D-Star Mods
7-7-12 9x

MOTOROLA

MICOR®

FM Two-Way Mobile Radio

406-420 MHz and 450-512 MHz

68P81015E70-H

Instruction Manual

AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Five reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us. (NOTE: One copy of each publication has already been distributed to Motorola Service Shops (MSS's) and field technical representatives (FTR's).

First Fold

Check item desired:

☐ **Basic Logic Circuit Guide** — 68P81105E88
Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.

☐ **"Digital Private-Line" Binary-Coded Squelch** — 68P81106E83
Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.

☐ **Safe Handling of CMOS Integrated Circuit Devices** — 68P81106E84
Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.

☐ **Reducing Noise Interference in Mobile Two-Way Radio Installations** — 68P81109E33
Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.

Second Fold

☐ **Anti-Skid Braking Precautions** — 68P81109E34
Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.

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MICOR

FM TWO-WAY MOBILE RADIO

406-420 MHz AND 450-512 MHz

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MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

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9/27/78-UP

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GENERAL

406-420 MHz * 450-470 MHz MODEL	INTERMITTENT MINIMUM RF POWER OUTPUT	MAXIMUM FINAL INPUT POWER	CONTINUOUS DUTY POWER OUTPUT	CONTINUOUS DUTY POWER INPUT	MAXIMUM BATTERY DRAIN* STANDBY @13.8 V	MAXIMUM BATTERY DRAIN* RECEIVE @13.8 V	MAXIMUM BATTERY DRAIN* TRANSMIT
T34RTA Series	25 W	80 W	25 W	80 W	.50 amp	2.6 amps @ 10 W audio output	10.5 A @13.6 V
T44RTA Series	45 W	120 W	35 W	100 W			15.9 A @13.6 V
T54RTA Series	75 W	180 W	35 W	110 W			25.0 A @13.4 V
T74RTA Series	100 W	270 W	35 W	120 W			35.5 A @13.4 V

470-512 MHz MODEL	INTERMITTENT MINIMUM RF POWER OUTPUT	ANTENNA GAIN	ERP‡	CONTINUOUS DUTY POWER OUTPUT	CONTINUOUS DUTY POWER INPUT	MAXIMUM BATTERY DRAIN* STANDBY @13.8 V	MAXIMUM BATTERY DRAIN* RECEIVE @ 13.8 V	MAXIMUM BATTERY DRAIN* TRANSMIT
T34RTA Series	19 W	5 db	50 W	19 W	70 W	.50 amp	2.6 amps @ 10 W audio output	9.5 A @13.6 V
T44RTA Series	39 W	5 db	100 W	35 W	100 W			15 A @13.6 V
T54RTA Series	59 W	5 db	150 W	35 W	110 W			23 A @13.4 V
T74RTA Series	78 W	5 db	200 W	35 W	110 W			30 A @13.4 V

‡Assumes 10 ft. of coaxial cable (0.95 db loss, Motorola Part No. 30C82921H01) between radio output connector and antenna.

*Drain figures for negative ground only; add 0.15 amp for positive ground operation.

DIMENSIONS	3-3/8" high x 13" wide x 17-1/2" long overall				
WEIGHT	approximately 25 lbs (shipping weight including accessories: approximately 50 lbs)				
FREQUENCY RANGE	406-420 MHz, 450-512 MHz				
METERING	A single scale, 0-50 microampere meter with 2,000 ohms equivalent series resistance or Motorola portable test set can be used to measure all circuits essential to tuning and checking				
TRANSMITTER RF POWER OUTPUT	406-420 MHz	--	45 W	--	100 W
	450-470 MHz	25 W	45 W	75 W	100 W
	470-512 MHz	19 W	39 W	59 W	78 W
OUTPUT IMPEDANCE	50 ohms				
SPURIOUS & HARMONIC EMISSION (conducted)	Spurious and harmonics more than 85 dB below carrier per EIA spec. RS152B, paragraph 4				
FREQUENCY STABILITY	Carrier maintained within ±0.0005% (±.0002% optional) from -30° C to +60° C ambient (+25° C ref).				
STANDARD MODELS	Up to ±500kHz with no degradation				
WIDE-SPACE MODELS	Two frequencies or two groups of frequencies may be spaced 5 MHz (450-470 MHz), 3 MHz (470-512 MHz), or -3 to +14 MHz (406-420 MHz). Frequencies within either group may be spaced ±500 kHz.				
MODULATION	16F3: ±5 kHz for 100% at 1000 Hz				
AUDIO SENSITIVITY	.080 volt ±3 dB for 60% maximum deviation at 1000 Hz				
FM NOISE	60 dB below 60% maximum deviation at 1000 Hz				
AUDIO RESPONSE	+1, -3 dB/octave pre-emphasis characteristic from 300 to 3000 Hz				
AUDIO DISTORTION	Less than 3% at 1000 Hz; 60% maximum deviation				

