POWER AMPLIFIER CONTINUOUS DUTY
MODEL TLD2600A SERIES

1. GENERAL

The TLD2600A Series Power Amplifier (refer to Table 1) consists of the power amplifier chassis and associated hardware, and contains three circuit boards: the power control board, the power amplifier board, and the exciter control voltage regulator board. The following sections detail the theory of operation and maintenance information for the power amplifier circuitry. Because the setting of the power levels is affected by the alignment of the exciter, the power set procedure is a part of the overall transmitter alignment procedure given in the Transmitter section of this manual.

Table 1. Power Amplifier Frequency Range

Model	Frequency Range (MHz)
TLD2601A	132-150.8
TLD2602A	150.8-162
TLD2603A	162-174

2. THEORY OF OPERATION

2.1 POWER AMPLIFIER BOARD
(Refer to Figure 1 and schematic diagram)

2.1.1 This series of power amplifiers requires a 400 mW rf input from the exciter board. This input is passed through a ferrite step-down transformer (to match the input impedance to the first stage) to the gain-controlled amplifier stage. The external power control circuit which drives the control stage transistor determines the gain of this stage. The power control circuit monitors the output of the final stages of the power amplifier and the load condition.

2.1.2 The output of the gain-controlled amplifier is passed through a fixed-tuned broadband matching network and applied to the pre-driver stage. A second ferrite transformer is utilized to match the single-ended output of the pre-driver stage to the input of the push-pull driver stage. The output of the driver stage is split by a pair of transformers to drive each of the push-pull final power amplifier stages. The output from each final stage is stepped up in impedance by ferrite transformers and paralleled to provide the 50 ohm output impedance to match the input impedance of the harmonic filter.

2.1.3 Pin 1 of the metering receptacle provides a means of checking the incoming signal from the exciter. Pin 2 permits observation of the drive output of the first stage and an indication of the operation of the pre-driver stage. Pins 3 and 4 reflect the output drive signal and operation of the two push-pull power amplifier stages. Reference position A on a Motorola Portable Test Set uses pin 7 of the metering socket as an A+ reference against which the outputs of pins 1, 2, 3, and 4 are checked. Switch the test set to reference position B which uses pin 6 as a reference and then switch to meter position 5. This provides a reading across a calibrated resistor through which the current is drawn by the final amplifier stages.

2.2 POWER CONTROL BOARD FUNCTIONAL THEORY OF OPERATION

2.2.1 Refer to the loop block diagram, Figure 2. The circuitry operates as a control loop which continually monitors the output from the final stages of the transmitter power amplifier and controls that output by regulating the gain of the first stage of the power amplifier.

2.2.2 Refer to the block diagram, Figure 3. The output of the integrated circuit differential amplifier, amplified by the dc amplifier, is the controlling input to the power amplifier board.

2.2.3 The output of the differential amplifier is determined by the potentials present on the non- inverting (+) and inverting (−) inputs. These potentials are developed by the power control board circuitry in the following manner.

2.2.4 When the impedances of the antenna circuitry (load) and the power amplifier are matched (a VSWR of 1:1), a bias voltage produced by the dc reference bias circuitry is placed on the inverting input (also called the "reference input") of the differential amplifier (see Figure 6).

POWER AMPLIFIER — CONTINUOUS DUTY

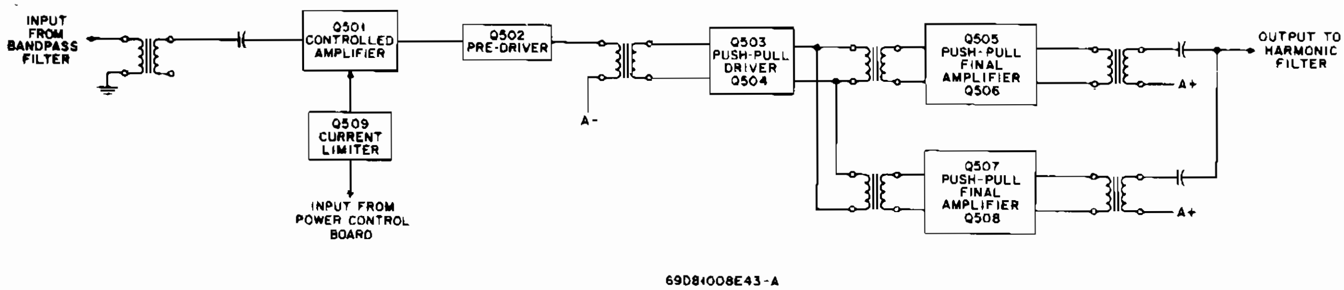


Figure 1. Block Diagram

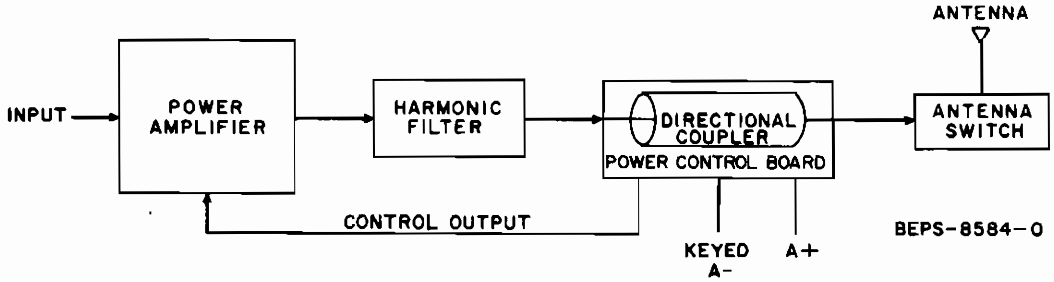


Figure 2. Loop Block Diagram

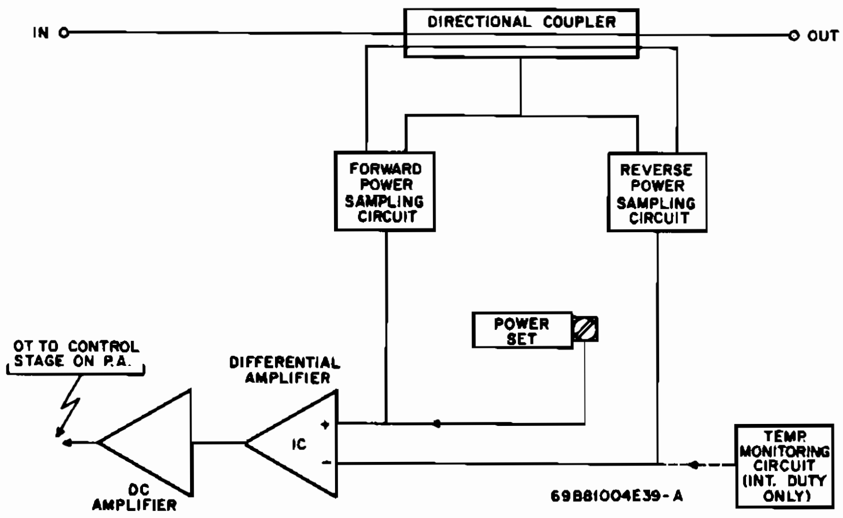


Figure 3. Power Control Board Block Diagram

2.2.5 When the transmitter is keyed, the forward (output) power from the final stages of the power amplifier is fed through the directional coupler to the antenna circuit. This flow of power is sampled by the forward power sampling circuitry and places a bias, proportional to the forward power, on the non-inverting input (pin 5) of the differential amplifier. The POWER SET potentiometer is then adjusted, changing the potential on the non-inverting input. As this voltage changes, relative to the reference input voltage, the output of the differential amplifier changes, in turn changing the loop control level and therefore the output of the power amplifier.

2.2.6 Once the power has been set to the proper level, any change in the output power will be instantly corrected by the circuitry. If the power increases, the increase causes the differential amplifier output voltage to increase, decreasing the output from the dc amplifier which decreases the gain of the power amplifier until the output returns to the preset level. A decrease in transmitter power amplifier output causes the reverse action.

2.2.7 Any power reflected back from the antenna circuit is detected by the reverse power sampling circuit. Reverse power causes a negative current to flow, which, in turn, decreases the potential on the reference input of the differential amplifier. Therefore, increasing levels of reflected power will cause the transmitter power output to be decreased to a safe level.

2.3 POWER CONTROL BOARD DETAILED THEORY OF OPERATION

2.3.1 Bias Circuitry

Since the power control board has the capability to regulate the output of the transmitter power amplifier from a completely cut-off state to above the rated output power, a definite controlled output level is necessary whenever the transmitter is keyed. The desired controlled output level is determined by bias voltages present on the inverting and non-inverting inputs of the differential amplifier IC601 (see Figure 4). Under normal oeprating conditions (1:1 VSWR; 100% rated power out) the bias on the differential amplifier inputs are developed as described in the following paragraphs.

2.3.1.1 Voltage Regulator and Main Divider Line

Refer to Figure 5. The A + supply to the board is regulated by a series regulator circuit providing a nominal voltage of 8.0 volts. The Zener diode holds the base of the series pass transistor at a fixed potential. The series pass transistor operates as a variable resistor to hold the input to the reference circuitry constant. The divider consisting of the two resistors and the diode provides the proper voltage tap points for the secondary voltage divider networks. All 220 pF capacitors in the board are used as rf bypasses.

2.3.1.2 Reference Bias Circuit

Refer to Figure 6. The reference bias is developed (with a 1:1 VSWR) by the voltage divider made up of two resistors and a diode between the regulated supply voltage and the switched A − source. Since A + is applied to the board continuously and A − is only applied when the transmitter is keyed by the push-to-talk switch, the larger capacitor connected between the inverting input and keyed A − provides a time constant which allows the inverting input bias to build up slowly when power is first applied. This prevents full power output from occurring until the leveling circuitry can react and reach a quiescent level.

2.3.2 Directional Coupler

The directional coupler measures the voltage and the current traveling in both directions. The detection of forward (output) power causes a proportional voltage bias that is combined with the voltage-divider generated bias to set the potential on the non-inverting input of the differential amplifier. Any reverse power detected causes the VSWR circuitry to decrease the power output.

