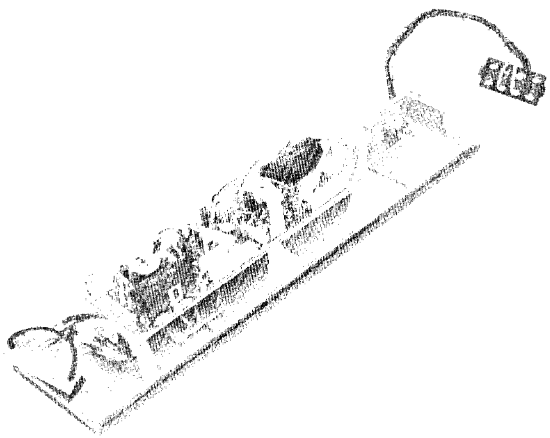
GE MOBILE RADIO

MASTR® Progress Line

POWER REGULATOR MODEL 4EP58A10

Maintenance Manual LBI3941E

DATAFILE FOLDER - DF0066 ***********



EP-58-A

SPECIFICATIONS*

	Voltage	Current
OUTPUT		
Receiver	Regulated +10 volts	125 milliamperes
Receiver Audio	Regulated +10 volts	50 milliamperes
Receiver Muting	Switched +10 volts	2.5 milliamperes
Transmitter Exciter	Continuous +10 volts	155 milliamperes
Transmitter PA	Keyed +10 volts	5 milliamperes
	Keyed 12.5 volts	10 amperes
BATTERY DRAIN		
Transmitter		
25-50 MHz	13.6 volts	10.5 amperes
132-174 MHz	13.6 volts	10.5 amperes
Receiver		
Standby (Squelched)	13.8 volts	200 milliamperes
Standby (Unsquelched)	13.8 volts	1.2 amperes
BATTERY VOLTAGE	13.6 volts ±20%, negative-ground 12-volt system	
TEMPERATURE RANGE	-30°C to +60°C (-22°F to +140°F)	

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with voltage or RF power; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

Transistorized Power Regulator Model 4EP58A10 contains the protective circuits for the transmitter PA stages, and provides all the regulated supply voltages for the two-way radio. Regulation of critical supply voltages provides improved performance over the wide range of input voltages encountered in mobile communications. The power regulator operates in 12-volt, negative ground systems only, and provides the following supply voltages:

- A continuous, regulated +10 volts for the transmitter exciter and receiver.
- A keyed, regulated +10 volts for the transmitter exciter, power detector, receiver muting, power regulator protective circuitry and Channel Guard.
- A keyed, controlled +12.5 volts for the transmitter PA supply.

Supply voltage (+12 volts) for the receiver audio stages, transmitter PA regulator, the 10-volt regulator, antenna switching relay and carrier control timer is taken directly from the vehicle battery. A simplified power distribution and switching diagram is shown in Figure 3.

The 10-volt keying circuit, two stages of the 10-volt regulator, the PA protective circuits and the 1st PA regulator driver are mounted on regulator board A501.

PA regulator transistors Q501 and Q502 and the 10-volt regulator Q503, are mounted on the regulator casting which acts as a heat sink for these stages.

CIRCUIT ANALYSIS

+10 VOLT REGULATOR

The +10 volt regulator provides a closely-controlled supply voltage for the transmitter, receiver, protective circuitry on the power regulator and channel guard board, and carrier control timer option.

Supply voltage from the vehicle battery is applied to the emitter of regulator transistor Q503 through L2, causing the transistor to conduct (see Figure 1). When the output voltage at the collector of Q503 tends to increase, the voltage at the base of Q6 tends to become more positive, causing Q6 to conduct more heavily. This causes the collector voltage of Q6 to become more negative, causing Q5 to conduct harder. With Q5 conducting harder, the voltage at the base of PNP transistor Q503 becomes more positive and Q503 conducts less. This increases the voltage drop across Q503, keeping the output voltage constant.

When the output voltage tends to decrease, Q6 and Q5 conduct less, causing Q503 to conduct harder. This reduces the voltage drop across Q503, keeping the output constant.

Potentiometer R21 and resistors R20 and R22 form a voltage divider so that R20 can be adjusted for a +10-volt output. Zener diode VR3 provides a voltage reference for the regulator. The output can be metered at the receiver centralized metering jack J442.

Diode CR5 provides reverse polarity protection for regulator transistor A503. Inadvertently connecting the battery cables to the wrong polarity will cause the shunt diode to conduct, blowing the main fuse.