"SENSITRON" RECEIVER

CHANNEL SPACING		25 kHz	
EIA MODULATION ACCEPTANCE		±7 kHz minimum	
FREQUENCY STABILITY		AFC channel element maintains receiver frequency within ±0.0002% of reference frequency from -30°C to +60°C ambient temperature (+25°C reference). (Optional ±0.0002% non-AFC channel element also available.)	
INPUT IMPEDANCE		50 ohms	
		NO PREAMPLIFIER	WITH PREAMPLIFIER
SENSITIVITY	20 DB QUIETING	0.5 uV	0.25 uV
	EIA SINAD	0.35 uV	0.175 uV
SELECTIVITY (EIA SINAD)		-90 dB @±25 kHz	
EIA SINAD INTERMODULATION		-85 dB	-80 dB
SPURIOUS AND IMAGE REJECTION		100 dB minimum	
SQUELCH SENSITIVITY CARRIER SQUELCH (adjustable)		.25 uV or less at threshold	.125 uV or less at threshold
TONE-CODED SQUELCH		.25 uV or less	.125 uV or less
AUDIO OUTPUT		10 watts at less than 5% distortion (into an 8-ohm load at 1000 Hz)	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC Designation:	450-470 MHz			
	25 W	45 W	75 W	100 W
1-Freq. -4-Freq.	CC4158	4162	4166	4170
4-Freq. WST	4159	4163	4167	4171
12-Freq.	4160	4164	4168	4172
12-Freq. WST	4161	4165	4169	4173

For 470-494 MHz Add -1 to CC#
For 494-512 MHz Add -2 to CC#

SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to any two-way mobile radio equipment. Normal use of this radio will result in exposures far below the OSHA limit. There are no reported incidents of physical damage resulting from the use of this type radio. However, the following precautions are recommended:

DO NOT operate the transmitter when someone outside the vehicle is within two feet of the mobile antenna.

DO NOT operate the transmitter near unshielded electrical blasting caps or in an explosive atmosphere.

EPS-18196-B

BASIC RADIO MODELS
CARRIER AND "PRIVATE-LINE" SQUELCH
LATER VERSIONS

MOTOROLA

BASIC RADIO SET MODEL CHART

FOR 406-420 MHz AND 450-512 MHz "MICOR"

FM TWO-WAY MOBILE RADIO SETS

NORMAL-SPACE AND WIDE-SPACE TRANSMITTER

1- TO 4-FREQUENCY AND 1- TO 12-FREQUENCY

(WHEN USED WITH APPROPRIATE NUMBER OF CHANNEL ELEMENTS)

CODE:

[X] = ONE SUPPLIED.

[+] = ONE SUPPLIED FOR SINGLE-FREQUENCY USE. ADDITIONAL QUANTITY CAN BE USED AS REQUIRED.

[0] = ONE SUPPLIED PER FIVE RADIO SETS)(OR LESS).

[2] = INDICATES QUANTITY SUPPLIED.

[/] = ONE ITEM SUPPLIED DEPENDANT ON FREQUENCY RANGE.

*REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL NUMBER ON THE UNIT CORRESPONDS WITH A SPECIFIC CARRIER-FREQUENCY RANGE. REFER TO APPROPRIATE SECTION OF THIS MANUAL FOR DETAILS.

≠ RF POWER OUTPUT REQUIRED FOR ERP OF 50, 100, 150 and 200 W: ASSUMES 10 FEET of COAXIAL CABLE (0.95 dB LOSS, MOTOROLA PART NO. 30C82921H01) BETWEEN RADIO OUTPUT CONNECTOR AND 5 dB GAIN ANTENNA.

NOTE: TLD8443A EXCITER PROVIDED FOR 450-470 MHz MODELS WITH OPTION W 184.

