



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

EXCITER

technical writing services

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.

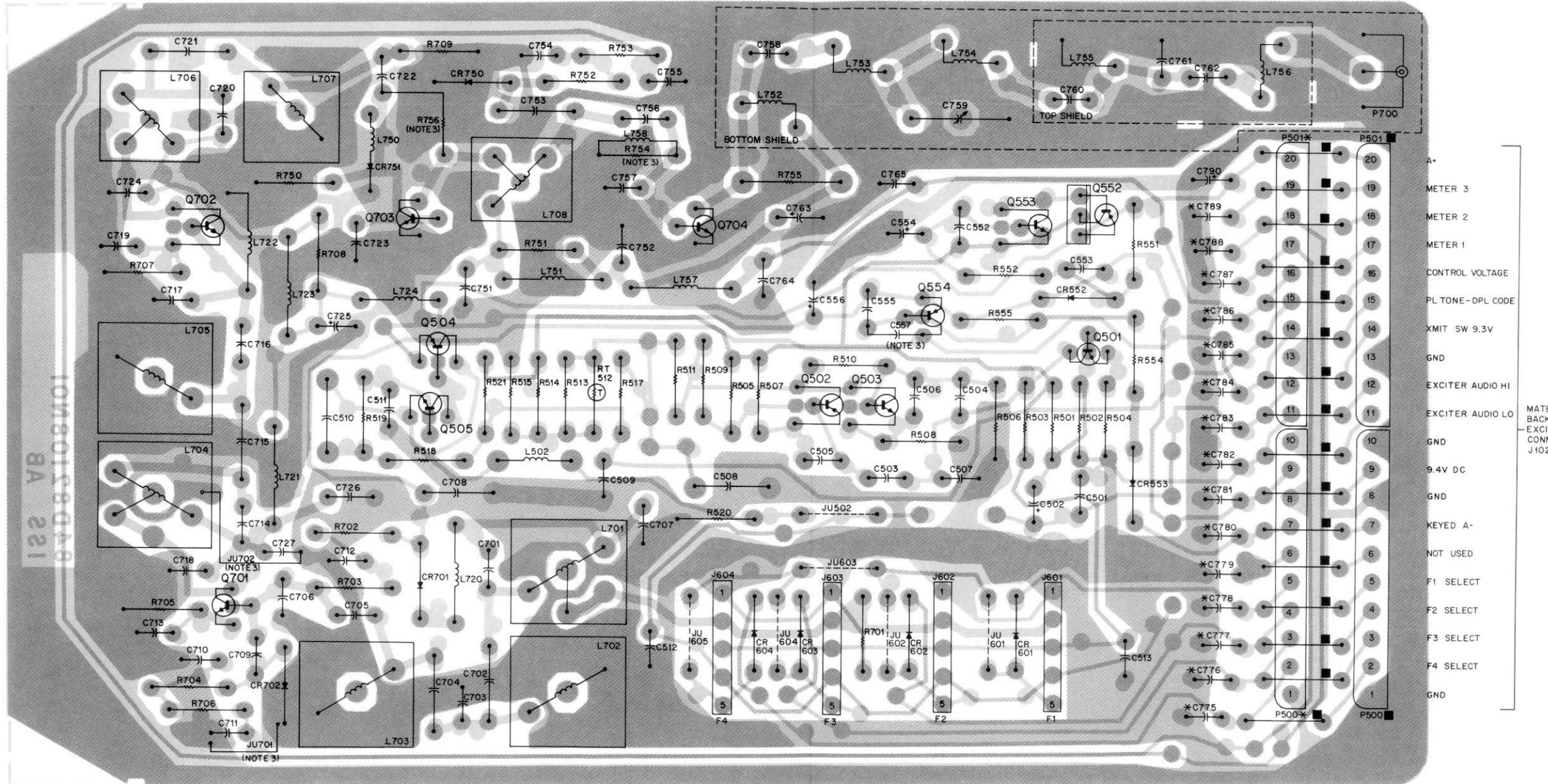
4. TROUBLESHOOTING

Refer to Table 1 for exciter troubleshooting procedure.