2.3.3 Protection Circuitry

2.3.3.1 Forward Power Bias and Detection Circuit

Refer to Figure 7. The forward power reference voltage divider comprised of two resistors and two potentiometers provides a stable potential that supplies a dc bias to the non-inverting input of the differential amplifier. With an approximately correct power output from the final stages of the power amplifier, a dc level proportional to that power is produced by the forward power detector circuit, which, in combination with the voltage developed by the voltage divider, produces a bias on the non-inverting input that can be adjusted by the POWER SET potentiometer. The POWER LIMIT control is pre-set to prevent over-dissipation if the POWER SET control should be set to maximum. (Refer to the CAUTION preceding maintenance information in this section.) The dc bias value will be determined by the power amplifier output and, with no reflected power (VSWR 1:1), balanced against the reference bias present on the inverting input of the differential amplifier. Once the bias has been set, and change in power output will change the bias on the non-inverting input causing the differential amplifier to compensate for the deviation. The forward power detector circuit (refer to Figure 8) detects rf power flowing through the directional coupler when the transmitter is keyed, and causes a small proportional current flow in the forward power sampling circuit. The diode converts the rf sample into a pulsating dc voltage and the dc filter removes the ripple. This is the dc voltage which is added to the dc bias already applied to the non-inverting input of the differential amplifier from the secondary divider circuitry.

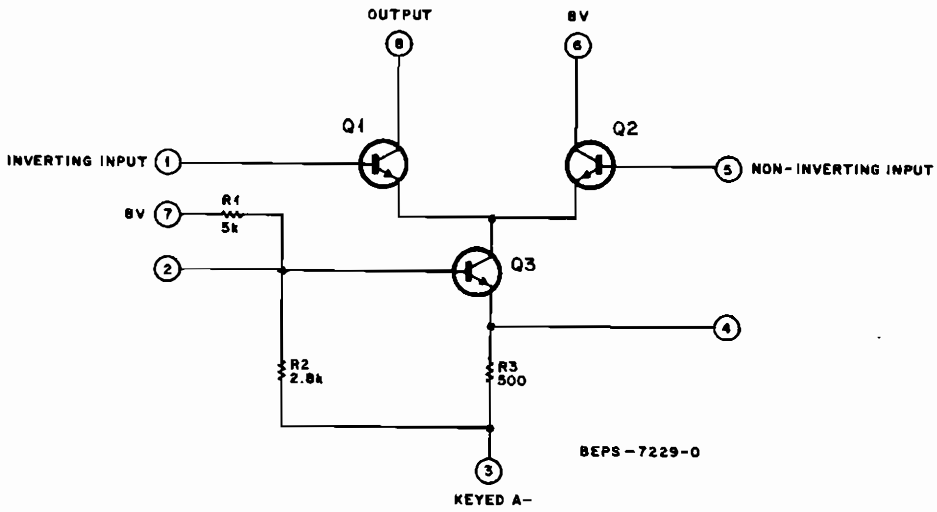


Figure 4. IC601 Schematic Diagram

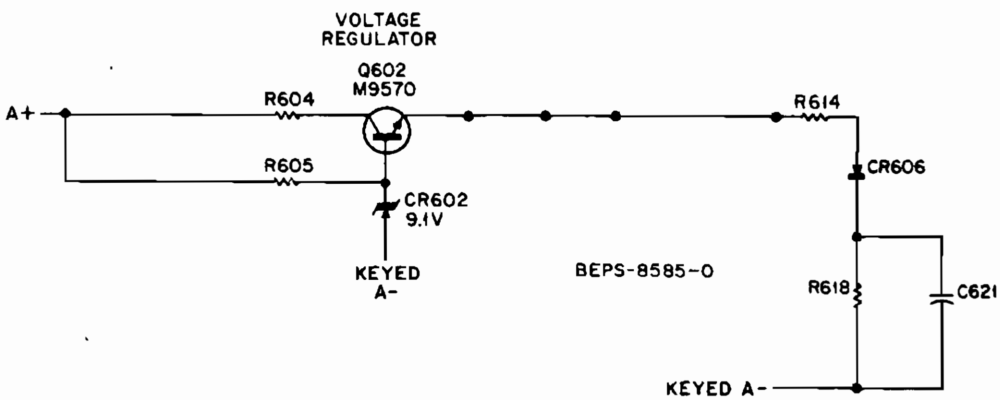


Figure 5. Voltage Regulator and Main Divider Line

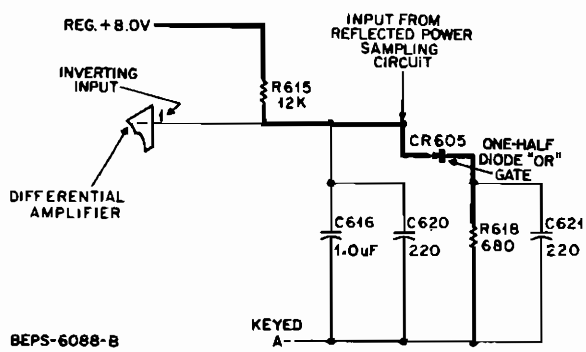


Figure 6. Reference Power Bias Circuit

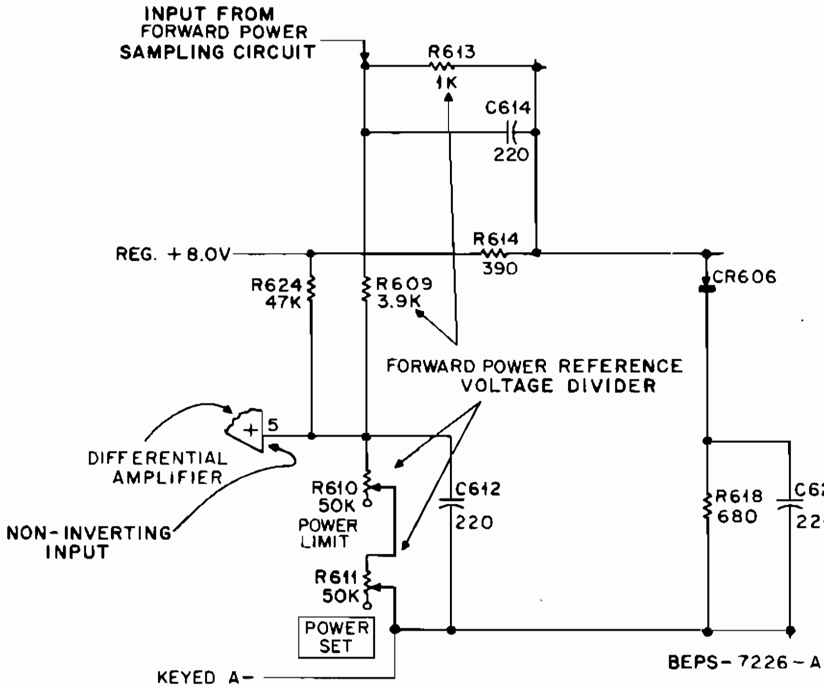


Figure 7. Forward Power Bias Circuit

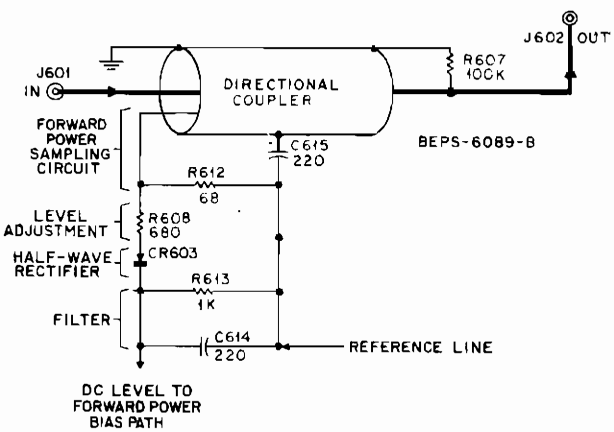


Figure 8. Forward Power Detector Circuit

2.3.3.2 VSWR — Reverse Power Detection Circuit

Since the power control board is now operating correctly with the proper amount of forward power and the correct biases, the detection of reflected power causes a decrease in the power amplifier's output in the following manner.

Refer to Figure 9. The components of the reverse power detector circuit function the same as those in the forward power detector. The voltage divider develops a bias voltage that isn't quite enough to forward bias the diode that makes up one-half of a diode "OR" gate. When reflected power is detected, the resultant negative-going dc level lowers the dc bias level and the combination of the two forward bias the diode. The negative-going dc level on the inverting input increases the output voltage of the differential amplifier, decreasing the dc control output to protect the final stages of the power amplifier.

2.3.3.3 DC Level Output Amplification

The output of the differential amplifier is applied to the base of a voltage-inverting transistor amplifier whose output supplies the output control current. As the forward power increases above the normal value, the output of the differential amplifier increases proportionally. Since the dc level is increasing the base, the PNP transistor conducts less and the potentials across the output load resistor, and on the control output line, decrease.

3. MAINTENANCE

3.1 POWER AMPLIFIER BOARD

3.1.1 General

NOTE

Because of the complexity involved and time required to remove the PA board, compared to plug-in boards, it is not recommended that the PA board be removed. Proper troubleshooting techniques will usually locate defective components "on the spot."

