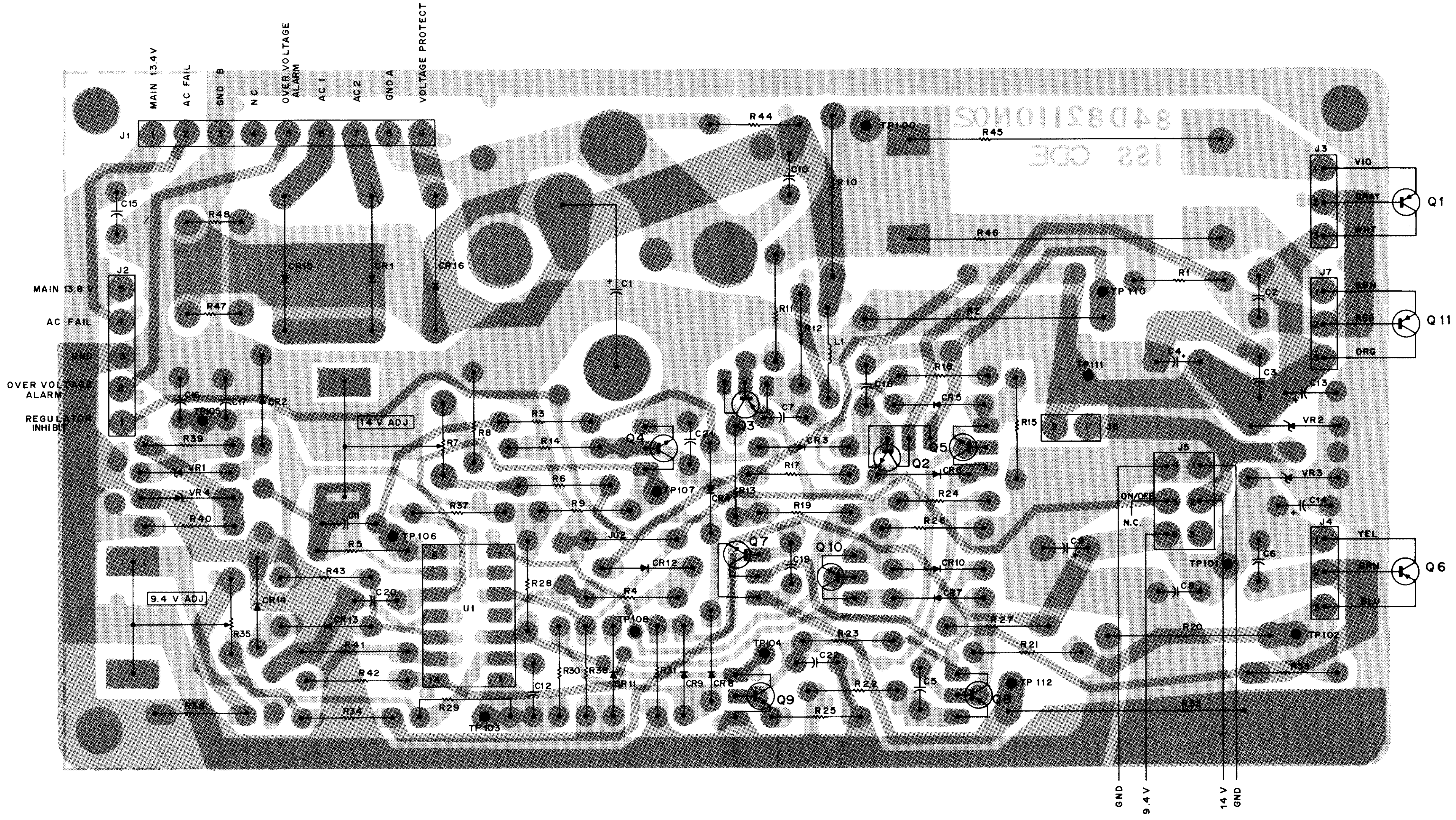
NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.
2. Voltages measured with DVM, with 1 megohm or greater input resistance.
3. Circuit conditions: load current = 2A, @ 120 V AC (line in).
4. R601 is mounted on power supply chassis.

TRN5336A Standard Power Supply Hardware Kit, and TRN6138B Distribution Board Schematic Diagram, Circuit Board Details, and Parts Lists
Motorola No. ***PEPS-34737-D***
(Sheet 2 of 2)
9/30/85- UP

STANDARD POWER SUPPLY

MODEL TPN1191A



SHOWN FROM COMPONENT SIDE

SOLDER SIDE BD DEPS-34349-A
COMPONENT SIDE BD DEPS-34350-A
OL DEPS-34351-A

TRN5119A Auxiliary Regulator Board
Schematic Diagram, Circuit Board Detail,
and Parts List
Motorola No. ***PEPS-38130-A***
(Sheet 1 of 2)
9/30/85-UP

parts list

TRN5119A Auxiliary Regulator Board PL-7945-A

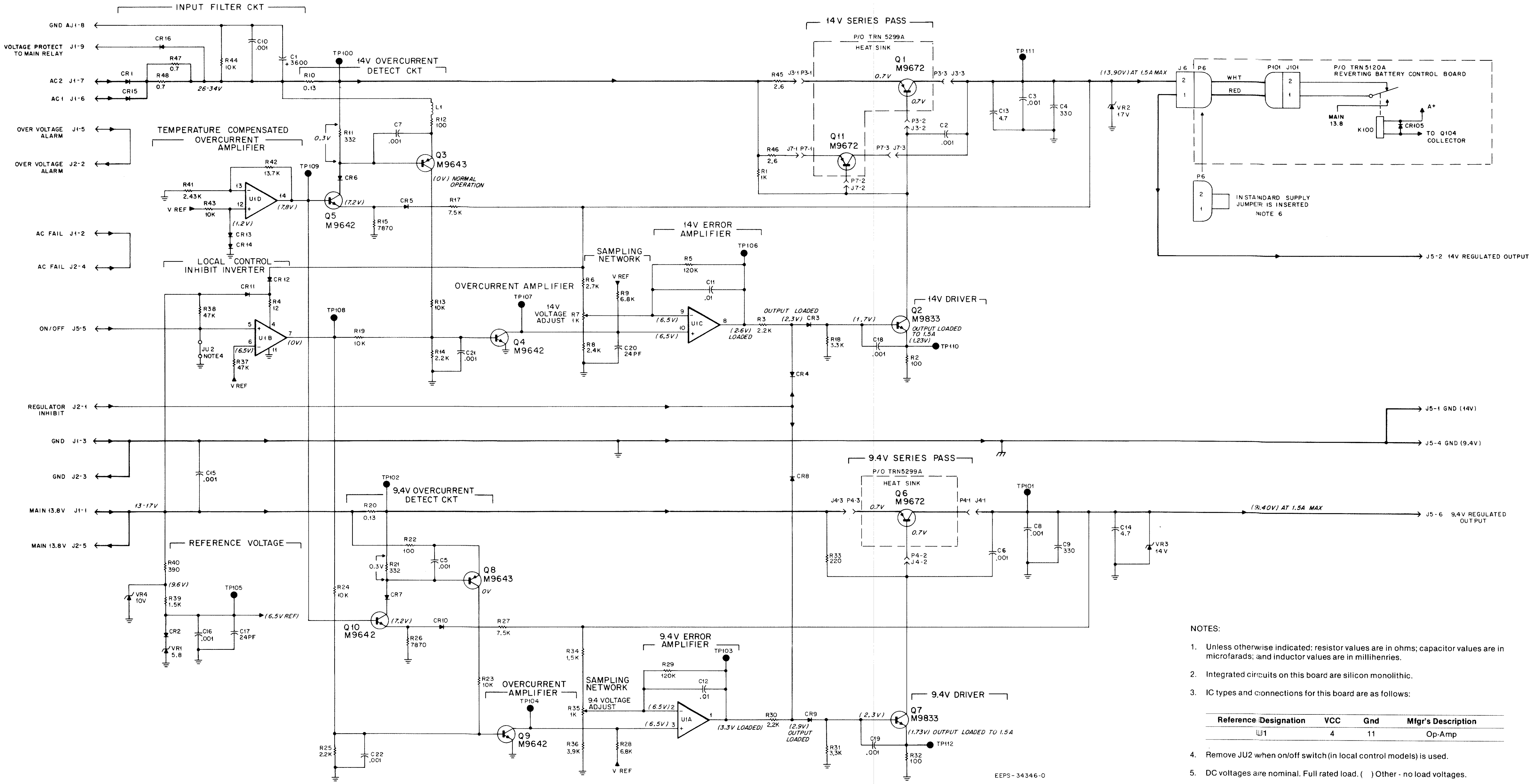
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF:
		unless otherwise stated:
C1	23-82394A19	3600 +150-10%; 40 V
C2, 3	21-11015B13	.001 ±10%; 100 V
C4	23-84665F15	330 +10-50%; 25 V
C5 thru 8	21-11015B13	.001 ±10%; 100 V
C9	23-84665F15	330 +10-50%; 25 V
C10	21-11015B13	.001 ±10%; 100 V
C11, 12	21-82428B21	.01 +10-30%; 100 V
C13, 14	23-84538G02	4.7 ±20%; 20 V
C15, 16	21-11015B13	.001 ±10%; 100 V
C17	21-11022G39	24 pF ±5%; 50 V
C18, 19	21-11015B13	.001 ±10%; 100 V
C20	21-11022G39	24 pF ±5%; 50 V
C21, 22	21-11015B13	.001 ±10%; 100 V
		diode: (see note)
CR1	48-82525G13	silicon
CR2 thru 12	48-83654H01	silicon
CR13, 14	48-82392B18	silicon
CR15	48-82525G13	silicon
CR16	48-82525G19	silicon
		connector, receptacle:
J1	29-82984N12	male; 8-contact
J2	9-83497F08	female, 5-contact
J3	28-82984N02	male; 3-contact
J4	28-82984N03	male; 3-contact
J5	1-80754D88	Assembly connector, consists of:
	15-84953L01	Housing, receptacle; 6-position
	39-82977N01	Contact, receptacle; 6 used
J6	28-82984N01	male; 2-contact
J7	28-82984N02	male; 3-contact
		jumper:
JU2	6-11009B23	"0" ohms
		coil, rf:
L1	24-83961B01	choke
		transistor: (see note)
Q2	48-869633	NPN; type M9833
Q3	48-869643	PNP; type M9643
Q4, 5	48-869642	NPN; ype M9642
Q7	48-869633	NPN; type M9833
Q8	48-869643	PNP; typ M9643
Q9, 10	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W:
		unless otherwise stated
R1	6-11009A49	1k
R2	17-82177B16	100 ±10%; 5 W
R3	6-11009A57	2.2k
R4	6-11009A03	12
R5	6-11009A99	120k
R6	6-11009A59	2.7k
R7	18-83083G14	var. 1k
R8	6-11009A58	2.4k
R9	6-11009A69	6.8k
R10	17-82036G24	0.13; 2 W
R11	6-84444A01	332 ±1%; 1/8 W
R12	6-11009A25	100
R13	6-11009A73	10k
R14	6-11009A57	2.2k
R15	6-10621C81	7.87k ±1%; 1/8 W
R17	6-10621C79	7.5k ±1%; 1/8 W
R18	6-11009A61	3.3k
R19	6-11009A73	10k
R20	17-82036G24	0.13; 2 W
R21	6-84444A01	332 ±1%; 1/8 W
R22	6-11009A25	100
R23, 24	6-11009A73	10k
R25	6-11009A57	2.2k
R26	6-10621C81	7.87k ±1%; 1/8 W
R27	6-10621C79	7.5k ±1%;1/8 W
R28	6-11009A69	6.8k
R29	6-11009A99	120k
R30	6-11009A57	2.2k
R31	6-11009A61	3.3k
R32	17-82177B16	100 ±10%; 5 W
R33	6-11009A33	220
R34	6-11009A53	1.5k
R35	18-83083G14	var. 1k
R36	6-11009A63	3.9k
R37, 38	6-11009A89	47k
R39	6-11009A53	1.5k
R40	6-11009A39	390
R41	6-10621C27	2.43k ±1%
R42	6-10621D05	13.7k ±1%; 1/8 W
R43, 44	6-11009A73	10k
R45, 46	17-82177B64	2.6; 10 W
R47, 48	17-82177B12	0.7 ±10%; 5 W
		integrated circuit: (see note)
U1	51-83629M08	quad op amp

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR1	48-82256C61	Zener, 5.8 V
VR2	48-82256C63	Zener, 17 V
VR3	48-82256C13	Zener, 14 V
VR4	48-82256C11	Zener, 10 V

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

STANDARD POWER SUPPLY

MODEL TPN1191A



NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.
2. Integrated circuits on this board are silicon monolithic.
3. IC types and connections for this board are as follows:

Reference Designation	VCC	Gnd	Mfgr's Description
U1	4	11	Op-Amp

4. Remove JU2 when on/off switch (in local control models) is used.
5. DC voltages are nominal. Full rated load. ( ) Other - no load voltages.
6. For non-battery supply (standard supply) insert connector jumper.

TRN5119A Auxiliary Regulator Board Schematic Diagram, Circuit Board Detail, and Parts List
Motorola No. ***PEPS-38130-A***
(Sheet 2 of 2)
9/30/85-UP

OPTION C28AN
BATTERY CHARGER POWER SUPPLY

MOTOROLA INC.
Communications
Sector

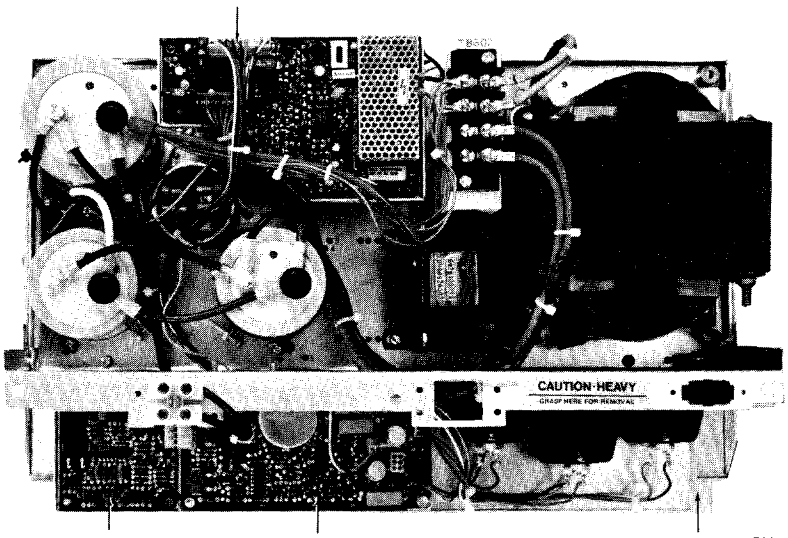


Figure 1. Model TPN1192A Battery Charger Power Supply

1. DESCRIPTION

1.1 A C28AN Battery Charger Power Supply is a factory installed accessory that is available for all models of Motorola base and repeater stations. Refer to Table 1 for the model complement of Option C28AN and a model breakdown of Model TPN1192A Battery Charger Power Supply.