Table 1. Exciter Troubleshooting Procedure

Symptom	Causes	Test or Correction
No Meter I Reading	<ol style="list-style-type: none"> 1. Unused or out-of-frequency range channel selected 2. No XMIT SWITCHED 9.3 V 3. No REG 9.4 V 4. Bad channel element 5. L701, L702, L703 mis-tuned 	<ol style="list-style-type: none"> 1. Ground channel element enable pin for active channel 2. Check for presence of keyed A--, check or replace Q554 3. Check circuitry of Q552 4. Try different channel or replace 5. Perform Exciter/PA Alignment
No Meter J Reading	<ol style="list-style-type: none"> 1. Bad Q701, Q702, and/or Q703 2. Improper control voltage 3. L704, L705, L706, L707 and/or L708 mis-tuned 	<ol style="list-style-type: none"> 1. Check and replace 2. Troubleshoot PA Power Control Board or Exciter Control Voltage Regulator Board 3. Perform Exciter/PA Alignment
Low or No Output Power	<ol style="list-style-type: none"> 1. Bad Q703 or Q704 2. Improper control voltage 3. Mis-tuned C759 	<ol style="list-style-type: none"> 1. Check and replace 2. Troubleshoot PA Power Control Board or Exciter Control Voltage Regulator Board 3. Retune for highest possible power output
Insufficient Deviation	<ol style="list-style-type: none"> 1. Bad Q501 2. Wrong jumpers installed 	<ol style="list-style-type: none"> 1. Check and replace 2. Check that J1501 is out and J1502 is in for non-DVP stations

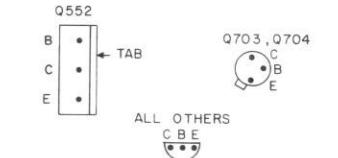
EARLIER VERSION EXCITER



SHOWN FROM COMPONENT SIDE

SOLDER SIDE BD-EEPS-34369-0
COMPONENT SIDE BD-EEPS-34368-0
OL-EEPS-34370-A

TRANSISTOR BASE DETAILS
(SHOWN FROM COMPONENT SIDE)



ALL OTHERS C BE

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.

TLD9231A and TLD9232B Simplex Exciter and
TLD9241B and TLD9242C Duplex Exciter
Circuit Board Detail
Motorola No. PEPS-34789-D
(Sheet 1 of 3)
9/13/84 - V & G