RADIO SET MODEL	TRANSMITTER RF POWER 406-420 MHz	450-470 MHz	512 MHz ≠	NO. OF FREQS.	TYPE OF SQUELCH SYSTEM
MODELS WITH STANDARD TRANSMITTER (MULTI-FREQ.)					
T34RTA-1800BA		25 W	19 W	12	CARRIER
T34RTA-1900BA		25 W	19 W	4	CARRIER
T34RTA-3800BA		25 W	19 W	12	"PL"
T34RTA-3900BA		25 W	19 W	4	"PL"
T44RTA-1800BA	45 W	45 W	39 W	12	CARRIER
T44RTA-1900BA	45 W	45 W	39 W	4	CARRIER
T44RTA-3800BA	45 W	45 W	39 W	12	"PL"
T44RTA-3900BA	45 W	45 W	39 W	4	"PL"
T54RTA-1800BA		75 W	59 W	12	CARRIER
T54RTA-1900BA		75 W	59 W	4	CARRIER
T54RTA-3800BA		75 W	59 W	12	"PL"
T54RTA-3900BA		75 W	59 W	4	"PL"
T74RTA-1800BA	100 W	100 W	78 W	12	CARRIER
T74RTA-1900BA	100 W	100 W	78 W	4	CARRIER
T74RTA-3800BA	100 W	100 W	78 W	12	"PL"
T74RTA-3900BA	100 W	100 W	78 W	4	"PL"
MODELS WITH WIDE-SPACED TRANSMITTER					
T34RTA-1803BA		25 W	19 W	12	CARRIER
T34RTA-1903BA		25 W	19 W	4	CARRIER
T34RTA-3803BA		25 W	19 W	12	"PL"
T34RTA-3903BA		25 W	19 W	4	"PL"
T44RTA-1803BA	45 W	45 W	39 W	12	CARRIER
T44RTA-1903BA	45 W	45 W	39 W	4	CARRIER
T44RTA-3803BA	45 W	45 W	39 W	12	"PL"
T44RTA-3903BA	45 W	45 W	39 W	4	"PL"
T54RTA-1803BA		75 W	59 W	12	CARRIER
T54RTA-1903BA		75 W	59 W	4	CARRIER
T54RTA-3803BA		75 W	59 W	12	"PL"
T54RTA-3903BA		75 W	59 W	4	"PL"
T74RTA-1803BA	100 W	100 W	78 W	12	CARRIER
T74RTA-1903BA	100 W	100 W	78 W	4	CARRIER
T74RTA-3803BA	100 W	100 W	78 W	12	"PL"
T74RTA-3903BA	100 W	100 W	78 W	4	"PL"
MODELS WITH STANDARD TRANSMITTER (SINGLE FREQ.)					
T34RTA-1000BA		25 W	19 W	1	CARRIER
T44RTA-1000BA	45 W	45 W	39 W	1	CARRIER
T54RTA-1000BA		75 W	59 W	1	CARRIER
T74RTA-1000BA	100 W	100 W	78 W	1	CARRIER
T34RTA-3000BA		25 W	19 W	1	"PL"
T44RTA-3000BA	45 W	45 W	39 W	1	"PL"
T54RTA-3000BA		75 W	59 W	1	"PL"
T74RTA-3000BA	100 W	100 W	78 W	1	"PL"