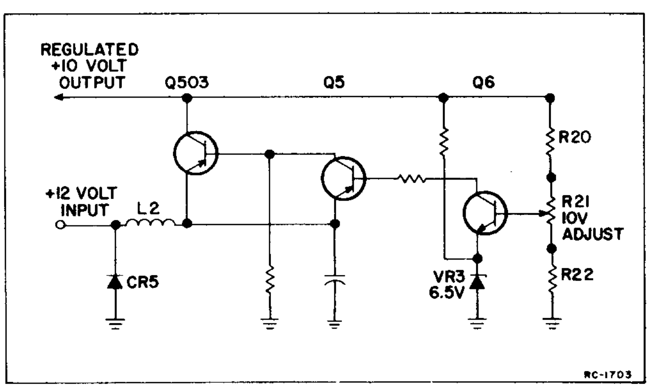


Figure 1 — +10 Volt Regulator Circuit

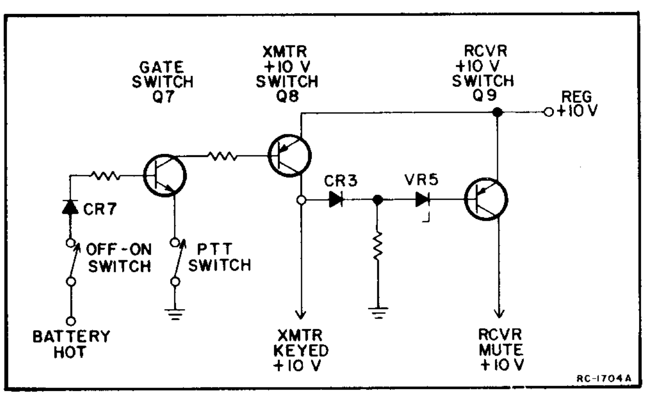
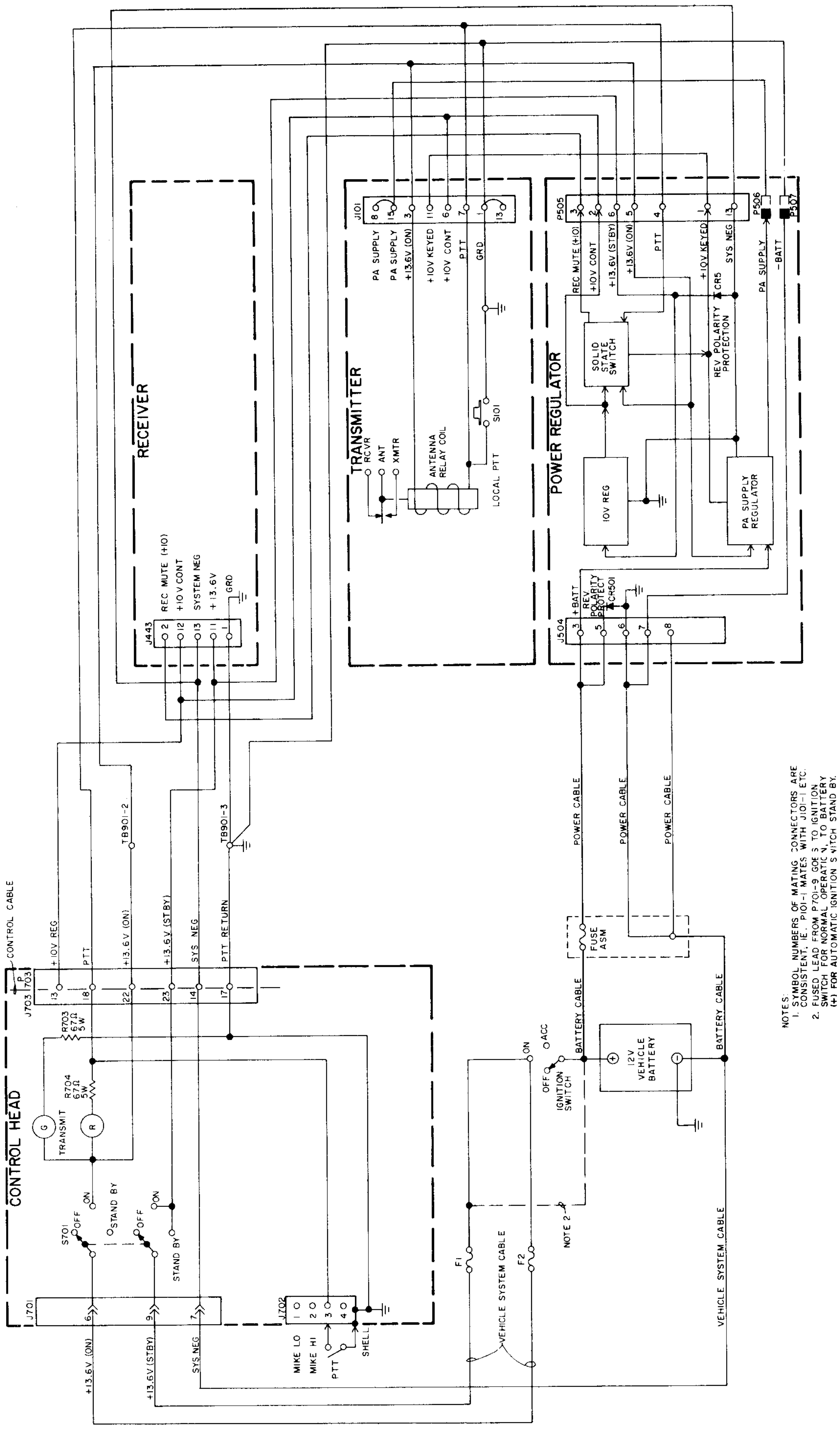


Figure 2 — +10 Volt Keying Circuit



NOTES:
1. SYMBOL NUMBERS OF MATING CONNECTORS ARE CONSISTENT, IE. P101-1 MATES WITH J101-1 ETC.
2. FUSED LEAD FROM P701-9 GOES TO IGNITION SWITCH FOR NORMAL OPERATION, TO BATTERY (+) FOR AUTOMATIC IGNITION SWITCH STAND BY.

Figure 3 - 12-Volt, Negative Ground Power Distribution Diagram

(19D413176, Rev. 1)

KEYED +10 VOLTS

A keyed +10 volts is used to activate the transmitter and squelch the receiver. Turning the OFF-ON switch on the control unit to the ON position applies the vehicle battery voltage to the anode CR7. (see Figure 2). This forward biases the diode so that the battery voltage is applied to the base of gating transistor Q7.

The emitters of transmitter switching transistor Q8 and receiver switching transistor Q9 are supplied with a continuous, regulated +10 volts. When the transmitter is not keyed, the +10 volts at the emitter of Q9 provides sufficient emitter-base bias to breakdown Zener diode VR5, causing Q9 to conduct. When conducting, +10 volts at the collector of Q9 is applied through a voltage divider network to the base of DC amplifier Q9 on the receiver audio board, turning it on. This turns off DC amplifier Q10 which activates the receiver noise squelch circuit.

With the battery voltage applied to the base of Q7, keying the microphone grounds the emitter, causing it to conduct. When conducting, the collector voltage of Q7 drops to ground potential, turning on PNP transmitter switching transistor Q8. The nominal +10-volt collector output voltage is applied to the transmitter exciter board, and to the transmitter PA voltage regulator protective circuitry to key the transmitter. Diode CR7 is connected in series with Q7 to provide polarity protection for the 10-volt switching circuit.

The +10 volts at the collector of Q8 also forward biases CR3 and VR5, turning off receiver switching transistor Q9. This removes +10 volts applied to DC amplifier Q9 on the receiver audio board, turning it off. Turning off Q9 keeps DC amplifier Q10 turned on, which removes the bias voltage to the audio stages, muting the receiver.

Releasing the PTT switch on the microphone turns off the transmitter 10-volt switch (Q8) on the regulator board, turning on the receiver switching transistor Q9. This applies +10 volts to the receiver DC amplifier (Q9), permitting the receiver noise squelch circuit to operate.

PROTECTIVE CIRCUITS

The protective circuits in the power regulator prevent any damage to the transmitter PA transistors that might result from an excessive PA transistor temperature, an excessive output VSWR, or a high input battery voltage. All of the protective circuits affect the action of transmitter PA supply regulator transistor Q501. The transistor acts as a variable resistance in series with the PA supply voltage, and increases or decreases the supply voltage (Vcc) as required. A circuit is also provided to protect Q501 from a short circuit in the PA supply lead.

Temperature Control

Temperature control is provided by thermistor RT1 which is mounted in the heat sink near the transmitter PA transistors. The thermistor is in the emitter biasing circuit of temperature and power control transistor Q4 (see Figure 4).