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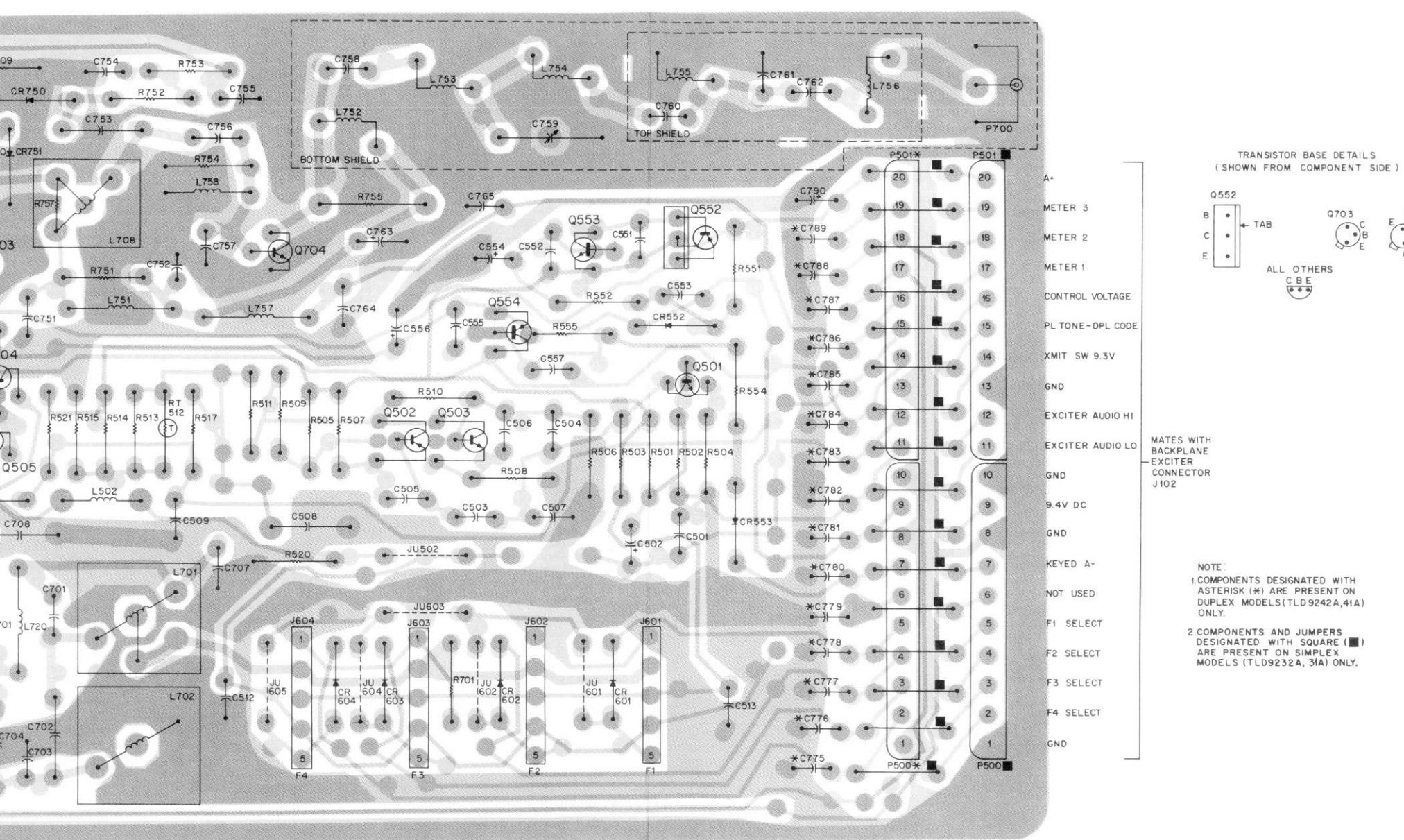
/TLD9232B Simplex Exciter
/TLD9242C Duplex Exciter