DESCRIPTION OF ITEMS / ITEMS INCLUDED

RADIO SET MODEL	RECEIVER RF & IF BOARD *TRE1200BA	CHANNEL ELEMENT, RECEIVER/TRANSMITTER KXN1024A	EXCITER (STANDARD) BOARD *TLE8420A (Note)	EXCITER (WIDE-SPACE) BOARD *TLE8430A	EXCITER OUTPUT FILTER *TFE6210A	POWER AMPLIFIER (25 W, STANDARD) *TLE1470A	POWER AMPLIFIER (45 W, STANDARD) *TLE1480A	POWER AMPLIFIER (75 W, STANDARD) *TLE1490A	POWER AMPLIFIER (100 W, STANDARD) *TLE1500A	POWER AMPLIFIER (25 W, WIDE-SPACE) *TLE1510A	POWER AMPLIFIER (45 W, WIDE-SPACE) *TLE1520A	POWER AMPLIFIER (75 W, WIDE-SPACE) *TLE1530A	POWER AMPLIFIER (100 W, WIDE-SPACE) *TLE1540A	POWER CONTROL BOARD (TRANSMITTER) TLN4926A	ANTENNA SWITCH/HARMONIC FILTER *TFE6220A	CONTROL (INTERCONNECT) BOARD TLN4930C
T34RTA-1800BA	X	+	X		X	X								X	X	X
T34RTA-1900BA	X	+	X		X	X								X	X	X
T34RTA-3800BA	X	+	X		X	X								X	X	X
T34RTA-3900BA	X	+	X		X	X								X	X	X
T44RTA-1800BA	X	+	X		X		X							X	X	X
T44RTA-1900BA	X	+	X		X		X							X	X	X
T44RTA-3800BA	X	+	X		X		X							X	X	X
T44RTA-3900BA	X	+	X		X		X							X	X	X
T54RTA-1800BA	X	+	X		X		X	X						X	X	X
T54RTA-1900BA	X	+	X		X		X	X						X	X	X
T54RTA-3800BA	X	+	X		X			X						X	X	X
T54RTA-3900BA	X	+	X		X			X						X	X	X
T74RTA-1800BA	X	+	X		X				X					X	X	X
T74RTA-1900BA	X	+	X		X				X					X	X	X
T74RTA-3800BA	X	+	X		X				X					X	X	X
T74RTA-3900BA	X	+	X		X				X					X	X	X
T34RTA-1803BA	X	+		X	2					X				X	X	X
T34RTA-1903BA	X	+		X	2					X				X	X	X
T34RTA-3803BA	X	+		X	2					X				X	X	X
T34RTA-3903BA	X	+		X	2					X				X	X	X
T44RTA-1803BA	X	+		X	2						X			X	X	X
T44RTA-1903BA	X	+		X	2						X			X	X	X
T44RTA-3803BA	X	+		X	2						X			X	X	X
T44RTA-3903BA	X	+		X	2						X			X	X	X
T54RTA-1803BA	X	+		X	2							X		X	X	X
T54RTA-1903BA	X	+		X	2							X		X	X	X
T54RTA-3803BA	X	+		X	2							X		X	X	X
T54RTA-3903BA	X	+		X	2							X		X	X	X
T74RTA-1803BA	X	+		X	2								X	X	X	X
T74RTA-1903BA	X	+		X	2								X	X	X	X
T74RTA-3803BA	X	+		X	2								X	X	X	X
T74RTA-3903BA	X	+		X	2								X	X	X	X
T34RTA-1000BA	X	+	X		X	X								X	X	X
T44RTA-1000BA	X	+	X		X		X							X	X	X
T54RTA-1000BA	X	+	X		X			X						X	X	X
T74RTA-1000BA	X	+	X		X				X					X	X	X
T34RTA-3000BA	X	+	X		X	X								X	X	X
T44RTA-3000BA	X	+	X		X		X							X	X	X
T54RTA-3000BA	X	+	X		X			X						X	X	X
T74RTA-3000BA	X	+	X		X				X					X	X	X