Under normal operating conditions, Q4

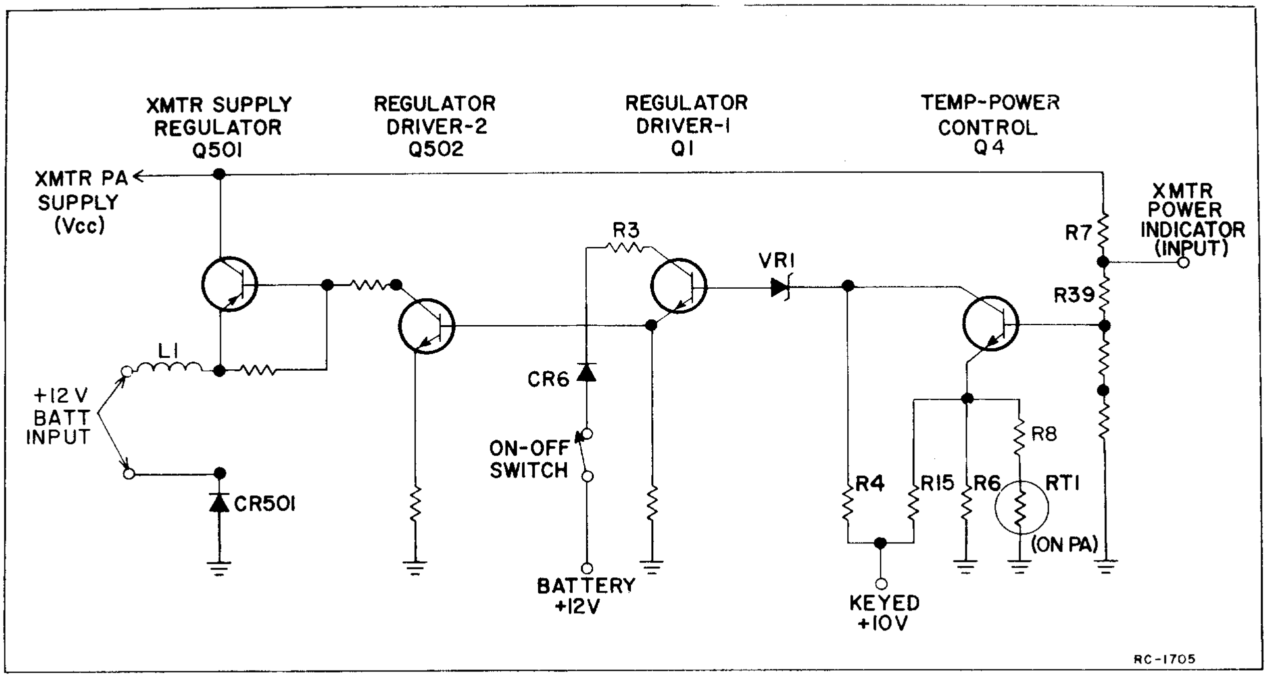


Figure 4 — Temperature Control Circuit

is biased so that it is just below conduction (turned off). When the temperature of the PA heat sink rises, the resistance of thermistor RT1 decreases, decreasing the emitter bias on Q4. If the temperature rises sufficiently, Q4 begins to conduct. When conducting, the collector potential of Q4 becomes more negative, which causes drivers Q1 and Q502 to conduct less.

PA supply regulator Q501 normally operates as a fully saturated stage (minimum resistance across the emitter-collector junction), with the PA supply voltage (Vcc) taken from the collector. When drivers Q1 and Q502 conduct less, the base of Q501 becomes more positive. This reduces the degree of saturation of Q501. Reducing the saturation of Q501 increases the voltage drop from emitter to collector, reducing the Vcc. When the PA heat sink temperature drops, Q4 will conduct less, and drivers Q1 and Q502 will conduct harder. This will cause Q501 to become more fully saturated so that the maximum Vcc will be applied to the transmitter.

Power Control

The power control circuit protects the transmitter PA transistors from the effects of de-tuned amplifier stages, an antenna mismatch or shorted antenna. The circuit is controlled by the differential amplifier in the transmitter power detector assembly.

With normal transmitter power output into a 50-ohm load, Q1 on the differential amplifier conducts and Q2 is turned off. This results in a voltage drop across R7 (on the power regulator board) which reduces the base bias on temperature-power control transistor Q4, keeping it turned off. This causes regulator drivers Q1 and Q502 to conduct heavily (see Figure 5).

A drop in power output reduces the drive to Q1 on the differential amplifier so that it conducts less, reducing the voltage drop across R6. This increases the forward bias on the base of temperature-power control transistor Q4 so that it starts to conduct. With Q4 conducting, regulator drivers Q1 and Q502 conduct less, lowering the degree of saturation of Q501 and reducing the Vcc.

An increase in the VSWR increases the reflected power input to the base of Q2 in the differential amplifier so that it starts to conduct. This causes Q1 to conduct less, due to the emitter bias developed across R5. With Q1 conducting less, the voltage drop across R7 on the power regulator board decreases. This causes the temperature-power control transistor (Q4) to start conducting, reducing the Vcc.

Temperature-power control transistor Q4 also provides some limiting of the Vcc. Under normal power output and temperature conditions, PA supply transistor Q501 operates fully saturated. In this condition, an increase in the vehicle battery voltage will cause an increase in the Vcc. Since the Vcc is connected to the base of control transistor Q4 through a voltage divider network, an increase in the Vcc increases the forward bias on control transistor Q2, causing it to conduct, which reduces the Vcc.

This limiting effect does not work in very low temperatures due to the increase in resistance of the thermistor in the emitter of control transistor Q4. At very low temperatures, the Vcc is limited by top voltage limiter Q2.

Diode CR501 provides reverse polarity protection for the circuit. Inadvertently connecting the battery cables to the wrong polarity will cause the shunt diode to conduct, blowing the main fuse.