PL 3934.D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR750	48-83654H01	silicon
CR751	48-82139G01	germanium
J601 thru 604	28-80096A02	connector, male; 5-con
L502	24-80036A02	coil, rf; choke; 1/2 t
L701	24-83377G11	choke; 6-1/2 turns
L702, 703	24-80068A17	6-1/2 turns; 1/2 in dia
L704	24-80068A18	4-1/2 turns; 1/2 in dia
L705	24-80068A19	4-1/2 turns; 1/2 in dia
L706	24-80034A02	3-1/2 turns; 1/2 in dia
L707	24-80034A03	3-1/2 turns; 1/2 in dia
L708	24-80034A01	3-1/2 turns; 1/2 in dia
L720, 721	24-82835G13	choke; 0.82 uH
L722	24-82723H04	0.29 uH
L723	24-82835G13	choke; 0.82 uH
L724	24-83961B01	3-1/2 turns; 1/2 in dia
L750	24-82723H27	choke; 1.2 uH
L751	24-82835G13	choke; 0.82 uH
L752	24-84411B03	11-1/2 turns; 1/2 in dia
L753	24-83884G01	3-1/2 turns; 1/2 in dia
L754	24-84411B04	10-1/2 turns; 1/2 in dia
L755	24-83884G07	2-1/2 turns; 1/2 in dia
L756	24-84411B04	10-1/2 turns; 1/2 in dia
L757	24-82835G13	choke; 0.82 uH
L758	24-83961B07	choke; 2 turns; 1/2 in dia
L759	24-83861B01	choke; 3 turns; 1/2 in dia
P500, 501	28-83254N01	connector, pl
	9-83497F05	male; 10-conn
P700	9-82872N01	female; 10-conn
Q501	48-869642	transistor; (NPN)
Q502	48-869643	PNP; type M
Q503	48-869642	NPN; type M
Q504	48-869643	PNP; type M
Q505	48-869642	NPN; type M
Q552	48-84411L10	PNP; type M
Q553	48-869642	NPN; type M
Q554	48-869649	PNP; type M
Q701	48-869494	NPN; type M
Q702	48-869638	NPN; type M
Q703	48-869657	NPN; type M
Q704	48-869859	NPN; type M
R501	6-11009A65	resistor, fixed;
R502	6-11009A57	unless otherwise specified
R503	6-11009A27	
R504	6-11009A25	
R505, 506	6-11009A83	
R507, 508	6-11009A13	
R509, 510	6-11009A93	
R511	6-10621B94	
R513	6-11009A85	
R514	6-11009A73	
R515	6-11009A73	
R517	6-11009A63	
R518, 519	6-10621C75	
R520	6-11009A43	
R521	6-11009A83	
R551, 552	6-11009A48	
R554	6-11009A59	
R555	6-11009A73	
R701	6-11009A65	
R702	6-11009A92	
R703	6-11009A49	
R704	6-11009A79	
R705L	6-11009A13	
R705H	6-11009A05	
R706L	6-11009A81	
R706H	6-11009A83	
R707	6-11009A17	
R708L	6-11009A23	
R708H	6-11009A25	
R709	6-11009A57	
R710	6-11009A25	
R711	6-11009A57	
R712	6-11009A73	
R750	6-11009A37	
R751	6-11009A17	
R752L	6-11009A90	
R752H	6-11009A93	
R753L	6-11009A90	
R753H	6-11009A93	
R754	6-11009A09	

DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
acle:	R755	6-125C31	180 ± 10%; 1/2 W
coded (VIO) (YEL) (ORG) (WHT) (WHT) (RED) (ORG)	R756	6-11009A57	2.2k
d (BRN) (PINK) d (ORG) (GRN) d (ORG)	R756L	6-11009A49	1k
L9231A, 32A only)	R756H	6-11009A57	2.2k
TLD9242B, 41A only) t (TLD9232B, 31A only)	R757L	6-11009E33	220
note)	RT512	6-84259H02	thermistor: 44k ± 10% @ 25°C
6%; 1/4 W: stated			mechanical parts
	3-84256M01	SCREW, tapping; 2 used	
	5-84220B01	GROMMET; 2 used	
	6-11009B23	JUMPERS; 15 used (TLD9232B, 31A only)	
	14-861196	INSULATOR; 2 used	
	26-80039A01	CAN, coil; 3 used	
	26-80150B01	HEAT SINK Q704	
	26-80196A01	CAN, coil; 5 used	
	26-83283N01	SHIELD, exciter top	
	26-83284N01	SHIELD, exciter bottom	
	42-82160N01	CLIP, shield mounting; 3 used	
	45-83824N01	EJECTOR, card; 2 used	
	5-84220B01	GROMMET; 2 used	
	42-82160N01	CLIP, shield mounting; 3 used	
		note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.	