1.2 The C28AN option permits the station to operate from 120 volt, 60 Hz ac power normally, but provides continued operation from 12-volt batteries (emergency power) if the ac power should fail. When ac power is restored, the power supply also operates as a battery charger to recharge the batteries. Refer to Table 2 for performance specifications.

1.3 The C28AN option includes a battery protection and alarm package that is factory installed, to improve emergency power backup by providing an audible alarm whenever the station is operating on batteries. The battery protection and alarm generates an audible alarm tone which "beeps" to indicate that the station is operating on emergency power. This tone burst, with a frequency of about 1400 Hz, is approximately 1/4 second long and repeats at 2-1/2 second intervals. On remote control stations, or repeater stations with wire line control, the alarm tone is injected into the audio line and is heard at the console (except when transmitting). On repeater stations, without wire line control, the tone is transmitted whenever the transmitter is keyed, so that anyone receiving signals from this station will know that it is operating on emergency power.

1.4 There are two ways of using the battery protection and alarm. One way is to shut off the low current regulators when the batteries have discharged to a certain level. This connection would protect the battery from damage due to excessive discharge, it also keeps the station from operating from voltages outside normal range.

1.5 The second method is to keep the regulators running continuously during emergency use. When connected in this manner, the tone burst changes to a continuous tone of about 1400 Hz when the batteries have discharged below a defined level.

1.6 The C28AN option also includes a 2nd continuous alarm tone which informs the user of a failure in the float charger which may result in battery damage. The tone is a continuous 1400 Hz tone. This overvoltage alarm will disconnect the transformer from the station and allow battery operation in the event of a controller failure.

1.7 The power supply/battery charger is of the controlled ferroresonant design. The supply provides high current A+ at 14.25 V dc, A+ at 13.90 V dc, and 9.4 V dc to power any continuous or intermittent duty radio. Current limiting, short circuit and over-voltage protection are also provided.

1.8 The batteries used as the emergency source can be of either the nickel-cadmium or lead-acid type. An automotive type battery is not recommended as an emergency dc supply.

1.9 A two-position switch on the battery charger board determines the charging rate of the batteries. In the FLOAT position, a voltage is supplied to the batteries, sufficient to maintain them in a fully charged state. The EQUALIZE position increases the charging voltage to restore the batteries after emergency use or where the condition of the battery dictates.

2. THEORY OF OPERATION

(Refer to attached diagram for circuit details.)

2.1 TRN5336A STANDARD POWER SUPPLY

The TRN5336A Standard Power Supply performs the conversion of ac line power to dc radio power. The supply consists of rectification and filtering. The secondary voltage of transformer T601 is rectified by CR601 and CR602. Ground connection for the diodes is provided through the heat sink to chassis. Output filtering is provided by the network of C602, C603, L601, and C604.

Table 1.
Model Complement of Option C28AN and Model TPN1192A Battery Charger Power Supply

Kit	Sub-Kit	Description
TKN8295A		Battery Charger Cable
TRN5155A		Battery Cable, External
TPN1192A		Battery Charger Power Supply
TPN6137B		Battery Charger Circuit Board
TRN5153A		Battery Charger Hardware
TRN5336A		Domestic Power Supply Hardware
TRN5362A		Interconnect Hardware
TPN1190A		Auxiliary Chassis with Battery Option
	TRN5119A	Auxiliary Regulator Circuit Board
	TRN5120A	Battery Revert Control Circuit Board
	TRN5209A	Hardware Kit
	TRN5299A	Chassis Kit

2.2 TRN6137B BATTERY CHARGER BOARD

Line and load regulation is controlled by the TRN6137B Battery Charger Board. Refer to schematic diagram attached at the end of this section. Regulation is accomplished by controlling the saturation of ferroresonant transformer T601 via a control inductor, L650. This inductor is switched across the resonant winding on the transformer as the output voltage reaches a preset level. Potentiometer R662 (VOLT. ADJ.) permits output voltage adjustment. Switching and timing circuitry for the control inductor is described in the following paragraphs.

2.2.1 Clock Generator

Q655 and Q650 derive a line frequency related clocking signal for timing and triggering purposes.

2.2.2 10 Volt Reference

Zener VR650 establishes a 10 volt reference used by the activity detector, stabilizer, and control voltage generator circuits.

2.2.3 Monostable Switch

U650D converts the clock signal into a monostable pulse which drives the ramp generator.

2.2.4 Ramp Generator

Q651 generates a ramp voltage in conjunction with C653.

2.2.5 Control Voltage Generator

U650A compares a reference voltage with the output voltage and generates a control voltage with gain to the pulse width modulator.

Table 2. Performance Specifications

Operating Temperature	-30° to +80°
Input Voltage	96 V to 132 V ac, 60 Hz

HIGH CURRENT OUTPUT

Output Voltage	13.1 V Lead Acid 14.25 V NiCad and also if any battery is *not* connected 14.1 V Lead Acid Equalize 15.25 V NiCad Equalize
Output Current	30.4A at 14.1 V (see graph for other points).
Load Transient	Shall not drop below 11.0 V for a 0 to 30.4A load with the 9.5 V regulator loaded to 1.5A.

9.4 V OUTPUT

Output Voltage	9.4 V dc nom. (9.1-9.7 adjustable).
Output Ripple	Less than 5 mV rms.
Line Regulation	Shall not change more than 50 mV over input range.
Load Regulation	Shall not change more than 0.150 V over load.
Output Current	1.1A at 80°C.

14 V OUTPUT

Output Voltage	13.9 V nom. (13.5-14.1 adjustable).
Output Ripple	Less than 5 mV rms.
Line Regulation	Shall not change more than 25 mV over input voltage.
Load Regulation	Shall not change more than 0.255 V over load.
Output Temperature Coefficient	1.5 mV/°C typical.
Output Current	1.16A at +80°C.

ALARM TONE OUTPUT

Alarm Tone Frequency	1400 Hz ±200 Hz @25°C.
Alarm Rep Rate	1.6 sec. to 4 sec.
Alarm Tone Duty Cycle	10% typical.
Tone Output Level	Adjustable from 0 V to 1 V p-p into a 600 ohm load.
Low Voltage Dropout Level	Adjustable 10.5 V nominal.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

2.2.6 Pulse Width Modulator

U650C compares the control voltage with the ramp and generates a pulse whose width is determined by how early in the ramp cycle the control voltage equals the ramp voltage.

2.2.7 Stabilizer

U650B keeps the monostable switch (U650D) from changing state for approximately 1/2 cycle to eliminate triggering errors due to line and load transients.

2.2.8 Power Switch

SCR Q656 and TRIAC Q657 work together to switch a control inductance in and out of the resonant winding on the power transformer. The diode bridge between the SCR and TRIAC allows the TRIAC to be triggered every half cycle.

2.2.9 Overvoltage Protection

Overvoltage comparator U651A and U651B compares the voltage appearing at the arm of R662 with a fixed voltage developed across a voltage divider consisting of R678, R683, and R655. Any increase or decrease in A+ voltage is reflected at the arm of R662 and applied to U651A-3. If the A+ voltage at U651A-3 rises above the fixed voltage applied to U651A-2, the output at U651A-1 goes high. This action begins charging capacitor C659. If the A+ voltage remains high, C659 will charge to a level above the reference applied to U651B-5. This causes U651B-7 to go high, which in turn, turns on Q660, Q654, and Q653. Once Q660 and Q664 are turned on, the overvoltage protection relay K650 is energized which removes the transformer secondary center tap return path. Relay K650 will now remain energized until ac power and/or battery power is disconnected from the station. Similarly, Q653 will remain turned on to provide the overvoltage alarm output at J603-5 until ac power and/or battery power is disconnected. Zener diode VR651 provides additional protection by forcing the overvoltage circuits to energize in the event that overvoltage sensing through R662 fails.

2.2.10 Line Fail Sense

Q658 and Q659 generate a "line fail" signal when a loss of clock signal is detected. Q658 senses failure at the ac line and Q659 generates the output signal AC FAIL.

2.2.11 Power Up Reset

Q662 and Q661 use the line fail sense signal from Q658 to generate a power up reset input to the pulse width modulator, U650C, each time power is turned on. The power up reset signal is applied to the control voltage input (U650C-9) of the pulse width modulator and enables quick power up.

2.3 TRN5119A AUXILIARY REGULATOR BOARD

The TRN5119A Auxiliary Regulator Board provides regulated 9.4 V and 14 V for the radio. The board circuitry consists of a reference voltage, 9.4 V and 14 V regulators, a temperature-compensated overcurrent amplifier, and a local control inhibit inverter.

2.3.1 Reference Voltage

The operational amplifiers on the circuit board require a stable reference voltage. This reference voltage is produced in two stages of circuitry. The first stage consists of VR4 and R40 which are connected to J1-1 and main 13.8 V. Diode VR4 regulates at 9.6 V. The second stage, which operates from this 9.6 V, is temperature compensated and consists of VR1, CR2, and R39. The resultant 6.5 V reference is fed to each of the operational amplifiers.

2.3.2 9.4 V Regulator

2.3.2.1 The 9.4 V regulator is a series pass type circuit using a PNP transistor (Q6). A PNP type transistor can provide voltage regulation with as little as 0.7 V differential between collector and emitter. This means that the input voltage can go as low as 10.4 V, and the circuitry will still maintain voltage regulation. The voltage regulator circuitry provides output voltage adjustment, correction for changes of input voltage and load requirements, and over-current protection.

2.3.2.2 The 9.4 V regulated output voltage (J5-6) is set by the 9.4 V VOLTAGE ADJUST potentiometer, R35. The voltage from R35 goes to U1A-2 and is compared to U1A-3, the reference voltage input. The differential voltage appears at U1A-1. For example, if U1A-2 becomes less positive, the output of U1A-1 becomes more positive, causing Q7 to conduct harder. Increased collector current at Q7 causes increased base-emitter current at Q6. As a result, Q6 conducts harder, with a resultant higher (more positive) regulated output voltage at J5-6.

2.3.2.3 The circuitry described in the previous paragraph is a negative feedback loop. It maintains a constant output voltage for changes in load or input voltage. The feedback loop has typically 50 dB of gain at dc to give a load/line regulation of ± 0.1 V dc maximum from no load to full load. As an example, for an increase in load current, the regulator output voltage would normally decrease. The reduced output voltage is sensed at U1A-2, which is now less positive than U1A-3, the reference voltage. U1A-1 goes more positive and drives Q7 into further conduction. An increase in collector current of Q7 causes increased conduction of Q6. The regulated output voltage returns to normal. A decrease in load current causes the opposite action.

2.3.2.4 The overcurrent protection circuitry is of the current foldback type. As the load increases beyond the knee, the output voltage and current decrease simultaneously to a final short circuit current of 0.77 amp maximum. The current is sensed across R20. When this voltage exceeds about 0.3 volt (representing a load current of approximately 2.3 amps), Q8 is forward biased and starts to conduct. When Q8 conducts, its collector goes positive, turning on Q9. The conduction of Q9 increases the voltage drop across R28 causing the voltage at U1A-3 to drop. The drop in voltage of U1A-3 causes a corresponding drop in voltage of U1A-1. This action causes Q7 and Q6 to conduct less current. As a result, the output voltage (9.4 V regulated) decreases. If the output current continues to increase, Q8 and Q9 conduct harder which results in a further reduction in voltage through Q6. This action continues until the output voltage drops to approximately 6.5 V. At this point, CR10 becomes forward biased increasing the current through Q10. This action causes Q8 to conduct harder which, through Q9, U1A, and Q7, reduces the current through Q6. Notice, therefore, a short circuit at the output of Q6 actually results in less dissipation through Q6 than full normal operating load. This prevents damage to Q6 due to overcurrent conditions.

2.3.3 14 V Regulator

2.3.3.1 The 14 V regulator is a series pass type circuit using PNP transistors (Q1 and Q11). A PNP type transistor can provide voltage regulation with as little as 0.7 V differential between collector and emitter. This means that the input voltage can go as low as 14.7 V, and the circuitry will still maintain voltage regulation. The voltage regulator circuitry provides output voltage adjustment, correction for changes of input voltage and load current, and overcurrent protection.

2.3.3.2 The input filter circuitry provides power to the 14 V regulator. CR1 and CR15 rectify ac to dc (26-34 V). Resistors R47 and R48 limit the surge and reduce the ripple current across filter capacitor C1.

2.3.3.3 The 14 V regulated (J5-2) output is set by the 14 V VOLTAGE ADJUST potentiometer, R7. The voltage from R7 goes to U1C-9 and is compared to U1C-10, the reference voltage input. The differential voltage appears at U1C-8. For example, if U1C-9 becomes less positive, the output at U1C-8 becomes more positive, causing Q2 to conduct harder. Increased collector current at Q2 causes increased base-emitter current at Q1 and Q11. As a result Q1 and Q11 conduct harder, with a resultant higher (more positive) regulated output voltage at J5-2.

2.3.3.4 The circuitry described in the previous paragraph is a negative feedback loop. It maintains a constant output voltage for changes in load or input voltages. The feedback loop has typically 50 dB of gain at dc to give a load/line regulation of ± 0.1 V dc maximum from no load to full load. As an example, for an increase in load current, the regulator output voltage would normally decrease. The reduced output voltage is sensed at U1C-9, which is now less positive than U1C-10, reference voltage input. U1C-8 goes more positive and drives Q2 into further conduction. An increase in collector current of Q2 causes increased conduction of Q1 and Q11. The regulator output returns to normal. A decrease in load current causes the opposite action.

2.3.3.5 The overcurrent protection circuitry is of the current foldback type. As the load increases beyond the knee, the output voltage and current decrease simultaneously to a final short circuit current of 0.77 ampere maximum. The current is sensed across R10. When this voltage exceeds about 0.3 volts (representing a load current of about 2.3 amperes), Q3 is forward biased and starts to conduct. Its collector goes positive, causing Q4 to conduct thru R13 and R14. Q4 conducting lowers the voltage at R9 (V REF). As the voltage on U1C-10 lowers, it causes the voltage on U1C-8 to go lower, forcing Q2, Q1, and Q11 to conduct less. As a result, the output voltage (14 V regulated) decreases. As output current increases, Q3 and Q4 conduct harder, resulting in higher Q1 and Q11 impedance. This action continues until the output voltage decreases to about 6.5 V. At this point, CR5 becomes forward biased, and the emitter current of Q5 increases. This results in an increased voltage across R11. This will forward bias Q3 harder. As a result less output current can be drawn under a short circuit condition. This is desirable because the power dissipated in Q1 and Q11 is now reduced.