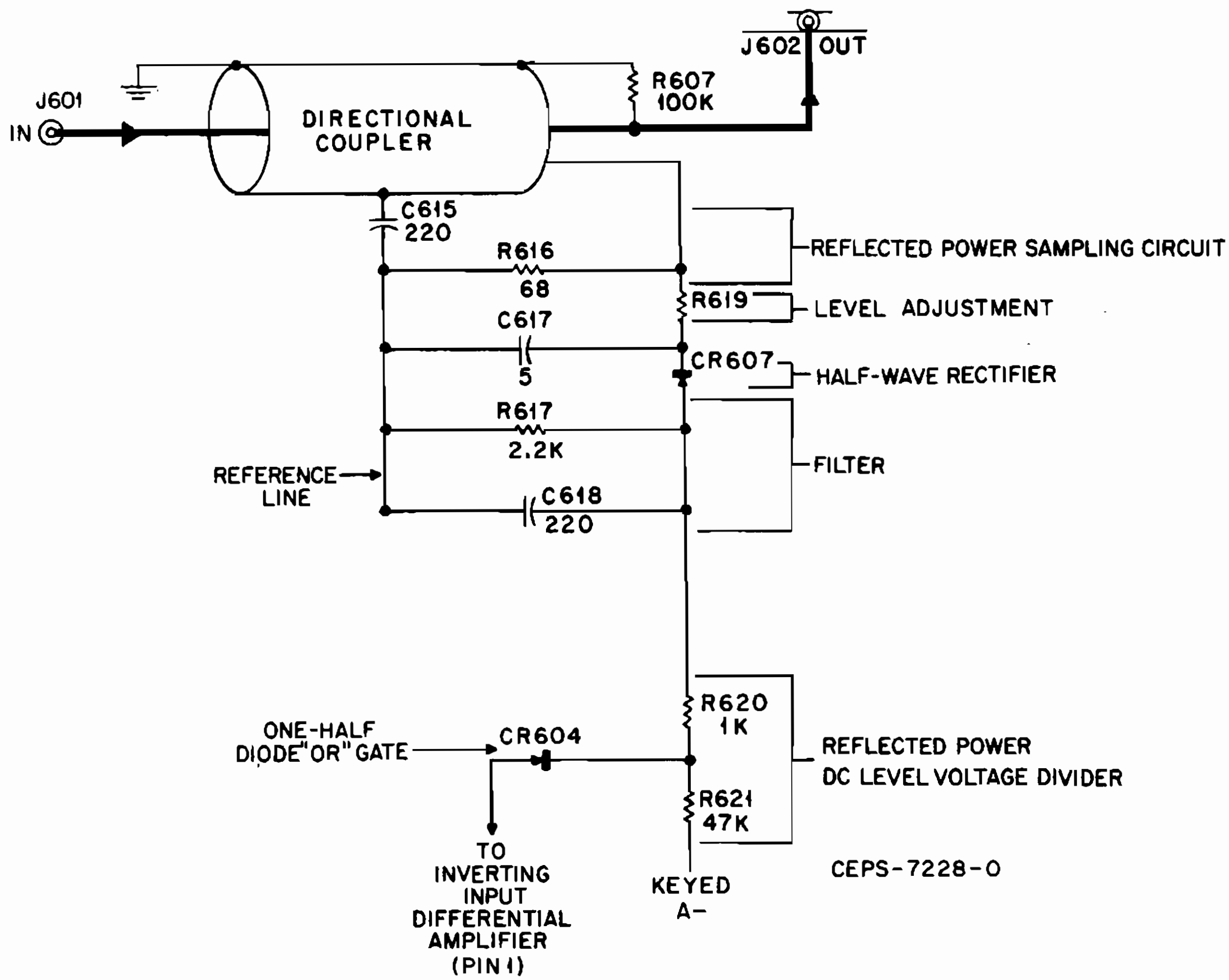


Figure 9. Reverse Power Detector Circuit

This section of the manual provides the maintenance shop procedures for the PA board. It assumes that preliminary tests have already localized the trouble to the PA board. These procedures include measurements with a Motorola portable test set, a VOM, a complete set of performance tests, and extensive troubleshooting procedures.

CAUTION

The PA board must be installed in the transmitter for testing to provide the necessary power, ground, control, heat sinking and signal connections.

3.1.2 Recommended Test Equipment

The following test equipment is the minimum required for troubleshooting and adjusting the PA.

- Motorola S1056B through S1059B Portable Test Set and Model TEK-37 or TEK-37A Adapter Cable. The portable test set is required for checking each stage for proper operation.
- A Motorola Solid-State DC Multimeter or a 20,000 ohm-per-volt multimeter should be used, however a low impedance multimeter is acceptable for dc voltage measurements only.
- Motorola T1013A RF Load Resistor (dummy load) or equivalent.

3.1.3 Test Set Metering

The PA is equipped with a metering receptacle which allows five major test points to be measured. PA metering can be made at each of the five test points by merely rotating a selector switch on the optional station meter kit or on the test set. A failure in almost any portion of the PA will produce a low or zero meter reading for one or more of the test points. Improper alignment will also cause improper meter readings.

3.1.4 Using the Portable Test Set

3.1.4.1 To make the measurements, the portable test set must be connected to the station as follows.

Step 1. Set the function selector switch of the portable test set to the XMTR position.

Step 2. Set the meter reversing switch of the test set to the METER REV position, the selector switch to position 1, and REF switch to position A.

Step 3. Connect the 20-pin meter cable plug to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

Step 4. Connect the red "control" plug of the adapter cable to the control receptacle on the remote control board. Connect the white "metering" plug of the adapter cable to the receptacle on the PA circuit board.

Step 5. The entire transmitter *is* necessary for testing PA boards including the power control board for proper control.

Step 6. The output of the station must be terminated in one of three types of loads:

(1) The antenna load.

(2) A dummy load such as Motorola's T1013A RF Load Resistor.

(3) An RF wattmeter.

NOTE

A dummy load is preferred to the antenna to eliminate the possibility of shutback by the power control board due to a defective antenna.

Step 7. Turn the station ON.

Step 8. Key the transmitter with the XMTR ON button on the test set. Observe the meter. Unkey the transmitter.

Step 9. Set the selector switch to positions 2, 3, & 4; then switch to reference position B and meter position 5 respectively, keying the transmitter and observing the meter reading for each. Refer to Table 2. On multi-frequency stations, repeat the readings for each frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows.

3.1.4.2 Each time maintenance is performed on the PA the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate an impending failure and corrective action may be taken before the circuit fails entirely.

3.1.5 Performance Tests

Step 1. No performance test of the power amplifier is required other than rf power output from the station as a whole. Before checking power output:

(1) The exciter board should be known to be operating normally.

(2) The power control board should be known to be functioning normally.

Step 2. Key the transmitter and observe power out, which should be 100 watts or value set from 50 to 100 watts depending upon licensing.

Table 2. Power Amplifier Board Metering

Selector Switch Position	Reference Switch Position Portable Test Set Only	Minimum Meter Readings	Circuit Metered	If Low, Defective Circuit Is: (See Troubleshooting Charts)
1	A	10 uA	Exciter Output (input to Controlled Amplifier Q501)	Exciter output, input circuitry of controlled amplifier stage Q501.
2	A	5 uA	Input of Pre-driver Stage (Q502)	Output of controlled amplifier stage input circuitry of predriver stage.
3	A	10 uA	Input of Final Amplifier Stage Q505, Q506	Input of Q505, Q506 stages, output of driver stage (Q502, Q503), output of pre-driver stage Q502.
4	A	10 uA	Input of Final Amplifier Stage Q507, Q508	Input of Q507, Q508 stage output of driver stage Q502, Q503. Output of pre-driver stage Q502.
5 (or 2)	B	29 uA max. 105 W	Total Current in Final Amplifier Stages Q505, Q506, Q507, Q508	Output of final amplifier stages Q505-Q508, power control board antenna switch, antenna.
6 (or 3)	B	12 V (0-30 V scale)	Final Amplifier Stage	Final amplifier stage A + or A – input.

3.2 POWER CONTROL BOARD

CAUTION

The power control board is incorporated in the transmitter to provide protection for the rf power transistors under environmental conditions such as voltage, load variation, and device variations. In order for the circuitry to operate properly and provide protection it is necessary to set the power output control (POWER SET) in accordance with the station alignment procedure.

3.2.1 General

3.2.1.1 Two basic maintenance approaches may be used for localizing and replacing trouble in these radio sets.

- Replace the defective circuit board with a spare and return the defective board to a maintenance shop for repair.
- Isolate and repair the trouble on the spot. This approach must be used if spares are not available.

3.2.1.2 Regardless of the maintenance approach used, a few simple tests on the overall radio set will localize the trouble to the power control board if it is defective. These procedures are given elsewhere in the manual. This section of the manual provides the maintenance shop level procedures for the power control circuitry. It assumes that preliminary tests have already localized the trouble to the power control board. These bench test type procedures inlcude measurements with a Motorola portable test set, a simple set of performance tests, and complete troubleshooting procedures including step-by-step circuit check-out.

3.2.2 Recommended Test Equipment

The following test equipment is the minimum required for troubleshooting and adjusting the board. All such equipment is battery operated. When ac operated equipment is used, the ground lead must not be electrically connected to ac line ground.

- Optional station metering or Motorola S1056B through S1059B Portable Test Set and Model TEK-37 or TEK-37A Adapter Cable. (The meter or portable test set is necessary to monitor forward and reverse power detectors.)
- Motorola Solid-State DC Multimeter or equivalent. A 20,000 ohm-per-volt multimeter may be used but a low impedance volt-ohm meter may not be used. This meter is used for measuring dc voltages and resistance.
- Motorola T1013A RF Load Resistor (Dummy Load) or equivalent.

3.2.3 Metering

The power control board is equipped with a metering receptacle which allows three major test points (forward power, reflected power and control current) to be measured. Refer to the troubleshooting charts or the schematic diagram for the correct meter indications.

3.2.4 Using Portable Test Set

Step 1. Set the function selector switch of the portable test set to the XMTR position.

Step 2. Set the meter reversing switch of the test set to the METER REV position.

Step 3. Set the REF switch to position A or B.

Step 4. Connect the 20-pin meter cable plug to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

Step 5. Connect the red "control" plug of the adapter cable to the control receptacle on the remote control circuit board. Connect the white "metering" plug of the adapter cable to the receptacle on the power control board.

Step 6. The output of the power control board must be terminated in one of three types of loads.

(1) The antenna load.

(2) A dummy load such as Motorola's T1013A RF Load Resistor.

(3) An RF wattmeter.

NOTE

A dummy load is preferred to the antenna to eliminate the possibility of shutback due to a defective antenna.

Step 7. Turn the station ON.

Step 8. Set the selector switch of the test set to position 1 and key the transmitter with the XMTR ON button on the test set. Observe the wattmeter, or the eter reading if a dummy load is used or if the antenna is used. Unkey the transmitter. Under normal conditions at rated power out, meter 1 should read between 15 uA and 45 uA typically. Refer to Table 3.

3.2.5 Performance Test, Power Set Control

This control allows the power output of the radio set to be varied from zero (0) power out with the control fully counterclockwise to greater than the rated output.

Table 3. Power Control Board Metering

Selector Switch Position	Reference Switch Position (See Note)	Normal Meter Readings	Function
1	A (Meter Reverse On)	15-45 uA	Indicates forward power output.
2	A	10 uA max.	A meter reading higher than the normal range indicates reflected power caused by a defective antenna, antenna switch, or cables.
5	B (Meter Reverse On)	50 uA max.	Indicates the relative level of drive sent to the PA on the blue control lead. A reading of greater than 35 uA indicates the power control board is set for a higher power than the radio is capable of supplying.

METERING NOTE

Alignment may be performed using a Motorola S1056B thru S1059B Portable Test Set. The OSC. & METER REV. SWITCH column refers to portable test set usage.

CAUTION

For proper operation of the protection circuitry, it is imperative that the POWER SET control never be left in a position that exceeds rated power output.

Refer to the power amplifier tune-up procedure.

Step 1. Key the transmitter.

Step 2. Adjust the POWER SET control until the rated power output is reached.

Step 3. Unkey the transmitter.

4. TROUBLESHOOTING PROCEDURES

4.1 GENERAL

If a problem has been localized to either the power amplifier or power control board decks, several checks can be made prior to extensive troubleshooting.

