



MOTOROLA INC.

Communications
Sector

EXCITER

MODELS TLD9231A AND TLD9232A SIMPLEX
TLD9241A AND TLD9242A DUPLEX

1. DESCRIPTION

1.1 The Model TLD9230A Series or TLD9240A Series Exciters provide the low power excitation for the FM transmitter. Up to four plug-in channel elements, one for each transmitter operating frequency, are used to develop a direct FM carrier signal of at least 1.5 watts.

1.2 The exciter is direct frequency-modulated for crystal-controlled frequency operation in the 132-174 MHz range. It consists of a modulator amplifier and clipper, emitter-follower splatter filter, channel element(s) (voltage-controlled crystal oscillator), first doubler, second doubler, driver, and final amplifier. The fundamental crystal frequency is multiplied by twelve to provide the transmitter carrier frequency.

1.3 When the exciter is used in PL/DPL coded stations, the PL/DPL encoding signals are inserted into the transmit audio at the input to the splatter filter stage.

2. THEORY OF OPERATION

Refer to the transmitter functional block diagram (in Transmitter section of this manual) and the exciter schematic diagram included in this section.

2.1 TRANSMIT AUDIO CIRCUIT

Exciter audio from the station control module (or test microphone) is applied to audio amplifier Q501, then routed to the clipper/pre-emphasis circuit of Q502 and Q503. This amplitude limited audio is combined with the PL or DPL code audio (if present) and routed via active splatter filter Q504-Q505, to the channel element(s).

2.2 CHANNEL ELEMENTS

2.2.1 Each channel element is comprised of a highly stable, frequency modulated crystal controlled oscillator. The channel element is a factory-sealed plug-in module, using an unheated crystal in an oscillator circuit that is temperature-compensated over an ambient

temperature range of -30°C to $+60^{\circ}\text{C}$ (-22°F to $+140^{\circ}\text{F}$). The oscillator operates at 1/12 of the transmitted carrier frequency.

2.2.2 The channel element contains a series combination of a varactor diode, a warping coil, and the crystal. A change in the series inductance or capacitance causes the crystal to vary its resonant frequency in proportion to the change. The audio voltage from the IDC circuitry (within the channel element) is applied to the varactor diode to cause a change in capacitance; this variation causes the carrier frequency to change (deviate) at the same audio rate. The variable warp coil and IDC potentiometer are accessible through holes in the top of each channel element, for fine frequency and IDC adjustments.

2.2.3 The exciter accepts up to four channel elements; one is required for each transmit frequency. A power input of +9.4 volts is applied continuously to all channel elements while the station is turned on. Channel element output is developed when a switched ground from the station control module is routed to the enable pin.

2.3 MULTIPLIERS AND AMPLIFIERS

2.3.1 The multipliers develop an output signal that is 12 times the channel element frequency, and the final amplifier provides power gain, as controlled by the power control board on the power amplifier.

2.3.2 The output of the activated channel element is routed through three tuned circuits in series. The tuned circuits (L701, L702, L703, and associated components) are tuned to the approximate third harmonic of the channel element frequencies. The signal from the tuned circuit is routed to first doubler Q701. First doubler Q701 and second doubler Q702 multiply the filtered output to 12 times the crystal frequency.

2.3.3 Driver and final amplifier Q703 and Q704 provide two stages of amplification at the transmit frequency. The power output level of the driver and final amplifier is controlled by varying the dc collector

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voltage on the transistors. For intermittent duty stations, the CONTROL VOLTAGE is developed on the power control board in the power amplifier. The CONTROL VOLTAGE changes as required to maintain correct PA output level and operating parameters. For continuous duty stations, the CONTROL VOLTAGE is developed on the exciter control voltage regulator board. The CONTROL VOLTAGE is set by the Exciter Level Control (R901).

3. EXCITER FUNCTIONAL TESTS

The tests in this section should be performed *after* servicing but *before* alignment, to verify that the exciter circuitry is operating correctly.

3.1 EXCITER POWER OUTPUT TEST

3.1.1 Intermittent Duty Station

Step 1. Disconnect exciter output cable from power amplifier chassis, and connect to rf wattmeter and dummy load.

Step 2. Set Power Set (R911) and Current Limit (R939) controls to mid-rotation. These controls are located on the power control board in the PA chassis. (Refer to Power Amplifier section for exact location.)

Step 3. Set Control Voltage Limit (R931) fully clockwise. This control is also located on the power control board.