2.3.4 Temperature Compensated Overcurrent Amplifier

The temperature compensated overcurrent amplifier (U1D) compensates the knee of the 9.4 V and 14 V overcurrent detect circuits (Q3 and Q8). Compensation allows operation from -30°C to +80°C without degradation in available output current. Compensation begins at diodes CR13 and CR14. These diodes are temperature sensitive, having a voltage decrease of about 2 mV for an increase of each degree centigrade. A temperature increase makes U1D-14 less positive. Both Q5 and Q10 reduce collector current with a reduction in voltage drop across R11 and R21. The reduced voltage across the bias resistors counteracts the effects of high ambient temperatures on Q3 and Q8.

2.3.5 Local Control Inhibit Inverter

The local control inhibit inverter (U1B) is used to turn off the 9.4 V and 14 V voltage regulators externally for local control operation. When used, jumper JU2 is removed, and J5-5 is connected to ground thru the normally closed contacts of a switch. Opening the switch contacts causes U1B-7 to go high. Both Q4 and Q7 are driven into saturation. U1C-8 and U1A-1 are pulled low which cuts off Q6, Q1, and Q11.

2.3.6 Overvoltage Protection Relay

On battery charging supplies, in the event of an overvoltage alarm, relay K650 will pull in to prevent overcharging of the battery system. With the wiper of K650 tied to the transformer center tap, the relay "pull in" will disconnect the high current A+ from the filter section. In addition to disconnecting the filter section, K650 opens the fuses F604 and F605 which feed the auxiliary regulator. By tying the positive terminal of C1 in the AUX regulator (via CR16) to the normally open contact of K650, the transformer windings are presented a relatively low impedance path through F604 and F605 when K650 energizes.

2.4 TRN5120A BATTERY REVERT CONTROL BOARD

The TRN5120A Battery Revert Control Board is a supervisory control board designed to regulate the transition from ac main power to battery back-up operation. To accomplish this the board: 1) switches out the 14 V regulator in the event of a power failure or controller failure, 2) monitors battery condition to prevent over-discharge, and 3) generates alarm tones to indicate ac power failures or controller failures.

2.4.1 Regulator Output Switching

2.4.1.1 In conditions where battery operation is required (i.e., ac power failure or controller failure) it is necessary to switch the low current A+ (regulated 14 V) load from the regulator output to the battery due to the high losses in the 14 V regulator. By using a relay to switch the output, the battery revert control board achieves a reduced IR loss between the battery and the load, which serves to lengthen the amount of time the user has to run his station.

2.4.1.2 The relay (K100) is controlled by the AC Fail and 0 V alarm signals which are generated in the ferroresonant controller. These signals are applied to the base of Q101 (AC Fail directly, and 0 V alarm through CR107) and are normally high. When these signals are high, the collector of Q101 saturates, preventing the relay driver (Q104) from turning on the relay.

2.4.2 Low Battery Voltage Dropout

2.4.2.1 When either AC Fail or 0 V alarm are low, a voltage comparator monitors the battery voltage to determine the battery condition. When the voltage drops below a certain voltage, the comparator shuts off the relay (K100), inhibits the low current regulators, and forces the alarm tone generator to produce a continuous tone.

2.4.2.2 The comparator consists of a Norton mode op amp (U100-C) biased to function as an inverting Schmitt trigger with an adjustable trigger level (R129) and a reset/inhibit input (via CR111). Under normal operation (AC Fail and 0 V alarm high), the comparator output is held low since Q101 is saturated, Q102 is shut off, and the current applied to U100C-8 through R106, CR111, and R111 is greater than the current applied to U100C-13 through R112. When AC Fail or 0 V alarm goes low, Q101 shuts off and Q102 saturates. This action back biases CR111 preventing any current flow through R111 thereby allowing the comparator to function. Once the A+ voltage drops below a certain voltage (manually set using R129) the comparator output goes high, causing Q103 and Q105 to saturate. The collector of Q103 is tied to the base of Q104, which drives the relay. Once Q103 saturates, no current flows in the base of Q104, shutting off K100. Q105 is tied to Q2 and Q7 (via CR4 and CR8) of the regulator. When Q105 saturates, the base drive of Q2 and Q7 is drawn off, causing the pass elements in the regulators to shut off. The comparator output is also fed into the pulse inhibit input of the pulse generator which causes the pulse generator to inhibit when the comparator output is high.

2.4.3 Alert Tone Generation

2.4.3.1 The battery revert control board is designed to provide two alert signals. The first is a pulsed 1400 Hz tone which indicates the loss of ac power. The second is a continuous 1400 Hz tone which indicates conditions which may result in battery damage.

2.4.3.2 By noting the sequence in which the continuous tone appears, the user can determine the nature of the problem. When a pulsed tone (indicating loss of ac power) is followed by a continuous tone, the user can assume that the batteries are fully discharged, and station operation may not last much longer. A continuous tone which suddenly appears, indicates that failure of the power supply has occurred and that battery operation has commenced.

2.4.3.3 The alert tones are generated by a phase shift oscillator whose output is gated by a pulse generator. This pulse generator is then controlled by a combination of AC Fail, 0 V alarm and the voltage comparator output.

2.4.3.4 The tone generator consists of a Norton type op amp (U100-B) with a phase shift feedback path to cause oscillation. A tone inhibit function has been added by tying the output of Q102 to the inverting input (via R134). When Q102 is high (i.e. AC Fail and 0 V alarm are high), enough current is forced into pin 6 of U100-C to cause the oscillator output to clamp to ground. Once Q102 goes low, the oscillator output dc voltage becomes 1/2 the output of the pulse generator which is fed into the non-inverting input of U100-D.

2.4.3.5 The pulse generator also consists of a Norton type op amp biased as an inverting Schmitt trigger (U100-D) with an RC network added to provide asynchronous switching. Under most conditions, the pulse generator is free running, however when the 0 V alarm goes low or the low voltage comparator output goes high the pulse generator is inhibited, and its output is forced high. The inhibit function is accomplished by applying either the output of U100-C (the low voltage comparator) or U100-A (a simple inverter which inverts 0 V alarm) to the non-inverting input of U100-D which forces the output high.

2.4.3.6 The tone generator output is fed via R126 and JU102 to R128 which allows the level to be adjusted. By removing JU102, 20 dB of attenuation can be obtained when R128 is at mid setting.

3. BATTERY CONNECTION AND INSTALLATION

3.1 POWER SUPPLY

3.1.1 Installation of the station with this option is standard except for the connection of the 12-volt battery (10 cells nickel-cadmium, 6 cells lead-acid).

3.1.2 Locate the battery in a secure place, and as close to the station as possible. The cable length must be kept as short as practical, because of the voltage drop in the battery cable. A substantial voltage drop can be developed across this low resistance due to the high currents drawn from the battery while transmitting.

3.1.3 Select a battery location that has an unobstructed air circulation, preferably a cool dry place with ample width aisles to permit easy access to all cells for installation, taking readings, adding water and cleaning. The battery must not be placed near radiators, boilers, or other heat-producing devices.

3.1.4 Capacity of a battery should be carefully determined before its purchase. Factors that influence the capacity are the busy hour load, the protection time desired, the final cell voltage limit and the minimum operating temperatures. For more information contact your Motorola Area Systems Engineer.

3.1.5 Connection of the battery terminals made during installation is extremely important to its service life. If connections are carefully made with clean, acidfree surfaces and kept tight by periodic checking, they will give trouble-free service over the life of the battery.

CAUTION
Do not attach batteries before setting the float voltage.

3.1.6 Adjustment of the float voltage of the power supply is required at the time the battery is installed. The float voltage is the A+ output voltage of the power supply which will keep a battery fully charged when connected across the A+ output terminals. The float voltage adjustment varies with the type of battery being installed and with the ambient temperature. Refer to paragraph 4, Level Adjustments, and to the battery manufacturer's literature for adjustment of the float voltage.

3.1.7 Give the battery a freshening or boost charge when it is received. Do this in accordance with the manufacturer's instructions.

3.1.8 Connect the battery cable from the junction box to the battery as follows:

Step 1. Remove fuse F610 from the battery cable to prevent accidental short circuiting during installation.

CAUTION
Observe proper polarity on battery connections.

Step 2. Connect the battery cable plug (P605) to J605 on the junction box, and route the battery cable to the battery connection points.

Step 3. Connect the red wire of the battery cable to the position (+) terminal of the battery.

Step 4. Connect the black wire of the battery cable to the negative (-) terminal of the battery.

Step 5. Check to assure proper polarity of the cable leads, and then reinstall fuse F6501, removed in Step 1.

3.1.9 If power is to be removed from the station for any reason after the initial installation, the most convenient method is to remove the in-line fuse (F601) from the battery cable.

3.2 BATTERY PROTECTION AND ALARM

3.2.1 The C28 option, as shipped from the factory, is wired to include the low voltage regulator dropout for battery protection. If it is desired to have the low voltage detect circuit to cause a continuous tone alarm rather than shut-off the regulators, cut jumper JU101 on the battery revert control board.

3.2.2 When ordered with the C28 option, the rf control chassis backplane will be jumpered to provide the alert tone in the phone line for base station operation, or to provide the alert tone in the exciter for repeater station operation. Refer to the following for jumper details.

- Standard Backplane
  - JU6 — IN / JU7 — OUT: Tone in phone line
- Optionable Backplane
  - JU13 — IN / JU14 — OUT: Base Station Operation
  - JU13 — OUT / JU14 — IN: Repeater Station Operation

4. LEVEL ADJUSTMENTS

4.1 A+ VOLTAGE ADJUSTMENT

The A+ output is factory adjusted for nickel cadmium batteries at 14.25 volts. If adjustment is necessary, set output voltage control, R662, in the station power supply for the desired float voltage as follows:

Step 1. Disconnect batteries and replace F602 if missing.

Step 2. Connect a dc voltmeter with 3% accuracy (or better) between terminals TB601+ and TB601- on the power supply. Allow the power supply to warm up for at least 10 minutes.

Step 3. Set the VOLT. ADJ. control R662 to provide a charging voltage: (a) as specified by the battery manufacturer; (b) of 14.25 volts if batteries are not to be connected at this time; (c) of 14.25 volts for nickelcadmium batteries, or; (d) of 13.1 volts for lead-acid batteries.

CAUTION
When operating the battery charging power supply without batteries, F602 must be present. F602 should be removed when batteries are present and attached to reduce battery drain via load resistor R140 under ac fail conditious.

4.2 REGULATED OUTPUT VOLTAGE ADJUSTMENT

The regulated output voltages can be adjusted with the auxiliary regulator board in the radio or on the service bench. If adjusted on the test bench, the regulator must be supplied 14 V at J1-1 and +28 V at J1-6 or J1-7. The outputs must be loaded to 1.1 ampere each.

Step 1. Measure the regulated output voltages at TP101 (9.4 V) and TP111 (14 V).

Step 2. Set R35 for 9.4 V ±0.1 V.

Step 3. Set R7 for 13.9 V ±0.1 V.

4.3 ALARM TONE LEVEL ADJUSTMENT

In remote control stations, and in repeaters with wire line control, the "tone level" control (R128) on the battery revert control board is factory preset to provide a level -20 dB below the set level on the audio control line. In "repeater only" stations, this control is set for a deviation of ±0.5 kHz.

The tone level control may be reset to suit the needs of a particular installation by the following procedure.

Step 1. Disconnect the station from the ac power line and allow it to operate on its battery. (This should turn on the alarm tone oscillator.)

Step 2. Set the volume control at a normal comfortable operating level with a received signal.

Step 3. Rotate TONE LEVEL ADJ control R128 until the alarm tone is clearly discernible, but not loud enough to effect the intelligibility of the audio signals on the line. The tone can be turned on continuously by grounding the positive lead of C103.

4.4 LOW-VOLTAGE DETECTOR ADJUSTMENT

Dropout voltage control R129 is factory preset, but may need resetting if any components in the lowvoltage detector or associated circuits have been replaced. If it is necessary to readjust the low-voltage detector control, use the following procedure.

Step 1. Disconnect ac and battery power from the station.

Step 2. Connect the output of a variable dc power supply (such as the Motorola R1011A) to TB601 in the power supply. Set the supply to 13.1 V before connecting.

Step 3. Preset low-voltage control R129 to the fully counterclockwise position.

Step 4. Set the output of the variable power supply at 10.5 V.

Step 5. Rotate dropout voltage control R129 clockwise until K100 de-energizes. Read the power supply output voltage just before the point of dropout.

Step 6. Check the relay operation by increasing the supply voltage until the relay pulls in and then reducing it until the relay drops out. Read the supply voltage at the point just before dropout. The relay should drop out when the supply voltage is between 10.0 and 10.8 volts.

Step 7. If the measured dropout voltage was outside the 10.0 to 10.8-volt range, readjust control R129 and recheck until it is within these limits. Clockwise rotation of R129 increases the dropout voltage; counterclockwise rotation decreases it.

Step 8. Turn off the variable power supply and completely disconnect it from TB601.

5. MAINTENANCE

5.1 INTRODUCTION

Maintenance and repairs of this power supply demand a thorough understanding of its operation. Refer to the power supply Theory of Operation for this information.

5.2 TEST EQUIPMENT REQUIRED

The following test equipment is necessary for efficient, accurate servicing in the event that maintenance is required.

- 3-1/2 digit DVM
- DC current meter (0-50 amperes)
- Load resistor (variable from 0 ohm to 15 ohms, and capable of carrying 50 amperes)
- Variable voltage ac line transformer (0-130 volts)
- Oscilloscope
- Variable power supply
- Bench service cord consisting of:

Qty	Part No.	Description
1	15-83183N01	Housing
2	39-83145N01	Contact
1	39-83145N02	Contact
1	30-865903	Cord

5.3 AUXILIARY REGULATOR CHASSIS REMOVAL

(Refer to Figure 2.)

The circuitry on the auxiliary regulator chassis can be serviced without removing the entire power supply. The auxiliary chassis below the main chassis can be disconnected and removed separately.

Step 1. Disconnect P1 and P5.

Step 2. Remove the three screws holding the auxiliary chassis to the main chassis. Use a magnetic screwdriver.

Step 3. Lift the auxiliary regulator chassis out of the cabinet.

Step 4. Remove circuit board(s) by compressing the plastic locking tabs.

5.4 POWER SUPPLY REMOVAL

(Refer to Figures 2 thru 5.)