4.2 VISUAL

Visually check for obvious physical defects such as broken leads, broken plating, broken or disconnected components or overheated parts. Before any attempt is made to change parts, the circuit should be checked to insure that the problem causing the original failure has been identified and corrected, otherwise damage to the new part may occur.

4.3 VOLTAGE CHECKS

Check for A+ and A− at the feedthrough connections and for proper voltages at the collectors of each transistor. Certain defects such as broken plating, broken leads etc. may not be obvious to a visual inspection.

4.4 TROUBLESHOOTING

4.4.1 If test set readings are abnormal or tests indicate subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component. Note that all power for the circuits in the PA and power control board is from A− referenced to A+ (not to chassis ground, this feature allows operation from positive or negative ground power sources when an optional positive ground converter is used).

CAUTION

Due to the voltage requirements of PNP transistors, all "rf ground" plating is A+ and is "hot" with respect to chassis ground in negative ground applications. Because of this, caution should be used to prevent connection of "ground" plating on the PA board to chassis ground, either directly or by the use of test equipment ground leads. If ac operated test equipment is used, the ground lead must not be electrically connected to ac line ground.

4.4.2 The schematic diagrams of the PA board and power control board contain the voltage readings required for troubleshooting. The readings are typical for normal operating conditions at rated power output for the radio. Refer to the troubleshooting charts and the schematics when a defect is suspected.

5. REPAIR PROCEDURES

5.1 RESISTANCE MEASUREMENT OF TRANSISTORS IN PUSH-PULL PAIRS

Due to the fact that transistors in push-pull pairs are dc connected at both base and emitter, BOTH devices should be measured when a defect in the pair is suspected.

5.2 TRANSISTOR REMOVAL PROCEDURE

Step 1. Unscrew both mounting screws from the base of the transistors. The nuts (for the mounting screws) on the reverse side of the shelf are captivated and will not fall out.

Step 2. Remove excess solder from around transistor tabs with a vacuum bulb type de-soldering device.

Step 3. Gently lift each lead, one at a time while applying heat.

Step 4. When all four leads are loose from the board carefully lift out the transistor.

5.3 TRANSISTOR INSTALLATION PROCEDURE

Step 1. Pre-tin underside of each transistor lead.

Step 2. Apply a light coat of Wakefield Thermal Compound to the underside of the transistor mounting base and to the heat sink.

Step 3. Install the transistor making sure that all collector leads face the proper direction. Refer to the circuit board detail.

Step 4. Screw down the two mounting screws securely.

Step 5. Solder each transistor lead one at a time to the circuit board. The use of a generous amount of solder will insure a good contact of the entire tab to the board. Use care that solder does not bridge to other plating or that solder does not flow into the cutout in the circuit board.

5.4 PROCEDURES FOR RESISTANCE MEASUREMENTS OF TRANSISTORS

Step 1. Set ohmmeter to RX1, RX10 or RX100 scale (preferably RX10 if available).

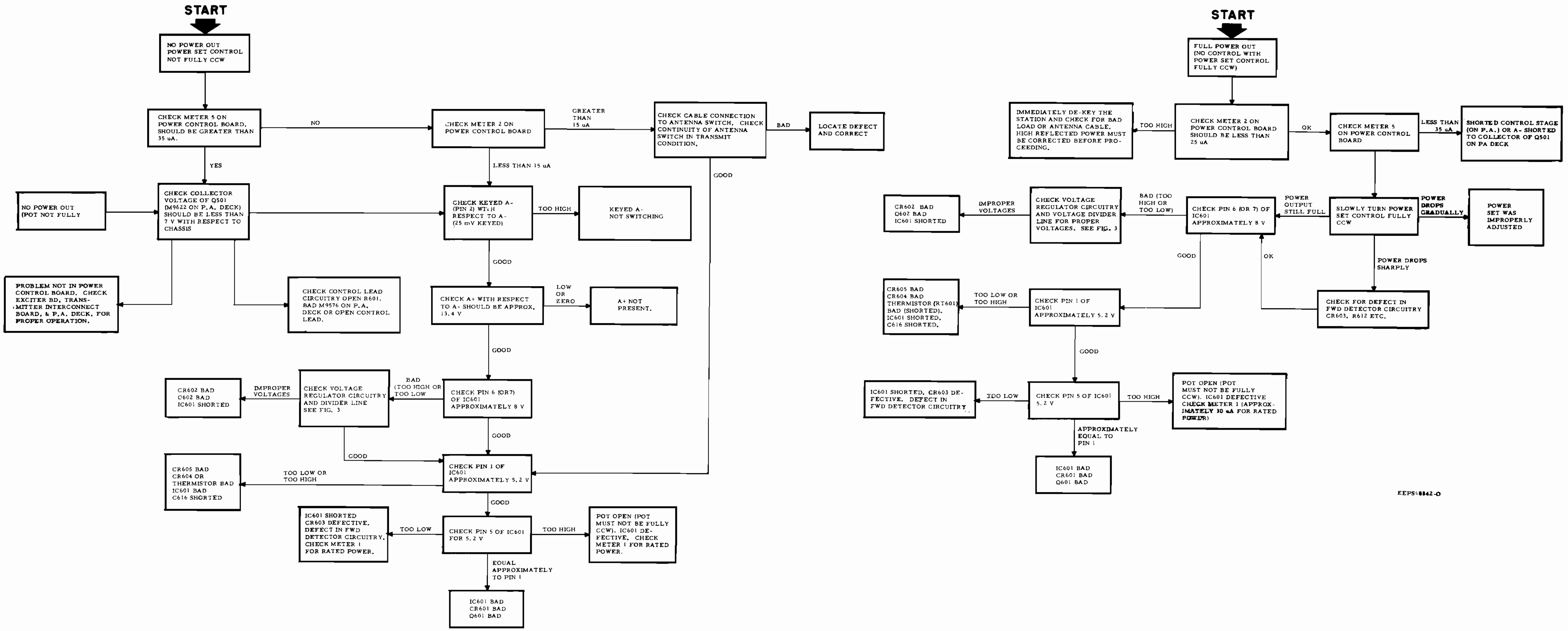
Step 2. Measure the resistance from lead to lead as described in (a) thru (c). Should any indication be observed in measurements (a) or (c), the transistor is defective and should be replaced.

(a) With the positive probe on the base, no indication (very high impedance) should be observed when the negative probe is touched to the collector or emitter. (Reverse drop measurement.)

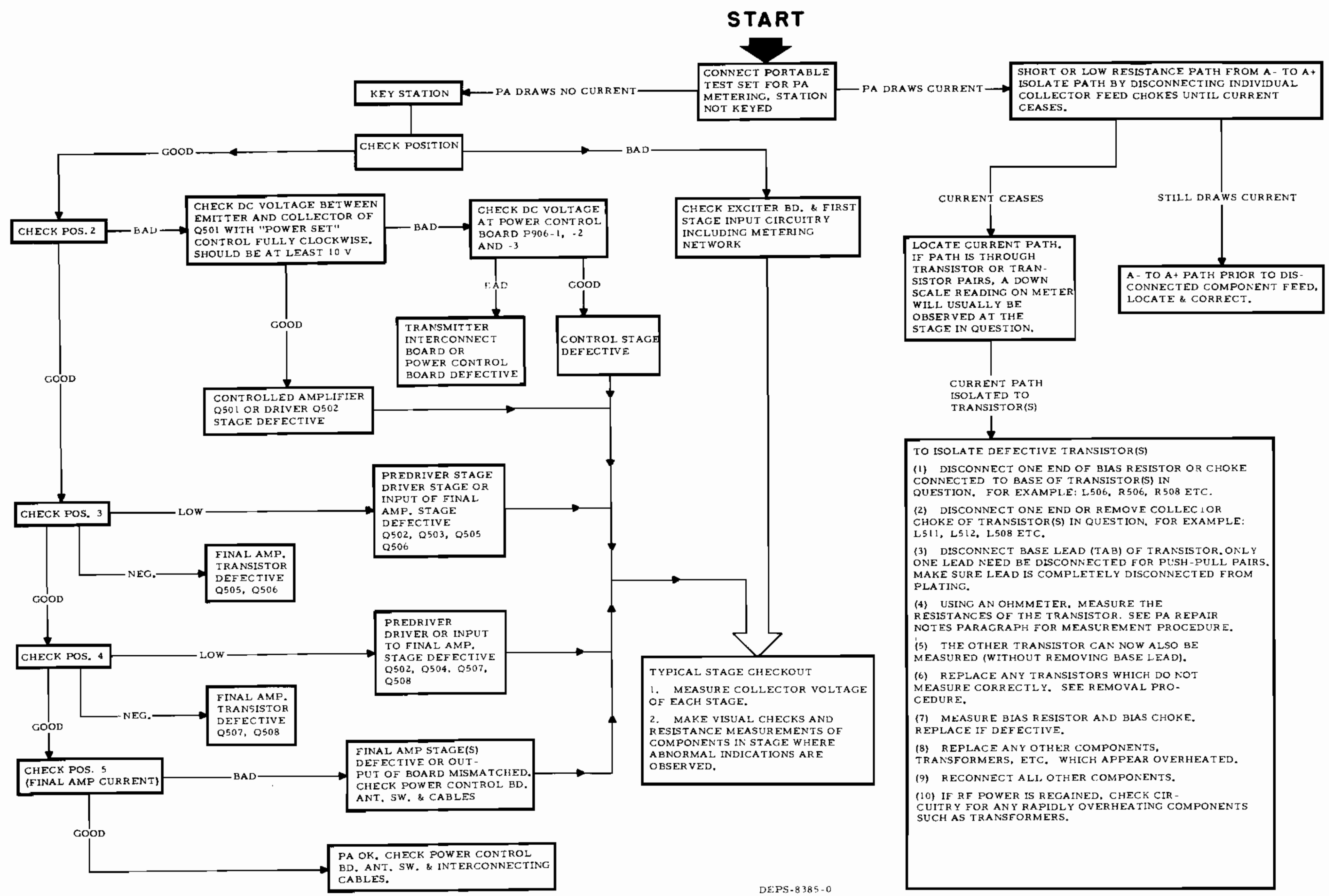
(b) With the negative probe on the base, a relatively low impedance should be observed when touching the positive probe to the collector and emitter. (Forward drop measurement.)

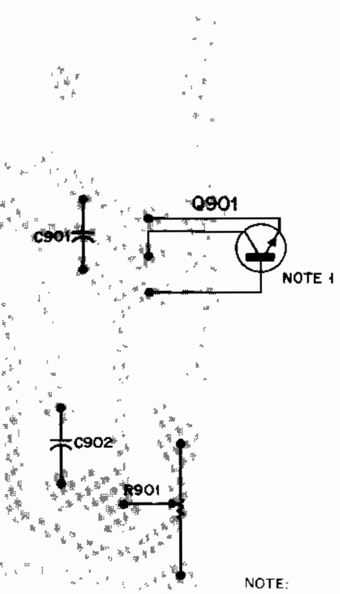
(c) No indication should be observed from collector to emitter regardless of the polarity of the ohmmeter probes.