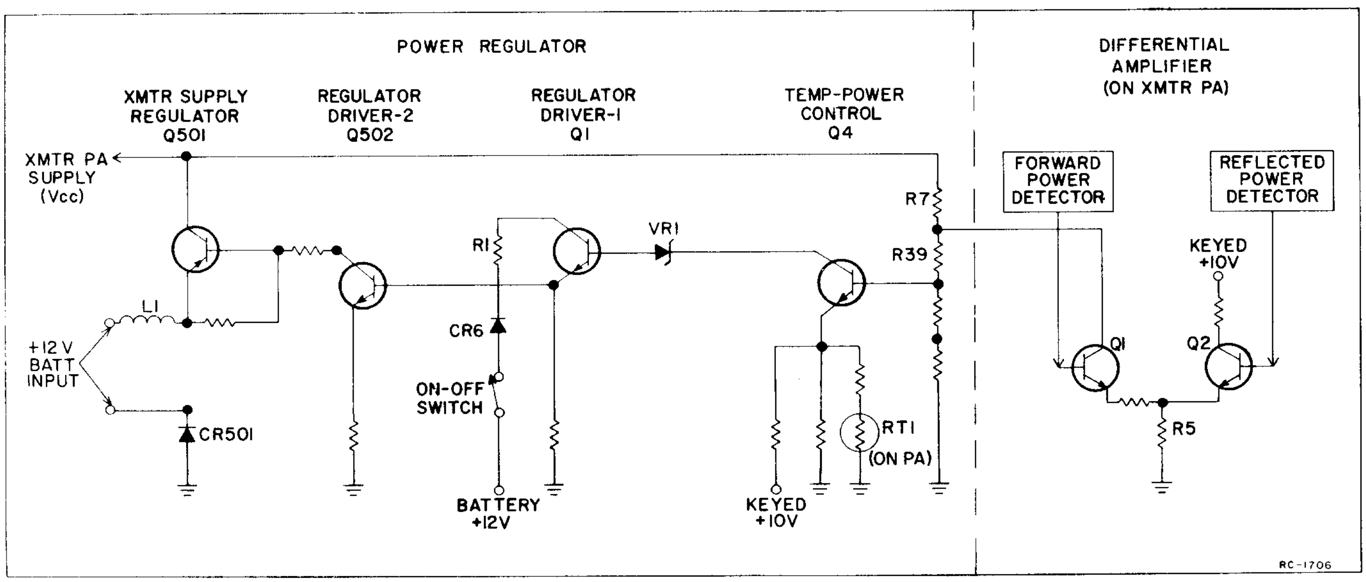


Figure 5—Power Control Circuit

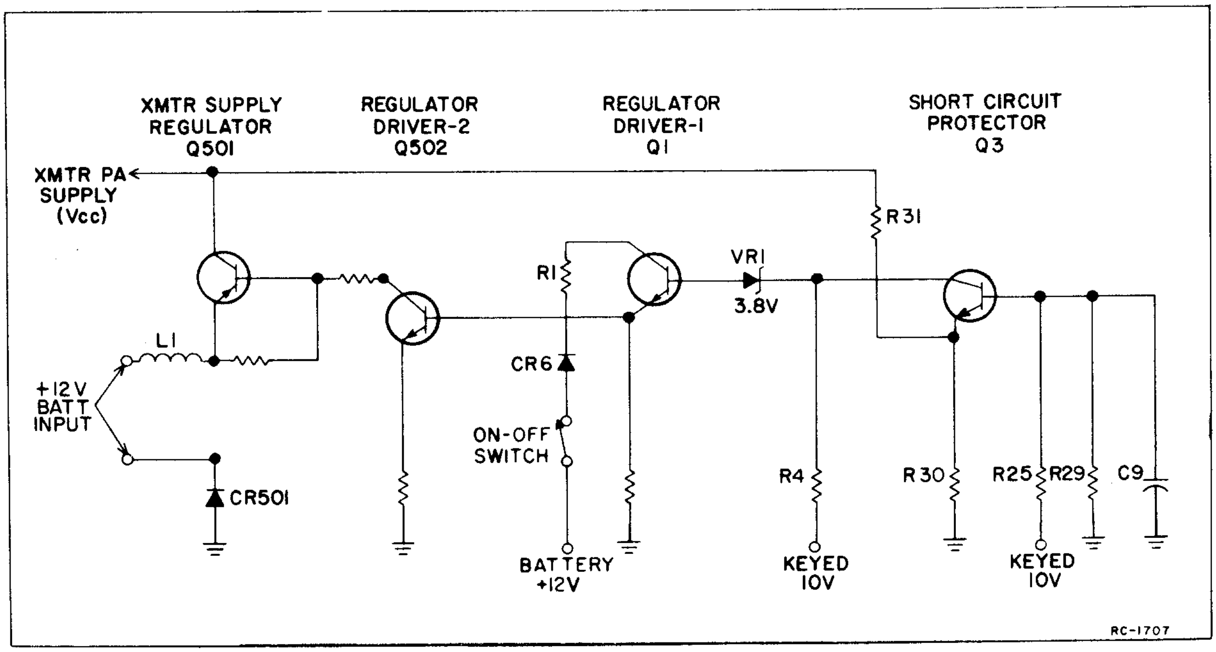


Figure 6—Short Circuit Protector Circuit

Short Circuit Protector

A short circuit protector is provided to protect Q501 from being damaged by a short in the PA supply line. Keying the transmitter applies +10 volt to the circuit, turning on the regulator drivers and Q501 (see Figure 6). The +10 volts is also applied to the collector and base of Q3. However, Q3 does not turn on immediately. Before Q3 can conduct, its base voltage must exceed its emitter voltage by approximately 0.5 volt. In order for this to occur, C9 must charge, which takes approximately eight milliseconds. This time delay permits regulator drivers Q1 and Q502 to turn on, and Q501 to become fully saturated. The supply voltage (Vcc) is then applied through a voltage divider network (R30 and R31) to the emitter of Q3, keeping the transistor turned off.

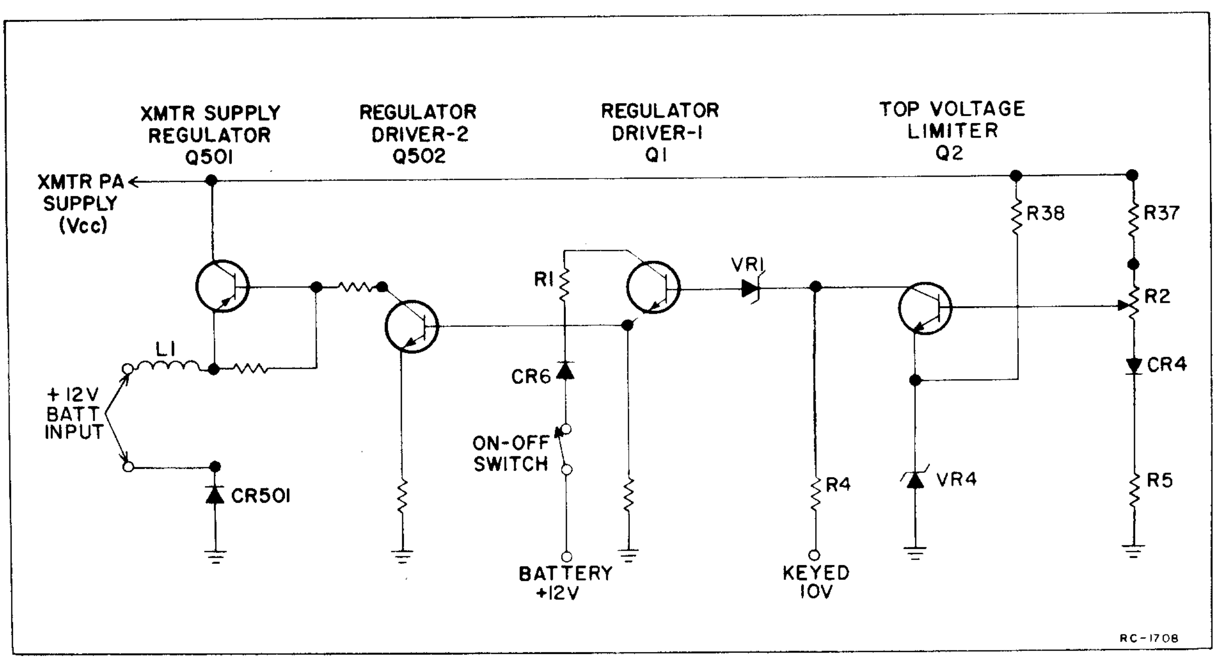


Figure 7—Top Voltage Limiter Circuit

If the supply voltage does not appear at the emitter of Q3, the transistor will turn on as soon as C9 is charged. When conducting, the collector of Q3 drops to near ground potential, removing the breakdown voltage on zener diode VR1. This switches off the regulator drivers and Q501 and removes all power to the transmitter PA. A short in the supply line while the transmitter is keyed also turns on Q3. This switches off Q501 and removes all power to the transmitter PA.

Top Voltage Limiter

With normal power output and moderate ambient temperatures, PA supply transistor Q501 operates fully saturated, so that an increase in battery voltage causes an increase in Vcc. When the Vcc is not high enough for power dissipation to endanger the PA transistors, the power and temperature control circuits will not reduce the Vcc. However, at very low ambient temperatures, a high value of Vcc that would not result in excessive power dissipation might permit RF voltages to rise enough to cause secondary breakdown in the PA transistors. Therefore, the voltage limiter places a top limit on the amount that the Vcc can rise under any condition (see Figure 7).

Keying the transmitter applies the output of Q501 to the cathode of zener diode VR4 and to voltage-divider network R37, R2, CR4 and R5. If the voltage at the base of Q2 exceeds the voltage at the cathode of VR4 by more than 0.6 volt, Q2 will begin to conduct. This causes the regulator drivers (Q1 and Q502) to conduct less, reducing the output of Q501. The maximum voltage is set at the factory for approximately 13 volts.

MAINTENANCE

ADJUSTMENT OF R33 AND R2

If it should be necessary to replace Sensitivity control R33, Top limiter control R2 or power regulator board A501, R33 and R2 must be properly adjusted before operating the radio. Complete instructions for setting R33 and R2 are contained in the Adjustment Procedure on page 9.

HEAT SINK SERVICING

Since the metal envelopes of Q501, Q502 and Q503 are at collector potential, they must be electrically isolated from ground. However, there must be a good path for heat from the transistors to reach the cast aluminum radiator (heat sink) in which they are mounted, so that the heat will be dissipated by the heat sink. The insulators used between the transistors and the heat sink not only isolate the transistors electrically, but also act as a good thermal conductor to conduct heat away from them.