WARNING

The power supply is unexpectedly heavy, balances sharply to the right, and is awkward to hold. Follow the removal instructions carefully.

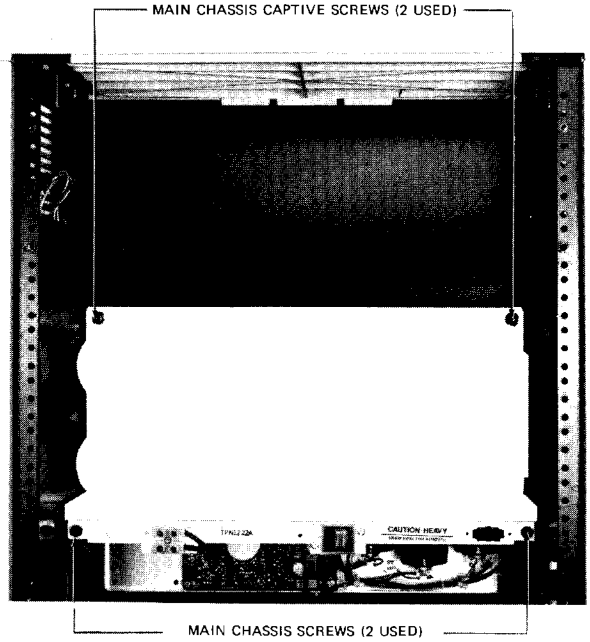


Figure 2. Power Supply Mounting Hardware

Step 1. Disconnect P5 and P103 (for battery power supply). Open tie wraps and reposition cable.

Step 2. Remove main chassis screws and loosen main chassis captive screws. Remove the two shipping screws (Motorola Part No. 3-83498N08) and washers (Motorola Part No. 4-135873) located under the main chassis side rails. These screws need to be replaced when re-installing the power supply unless the station is to be shipped to another location. Retain the screws for future shipping needs.

Step 3. Slide power supply chassis to you until chassis is flush with cabinet as shown in Figure 3.

WARNING
DO NOT ALLOW CHASSIS TO SLIDE FREELY BEYOND FRONT OF CABINET. CABINET RAIL SUPPORT ENDS ABRUPTLY.

Step 4. Grip the main chassis with the right hand as shown in Figure 4. Find a comfortable grip around the flattened parts of the metal. Adjacent parts have sharp edges.

Step 5. Plant your feet firmly with good balance to receive a heavy weight.

Step 6. Slide the power supply toward you. Slightly tilt the chassis toward you and reach the left hand over the top to balance the chassis on the cabinet rails. Press the chassis firmly against the rails or the chassis will suddenly slide out of the cabinet. See Figure 5.

Step 7. Reposition the left hand from balancing the chassis to a firm grip.

Step 8. Brace your body to receive a heavy weight, and lift the power supply chassis free of the cabinet.

5.5 BATTERY MAINTENANCE

The battery or batteries used for emergency power require certain routine maintenance procedures to assure long trouble-free operation. Persons servicing the batteries should refer to the manufacturer's recommendations for routine maintenance. In addition, certain maintenance procedures are appropriate following each interval of emergency power operation.

Routine battery maintenance procedures for the two most common battery types are given (nickel-cadmium and lead-acid). The importance of keeping good battery maintenance records cannot be overemphasized. A chart or table is needed, listing all voltage readings, temperature and hydrometer readings (where applicable), versus the dates on which the readings were taken. To be most effective, the battery report charts should be kept at the battery location for ready reference.

5.5.1 Nickel-Cadmium Batteries

Perform the following routine maintenance procedures at six-month intervals.

Step 1. Clean the battery and inspect it for damage.

Step 2. Measure cell voltages and enter the voltage readings on your maintenance report.

Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for 48 hours or until three consecutive cell measurements show no change (readings to be taken at 1/2-hour intervals). The terminal voltage of the battery should then read 15.25 ± 0.2 volts.

Step 3. Add water as required to keep the electrolyte solution in each cell above minimum. Use *distilled water only*. Check the battery manufacturer's service literature for instructions on filling.

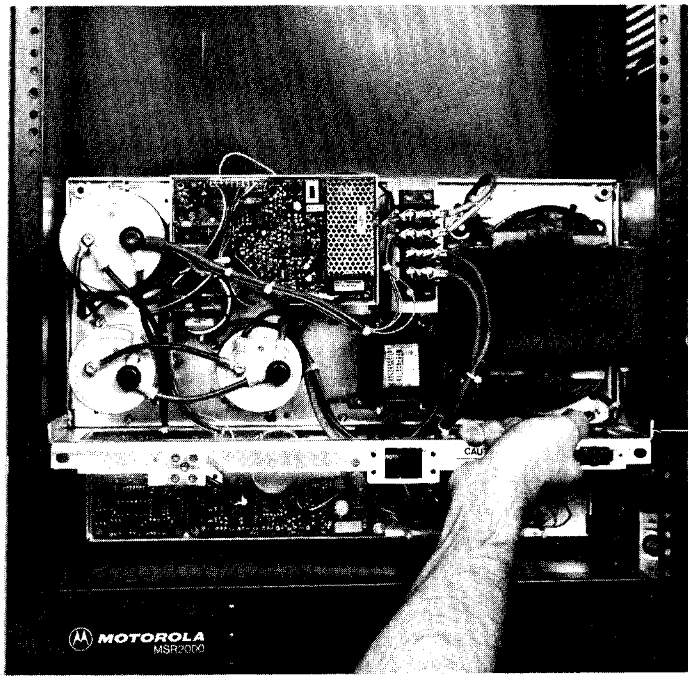


Figure 3. Power Supply Chassis Travel Distance

CAUTION

Do not use any tool on a nickel-cadmium battery which may have been used with lead-acid batteries. To do so may destroy the nickel-cadmium battery due to chemical contamination by electrolyte or other foreign matter from the lead-acid battery existing on the tool in question.

If frequent replacement of water is required, the charging rate may be too high. In this case, carefully check the A+ voltage with the switch in the FLOAT position for the specified 14.25 volts. Under certain high ambient temperature conditions, the battery may require water even though the charging voltage is correct. In this case, the charging voltage should be reduced until infrequent addition of water is required.

5.5.2 Lead-Acid Batteries

Perform the routine maintenance procedures monthly.

Step 1. Clean the battery and inspect it for damage.

Step 2. Measure cell voltages and enter the voltage readings on your maintenance report. Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for the number of hours recommended by the manufacturer.

Step 3. Take specific gravity readings with a hydrometer calibrated for the type of electrolyte used.

Step 4. Observe the necessary precautions to see that the readings are accurate, that no chemical contamination of the cells occurs, and to prevent bodily injury from contact with the electrolyte.

Step 5. After taking a reading, always return the electrolyte in the hydrometer syringe to the cell from which it came. (Failure to do so will decrease the specific gravity of the cell when water is added to fill up the cell.)

Step 6. For an accurate comparison with "standard" specific gravity readings, as published in manufacturer's specifications, a correction factor must be applied to all readings to normalize them with the standard values, when taken at temperatures other than 77+ Fahrenheit. However, if the battery temperature tends to be the

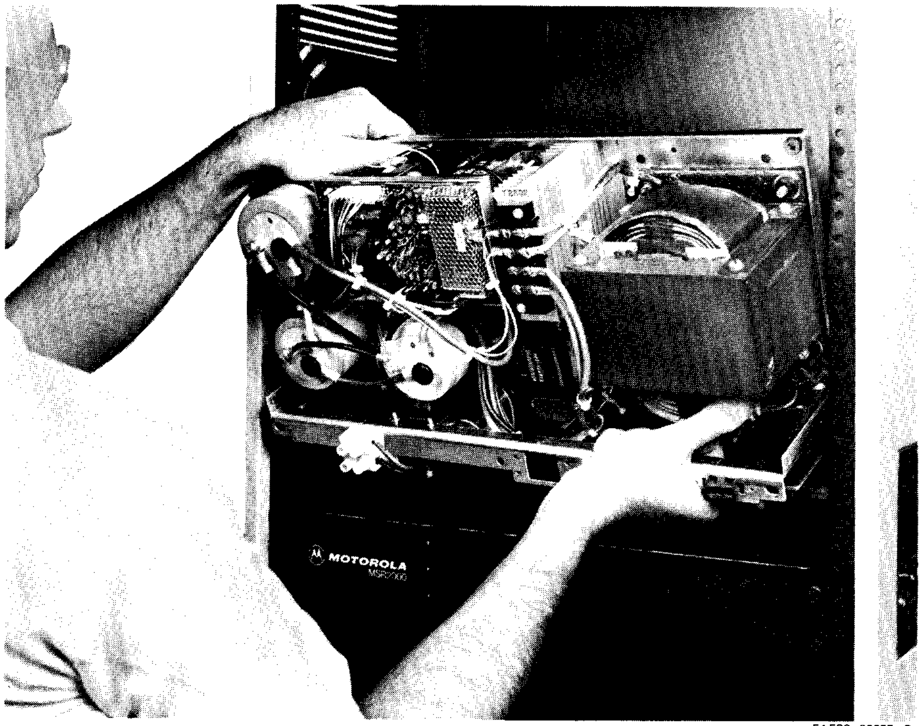


Figure 4. Properly Gripped Chassis

same each time specific gravity readings are taken, a trend toward a change in specific gravity will be apparent without having to apply the correction factor to the readings.

The correction factor is easily applied, due to a linear relationship between changes in temperature and specific gravity above and below 77 + F. For each three degrees above 77 + F, add .001 (known as "1 point") to the "standard" value of specific gravity. Conversely, for each three degrees below 77 + F, subtract 1 point.

Step 7. Take a specific gravity reading of the "pilot cell" monthly. It is not necessary to continually check the specific gravity of all cells, because any gradual changes usually occur simultaneously in all cells. One cell is therefore chosen and designated the "pilot cell," and the monthly routine specific gravity readings are always taken from this one cell. (Be sure to indicate on the maintenance chart which cell is the pilot cell.)

Take specific gravity readings of all the battery cells every three months, and record them on the maintenance chart.

Step 8. Add water as required to keep the electrolyte solution in each cell up to a minimum level. In some batteries, the electrolyte level should be between the high and low-level marks on the inside of each cell. If the cells have no such markers, check the manufacturer's literature. Use *distilled water only*.

CAUTION

Do not use any tool on a lead-acid battery which may have been used with nickel-cadmium batteries. To do so may destroy the lead-acid battery, due to chemical contamination by electrolyte or other foreign matter from the nickel-cadmium battery existing on the surface of the tool in question.

If frequent replacement of water is required, the charging rate may be too high. In this case, carefully check the A+ voltage for the specified 13.0 volts with the switch in the FLOAT position. Under certain high ambient temperature conditions, the battery may require fre-

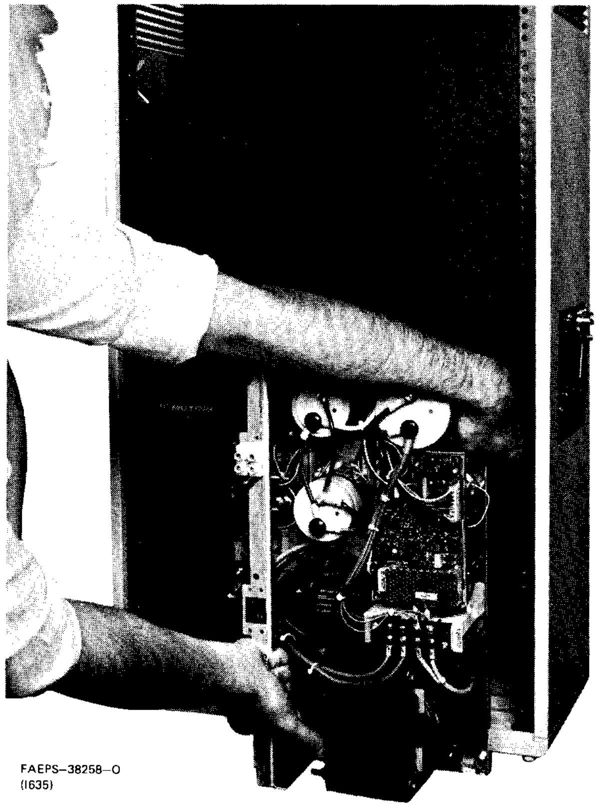


Figure 5. Power Supply Removed From Cabinet

quent water replacement even though the correct charging voltage is maintained. In this case, the specified 13.0 volts may be reduced until infrequent addition is required.

Step 9. Equalize charging of a lead-acid battery should be performed under any one of the following conditions:

- following each known use (or discharge) of the battery,
- if the specific gravity of the pilot cell or any other cell is more than ten-thousandths (10 points) below its full-charge value,
- if the difference in voltage between any two cells is .05 volt or more,
- as part of each monthly routine maintenance procedure independent of any of the previous conditions stated.

Equalize charging should continue for: (a) the number of hours specified by the battery manufacturer, which will vary according to temperature, charging voltage and the manufacturer's recommendations or; (b) until three successive readings of cell voltage and specific gravity show *no change* (readings to be taken at 1/2-hour intervals).

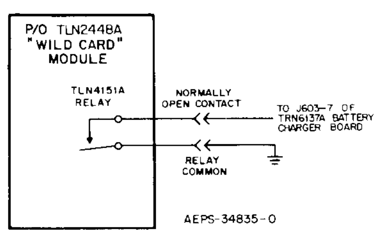


Figure 6. Remote Control of Float-Equalize

5.5.3 Remote Control

Equalize charging may be remotely controlled in tone remote control base and repeater stations. This can be accomplished with a TLN2448A "Wild Card" Module and a TLN4151A Relay as shown in Figure 6. Leave the FLOAT-EQUALIZE switch in the FLOAT position.