POWER CONTROL BOARD TROUBLESHOOTING CHART



POWER AMPLIFIER TROUBLESHOOTING CHART





NOTE:
1. Q901 IS MOUNTED TO AN INPUT BRACKET WHICH IS P/O TLN2424A

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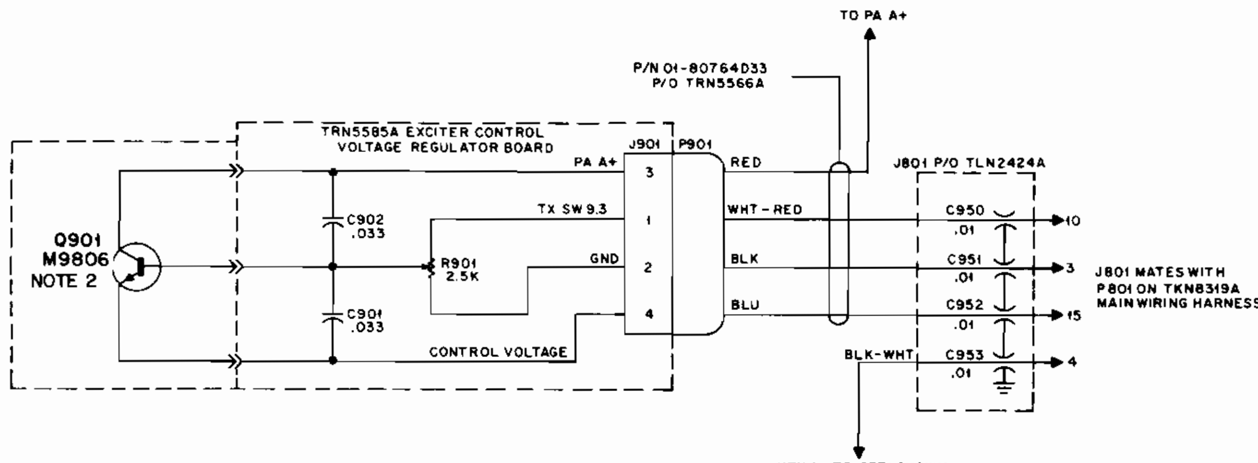


NOTES
1 UNLESS OTHERWISE INDICATED RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN MICROFARADS
2 Q901 IS MOUNTED TO AN INPUT BRACKET WHICH IS P/O TLN2424A

BEPS-35244-O

Model Complement

Model	Kit	Description
TLN2424A		Power Amplifier Input Bracket Assembly
	TRN5566A	PA Input Bracket
	TKN8336A	Power Amplifier Cable
	TRN5585A	Exciter Control Voltage Regulator

parts list

TRN5566A Input Bracket — PL-8193-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: + 100-0%:
		unless otherwise stated
C560, 561, 562	21-410115	220 pF ± 20%; 500 V
C565, 566	21-84211B01	.01 uF; 250 V
C950 thru 953	21-82812H03	1000 pF; 500 V (feed-thru)
		connector, receptacle:
J501	9-84968D01	female; single-contact
J801	1-80764D32	assembly bracket; includes:
		C950, 951, 952, 953
	7-84355N01	BRACKET, PA input
	9-84935D01	SOCKET, transistor
	4-83755H01	WASHER, solder; 4 used
		connector, plug; includes:
P901	15-83498F41	HOUSING, 4-position
	29-83499F01	TERMINAL; 4 used
		transistor: (see note)
Q509	48-869627	type M9627
Q901	48-869806	NPN; type M9806
		terminal board:
TB1	31-50378	barrier type-2 terminals
		assembly cable:
W501	1-80727B92	assembly rf-input, includes: J501
	30-83794C01	CABLE, coaxial, WHT; 8" used
		mechanical parts
	2-115968	NUT; 1/4-28 x 3/8 x 1/8"; 2 used
	3-3360	SCREW, tapping; 6-20 x 1/2"; 2 used
	3-8153	SCREW, tapping; 8-15 x 3/4"; 2 used
	3-129841	SCREW, machine; 4-40 x 1/4"
	4-7557	WASHER, flat; .172 x .375 x .033"; 2 used
	4-7678	WASHER, lock; 1/4" external; 2 used
	4-84180C01	WASHER, insulator
	14-865875	INSULATOR, transistor
	14-84391F01	INSULATOR, transistor
	29-5223	LUG, soldering; 2 used
	43-82980N01	STANDOFF; 2 used
	75-10605A04	CUSHION; foam

TKN8336A Cable Power Amplifier — PL-8191-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J803	9-844509	female; single-contact (BNC)
P602	28-82365D03	male; single-contact (phono)
W601	1-80727B96	assembly rf output includes:
		J803 and P602
	30-82921H01	CABLE, coaxial, WHT; 8" used

TRN5585A Exciter Control Voltage Regulator — PL-8192-O

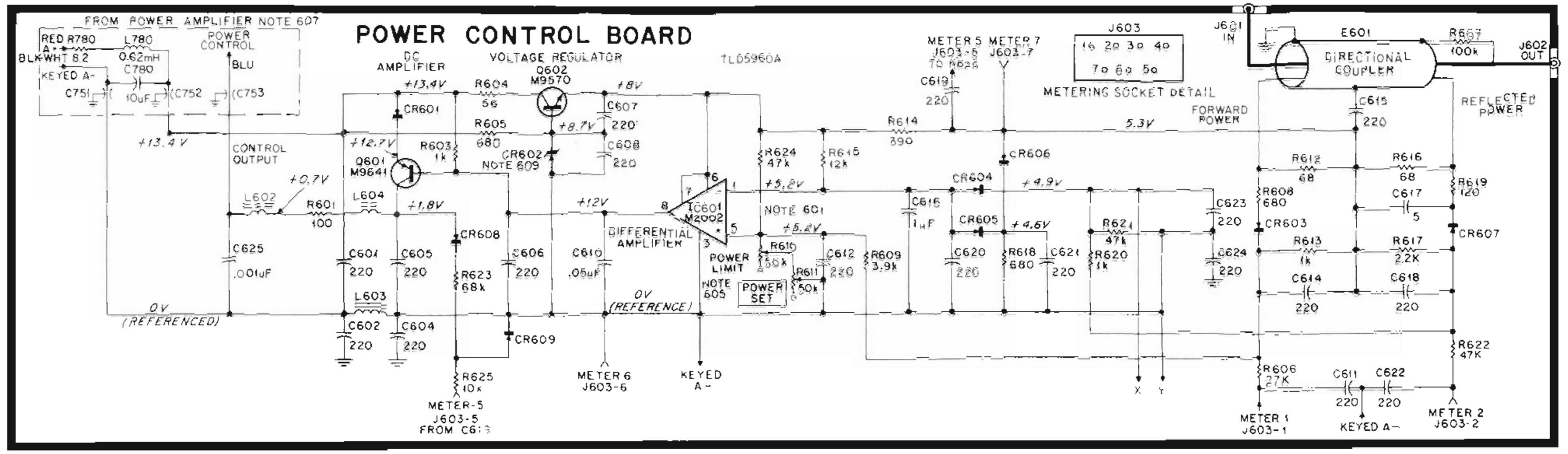
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor; ± 80-20%; 50 V:
C301, 302	21-11021H06	.033 uF
		connector, plug:
J901	28-82984N04	male; 4-contact
		resistor, variable:
R304	18-83083G11	2.5k
		mechanical parts
	9-80028A01	SOCKET, 3 pin

TRN5585A Exciter Control Voltage Regulator
P/O TLN2424A Power Amplifier Input Bracket Assembly
Schematic Diagram, Circuit Board Detail, and
Parts Lists
Motorola No. PEPS-35247-A
1/14/83- V & G