RADIO SET MODEL	AUDIO & SQUELCH BOARD TRN6540A	AUDIO POWER AMPLIFIER BOARD TLN4290B	"12-FREQUENCY" MATRIX BOARD TLN4934A	"PL" ENCODER BOARD (450-512 MHz) TLN5732A	"PL" DECODER BOARD TLN4294B	"VIBRASENDER" RESONANT REED (FORMERLY TLN6824A) *KLN6210A	"VIBRASPONDER" RESONANT REED TLN8381A	HARDWARE KIT (STANDARD TRANSMITTER, (450-512 MHz) TLN5096B	HARDWARE KIT (PRIVATE LINE/DPL) TLN4931B	HARDWARE KIT (WIDE-SPACED TRANSMITTER) 450-512 MHz TLN5097B	TUNING TOOLS TLN5048A	HARDWARE KIT (WIDE-SPACED) 406-420 MHz TLN5662A	HARDWARE KIT (STANDARD) 406-420 MHz TLN5664A	HOUSING KIT THN6367A	ENCODER BOARD, "PRIVATE-LINE" (406-420 MHz) TLN4928A
T34RTA-1800BA	X	X	X					/			0			X	
T34RTA-1900BA	X	X						/			0			X	
T34RTA-3800BA	X	X	X	/	X	X	X	/	X		0			X	/
T34RTA-3900BA	X	X		/	X	X	X	/	X		0			X	/
T44RTA-1800BA	X	X	X					/			0		/	X	
T44RTA-1900BA	X	X						/			0		/	X	
T44RTA-3800BA	X	X	X	/	X	X	X	/	X		0		/	X	/
T44RTA-3900BA	X	X		/	X	X	X	/	X		0		/	X	/
T54RTA-1800BA	X	X	X					/			0			X	
T54RTA-1900BA	X	X						/			0			X	
T54RTA-3800BA	X	X	X	/	X	X	X	/	X		0			X	/
T54RTA-3900BA	X	X		/	X	X	X	/	X		0			X	/
T74RTA-1800BA	X	X	X					/			0		/	X	
T74RTA-1900BA	X	X						/			0		/	X	
T74RTA-3800BA	X	X	X	/	X	X	X	/	X		0		/	X	/
T74RTA-3900BA	X	X		/	X	X	X	/	X		0		/	X	/
T34RTA-1803BA	X	X	X							/	0			X	
T34RTA-1903BA	X	X								/	0			X	
T34RTA-3803BA	X	X	X	/	X	X	X		X	/	0			X	/
T34RTA-3903BA	X	X		/	X	X	X		X	/	0			X	/
T44RTA-1803BA	X	X	X							/	0	/		X	
T44RTA-1903BA	X	X								/	0	/		X	
T44RTA-3803BA	X	X	X	/	X	X	X		X	/	0	/		X	/
T44RTA-3903BA	X	X		/	X	X	X		X	/	0	/		X	/
T54RTA-1803BA	X	X	X							/	0			X	
T54RTA-1903BA	X	X								/	0			X	
T54RTA-3803BA	X	X	X	/	X	X	X		X	/	0			X	/
T54RTA-3903BA	X	X		/	X	X	X		X	/	0			X	/
T74RTA-1803BA	X	X	X							/	0	/		X	
T74RTA-1903BA	X	X								/	0	/		X	
T74RTA-3803BA	X	X	X	/	X	X	X		X	/	0	/		X	/
T74RTA-3903BA	X	X	X	/	X	X	X		X	/	0	/		X	/
T34RTA-1000BA	X	X						/			0			X	
T44RTA-1000BA	X	X						/			0			X	
T54RTA-1000BA	X	X						/			0			X	
T74RTA-1000BA	X	X						/			0			X	
T34RTA-3000BA	X	X		/	X	X	X	/	X		0			X	
T44RTA-3000BA	X	X		/	X	X	X	/	X		0			X	/
T54RTA-3000BA	X	X		/	X	X	X	/	X		0			X	/
T74RTA-3000BA	X	X		/	X	X	X	/	X		0			X	/
														X	/

EPS-17026-A

BASIC RADIO MODELS "DIGITAL PRIVATE-LINE" LATER VERSIONS

MOTOROLA

MODEL CHART

FOR

406-420 MHz AND 450-512 MHz "MICOR" FM TWO-WAY RADIO

BASIC RADIO SET MODELS

WITH "DIGITAL PRIVATE-LINE" CODED SQUELCH AND

STANDARD-SPACED AND WIDE-SPACED TRANSMITTER

CODE:

- [X] = ONE ITEM SUPPLIED.
- [/] = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY RANGE.
- [0] = ONE ITEM SUPPLIED FOR FIVE RADIO SETS OR LESS.
- [4] = NUMBER INDICATES QUANTITY SUPPLIED.
- * = REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL NUMBER STAMPED ON THE CHASSIS CORRESPONDS WITH A SPECIFIC CARRIER FREQUENCY RANGE.