Table 3. Troubleshooting Chart

Symptom	Action
A. No Output Voltage	1. Check primary line connection to supply. 2. Check for transformer secondary voltage at TB602. 3. Check for continuity through relay.
B. Relay pulls in when power is applied.	1. Check for trigger pulses at pin 8, U650C. a) If no trigger is present, check for proper signals from RAMP GEN. back to CLOCK GEN. If proper signals are present, check voltages at STABILIZER and CONTROL VOLTAGE GEN. b) If correct trigger pulses are present, check power switching circuitry (Q656 through Q657). 2. Check OVERVOLTAGE COMPARATOR and ACTIVITY DETECTOR for proper levels. 3. Check RELAY DRIVER and RELAY LATCH transistors (Q654 and Q660).
C. A+ output voltage too high and cannot adjust.	Check for trigger pulses at pin 8, U650C. 1. If no trigger present, check for proper signals from RAMP GEN. back to CLOCK GEN. If proper signals are present, check voltages at STABILIZER and CONTROL VOLTAGE GEN. 2. If correct trigger pulses are present, check power switching circuitry (Q656 through Q657).
D. A+ output voltage too low.	1. Check for trigger pulses at pin 8, U650C. a) If no trigger present, check for proper signals from RAMP GEN. back to CLOCK GEN. If proper signals are present, check voltages at STABILIZER and CONTROL VOLTAGE GEN. b) If correct trigger pulses are present, check power switching circuitry (Q656 through Q657). 2. Check power diodes CR601, CR602.
E. No regulated output voltage.	1. Check for approximately 14 volts at J1-1. If no voltage, check fuse F603. 2. Check for approximately 6.5 volts at TP105, 6.55 V REF. If no voltage, check CR2 and VR1. 3. Check for grounded CR4 and CR8, REGULATOR INHIBIT lead. 4. Check for defective U1B. 5. Check for defective U1D.
F. 9.4 V regulated output: OK. No 14 V regulated output.	1. Check fuses F605 and F604. 2. Check Q3 and Q4. TP105 should be 6.5 volts. 3. Check U1C. 4. Check Q2 for open circuit. 5. Check Q1 and Q11 for open circuit. 6. Check VR2 for short. 7. Check for short circuit at J5-2.
G. 14 V regulated output: OK. No 9.4 V regulated output.	1. Check Q8 and Q9. TP104 should be 6.5 volts. 2. Check U1A. 3. Check Q7 for open circuit. 4. Check Q6 for open circuit. 5. Check VR3 for short circuit. 6. Check for short circuit at J5-6.
H. Regulators cannot supply full rated current of 1.5A (output drops more than 1 volt).	1. Check U1D, Q3, Q4, Q8 and Q9.
I. Short circuit current greater than 0.8A, and possibly input fuse blowing.	1. Overcurrent detect circuits defective. Check U1D, Q3, Q4, Q8, and Q9. 2. Check CR5 and CR10.
J. Regulated output voltages cannot be adjusted to 9.4 ±0.1 V and 13.9 ±0.1 V.	1. Check 6.5 V REF. It should be 6.5 ±0.2 volts. If not, check CR2, VR1, and VR4. 2. Check regulator feedback loop: U1A, Q7, and Q6; U1C, Q2, Q1, and Q11. 3. Check for high leakage Q2 and Q7.
K. High ac ripple voltage on 14 V regulated output: greater than 10 mV at 1.5A.	1. Check filter capacitor C1 for low capacity or leakage. Ripple voltage at TP100 is greater than 4 V peak-to-peak. 2. Check U1C for low loop gain: less than 20 dB.
L. Voltage switched from 14 V out to main 13.8 V.	1. Check relay K100. 2. Check Q101 thru Q104. 3. Check ferroresonant controller and fuses. 4. Check ac power.
M. Regulator inhibit low and regulators shut down.	1. Check Q105. 2. Check U100A. 3. Check Q101 and Q102. 4. Check battery voltage.
N. Continuous tone out.	1. Check U100A, B and D. 2. Check battery voltage. 3. Check ferroresonant controller.
O. Pulsed tone out.	1. If AC FAIL is low, check primary circuits and fuses. 2. If AC FAIL is not low, check Q102, CR109, and Q101.
P. AC FAIL or 0 V ALARM low, and no tone.	1. If no tone at TP103, check U100C, Q102, R120, R139, phase shift network and U100C. 2. If there is a tone at TP103 and JU102 is in, readjust R128.

parts list

TRN5299A Chassis — PL-8013-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode: (see note)
Q1,6,11	48-869672	PNP; type M9672
		connector:
P3	15-83498F39	HOUSING, 3 position (WHT)
P4	15-83498F40	HOUSING, 3 position (RED)
P7	15-83498F39	HOUSING, 3 position (WHT)
		mechanical parts
	3-136143	SCREW, tapping: 8-32 x 1/4"; 6 used
	43-83561N01	STANDOFF, twist lock; 2 used
	3-136850	SCREW, tapping: 6-32 x 1/2"; 6 used
	9-82973A01	SOCKET, transistor; 3 used
	14-865854	INSULATOR; 3 used
	26-82979N01	HEAT SINK; 3 used
	29-83499F01	TERMINAL; 9 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN5297A Hardware Kit
TRN5298A Hardware Kit — PL-8014-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P6,101	15-83498F38	HOUSING, 2 position
		mechanical parts
	3-134185	SCREW, tapping: 6-32 x 1/4"
	43-82980N01	STANDOFF; 3 used TRN5297A; 5 used TRN5298A
	43-82980N02	STANDOFF, spacer; 2 used TRN5298A
	43-83561N01	STANDOFF, twist lock; 2 used
	1-80754D87	Assembly Wire and Lug includes: (p/o TRN5297A)
	29-83499F01	TERMINAL; 2 used
	1-80754D97	Assembly Wire and Lug includes: (p/o TRN5298A)
	29-83499F01	TERMINAL; 2 used
	1-80754D98	Assembly Wire and Lug includes: (p/o TRN5298A)
	29-83499F01	TERMINAL; 2 used
	42-10217A02	STRAP, ties

TRN5362A Interconnect Battery Charger Hardware — PL-8016-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
P1,603	15-83498F45	HOUSING; 9 position
		resistor:
R140	17-83389G02	30 ohms ±5%; 20 W
		mechanical parts
	3-83498N04	SCREW, tapping: M4 x 0.7 x 7mm; 3 used
	46-84549F01	PLUG, polarizing; 2 used
	29-83499F01	TERMINAL; 16 used
	3-10943M25	SCREW, tapping M4 × 0.7 × 20mm; 2 used
	29-82907N07	TERMINAL, ring
	29-83883C02	TERMINAL
	30-84204N01	CABLE, 4-conductor; 6.63"

TKN8295A Internal Battery Cable Kit
TKN8845A Internal Battery Cable Kit (DC Only) — PL-8017-E

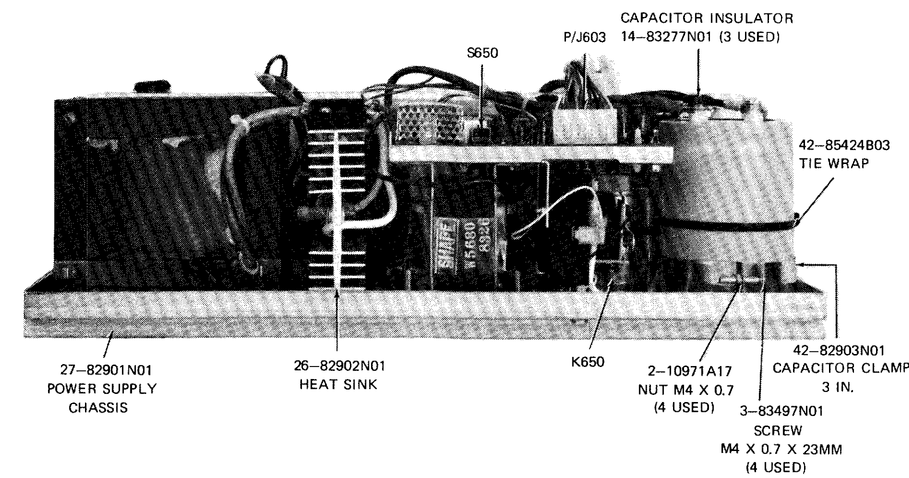
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J605		assembly connector, includes:
	15-83502N01	HOUSING, single contact; 2 used
	39-83503N02	CONTACT, battery; 2 used
		mechanical parts
	7-83504N01	BRACKET, male mounting
	7-83505N01	BRACKET, female mounting
	2-10971A18	NUT, machine: M5 x 0.8; 2 used
	3-83497N02	SCREW, machine: M5 x 0.8 x 12 mm; 2 used
	4-7658	WASHER, lock: #10 internal; 2 used
	42-10217A02	STRAP, tie: .091 x 3.62; 3 used

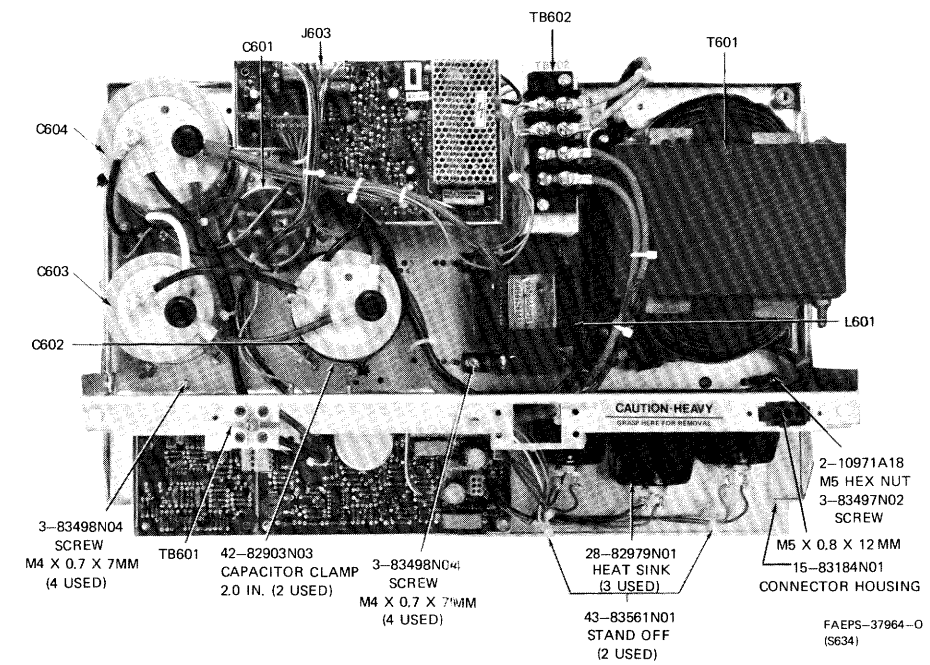
TRN5153A Battery Charger PS. Hardware Kit — PL-8018-C

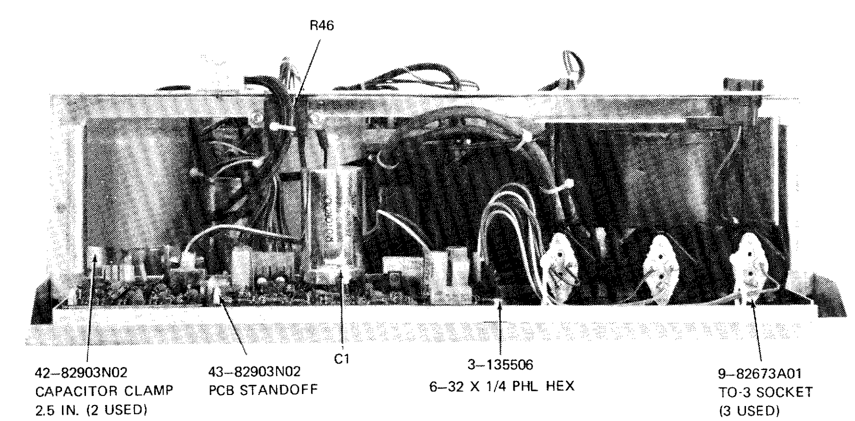
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil, rf:
L650	25-82419N05	65 mh
		connector, plug:
P606	15-83142M08	HOUSING, 4 position
		relay:
K650	80-83013N01	1 form "C"; coil res. 70 ohms
		mechanical parts
	2-10971A17	NUT, machine: M4 × 0.7 hex
	3-83497N03	SCREW, machine
	3-83497N02	SCREW, machine: M5 × 0.8 × 12mm
	3-83498N04	SCREW, tapping: M4 × 0.7 × 7mm; 4 used
	3-83498N06	SCREW, tapping: M4 × 0.7 × 16mm; 2 used
	4-7651	LOCKWASHER: #8 internal; 3 used
	5-82904N02	GROMMET, transformer; 4 used
	7-83364N01	BRACKET, charger board
	15-83901N01	COVER, battery: option, board
	29-82907N02	TERMINAL, ring; 2 used
	29-83113N03	TERMINAL, right angle; 2 used
	39-82717M01	CONTACT, receptacle; 4 used
	39-83503N02	CONTACT, battery connector; 2 used
	2-10971A18	NUT; M5 × 0.8
	4-7658	LOCKWASHER; #10 internal
	14-83986N01	INSULATOR
	29-82907N05	TERMINAL, ring: 10 ga.; 2 used
	43-82980N03	STANDOFF; 6 used
	42-10217A02	STRAP, tie: nylon
	54-83971N01	LABEL

TRN5155A External Battery Cable Kit — PL-8059-C

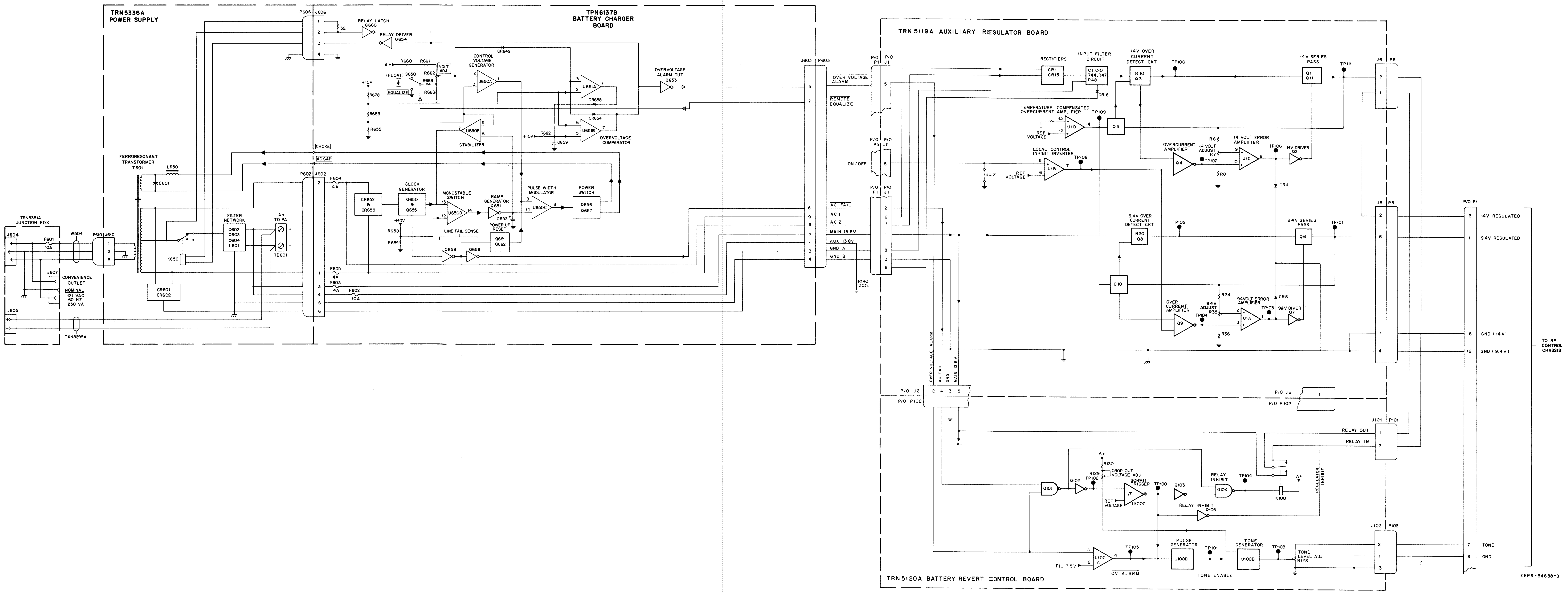
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F610	65-82846N01	60 amp; 300 V
		connector, plug:
P605		assembly, connector; includes:
	15-83502N01	HOUSING, single contact; 2 used
	39-83503N02	CONTACT, battery; 2 used
		mechanical parts
	3-138490	SCREW, tapping: 8-18 x 1 1/4"; 2 used
	9-82842N01	BLOCK, fuse
	29-847817	LUG, ring tongue; 2 used
	42-10217A02	STRAP, tie; 3 used