electrical parts list

TLD5960A Power Control Board (High Power) PL-8266-O

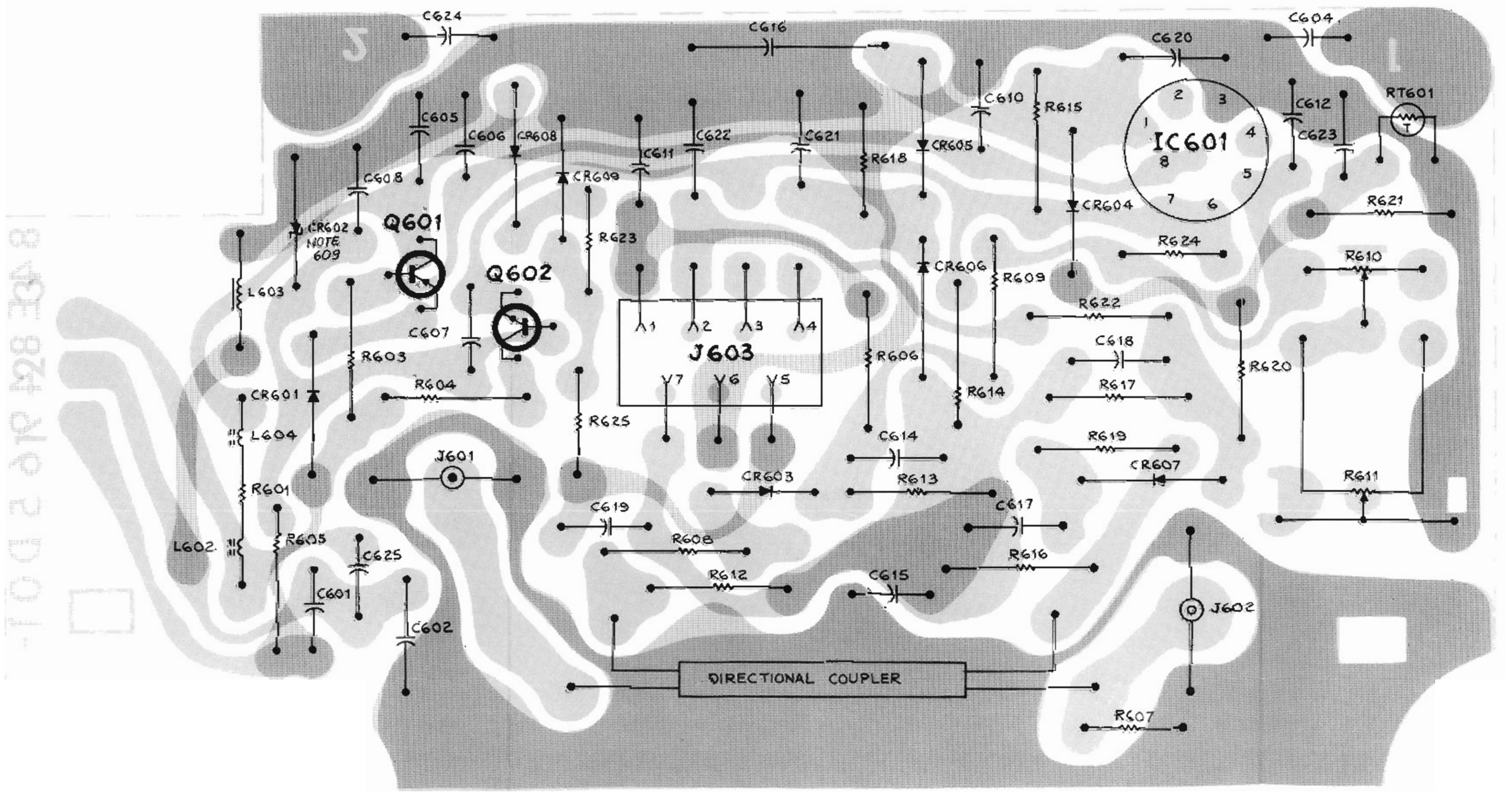
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 20%; 500 V: unless otherwise stated
C601, 602, 604 thru 608	21-83596E10	220 pF
C610	21-82372C04	.05 uF + 80-20%; 25 V
C611, 612, 614, 615	21-83596E10	220 pF; 500 V
C616	23-83214C04	1.0 uF ± 20%; 15 V
C617	21-82133G53	5 pF ± 0.5 pF, 500 V; NPO
C618 thru 624	21-83596E10	220 pF ± 20%; 500 V
C625	21-82187E14	.001 uF ± 10%; 100 V
		semiconductor device, diode:
CR601	48-83654H01	silicon
CR602	48-83696E04	Zener (9.1 V)
	or 1-80709D68	hybrid assembly
CR603	48-84616A01	silicon
CR604, 605, 606	48-82392B18	silicon
CR607	48-84616A01	silicon
CR608	48-82392B03	silicon
CR609	48-82392B18	silicon
		coupler, line:
E601	58-84685B01	dual
		integrated circuit:
IC601	51-84320A02	M2002
		connector, receptacle:
J601	28-84227B02	male; single-contact
J602	9-84231B02	female; single-contact
J603	9-84207B01	female; 7-contact
		coil, rf:
L602	76-83960B01	ferrite bead
L603	24-83961B01	choke
L604	76-83960B01	ferrite bead
		transistor:
Q601	48-869641	PNP; type M9641
Q602	48-869570	NPN; type M9570
		resistor, fixed ± 10%; 1/4 W: unless otherwise stated
R601	17-82291B21	100 ± 5%; 3 W
R603	6-124C49	1k
R604	6-124C19	56
R605	6-124A45	680 ± 5%
R606	6-124A83	27k ± 5%
R607	6-124C97	100k
R608	6-124A45	680 ± 5%
R609	6-124A63	3.9k ± 5%
R610	18-83083G26	variable; 50k
R611	18-83083G20	vaiable; 50k
R612	6-124A21	68 ± 5%
R613	6-124A49	1k ± 5%
R614	6-124A39	390 ± 5%
R615	6-124C75	12k
R616	6-124A21	68 ± 5%
R617	6-124A57	2.2k ± 5%
R618	6-124A45	680 ± 5%
R619	6-124A27	120 ± 5%
R620	6-124C49	1k
R621	6-124A89	47k
R622	6-124A89	47k ± 5%
R623	6-185A93	68k ± 5%; 1/8 W
R624	6-185B99	47k; 1/8
R625	6-185A73	10k ± 5%; 1/8 W
		mechanical parts
	3-139506	SCREW, tapping; 4-40 x 5/16"; 4 used
	42-84284B01	RETAINER; 4 used
	55-84300B04	HANDLE



EEPS-35250-O

NOTES:

601. Voltages at pins 1 and 5 should differ by less than 50 mV.
603. Typical Voltages under normal operating conditions.
604. Unless otherwise stated: capacitor values are in picofarads.
605. Factory adjustment.
607. Not part of or mounted on power control board. Part of Model TRN5577A P.A casing and hardware
609. On model TLD5960A CR602 is a hybrid assembly.



SHOWN FROM SOLDER SIDE

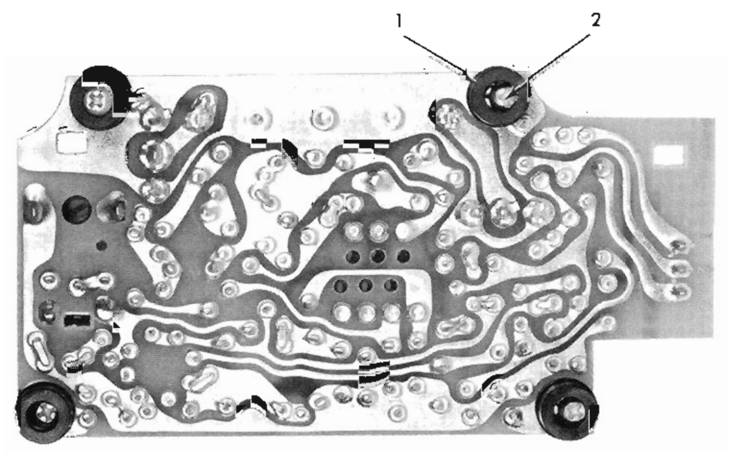
COMPONENT SIDE
SOLDER SIDE

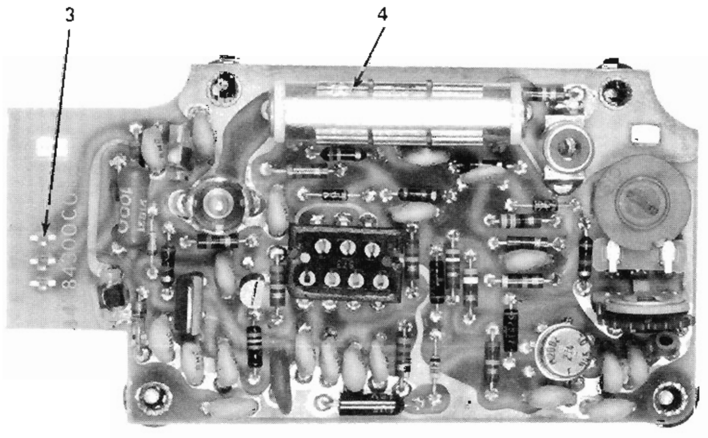
OL-CEPS-16813-C

parts list

Mechanical Parts List PL-854-D

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B01	RETAINER; 4 used
2	3-139506	SCREW, tapping; 4-40 x 5/16"
3	29-84028H01	TERMINAL, male; 3 used
4	42-84678B01	CLIP, component
		non-coded items
	55-84300B04	HANDLE, plastic
	1-80797B34	CABLE ASSEMBLY (TLD8610AV & TLD8620AV only) includes:
	42-10217A02	STRAP, tie





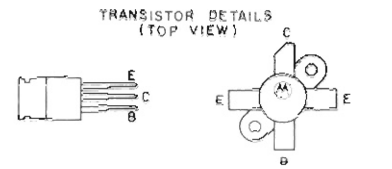
EEPS-6542-O

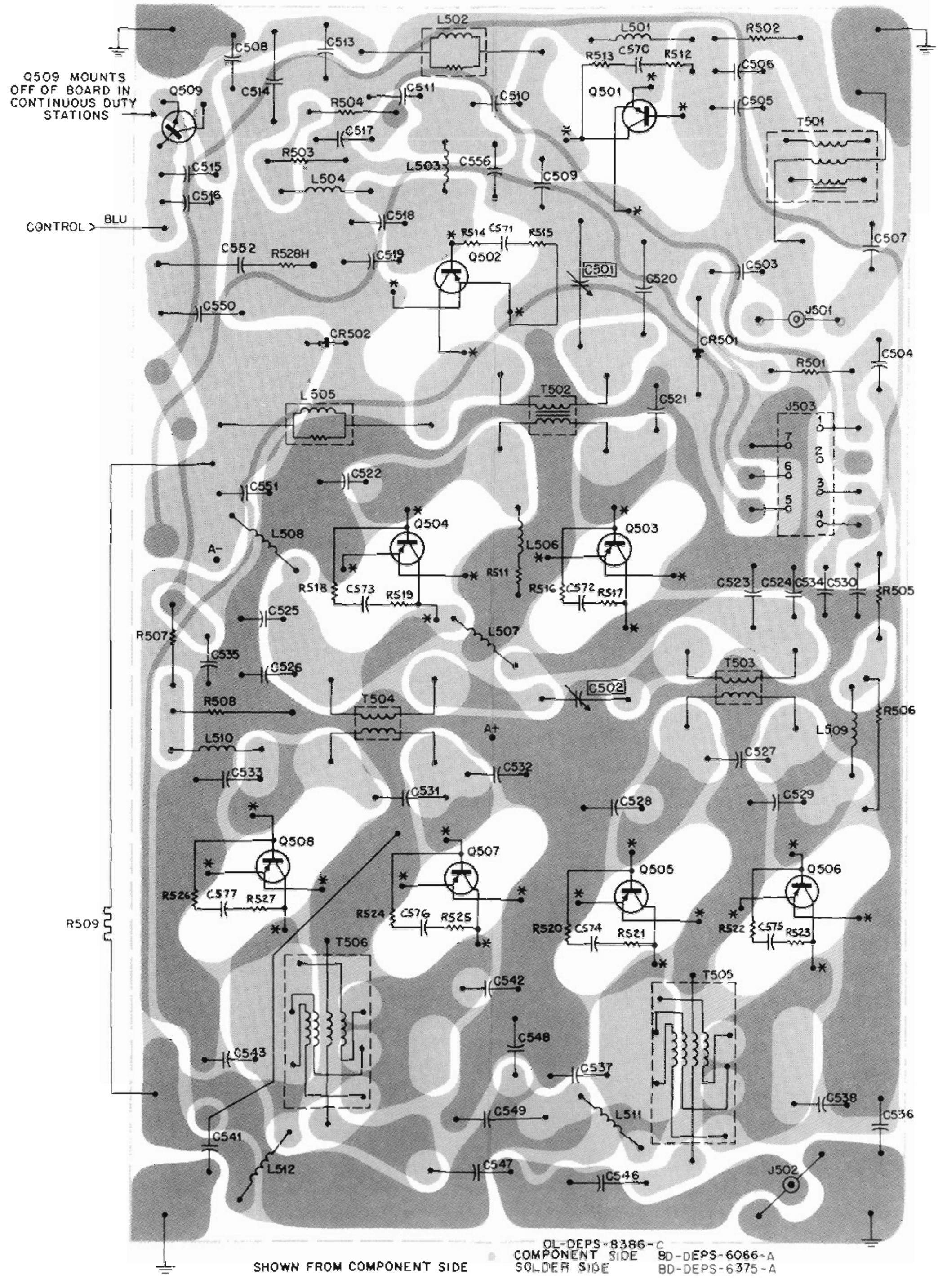
TLD5960A Power Control Board Schematic Diagram, Circuit Board Detail, and Parts Lists
Motorola No. PEPS-35251-O
11/15/82 - V & G