Step 4. Key transmitter and observe wattmeter. Power output is normally at least 1.5 watts.

3.1.2 Continuous Duty Station

Step 1. Disconnect exciter output cable from power amplifier chassis, and connect to rf wattmeter and dummy load.

Step 2. Set Exciter Level Control (R901) fully clockwise (CW). This control is located on the power amplifier.

Step 3. Key the transmitter and observe the wattmeter. Power output is normally at least 0.75 watts.

3.2 FREQUENCY TEST

Step 1. Terminate the transmitter in an antenna or dummy load and measure the radiated signal frequency with a Motorola digital frequency meter or other highly accurate frequency measuring device ($\pm .00005\%$ or better) when the transmitter is keyed in the following steps.

Step 2. Key the transmitter to produce an unmodulated carrier signal. In stations equipped with PL or DPL signaling, disable the encoder by shorting the disable pin to ground (pin 14 on the PL/DPL position on the backplane interconnect board).

NOTE

Do not use microphone push-to-talk switch to key station. Background noise can modulate the transmitter.

Step 3. Read transmitter output frequency. Repeat for each channel on multi-frequency stations.

3.3 DEVIATION TEST

Step 1. Terminate transmitter with an antenna or dummy load and measure the radiated signal deviation using a Motorola deviation monitor when the transmitter is keyed in the following steps.

Step 2. (PL/DPL models only.) Remove PL/DPL inhibit jumper (if installed during previous test). Key transmitter without voice modulation. Normal PL/DPL deviation is 0.5 to 1 kHz.

Step 3. Connect audio oscillator to exciter board pins P501-12 (EXCITER AUDIO HI) and P501-11 (EXCITER AUDIO LO). Set audio oscillator to 1000 Hz at 1 volt output. Normal deviation is 4.7 kHz.

Step 4. Adjust audio oscillator over 300-3000 Hz range, keeping audio level at 1 volt. Normally, deviation never exceeds ± 5 kHz, nor is less than ± 2.5 kHz.

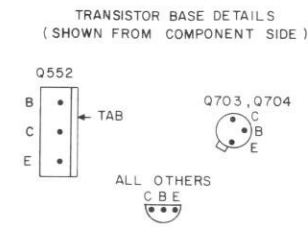
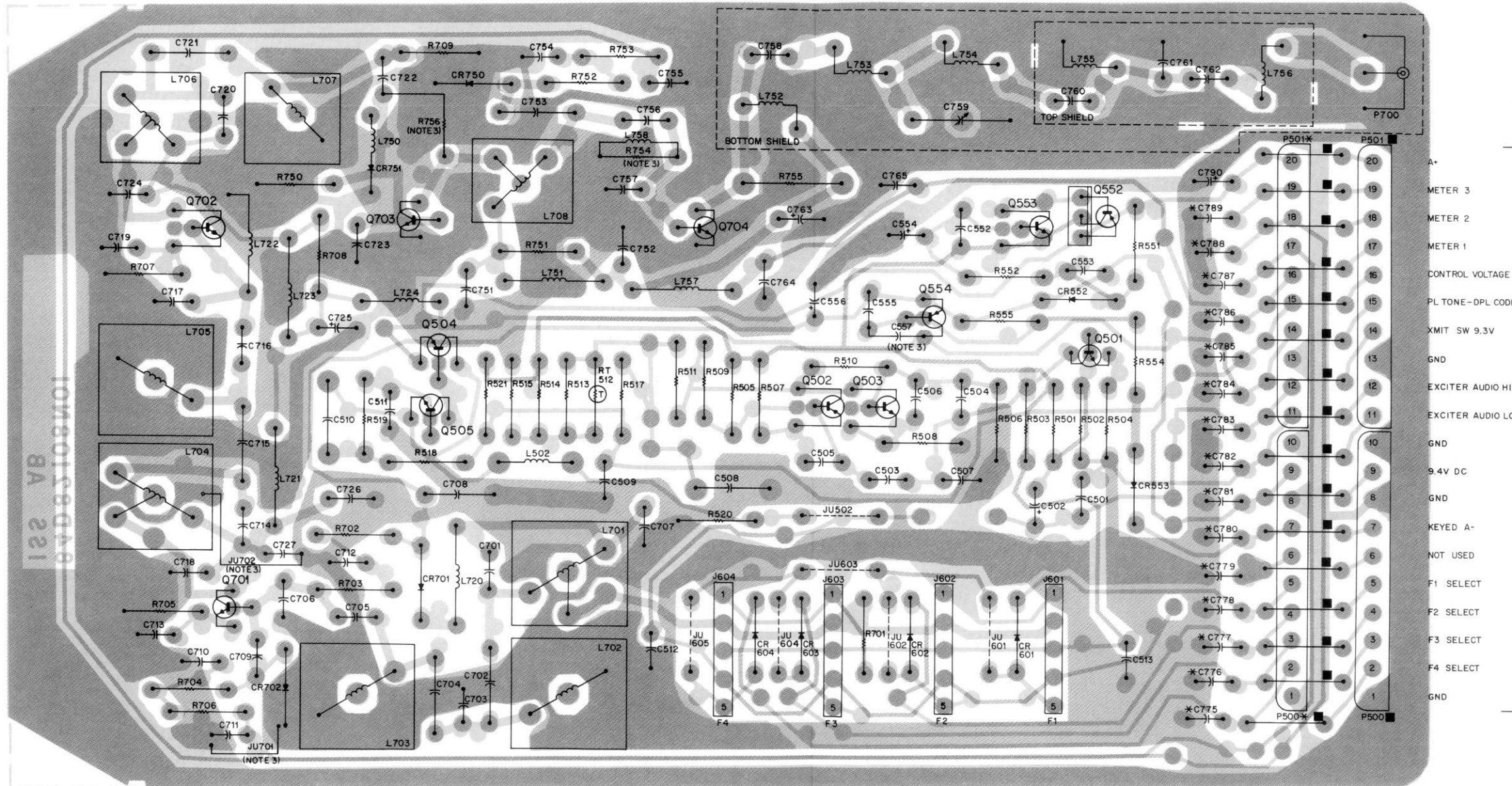
4. TROUBLESHOOTING