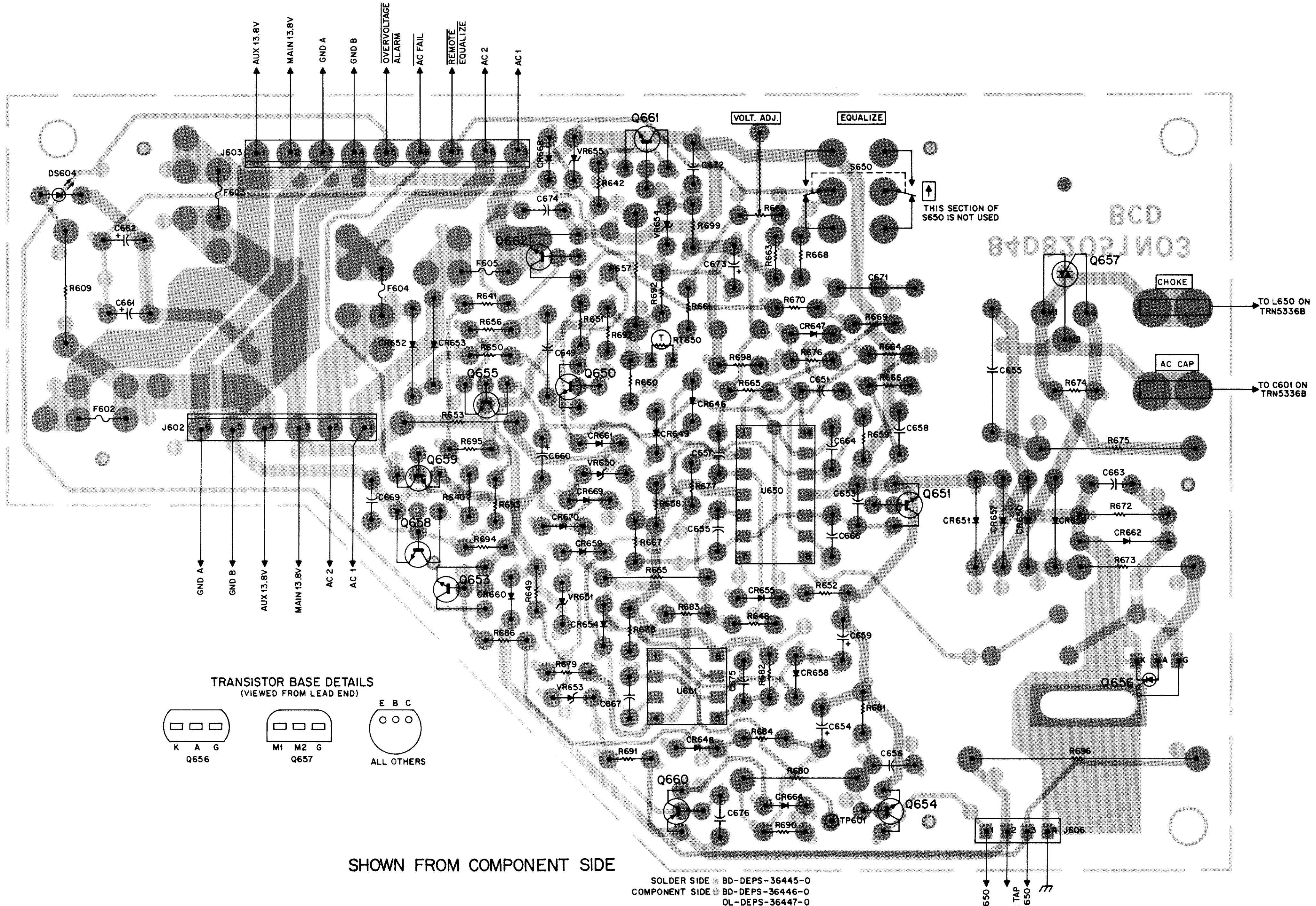




OPTION C28AN
BATTERY CHARGER POWER SUPPLY
FUNCTIONAL BLOCK DIAGRAM



OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



TRN5336A Standard Power Supply, and TPN6137B Battery Charger Board Schematic Diagram, Circuit Board Detail, and Parts Lists
Motorola No. ***PEPS-34740-D***
(Sheet 1 of 2)
9/30/85- UP

parts list

TPN6137B Battery Charger Circuit Board — PL-8495-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 20%; 25 V: unless otherwise stated
C649	21-82372C05	0.2 + 80-20%
C650	8-84637L34	.33 ± 10%; 50 V
C651	8-11017A09	.015 ± 5%; 50 V
C653	8-11017A10	.018 ± 5%; 50 V
C654	23-11019A40	47
C655	8-82860N01	.047 ± 10%, 250 V
C656, 657, 658	21-11014H32	20 pF ± 5%; 100 V
C659	23-11019A40	47 ± 10%
C660	23-11019A11	2.2; 50 V
C661, 662	23-11019A48	220; 10 V
C663 thru 667	21-11014H32	20 pF ± 5%; 100 V
C668	21-83596E20	.01 ± 20%; 1000 V
C669	21-11014H32	20 pF ± 5%; 100 V
C670		NOT USED
C671	8-84637L22	.22 ± 10%; 100 V
C672	21-11014H32	20 pF ± 5%; 100 V
C673	23-11019A46	100 ± 20%; 25 V
C674, 675, 676	21-11014H32	20 pF ± 5%; 100 V
		diode: (see note)
CR646 thru 649	48-11034D01	silicon
CR650, 651	48-82466H18	silicon
CR652, 653	48-82466H13	silicon
CR654, 655	48-11034D01	silicon
CR656, 657	48-82466H18	silicon
CR658, 659	48-11034D01	silicon
CR660	48-82466H18	silicon
CR661	48-11034D01	silicon
CR662	48-83654H01	silicon
CR663, 664, 665	48-11034D01	silicon
CR668, 669, 670	48-11034D01	silicon
		light emitting diode: (see note)
DS604	48-84404E04	green
		fuse:
F602	65-139767	10 amp; 32 V
F603, 604, 605	65-82859N01	4 amp; 32 V
		connector, plug:
J602	28-82984N06	male; 6-contact
J603	28-82984N10	male; 9-contact
J606	28-83143M05	male; 4-contact
		transistor: (see note)
Q650	48-869643	PNP; type M9643
Q651	48-869642	NPN; type M9642
Q653	48-869642	NPN; type M9642
Q654	48-869648	NPN; type M9648
Q655	48-869643	PNP; type M9643
Q656	48-82604N01	silicon controlled rectifier
Q657	48-82965F02	TRIAC; 15 amp; 800 V
Q658	48-869642	NPN; type M9642
Q659	48-869528	NPN; type M9528
Q660	48-869643	PNP; type M9643
Q661, 662	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R609	6-125C51	1.2k ± 10%; 1/2 W
R640, 641	6-11009E49	1k
R642	6-125A33	220; 1/2 W
R648	6-11009E89	47k
R649	6-11009E61	3.3k
R650	6-11009E56	2k
R651	6-11009E63	3.9k
R652	6-11009E60	3k
R653	6-125A31	180; 1/2 W
R655	6-84640C25	2.1k ± 1%
R656	6-11009E56	2k
R657	6-125C35	270; 1/2 W
R658	6-11009F12	390k
R659	6-11009F08	270k
R660	6-11009E57	2.2k
R661	6-11009E67	5.6k
R662	18-82374N10	variable: 1k; 0.25 W
R663	6-11009E61	3.3k
R664	6-11009E63	3.9k
R665	6-11009E85	33k
R666	6-11009E53	1.5k
R667	6-11009F10	330k
R668	6-11009E83	27k
R669	6-11009E89	47k
R670	6-11009E55	1.8k
R672	6-11009E49	1k
R673	6-125C59	2.7k ± 10%; 1/2 W
R674	6-11009E29	150
R675	6-126A49	1k; 1 W, 5%
R676	6-11009E65	4.7k
R677	6-11009E89	47k
R678	6-11009E55	1.8k
R679	6-11009E44	620
R680	6-125A45	680; 1/2 W, 5%
R681	6-11009E53	1.5k

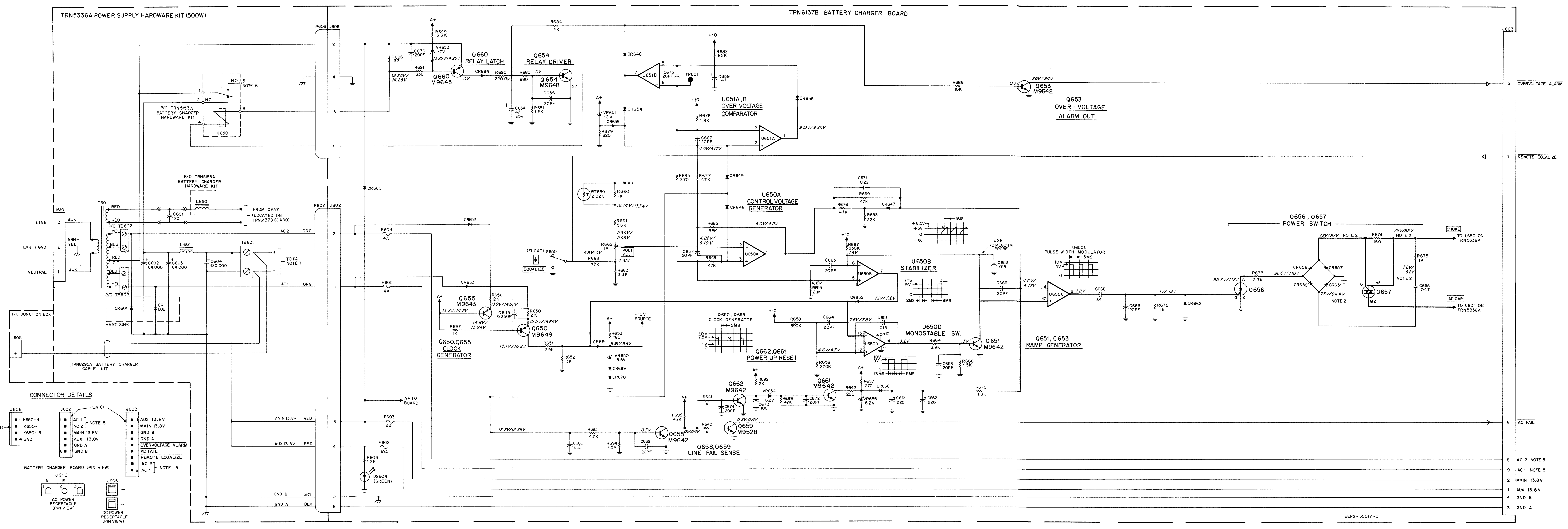
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R682	6-11009E95	82k
R683	6-11009E35	270
R684	6-11009E57	2k
R686	6-11009E73	10k
R690	6-11009E33	220
R691	6-11009E37	330
R692	6-11009E56	2k
R693	6-11009E65	4.7k
R694	6-11009E53	1.5k
R695	6-11009E65	4.7k
R696	17-82177B02	32; 5 W
R697	6-11009E49	1k
R698	6-11009E81	22k
R699	6-11009E89	47k
		thermistor:
RT650	6-82769A08	2.02k @ 25°C
		switch:
S650	40-83204B02	dpdt
		integrated circuit: (see note)
U650	51-83629M58	quad operational amplifier
U651	51-83629M77	dual operational amplifier
		voltage regulator:
VR650	48-82256C56	Zener; 8.8 V
VR651	48-82256C25	Zener; 12 V
VR652	48-83461E40	Zener; 5.1 V
VR653	48-82256C63	Zener; 17 V
VR654, 655	48-83461E30	Zener; 6.2 V
		mechanical parts
	2-10971A16	NUT; M3-0.5
	3-83497N04	SCREW, machine: M3 × 0.5 × 8mm
	4-7683	LOCKWASHER, #4 internal
	14-83820M02	INSULATOR, transistor
	26-84275L01	HEAT SINK
	29-82906N01	TERMINAL, blade fuse; 8 used
	29-10231A10	TERMINAL, mounting faston; 2 used

TRN5336A Power Supply Hardware Kit (500 W) — PL-8020-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C601	8-82682N01	20 uF ± 6%; 330 V
C602,603	23-82681N01	64,000 uF + 75-7%; 20 V
C604	23-82681N02	120,000 uF + 75-10%; 20 V
		diode: (see note)
CR601,602	48-82732C09	silicon
		connector, receptacle:
P602	9-83360N01	female; 6 contact
		coil:
L601	25-82686N01	choke; 420 uH
		transformer:
T601	25-82253N01	power: 500 W; 60 Hz
		terminal, board:
TB601	31-83576K02	2-terminals
		mechanical parts
	2-10971A17	NUT, machine: M4 x 0.7 hex; 4 used
	3-10907A55	SCREW, machine: M6 x 1 x 25mm; 4 used
	3-83497N01	SCREW, machine: M4 x 0.7 x 25mm; 4 used
	3-83498N04	SCREW, tapping: M4 x 0.7 x 7mm; 18 used
	3-83498N06	SCREW, tapping: M4 x 0.7 x 16mm; 3 used
	3-83678N02	SCREW, tapping; M3 x 0.5 x 5mm
	4-7651	LOCKWASHER, #8 internal; 12 used
	4-83499N01	WASHER, insulator; 3 used
	4-7658	LOCKWASHER, #10 internal; 25 used
	5-82904N01	GROMMET; 4 used
	14-83277N01	INSULATOR, lug; 3 used
	14-84088N01	INSULATOR, cap terminals; 2 used
	14-84548A01	INSULATOR, washer; 2 used
	26-82902N01	HEAT SINK
	29-82607B09	LUG, ring tongue; 2 used
	29-82607B05	LUG, ring tongue; 4 used
	29-82907N05	TERMINAL, ring (YEL) 6 used
	29-82907N07	TERMINAL, ring; (RED) 2 used
	29-83113N01	TERMINAL, right angle; 6 used
	29-83137N01	TERMINAL, splice; 2 used
	39-83146N01	CONTACT, socket
	42-85238	CLAMP, cable; 2 used
	42-10217A02	STRAP, tie; .091 x 3.62; 16 used
	42-35424B03	STRAP, tie: .094 x 14; 3 used
	42-82903N01	CLAMP, cap; 2"
	42-82903N02	CLAMP, cap: 2 1/2"; 2 used
	42-82903N03	CLAMP, cap; 3"
	29-82907N06	TERMINAL, ring (BLU)
	54-83971N01	LABEL; 2 used
	54-84046N01	LABEL
	75-83056P01	PAD, snap-on
	31-811350	TERMINAL, board; 4 terminal