PA COMPONENT VALUES

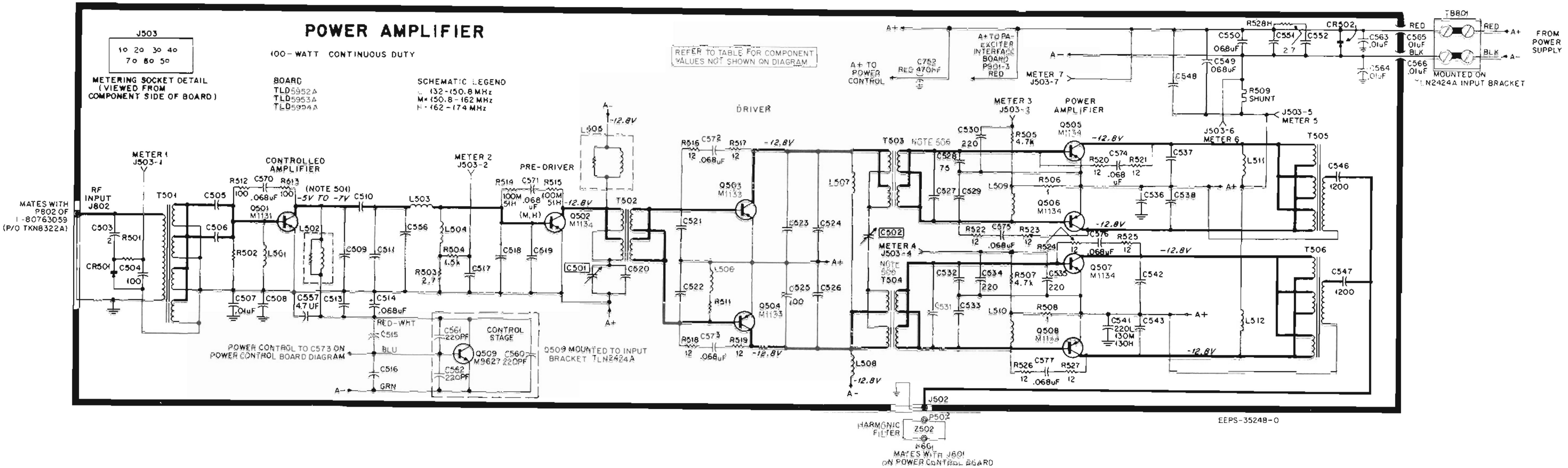
REF	136-150.8 MHz	150.8-162 MHz	162-174 MHz
C501	4-40	1.5-18	1.5-18
C502	2.4-27	2-19.3	2-19.3
C505	62	49	62
C506	62	51	34
C508	160	130	130
C509	15	15	10
C510	175	51	39
C511	62	51	39
C513	160	130	130
C515	-	3.3 uF	3.3 uF
C518	49	60	49
C519	49	60	43
C520	30	25	20
C521	62	43	43
C522	56	39	51
C523	80	100	120
C524	-	.01 uF	.05 uF
C526	-	.01 uF	.05 uF
C527	43	30	24
C528	75	75	80
C529	60	51	51
C531	43	30	24
C532	75	75	80
C533	62	60	68
C536	220	390	-
C537	130	150	100
C538	130	150	120
C541	220	130	130
C542	130	150	100
C543	120	130	100
C546	1200	1200	1200
C547	1200	1200	1200
C548	160	130	130
C551	160	130	130
C552	15 uF	100 uF	100 uF
C556	30	10	6
C557	-	-	4.7 uF
C571	-	.068 uF	.068 uF
L503	7-84400B03	1-1/2 turns	1-1/2 turns
L504	1 turn	1 turn	85
L506	.039 uH	.039 uH	290 nH
L507	2-1/2 turns	4-1/2 turns	4-1/2 turns
L508	2-1/2 turns	4-1/2 turns	4-1/2 turns
L509	0.29 uH	.039 uH	290 nH
L510	0.29 uH	.039 uH	290 nH
L511	4-1/2 turns	4-1/2 turns	0.29 uH
L512	4-1/2 turns	4-1/2 turns	0.29 uH
R501	100k	150k	150k
R502	10	10	49
R511	2.7	2.7	-
R514	-	100	51
R515	-	100	51
R528	-	-	2.7
T503	25-84859L01	25-84854L02	24-82060L01
T504	25-84859L02	25-84854L02	24-82060L01
T505	25-84860L01	25-84860L01	25-84861L01
T506	25-84860L01	25-84860L01	25-84861L01

EPS-26749-O





* THESE TRANSISTOR LEADS ARE CONNECTED TO ONLY THE COMPONENT SIDE OF THE BOARD



NOTES:

501. Voltages dependent upon amount of cutback from power control board.
502. Voltages measured in respect to A+ unless otherwise specified.
503. Unless otherwise specified:
Capacitor values are in picofarads.
506. For frequency range 162-174 MHz air-core transformers.

PARTS LISTS SHOWN ON BACK OF THIS DIAGRAM

TLD5950A Series Power Amplifier Board Schematic Diagram, Circuit Board Detail, and Parts Lists
Motorola No. ***PEPS-35249-O***
11/15/82 V & G

parts list

TRN5577A PA Casting and Hardware Kit PL-8218-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C563, 564	21-84211B02	.01 uF + 100-0%; 250 V
C780	23-83214C20	10 uF ± 20%; 20 V
		coil, rf:
L780	24-80900A61	choke; 0.62 mH
		resistor; fixed:
R780	6-124B67	8.2 ± 5%; 1/4 W
		mechanical parts
	2-119913	NUT, 8-32 x 11/32 x 1/8"; 2 used
	3-131195	SCREW, machine; 6-32 x 3/8"; 18 used
	3-134184	SCREW, tapping; 4-40 x 5/16"; 8 used
	3-134185	SCREW, tapping; 6-32 x 1/4"; 4 used
	3-136930	SCREW, tapping; 4-40 x 1/2"; 4 used
	3-83677N04	SCREW, capture; 4 used
	4-7557	WASHER, flat, .172 x .375 x .033; 4 used
	4-801846	WASHER, insulator; 3/8"; 2 used
	7-84347N01	BRACKET, mounting; (RH)
	7-84347N02	BRACKET, mounting (LH)
	15-84403D01	COVER, power control
	26-84404D03	HEAT EXCHANGE, PA
	31-131744	TERMINAL, strip; 2 insulated #2 mounting
	42-84328E01	CLIP
	66-106515	WRENCH, Allen

TRN5586A PA Hardware PL-8219-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 20%; 500 V:
C751, 752, 753	21-821474	470 pF; (feed-thru)
		transistor: (see note)
Q501	48-84411L31	PNP; type M1131
Q502	48-84411L32	PNP; type M1132
Q503, 504	48-84411L33	PNP; type M1133
Q500 thru 508	48-84411L34	PNP; M1134
		mechanical parts
	3-114406	SCREW, cap; 4-40 x 5/16"; 20 used
	3-134184	SCREW, tapping; 4-40 x 5/16"; 3 used
	14-84290B02	INSULATOR
	26-84911L01	SHIELD, PA
	42-10217A02	STRAP, tie: .091 x 3.62 nylon; 3 used
	54-84429N01	LABEL, PA
	4-83755H01	WASHER, solder; 7 used
	7-82379M01	BRACKET
	9-84234E10	CONNECTOR, receptacle; 3 used

PA Output (Harmonic) Filter PL-1722-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		filter, rf; low pass:
Z502L	TFD6101A	132-150.8 MHz
Z502M, 502H	TFD6102A	150.8-174 MHz