Refer to Table 1 for exciter troubleshooting procedure.

Table 1. Exciter Troubleshooting Procedure

Symptom	Cause	Test or Correction
No Meter 1 Reading	1. Unused or out-of-frequency range channel selected	1. Ground channel element enable pin for active channel
	2. No XMIT SWITCHED 9.3 V	2. Check for presence of keypad A -, check or replace Q554
	3. No REG 9.4 V	3. Check circuitry of Q552
	4. Bad channel element	4. Try different channel or replace
	5. L701, L702, L703 mis-tuned	5. Perform Exciter/PA Alignment
No Meter 3 Reading	1. Bad Q701, Q702, and/or Q703	1. Check and replace
	2. Improper control voltage	2. Troubleshoot PA Power Control Board or Exciter Control Voltage Regulator Board
	3. L704, L705, L706, L707 and/or L708 mis-tuned	3. Perform Exciter/PA Alignment
Low or No Output Power	1. Bad Q703 or Q704	1. Check and replace
	2. Improper control voltage	2. Troubleshoot PA Power Control Board or Exciter Control Voltage Regulator Board
	3. Mis-tuned C759	3. Retune for highest possible power output
Insufficient Deviation	1. Bad Q501	1. Check and replace
	2. Wrong jumpers installed	2. Check that JU501 is out and JU502 is in for non-DVP stations

EARLIER VERSION EXCITER



- A+ METER 3
- METER 2
- METER 1
- CONTROL VOLTAGE
- PL TONE-DPL CODE
- XMIT SW 9.3V
- GND
- EXCITER AUDIO HI
- EXCITER AUDIO LO
- GND
- 9.4V DC
- GND
- KEYED A-
- NOT USED
- F1 SELECT
- F2 SELECT
- F3 SELECT
- F4 SELECT
- GND

MATES WITH BACKPLANE EXCITER CONNECTOR J102

- NOTE:
1. COMPONENTS DESIGNATED WITH ASTERISK (*) ARE PRESENT ON DUPLEX MODELS (TLD9242A) ONLY.
 2. COMPONENTS AND JUMPERS DESIGNATED WITH SQUARE (■) ARE PRESENT ON SIMPLEX MODELS (TLD9232A) ONLY.
 3. C557, R754, R756, JU701, AND JU702 ARE LOCATED ON SOLDER SIDE.