Silicone grease is used on each side of the transistor insulators to improve the thermal contact, and allow the heat to be transferred more readily to the heat sink. Always make sure that there is a coating of silicone grease on each side of the insulator whenever one of the transistors is replaced.

RE-INSTALLATION

The Royal Professional mobile combination operates in 12-volt, negative ground vehicle systems only! If the radio is ever moved to a different vehicle, always check the battery polarity and voltage of the new system before using the radio.

CAUTION

Do not install the Royal Professional in a vehicle system using a circuit breaker. The radio must be operated in a system protected by a 15-amp quick blow fuse (similar to GE Fuse Assembly 19B216021-G4 and fuse 1R11-P4).

DISASSEMBLY (Fig. 8)

To service the power regulator --

1. Pull the locking handle down and pull radio out of mounting frame.
2. Remove the two screws in bottom cover and take off cover.

To remove the power regulator from the system frame --

1. Complete Steps 1 and 2 above.
2. Remove the two Phillips-head retaining screws in the front casting, and pull casting away from system frame.
3. Unplug the power cable and pry power connector out of connector supporting bracket. Next, unplug systems connector and the two clip-on connectors at the back of the power regulator.
4. Lift the Two-Way Radio away from power regulator.

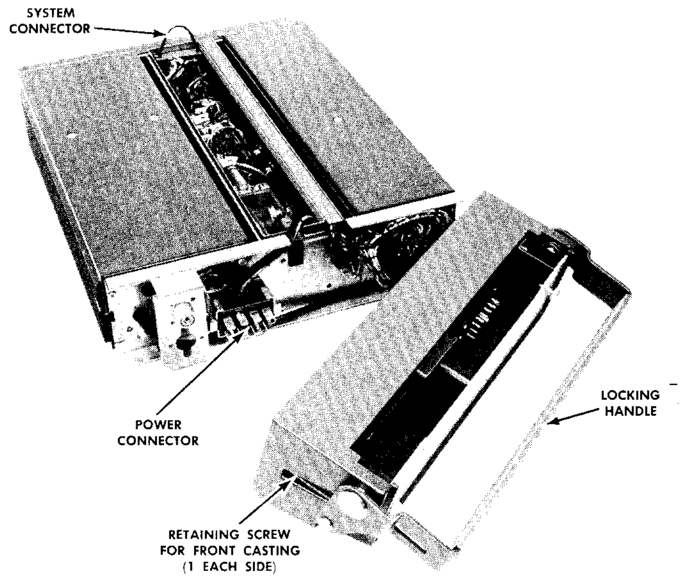


Figure 8—Disassembly of Power Regulator

TROUBLESHOOTING PROCEDURE

POWER REGULATOR MODEL 4EP58A10

This procedure should be used in conjunction with voltage readings on the power regulator schematic diagram (see Table of Contents).

SYMPTOM	PROCEDURE
No PA supply voltage (Vcc) when transmitter is keyed. (Check with GE Test Set Model 4EX3A10 in Position G on the 15-volt scale, and polarity switch in (-) position).	1. Check the 15-amp input fuse in the battery cable. 2. Check for keyed 9.5 volts at J16 on power regulator board A501. If voltage is present, check for approximately 3.5 volts at A501-J2. If voltage is present on J2, check Q501 and Q502. NOTE This reading may vary from 1.8 to 3.5 volts when protective circuits are activated by low power output or high PA heatsink temperature. The base-to-emitter voltage of Q2, Q3 and Q4 should be less than 0.6 volts when the circuits are not activated. 3. Check to see if a continuous 9.5 volts (instead of keyed voltage) is present at J16. A continuous voltage will activate short circuit protector.
No regulated +10 volts.	1. Check input fuse. Check setting of R21. 2. Check for approximately +12 volts at emitter of Q503. If voltage is present, check for shorted Q5.
Vcc applied continuously (transmitter keyed or unkeyed).	1. Check for 12 volts at the collector of Q7. a. If voltage is present, check for shorted Q8. b. If the voltage is not present, check the Push-to-Talk circuit for a short to ground.
Vcc too low.	1. Check for 3.5 volts at A501-J2. If reading is less than 3.5 volts, check to see that protective circuits are not activated (base-to-emitter voltage of Q2, Q3 and Q4 should be less than 0.6 volt if not activated). 2. If voltage at A501-J2 is greater than 3.5 volts, check Q501, Q502 and associated circuitry.
Vcc too high (greater than 13.0 volts).	1. Check for shorted Q501.
No keyed 9.5 volts. (Vcc present)	1. Check wiring from A501-J16.
No keyed 9.5 volts or Vcc.	1. Check for a voltage drop of from 12 volts to approximately zero volts on the collector of Q7 when the transmitter is keyed. a. If no voltage drop, check the wiring from A501-J14 through the PTT circuit. b. If the voltage drop is present, check the base circuit of Q8.

ADJUSTMENT PROCEDURE

If it is necessary to replace power regulator board A501, or either Sensitivity control R33 or Top Limiter control R2 on the power regulator board, follow the procedure listed below. If the power regulator board is replaced, both R33 and R2 (in that order) must be adjusted as directed. If either R33 or R2 is replaced, only the new control must be adjusted as directed.

EQUIPMENT REQUIRED

1. VOM with at least 3% accuracy (Triplett 630 or equivalent)
2. Milliammeter with at least 3% accuracy, and a 0 to 5 milliamp range
3. Variable resistor, 0 to 5000 ohms
4. Fixed resistor, 300 ohms ±5%
5. Variable power source (from 13.6 to 16.3 volts under a 12-ampere load) connected to the vehicle battery cables
6. Cement for securing R33 or R2 after adjustment (Loctite® 404 or equivalent).

> NOTE
>
> The transmitter must be properly aligned and drawing at least 7 amperes of load current before making these adjustments.

ADJUSTMENT OF R33

1. Turn R33 fully in direction of arrow
2. Disconnect the Brown lead from A501-J6 and the White-Orange-Red lead from A501-J8. Connect the 300-ohm fixed resistor from J6 to ground as shown in Figure 1
3. Adjust the power source for 13.6 volts. Then key the transmitter and re-adjust the power source for 13.6 volts if necessary
4. Connect the VOM across P101-8 and P101-13 (ground). Then key the transmitter and adjust R33 according to the applicable procedure as follows:
   - For Revision A and earlier of Model 4EP58A10: carefully adjust R33 for a VOM reading of 9.9 volts.
   - For Revision B or later of Model 4EP58A10: carefully adjust R33 for a VOM reading of 8.5 volts.

> CAUTION
>
> This is a critical adjustment. Failure to adjust R33 correctly may result in damage to the transmitter PA transistors.

5. Apply sufficient cement to secure R33. Then disconnect the 300-ohm resistor from J6, and re-connect the Brown and White-Orange-Red leads.

ADJUSTMENT OF R2

1. Turn R2 fully clockwise (in direction of arrow)
2. Disconnect the Brown lead from A501-J6 and the White-Orange-Red lead from A501-J8. Connect the 5000-ohm variable resistor in series with the milliammeter, and connect one end of the circuit to J8 and the other end to ground as shown in Figure 1.