LEGEND:
L = 132-150.8 MHz
M = 150.8-162 MHz
H = 162-174 MHz

TLD5952A PA Board (132-150.8 MHz)
TLD5953A PA Board (150.8-162 MHz)
TLD5954A PA Board (162-174 MHz) PL-6100-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF; ± 5%; 500 V: unless otherwise stated
C501L	20-83201B09	variable; 4-40
C501M, 501H	20-83201B07	variable; 1.5-18
C502L	19-83491E08	variable; 2.4-27 (voltage not stated)
C502M, 502H	19-83491E07	variable; 2-19.3 (voltage not stated)
C503	21-83406D52	2
C504	21-84494B04	100
C505L	21-84494B02	62
C505M	21-84494B25	49
C505H, 506L	21-84494B02	62
C506M	21-84494B01	51
C506H	21-84494B30	34
C507	21-82428B59	.01 uF + 80-20%; 200 V
C508L	21-84494B51	160
C508M, 508H	21-84494B26	130
C509L, 509M	21-84494B38	15
C509H	21-84494B29	10
C510L	21-84494B09	175
C510M	21-84494B01	51
C510H	21-84494B24	39
C511L	21-84494B02	62
C511M	21-83366K20	51
C511H	21-84494B24	39
C513L	21-84494B51	160
C513M, 513H	21-84494B26	130
C514, 549, 550	8-83813H05	.068 uF ± 10%; 100 V
C515L		NOT USED
C515M	23-11019A16	4.7 uF; 35 V
C516M	23-83908L01	100 uF; 25 V
C516L, 516H	23-83214C10	47 uF ± 20%; 6 V
C517	21-83596E10	220
C518L	21-84494B25	49
C518M	21-84494B35	60
C518H, 519L	21-84494B25	49
C519M	21-84494B35	60
C519H	21-84494B28	43
C520L	21-84936A06	30 ± 1.5 pF; 2000 V
C520M	21-84936A04	25; 2000 V
C520H	21-84936A03	20; 2000 V
C521L	21-84494B02	62
C521M, 521H	21-84494B28	43
C522L	21-84494B45	56
C522M	21-84494B24	39
C522H	21-84494B01	51
C523L	21-83366K12	80; 250 V
C523M	21-83364K13	100; 250 V
C523H	21-83366K14	120; 250 V
C524L, 526L		NOT USED
C524M, 526M	21-82428B59	.01 uF + 80-20%; 200 V
C524H, 526H	21-82372C04	.05 uF + 80-20%; 25 V
C525	21-83366K13	100; 250 V
C527L	21-83366K19	43
C527M	21-83366K18	30
C527H	21-83366K17	24
C528L, 528M	21-83366K24	75
C528H	21-83366K25	80
C529L	21-83366K21	60
C529M, 529H	21-83366K20	51
C530	21-83596E10	220
C531L	21-83366K19	43
C531M	21-83366K18	30
C531H	21-83366K17	24
C532L, 532M	21-83366K24	75
C532H	21-83366K25	80
C533L	21-83366K22	62
C533M	21-83366K21	60
C533H	21-83366K23	68
C534, 535	21-83596E10	220
C536L	21-84494B12	220
C536M	21-84494B18	390
C536H		NOT USED
C537L	21-83366K15	130; 250 V
C537M	21-83366K16	150; 250 V
C537H	21-83366K13	100; 250 V
C538L	21-83366K15	130; 250 V
C538M	21-83366K16	150; 250 V
C538H	21-83366K14	120; 250 V
C541L	21-84494B12	220
C541M, 541H	21-84494B26	130
C542L	21-83366K15	130; 250 V
C542M	21-83366K16	150; 250 V
C542H	21-83366K13	100; 250 V
C543L	21-83366K14	120; 250 V
C543M	21-83366K15	130; 250 V
C543H	21-83366K13	100; 250 V
C546, 547	21-84426B36	1200
C548L	21-84494B51	160
C548M, 548H	21-84494B26	130
C551L	21-84494B51	160
C551M, 551H	21-84494B26	130
C552L	23-83214C02	15 uF ± 20%; 25 V
C552M	23-84669A19	100 uF + 150-20%; 20 V
C552H	23-82783B04	100 uF ± 20%; 25 V
C556L	21-84494B33	30
C556M	21-84494B29	10
C556H	21-84494B74	6
C557H	23-82783B25	4.7 uF ± 10%; 25 V
		semiconductor device, diode: (see note)
CR501	4882139G01	germanium
CR502	48-82525G01	silicon
		connector, receptacle; female:
P501, 502	28-84227B01	coaxial, miniature type
J503	9-84207B01	7-contact
		coil, rf:
L501	24-83961B01	choke; 3 turns; coded BRN
L502	24-84392B03	choke; 6 turns
L503L	7-84400B03	Inductor "bracket"
L503M, 503H	24-83884G03	1-1/2 turns
L504L, 504M	24-83961B03	choke; 1 turns; coded WHT
L504H	24-82723H18	choke; 85 nH
L505	24-84392B02	choke; 4 turns
L506L, 506M	24-82723H02	choke; 39 nH
L506H	24-82723H20	choke; 290 nH
L507L, 508L	24-8547G10	choke; 2-1/2 turns
L507M, 507H, 508M, 507H	24-84393B02	choke; 4-1/2 turns
L509L, 510L	24-82723H04	choke; 0.29 uH
L509M, 510M	24-82723H02	choke; 39 nH
L509H, 510H	24-82723H20	choke; 290 nH
L511L, 511M	24-84393B02	4-1/2 turns
L511H	24-82723H04	choke; 0.29 uH
L512L, 512M	24-84393B02	4-1/2 tuns
L512H	24-82723H04	choke; 0.29 uH
E101M, 102M	76-83960B01	ferrite bead
		resistor, fixed: ± 10%; 1/4 W: unless otherwise stated
R501L	6-124C97	100k
R501M, 501H	6-124D02	150k
R502L, 502M	6-124A01	10 ± 5%
R502H	6-124C17	47
R503	6-124B55	2.7 ± 5%
R504	6-124C53	1.5k
R505, 507	6-124C65	4.7k
R506, 508	6-125D70	1; 1/2 W
R509	6-84232B01	(meter shunt)
R511L, 511M	6-124D55	2.7 ± 5%
R528H	6-124D55	2.7 ± 5%
		transformer, rf:
T501	25-84396B01	pri: 5 turns sec: 4 windings, 1 turn each
T502	25-84397B01	pri: 2 windings, 1-3/4 turns each sec: 2 windings, 1-3/4 turns each
T503L	25-84859L01	pri: 2 windings, 2-3/4 turns each sec: 2 windings, 2-3/4 turns each NOTE: ("left hand" windings)
T503M	25-84854L01	pri: 3-3/4 turns sec: 3-3/4 turns
T503H	24-82060L01	pri: 2 windings, 2 turns each sec: 2 windings, 2 turns each
T504L	25-84859L02	pri: 2 windings, 2-3/4 turns each sec: 2 windings, 2-3/4 turns each NOTE: ("right hand" windings)
T504M	25-84854L02	pri: 3-3/4 turns sec: 3-3/4 turns
T504H	24-82060L01	pri: 2 windings, 2 turns each sec: 2 windings, 2 turns each
T505L, 505M	25-84860L01	pri: 3 windings, 1-1/2 turns each sec: 6 turns
T505H	25-84861L01	pri: 3 windings, 1-1/2 turns each sec: 5 turns
T506L, 506M	25-84860L01	pri: 3 windings, 1-1/2 turns each sec: 6 turns
T506H	25-84861L01	pri: 3 windings, 1-1/2 turns each sec: 5 turns

TRN8069A Resistor-Capacitor Network Kit (132-150.8 MHz)
TRN6445A Resistor-Capacitor Network Kit (150.8-162 MHz)
TLD5502A Resistor-Capacitor Network Kit (162-174 MHz) PL-5396-A

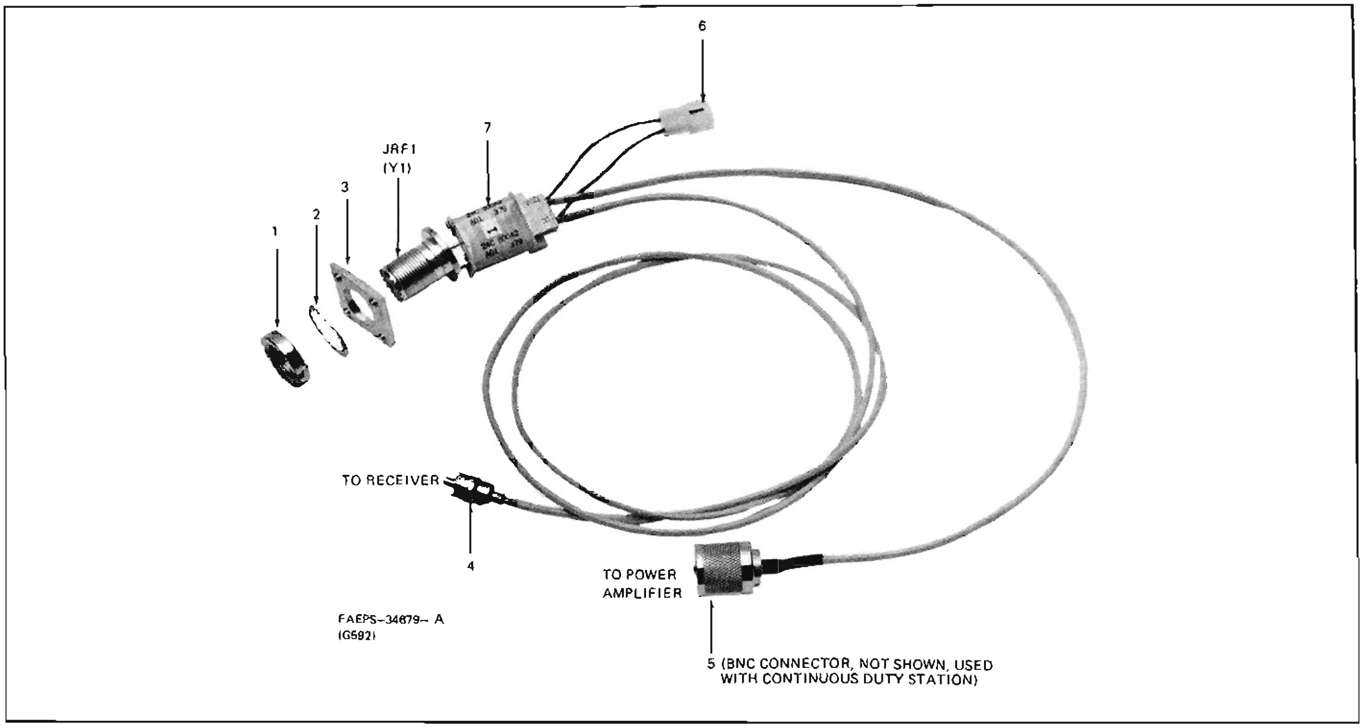
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; ± 10%; 100 V: unless otherwise stated
C570, 572 thru 577	8-83813H05	.068 uF
C571L		NOT USED
C571M, 571H	8-83813H05	.068 uF
		resistor, fixed: ± 10%; 1/2 W: unless otherwise stated
R512, 513	6-125C25	100
R514L, 515L		NOT USED
R514M, 515M	6-125C25	100
R514H, 515H	6-125A18	51 ± 5%; 1/2 W
R516 thru 527	6-125C03	12

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

MOTOROLA INC.
Communications
Sector

ANTENNA SWITCH

MODEL TRN5122A (INTERMITTENT DUTY)
MODEL TRN5571A (CONTINUOUS DUTY)



ANTENNA SWITCH REPLACEMENT

1. Remove the card cage per manual instructions in the maintenance section.

2. Note the positions of the tie wraps and cable clamps, and pay attention to cable routing.

3. Remove the appropriate cable clamps, and clip the necessary tie wraps.

4. Remove the antenna switch:

4.1 Unfasten the receiver antenna connector from the card cage chassis (2 screws).

4.2 Disconnect the rf connector from the PA output

4.3 Unfasten the 2 pin molex connector.

4.4 Remove the antenna switches spanner nut from the junction box.

5. Installation is the reverse of the above. Remember to fasten the cables with new tie wraps.

parts list

TRN5122A Antenna Switch PL-8027-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	2-80008A01	NUT, spanner
2	4-114522	LOCKWASHER, 5/8"
3	43-82895N01	SPACER
4	28-82875N01	CONNECTOR, receiver
5	28-84579F01	CONNECTOR, PA (P803) Intermittent Duty
	28-83099K01	CONNECTOR, PA (P803) continuous duty
6		J801 consists of 15-84861K02 Housing, 29-84706E05 TERMINALS
7		ANTENNA SWITCH, non-serviceable