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A

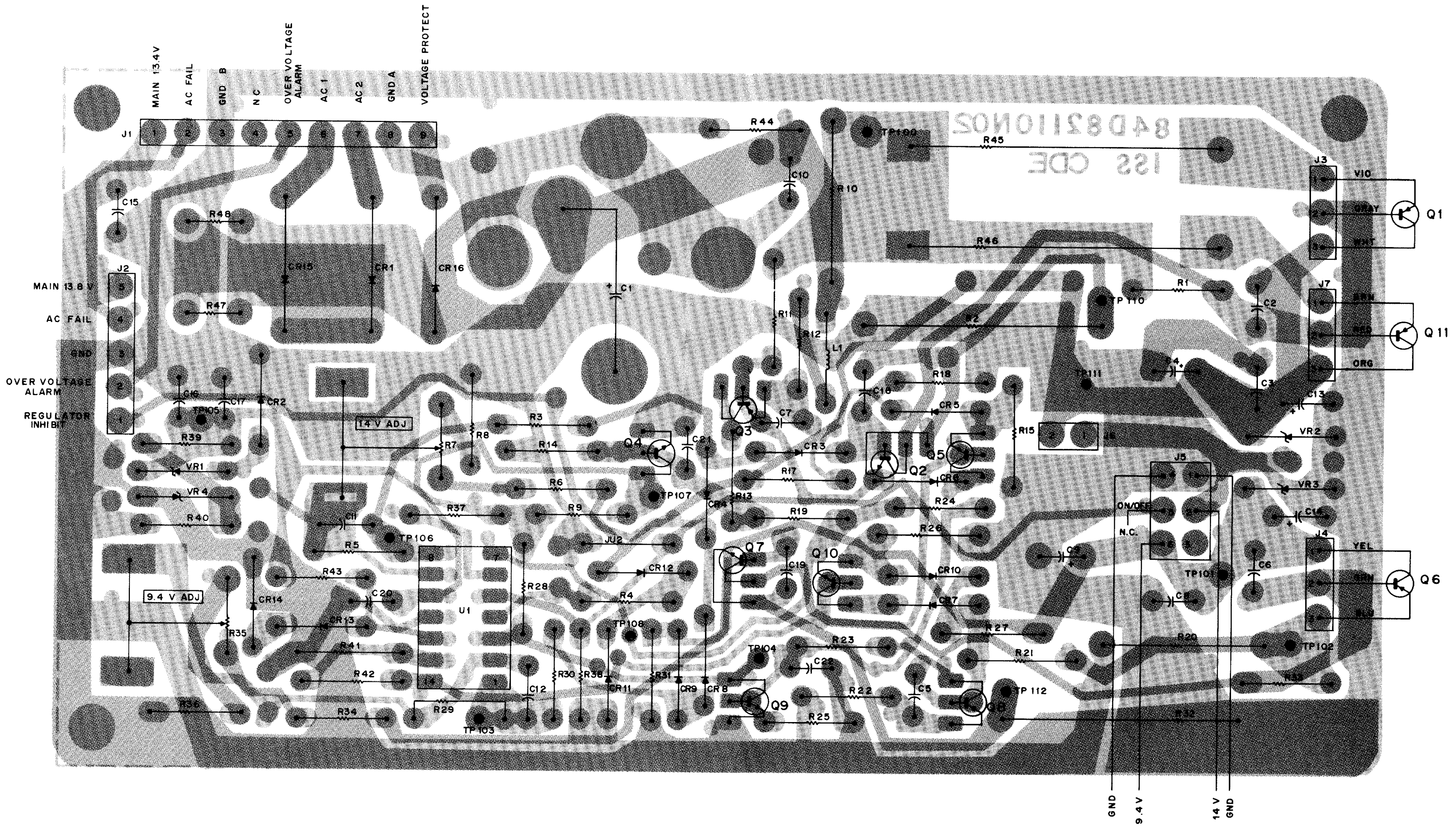


NOTES:

1. Unless specified otherwise, all capacitor values are in microfarads and resistor values in ohms.
2. Waveform is non-sinusoidal. Voltage in recorded rms.
3. Voltages measured with DVM, with 1 meg ohm or greater input impedance.
4. Voltages measured correspond to SW650 = float position/equalize position, 120 V ac line, 2A load current, with output voltage set to 13.2 V in the float position by R662. Voltage measured @ TB601.
5. Used in MSR 2000 stations only.
6. To J1-9 of TRN5119A Auxiliary regulator board in MSR 2000 stations only.
7. The + and — wires from TB601 connect to TB801 on MSR 2000 stations and directly to the power amplifier on MSF 5000 stations.

TRN5336A Standard Power Supply, and TPN6137B Battery Charger Board Schematic Diagram, Circuit Board Detail, and Parts Lists
*Motorola No. **PEPS-34740-D***
(Sheet 2 of 2)
9/30/85- UP

OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



SHOWN FROM COMPONENT SIDE

SOLDER SIDE ▪ BD DEPS-34349-A
COMPONENT SIDE ▪ BD DEPS-34350-A
OL DEPS-34351-A

TRN5119A Auxiliary Regulator Board
Schematic Diagram, Circuit Board Detail,
and Parts Lists
Motorola No. ***PEPS-34738-C***
(Sheet 1 of 2)
9/30/85-UP

parts list

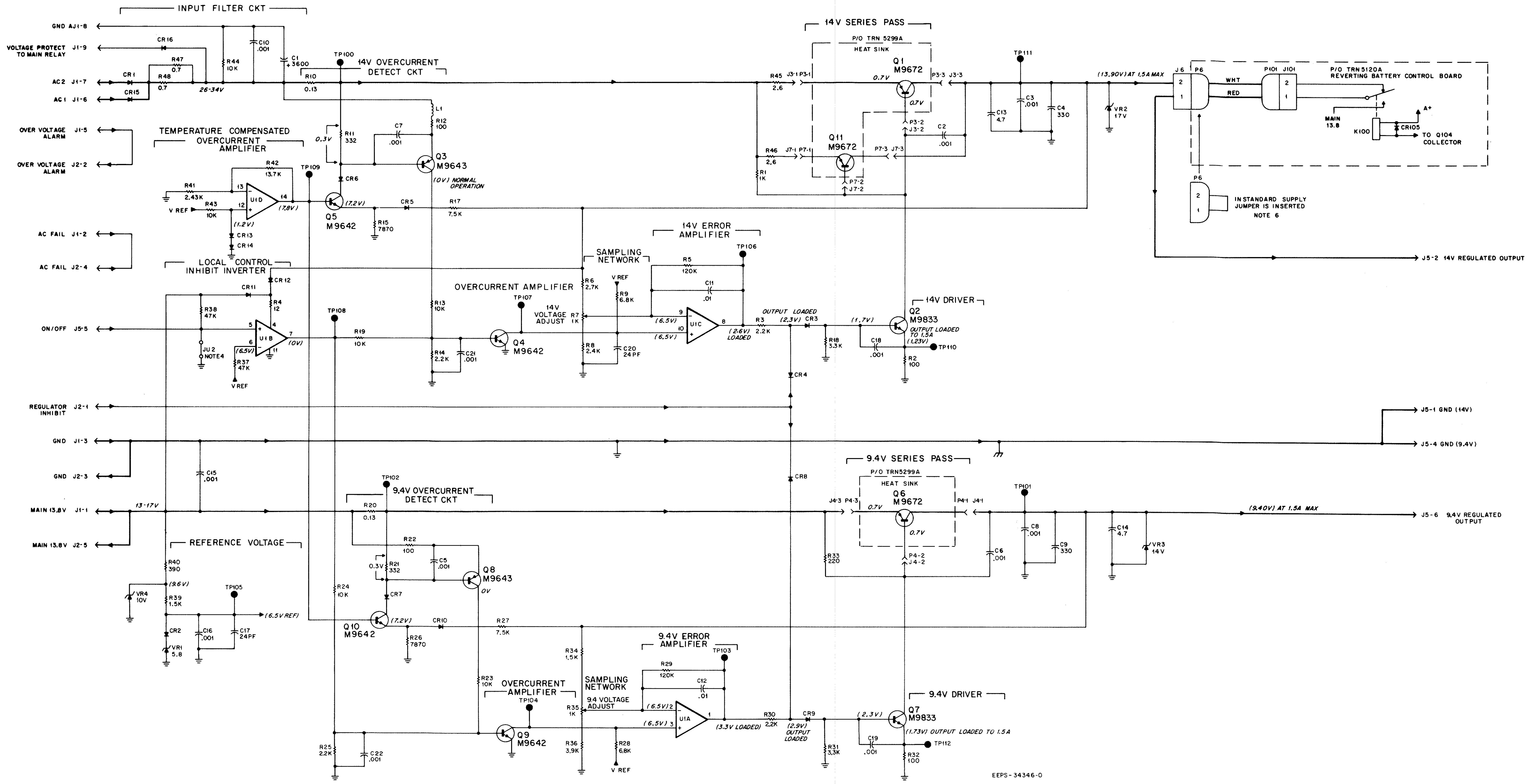
TRN5119A Auxiliary Regulator Board — PL-7945-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF: unless otherwise stated:
C1	23-82394A19	3600 +150-10%; 40 V
C2, 3	21-11015B13	.001 ±10%; 100 V
C4	23-84665F15	330 +10-50%; 25 V
C5 thru 8	21-11015B13	.001 ±10%; 100 V
C9	23-84665F15	330 +10-50%; 25 V
C10	21-11015B13	.001 ±10%; 100 V
C11, 12	21-82428B21	.01 +10-30%; 100 V
C13, 14	23-84538G02	4.7 ±20%; 20 V
C15, 16	21-11015B13	.001 ±10%; 100 V
C17	21-11022G39	24 pF ±5%; 50 V
C18, 19	21-11015B13	.001 ±10%; 100 V
C20	21-11022G39	24 pF ±5%; 50 V
C21, 22	21-11015B13	.001 ±10%; 100 V
		diode: (see note)
CR1	48-82525G13	silicon
CR2 thru 12	48-83654H01	silicon
CR13, 14	48-82392B18	silicon
CR15	48-82525G13	silicon
CR16	48-82525G19	silicon
		connector, receptacle:
J1	29-82984N12	male; 8-contact
J2	9-83497F08	female, 5-contact
J3	28-82984N02	male; 3-contact
J4	28-82984N03	male; 3-contact
J5	1-80754D88	Assembly connector, consists of:
	15-84953L01	Housing, receptacle; 6-position
	39-82977N01	Contact, receptacle; 6 used
J6	28-82984N01	male; 2-contact
J7	28-82984N02	male; 3-contact
		jumper:
JU2	6-11009B23	"0" ohms
		coil, rf:
L1	24-83961B01	choke
		transistor: (see note)
Q2	48-869633	NPN; type M9833
Q3	48-869643	PNP; type M9643
Q4, 5	48-869642	NPN; ype M9642
Q7	48-869633	NPN; type M9833
Q8	48-869643	PNP; typ M9643
Q9, 10	48-869642	NPN; type M9642
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009A49	1k
R2	17-82177B16	100 ±10%; 5 W
R3	6-11009A57	2.2k
R4	6-11009A03	12
R5	6-11009A99	120k
R6	6-11009A59	2.7k
R7	18-83083G14	var. 1k
R8	6-11009A58	2.4k
R9	6-11009A69	6.8k
R10	17-82036G24	0.13; 2 W
R11	6-84444A01	332 ±1%; 1/8 W
R12	6-11009A25	100
R13	6-11009A73	10k
R14	6-11009A57	2.2k
R15	6-10621C81	7.87k ±1%; 1/8 W
R17	6-10621C79	7.5k ±1%; 1/8 W
R18	6-11009A61	3.3k
R19	6-11009A73	10k
R20	17-82036G24	0.13; 2 W
R21	6-84444A01	332 ±1%; 1/8 W
R22	6-11009A25	100
R23, 24	6-11009A73	10k
R25	6-11009A57	2.2k
R26	6-10621C81	7.87k ±1%; 1/8 W
R27	6-10621C79	7.5k ±1%;1/8 W
R28	6-11009A69	6.8k
R29	6-11009A99	120k
R30	6-11009A57	2.2k
R31	6-11009A61	3.3k
R32	17-82177B16	100 ±10%; 5 W
R33	6-11009A33	220
R34	6-11009A53	1.5k
R35	18-83083G14	var. 1k
R36	6-11009A63	3.9k
R37, 38	6-11009A89	47k
R39	6-11009A53	1.5k
R40	6-11009A39	390
R41	6-10621C27	2.43k ±1%
R42	6-10621D05	13.7k ±1%; 1/8 W
R43, 44	6-11009A73	10k
R45, 46	17-82177B64	2.6; 10 W
R47, 48	17-82177B12	0.7 ±10%; 5 W
		integrated circuit: (see note)
U1	51-83629M08	quad op amp

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR1	48-82256C61	Zener, 5.8 V
VR2	48-82256C63	Zener, 17 V
VR3	48-82256C13	Zener, 14 V
VR4	48-82256C11	Zener, 10 V

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



NOTES:

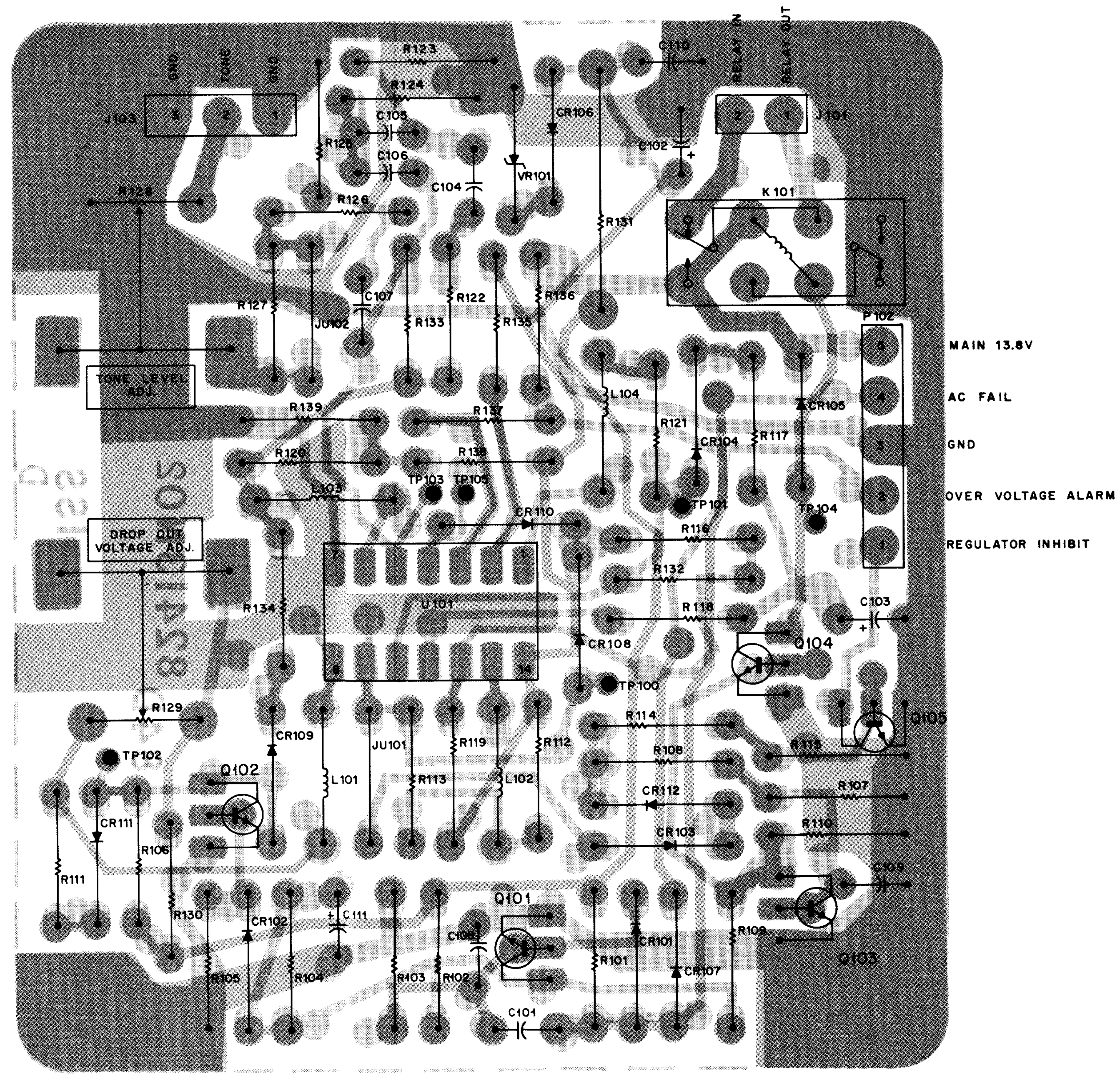
1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries.
2. Integrated circuits on this board are silicon monolithic.
3. IC types and connections for this board are as follows:

Reference Designation	VCC	Gnd	Mfgr's Description
U1	4	11	Op-Amp

4. Remove JU2 when on/off switch (in local control models) is used.
5. DC voltages are nominal. Full rated load. ( ) Other - no load voltages.
6. For non-battery supply (standard supply) insert connector jumper.

TRN5119A Auxiliary Regulator Board Schematic Diagram, Circuit Board Detail, and Parts Lists
Motorola No. ***PEPS-34738-C***
(Sheet 2 of 2)
9/30/85- UP

OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



SHOWN FROM COMPONENT SIDE

SOLDER SIDE BD CEPS-34352-A
COMPONENT SIDE BD CEPS-34353-A
OL CEPS-34354-A

TRN5120A Battery Revert Control Board
Schematic Diagram, Circuit Board Detail,
and Parts Lists
Motorola No. PEPS-34742-A
(Sheet 1 of 2)
10/31/83 -UP

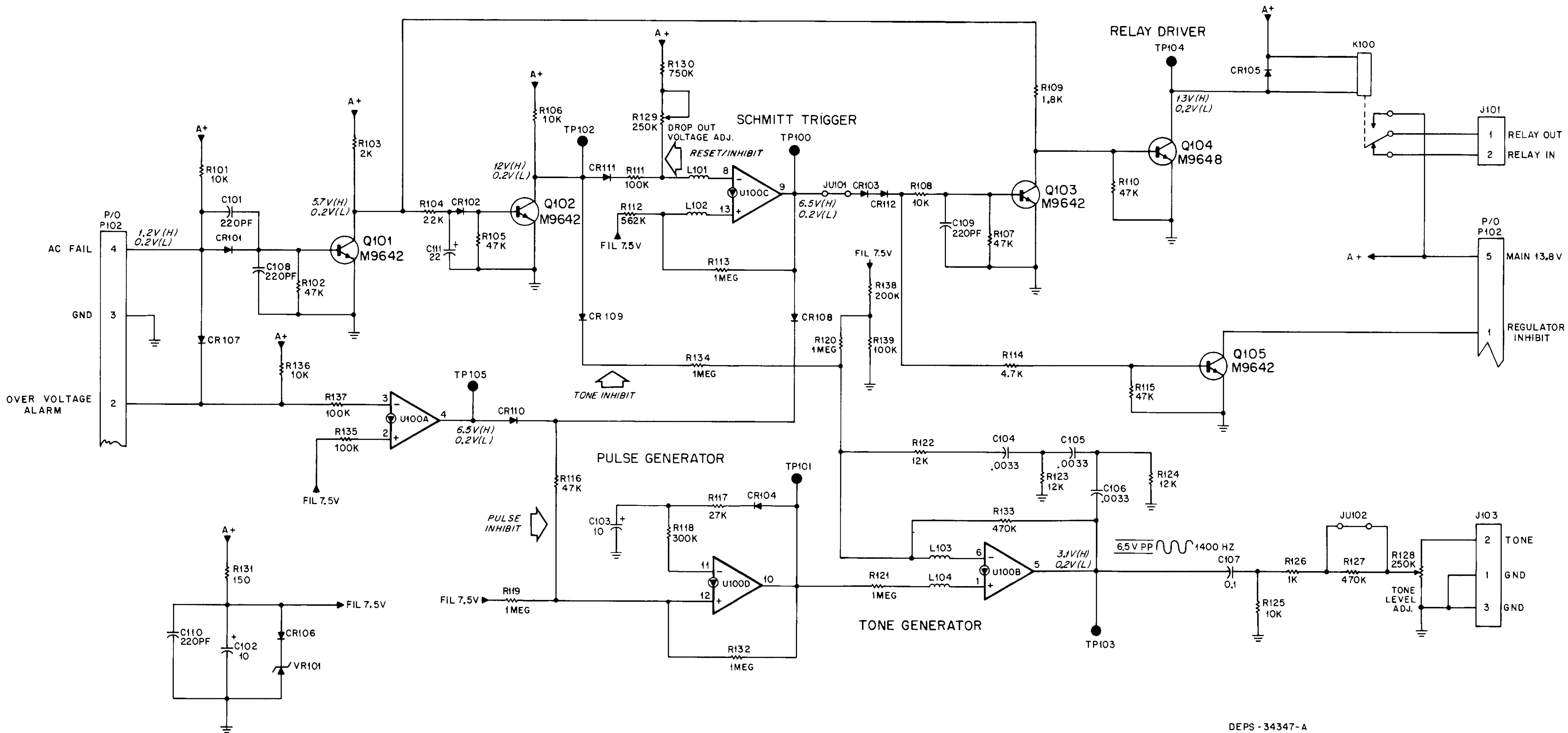
parts list

TRN5120A Battery Revert Control Board PL-7946-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF: unless otherwise stated
C101	21-11015B05	220 pF ± 10%; 100 V
C102	23-11019A20	10 ± 20%; 25 V
C103	23-11013C07	10 ± 10%; 15 V
C104, 105, 106	8-11017A05	.0033 ± 5%; 50 V
C107	8-11017B17	0.1 ± 10%; 50 V
C108, 109, 110	21-11015B05	220 pF ± 10%; 100 V
C111	23-11019A27	22 ± 20%; 25 V
		diode: (see note)
CR101 thru 104	48-83654H01	silicon
CR105, 106	48-82466H18	silicon
CR107 thru 112	48-83654H01	silicon
		connector, receptacle:
J101	28-82984N01	male, 2-contact
J103	28-82984N02	male; 3-contact
		jumper:
JU101, 102	6-11009B23	resistive
		relay:
K100	80-84134D01	dpdt
		coil, rf:
L101 thru 104	24-83961B02	5-turns; coded GRN
		connector, plug:
P102	28-83274N02	male: 5-contact; right angle
		transistor: (see note)
Q101, 102, 103	48-869642	NPN; type M9642
Q104	48-869648	NPN; type M9648
Q105	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R101	6-11009A73	10k
R102	6-11009A89	47k
R103	6-11009A56	2k
R104	6-11009A81	22k
R105	6-11009A89	47k
R106	6-11009A73	10k
R107	6-11009A89	47k
R108	6-11009A73	10k
R109	6-11009A55	1.8k
R110	6-11009A89	47k
R111	6-11009A97	100k
R112	6-10621E61	562k ± 1%; 1/8 W
R113	6-11009B22	1 meg
R114	6-11009A65	4.7k
R115, 116	6-11009A89	47k
R117	6-11009A83	27k
R118	6-11009B09	300k
R119, 120, 121	6-11009B22	1 meg
R122, 123, 124	6-11009A75	12k
R125	6-11009A73	10k
R126	6-11009A49	1k
R127	6-11009B14	470k
R128, 129	18-83083G31	var. 250k
R130	6-1100B19	750k
R131	6-126C29	150 ± 10%; 1 W
R132	6-11009B22	1 meg
R133	6-11009B14	470 k
R134	6-11009B22	1 meg
R135	6-11009A97	100k
R136	6-11009A73	10k
R137	6-11009A97	100k
R138	6-11009B05	200k
R139	6-11009A97	100k
		integrated circuit: (see note)
U100	51-83629M72	quad op amp
		voltage regulator: (see note)
VR101	48-83461E42	Zener, 6.8 V
		mechanical parts
	43-82980N01	STAND-OFF, board support; 2 used
	43-82980N02	STAND-OFF, board spacer; 2 used
	15-83498F38	HOUSING, connector: 2-position; 2 used
	29-83499F01	TERMINAL; 4 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



TRN5120A Battery Revert Control Board
Schematic Diagram, Circuit Board Detail,
and Parts Lists
Motorola No. PEPS-34742-A
(Sheet 2 of 2)

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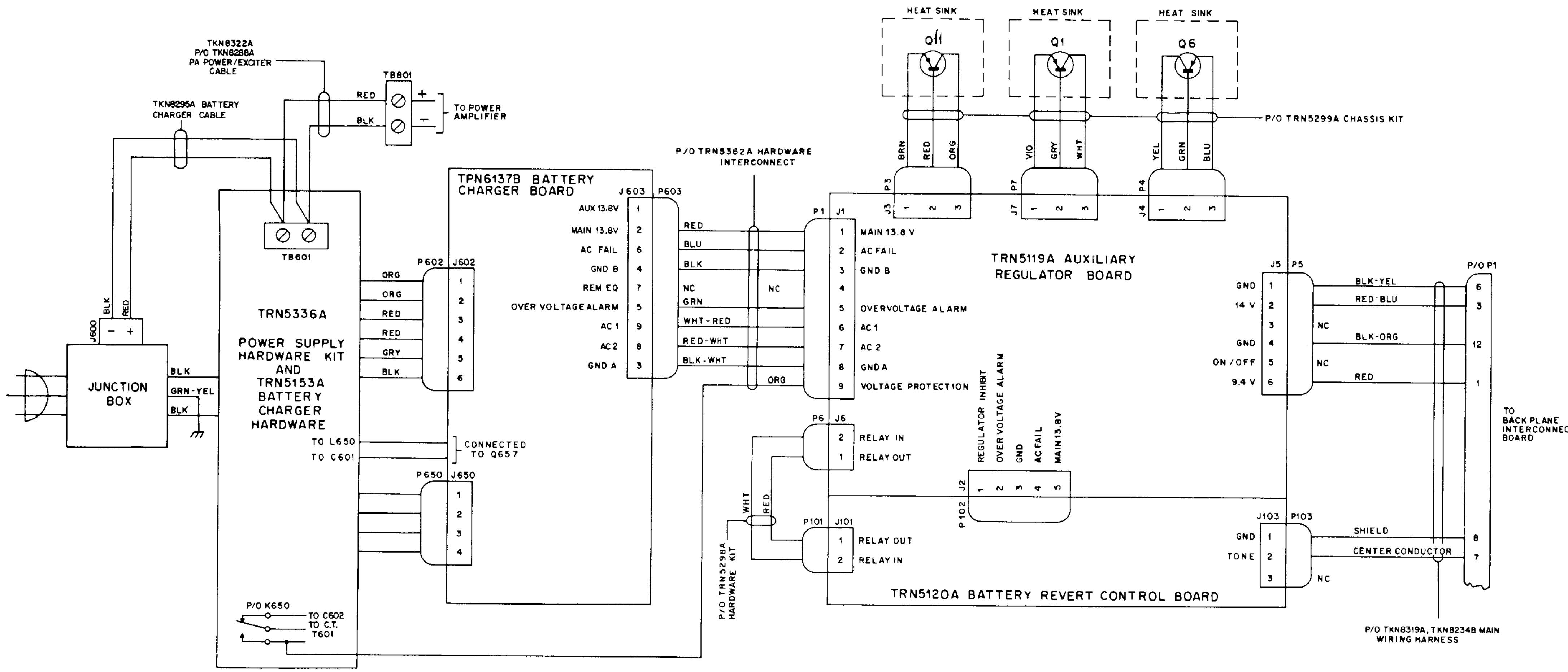
OPTION C28AN
BATTERY CHARGER POWER SUPPLY
MODEL TPN1192A



DEPS-34366-A

TPN1192A Battery Charger Power Supply
Cable Interconnect Wiring Diagram
Motorola No. DEPS-34366-A
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