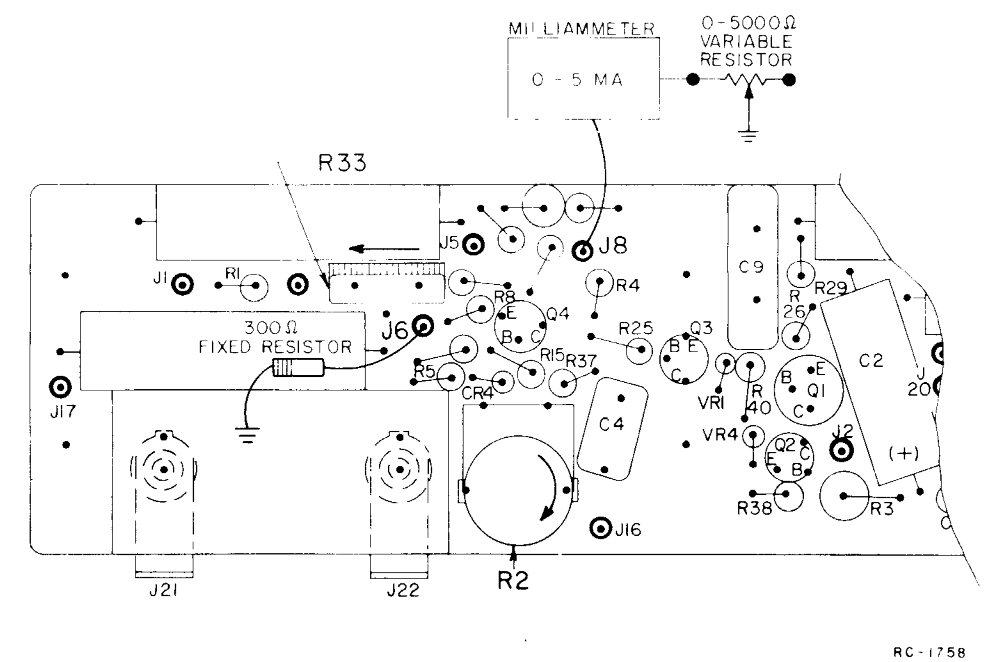
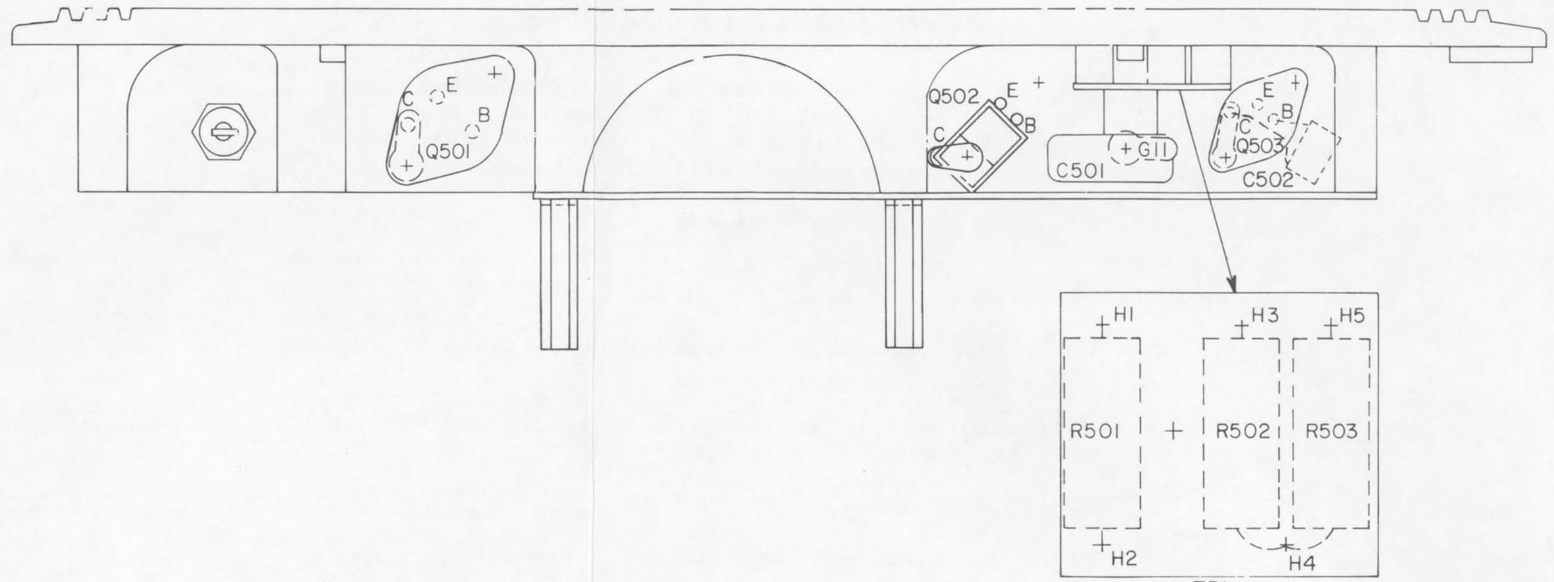


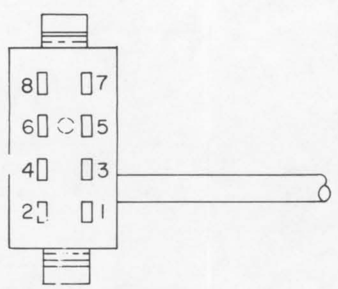
Figure 1 - Power Regulator Board Set-Up

3. Adjust the power source for 16.3 volts. Then key the transmitter and re-adjust the power source for 16.3 volts if necessary.
4. Key the transmitter and adjust the variable resistor for a milliammeter reading of 2.0 milliamps.
5. Key the transmitter and carefully adjust R2 for a VOM reading of 13.0 volts as measured from P101-8 to P101-13 (ground).

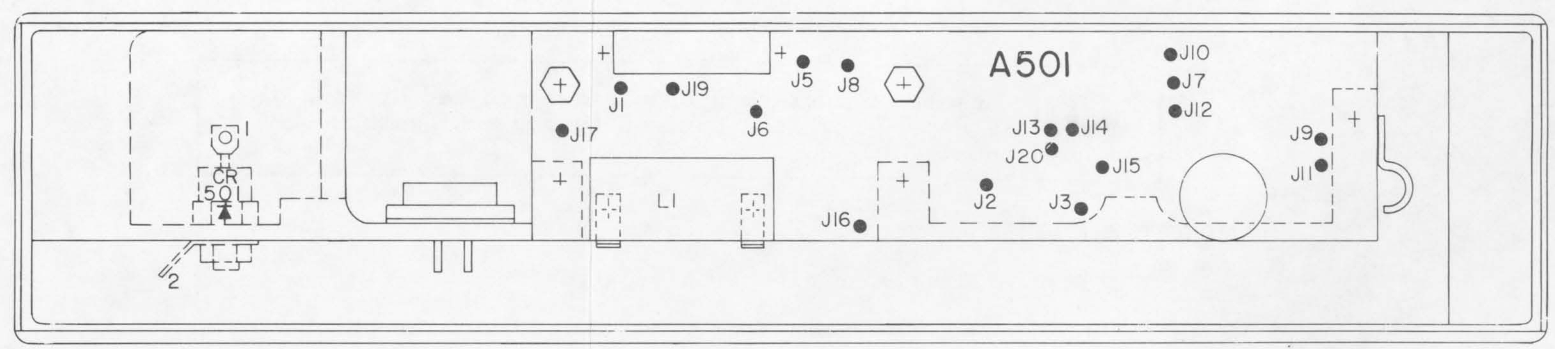
> CAUTION
>
> This is a critical adjustment Failure to adjust R2 correctly may result in damage to the transmitter PA transistors.