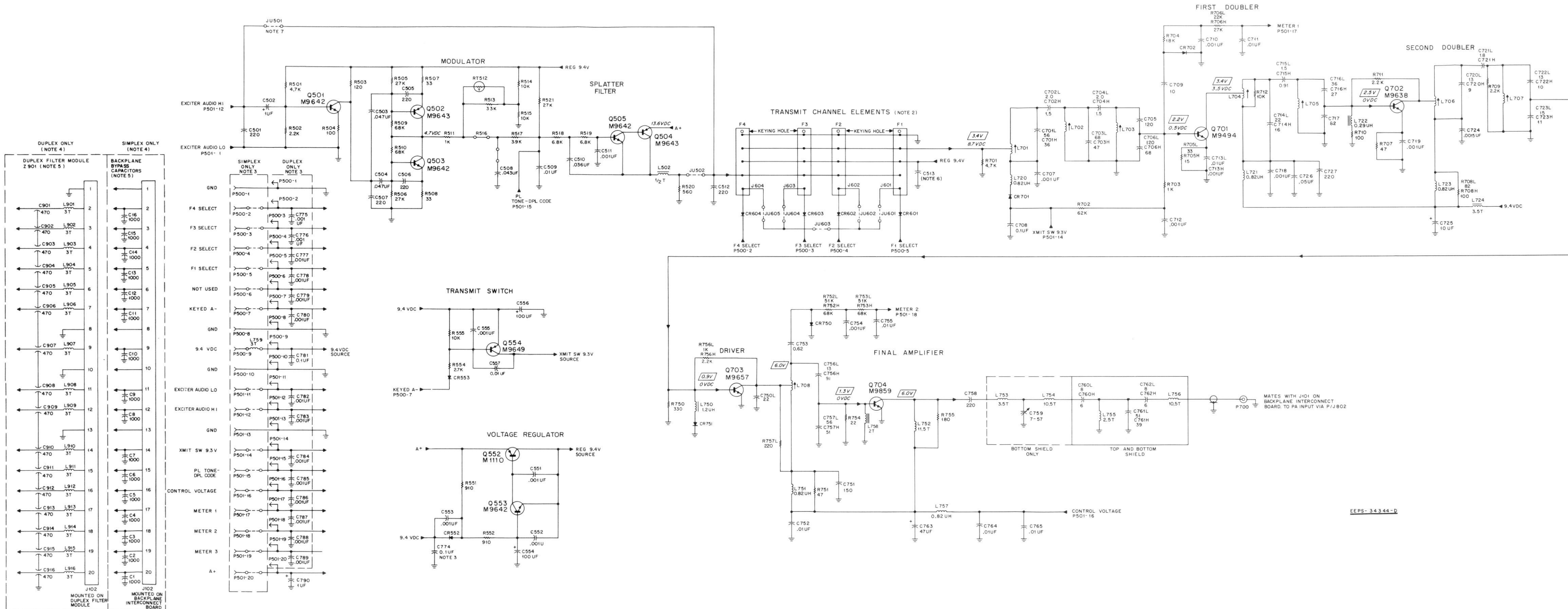
SHOWN FROM COMPONENT SIDE

SOLDER SIDE: BD-EEPS-34369-0
 COMPONENT SIDE: BD-EEPS-34368-0
 QL-EEPS-34370-A

TLD9231A and TLD9232B Simplex Exciter and
 TLD9241B and TLD9242C Duplex Exciter
 Circuit Board Detail
 Motorola No. PEPS-34789-D
 (Sheet 1 of 3)
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Exciter Range			
Kit No.	Range	Frequency (MHz)	Type
TLD9231A	Low (L)	132-150.8	Simplex
TLD9232B	High (H)	146-174	Simplex
TLD9241B	Low (L)	132-150.8	Duplex
TLD9242C	High (H)	146-174	Duplex

- NOTES:
- Unless otherwise indicated, resistor values are in ohms and capacitor values are in picofarads.
 - Transmitter frequency calculation: $F_{oscillator} = F_{channel} \times 12$
 - TLD9231A/TLD9232B Simplex Exciter uses jumpers shown, with female edge connectors P500/P501. TLD9241/TLD9242 Duplex Exciter uses C775-C789 shown, with male edge connectors P500/P501.
 - Simplex exciter is connected to male backplane connector J102. Duplex exciter is connected to female filter module connector J102.
 - Backplane bypass capacitors C1-C16 and duplex filter module are part of backplane interconnect board assembly. Refer to associated Control and Applications manual for replacement parts information and location.
 - Refer to parts list for component values.
 - JU501 always out on standard models.

TLD9231A and TLD9232B Simplex Exciter and TLD9241B and TLD9242C Duplex Exciter Schematic Diagram Motorola No. PEPS-34789-D (Sheet 3 of 3) 9/13/84 - V & G

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