LATER VERSION EXCITER



SHOWN FROM COMPONENT

SOLDER SIDE BD-DEPS-35241-0
COMPONENT SIDE BD-DEPS-35242-0
OL-EEPS-35243-0

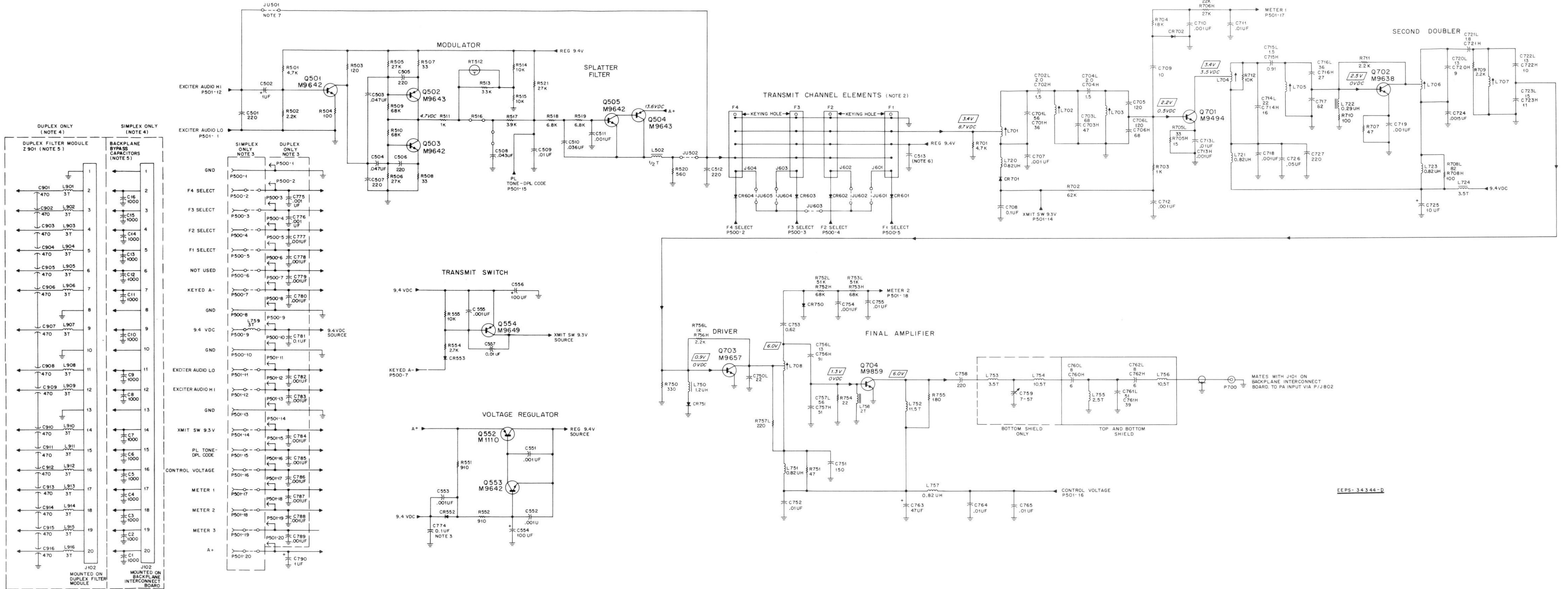
DESIGNATED WITH
ARE PRESENT ON
LS (TLD 9242A,41A)

AND JUMPERS
WITH SQUARE (■)
ON SIMPLEX
9232A, 31A) ONLY.

*TLD9231A and TLD9232B Simplex Exciter and
TLD9241B and TLD9242C Duplex Exciter
Circuit Board Detail and Parts Lists
Motorola No. PEPS-34789-D*

(Sheet 2 of 3)
9/13/84 - V & G

EXCITER



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:

1. Unless otherwise indicated: resistor values are in ohms and capacitor values are in picofarads.
2. Transmitter frequency calculation:
Foscillator = Channel/12
3. 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.
4. Simplex exciter is connected to male backplane connector J102. Duplex exciter is connected to female filter module connector J102.
5. 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.
6. Refer to parts list for component values.
7. 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)**