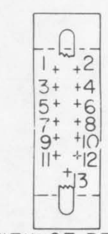
6. Apply sufficient cement to secure R2. Then disconnect the milliammeter and variable resistor, and reconnect the Brown and White-Orange-Red leads.



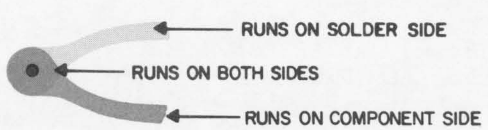


TYP NUMBERING OF J504

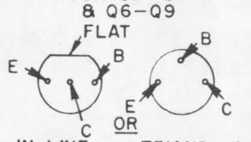




VIEW OF P505



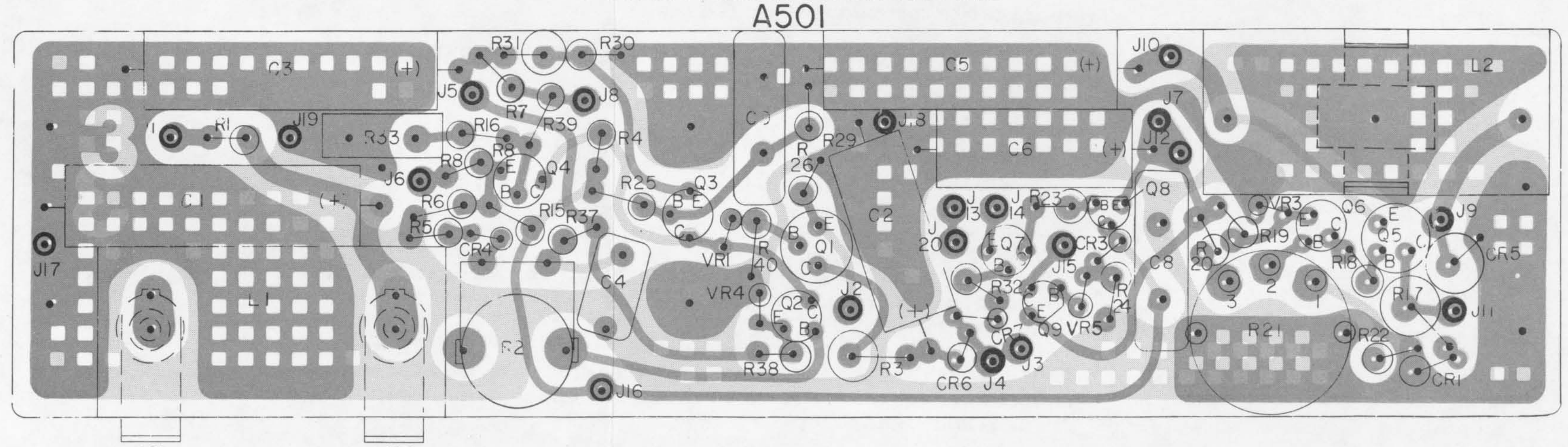
LEAD IDENTIFICATION FOR Q2-Q4 & Q6-Q9



VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

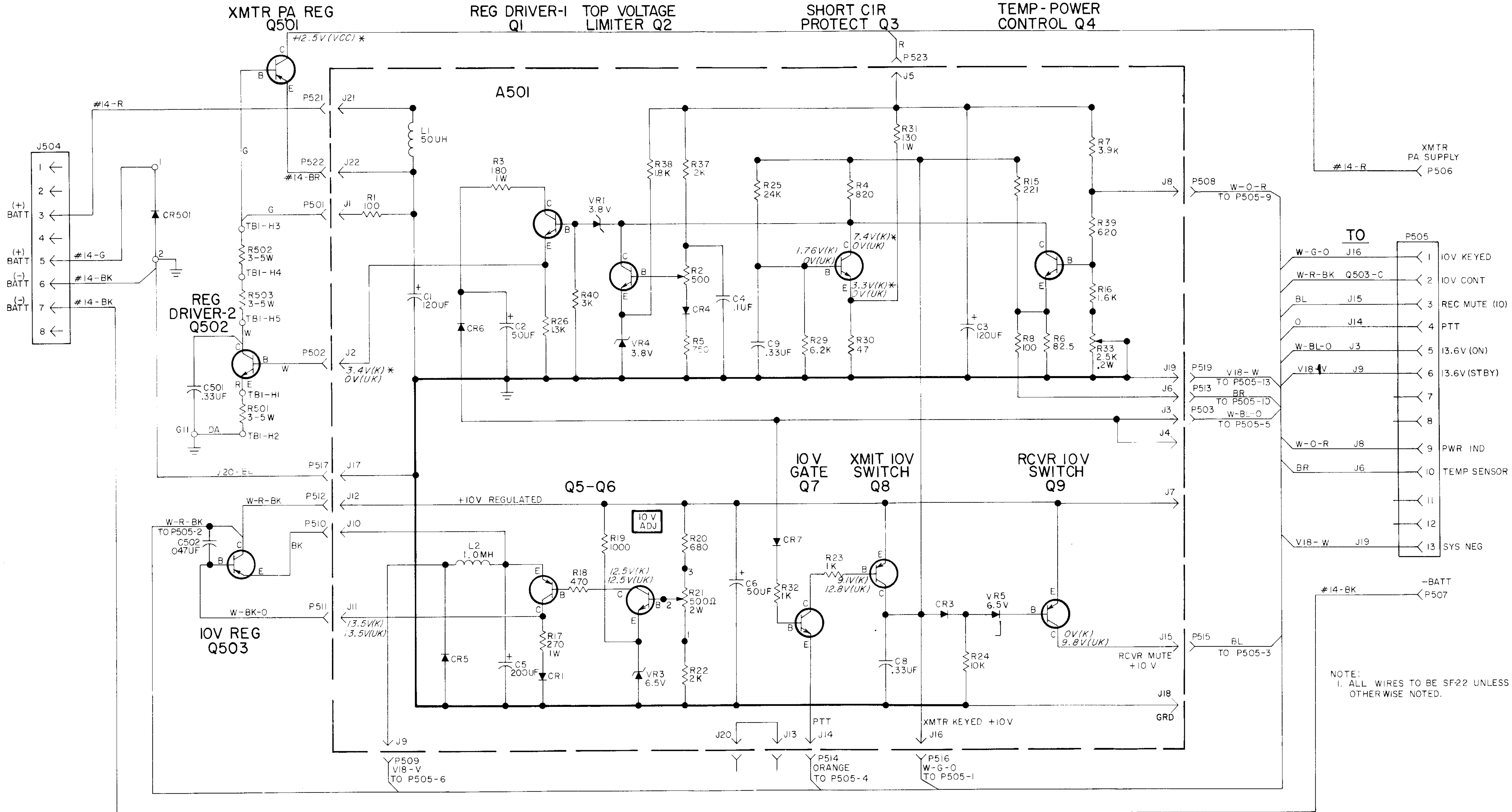
POWER REGULATOR BOARD
A501



(19D413211, Rev. 5)
(19C311810, Sh. 1, Rev. 3)
(19C311810, Sh. 2, Rev. 3)

OUTLINE DIAGRAM

POWER REGULATOR
MODEL 4EP58A10



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EP58A10	F

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

VOLTAGE READINGS

ALL READINGS ARE DC VOLTAGES TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED FROM TRANSISTOR PIN TO GROUND. READINGS FOLLOWED BY "K" TAKEN WITH XMTR KEYED. READINGS FOLLOWED BY "UK" TAKEN WITH XMTR UNKEYED. READINGS MARKED WITH (*) WILL VARY WITH POWER OUTPUT AND TEMPERATURE.

(19D402973, Rev. 12)

SCHEMATIC DIAGRAM

POWER REGULATOR
MODEL 4EP58A10

PARTS LIST

LBI-3918D

POWER REGULATOR
MODEL 4EP58A10
REV F

SYMBOL	GE PART NO.	DESCRIPTION
A501		POWER REGULATOR 19C311440G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C2	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C3	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C4	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C5*	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TT.
		In Models earlier than REV A:
	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TT.
C6	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TT.
C8 and C9	19A116080P10	Polyester: 0.33 µf ±20%, 50 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	4037822P1	Silicon.
CR2*	19A115250P1	Silicon. Deleted by REV D.
CR3 and CR4	19A115250P1	Silicon.
CR5	19A115823P1	Silicon.
CR6	4037822P1	Silicon.
CR7	19A115250P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J1 thru J3	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J4*	4033513P4	Contact, electrical: sim to Bead Chain L93-3. Added by REV C.
J5 thru J17	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J18*	4033513P4	Contact, electrical: sim to Bead Chain L93-3. Added by REV C.
J19 and J20	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J21 and J22	4033284P3	Terminal, quick disconnect: sim to Alcon 3-1243.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A115392P1	Choke, RF: 50 µh ±10%, .02 ohm DC res max.
L2*	19A115894P1	Audio freq: 1.0 mh inductance, 0.35 ohms DC res.
		In Models earlier than REV A:
	19A115543P1	Choke, RF: 240 µh ±10%, .128 ohms DC res max.
		- - - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q2 thru Q4	19A115123P1	Silicon, NPN; sim to Type 2N2712.
Q5	19A115706P1	Silicon, PNP; sim to Type 2N3638.
Q6 and Q7	19A115123P1	Silicon, NPN; sim to Type 2N2712.
Q8 and Q9	19A115768P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77P101K	Composition: 100 ohms ±10%, 1/2 w.
R2	19B209358P2	Variable, carbon film: approx 25 to 500 ohms ±20%, 0.2 w; sim to CTS Type U-201.
R3	3R78P181K	Composition: 180 ohms ±10%, 1 w.
R4	3R77P821K	Composition: 820 ohms ±10%, 1/2 w.
R5*	3R77P751J	Composition: 750 ohms ±5%, 1/2 w.
		In Models of REV D and earlier:
	3R77P911J	Composition: 910 ohms ±5%, 1/2 w.
R6	19A116278P89	Metal film: 82.5 ohms ±2%, 1/2 w.
R7*	3R77P392J	Composition: 3900 ohms ±5%, 1/2 w.
		In Models earlier than REV B:
	3R77P272J	Composition: 2700 ohms ±5%, 1/2 w.
R8	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R15	19A116278P134	Metal film: 221 ohms ±2%, 1/2 w.
R16	3R77P162J	Composition: 1600 ohms ±5%, 1/2 w.
R17	3R77P271K	Composition: 270 ohms ±10%, 1/2 w.
R18	3R77P471K	Composition: 470 ohms ±10%, 1/2 w.
R19	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R20	3R77P681J	Composition: 680 ohms ±5%, 1/2 w.
R21	19A115681P5	Variable, wirewound: 500 ohms ±20%, 2 w; sim to CTS Series 115.
R22	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R23	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R24	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R25	3R77P243J	Composition: 24,000 ohms ±5%, 1/2 w.
R26	3R77P132J	Composition: 1300 ohms ±5%, 1/2 w.
R29	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R30	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R31	3R78P131J	Composition: 130 ohms ±5%, 1 w.
R32	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R33*	19B209358P104	Variable, carbon film: approx 50 to 2500 ohms ±10%, 0.2 w; sim to CTS Type X-201.
		In Models earlier than REV B:
	19B209358P103	Variable, carbon film: approx 25 to 1000 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R37*	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
		In Models of REV D and earlier:
	3R77P162J	Composition: 1600 ohms ±5%, 1/2 w.
R38	3R77P182K	Composition: 1800 ohms ±10%, 1/2 w.
R39*	3R77P621J	Composition: 620 ohms ±5%, 1/2 w.
		In Models earlier than REV B:
	3R77P182J	Composition: 1800 ohms ±5%, 1/2 w.
R40	3R77P302J	Composition: 3000 ohms ±5%, 1/2 w.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - -
VR1	4036887P3	Silicon, Zener.
VR3	4036887P6	Silicon, Zener.
VR4	4036887P3	Silicon, Zener.
VR5*	4036887P6	Silicon, Zener. Added by REV D.
		CHASSIS 19D413137G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C501	19A115028P17	Polyester: 0.33 µf ±20%, 100 VDCW.
C502*	19A116080P5	Polyester: 0.047 µf ±20%, 50 VDCW. Added by REV F.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR501	19A115617P2	Silicon, stud-mounted.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J504	19A121524G1	Connector assembly.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P501 thru P503	4029840P2	Contact, electrical: sim to Amp 42827-2.
P505	19B204781P1	Plug, phen: 13 female contacts.
P506 and P507	19B209151P1	Terminal, solderless: sim to AMP 42284-5.
P508	4029840P2	Contact, electrical: sim to Amp 42827-2.
P509	4029840P1	Contact, electrical: sim to AMP 41854.
P510 thru P516	4029840P2	Contact, electrical: sim to Amp 42827-2.
P517	4029840P1	Contact, electrical: sim to AMP 41854.
P519	4029840P1	Contact, electrical: sim to AMP 41854.
P521 and P522	19B209151P1	Terminal, solderless: sim to AMP 42284-5.
P523	4029840P2	Contact, electrical: sim to Amp 42827-2.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q501	19A115977P1	Silicon, PNP.
Q502	19A116118P3	Silicon, NPN.
Q503	19A115822P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R501 thru R503	5493035P6	Wirewound: 3 ohms ±5%, 5 w; sim to Hamilton Hall Type HR.
		- - - - - - - - - TERMINAL BOARDS - - - - - - -
TB1	19B216172G1	Eyelet board.
		HARNESS ASSEMBLY 19D413137G2 (Includes J504, P501-P503, P505-P517, P519, P521-P523).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	7118719P10	Clip, spring tension: sim to Prestole E-50019-041. (Used with L2 on A501).
	4036555P1	Insulator, washer: nylon. (Used with Q1 and Q5 on A501).
	19C311823P1	Heat sink/Chassis.
	7763541P5	Clip, spring tension. (Mounts harness to P505).
	19A121271P1	Insulator. (Used with P505).
	4029974P1	Insulator, plate. (Used with Q501).
	19A129582P3	Spacer. (Used to mount cover).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To reduce alternator whine. Changed C5 and L2.

REV. B - To make power regulator compatible with Low Band transmitter. Changed R7, R33 and R39.

REV. C - To provide connections for carrier control timer option 19B205924G2, Revision A or later. Added J4 and J18.

REV. D - To prevent RF from unmuting the receiver. Replaced CR2 with Zener diode VR5.

REV. E - To re-center adjustment range of Top Limiter control R2. Changed R5 and R37.

REV. F - To prevent oscillation at the regulated 10-volt output. Added C502.