MODELS WITH STANDARD TRANSMITTER

ITEM	DESCRIPTION	T34RTA-6000AA	T34RTA-6800AA	T34RTA-6900AA	T44RTA-6000AA	T44RTA-6800AA	T44RTA-6900AA	T54RTA-6000AA	T54RTA-6800AA	T54RTA-6900AA	T74RTA-6000AA	T74RTA-6800AA	T74RTA-6900AA
TRANSMITTER RF POWER		25 W	25 W	25 W	45 W	45 W	45 W	75 W	75 W	75 W	100 W	100 W	100 W
NUMBER OF FREQUENCIES		1	12	4	1	12	4	1	12	4	1	12	4
*TLE8420A	EXCITER BOARD (STANDARD) 450-512 MHz)	/	/	/	/	/	/	/	/	/	/	/	/
*TLE8430A	EXCITER BOARD (WIDE-SPACED) 450-512 MHz)												
TLE8041A	EXCITER BOARD (STANDARD) 406-420 MHz				/	/	/				/	/	/
TLE8051A	EXCITER BOARD (WIDE-SPACED) 406-420 MHz												
*TLE1470A	POWER AMPLIFIER (25-WATT) STANDARD	/	/	/									
*TLE1480A	POWER AMPLIFIER (45-WATT) STANDARD				/	/	/						
*TLE1490A	POWER AMPLIFIER (75-WATT) STANDARD							/	/	/			
*TLE1500A	POWER AMPLIFIER (100-WATT) STANDARD										/	/	/
*TLE1510A	POWER AMPLIFIER (25-WATT) WIDE-SPACED												
*TLE1520A	POWER AMPLIFIER (45-WATT) WIDE-SPACED												
*TLE1530A	POWER AMPLIFIER (75-WATT) WIDE-SPACED												
*TLE1540A	POWER AMPLIFIER (100-WATT) WIDE-SPACED												
KXN1024A	CHANNEL ELEMENT, TRANSMITTER/RECEIVER	X	12	4	X	12	4	X	12	4	X	12	4
*TFE6210A	EXCITER OUTPUT FILTER	/	/	/	/	/	/	/	/	/	/	/	/
*TFE6220A	ANTENNA SWITCH/HARMONIC FILTER (470-512 MHz)	/	/	/	/	/	/	/	/	/	/	/	/
*TFE6330A	ANTENNA SWITCH/HARMONIC FILTER (406-470 MHz)										/	/	/
TLN4926A	POWER CONTROL BOARD	X	X	X	X	X	X	X	X	X	X	X	X
*TRE1200BA	RECEIVER BOARD	/	/	/	/	/	/	/	/	/	/	/	/
TLN4930C	INTERCONNECT CONTROL BOARD	X	X	X	X	X	X	X	X	X	X	X	X
TRN6540A	AUDIO & SQUELCH BOARD	X	X	X	X	X	X	X	X	X	X	X	X
TLN4290B	AUDIO POWER AMPLIFIER BOARD	X	X	X	X	X	X	X	X	X	X	X	X
TRN6112A	DECODER HARDWARE KIT	X	X	X	X	X	X	X	X	X	X	X	X
TLN4931B	HARDWARE KIT PL/DPL	X	X	X	X	X	X	X	X	X	X	X	X
TLN5097B	HARDWARE KIT (WIDE-SPACED) 450-512 MHz												
TLN5096B	MODEL HARDWARE KIT (STANDARD) 450-512 MHz	/	/	/	/	/	/	/	/	/	/	/	/
TLN5662A	MODEL HARDWARE KIT (WIDE-SPACED) 406-420 MHz												
TLN5048A	TUNING TOOL KIT	0	0	0	0	0	0	0	0	0	0	0	0
TLN4934A	12-FREQUENCY MATRIX BOARD		X			X			X			X	
TLN5729A	"DIGITAL PL" DECODER	X	X	X	X	X	X	X	X	X	X	X	X
TLN5726A	"DIGITAL PL" ENCODER	X	X	X	X	X	X	X	X	X	X	X	X
TRN6005A	CODE PLUG KIT	X	X	X	X	X	X	X	X	X	X	X	X
TRN6332A	CODE DISABLE PLUG KIT	X	X	X	X	X	X	X	X	X	X	X	X
TLN5664A	HARDWARE KIT (STANDARD) 406-420 MHz				/	/	/				/	/	/
THN6367A	HOUSING KIT	X	X	X	X	X	X	X	X	X	X	X	X

MODELS WITH WIDE-SPACED TRANSMITTER

ITEM	DESCRIPTION	T34RTA-6803AA	T34RTA-6903AA	T44RTA-6803AA	T44RTA-6903AA	T54RTA-6803AA	T54RTA-6903AA	T74RTA-6803AA	T74RTA-6903AA
TRANSMITTER RF POWER		25 W	25 W	45 W	45 W	75 W	75 W	100 W	100 W
NUMBER OF FREQUENCIES		12	4	12	4	12	4	12	4
*TLE8420A	EXCITER BOARD (STANDARD) 450-512 MHz)								
*TLE8430A	EXCITER BOARD (WIDE-SPACED) 450-512 MHz)	/	/	/	/	/	/	/	/
TLE8041A	EXCITER BOARD (STANDARD) 406-420 MHz								
TLE8051A	EXCITER BOARD (WIDE-SPACED) 406-420 MHz			/	/			/	/
*TLE1470A	POWER AMPLIFIER (25-WATT) STANDARD								
*TLE1480A	POWER AMPLIFIER (45-WATT) STANDARD								
*TLE1490A	POWER AMPLIFIER (75-WATT) STANDARD								
*TLE1500A	POWER AMPLIFIER (100-WATT) STANDARD								
*TLE1510A	POWER AMPLIFIER (25-WATT) WIDE-SPACED	/	/						
*TLE1520A	POWER AMPLIFIER (45-WATT) WIDE-SPACED			/	/				
*TLE1530A	POWER AMPLIFIER (75-WATT) WIDE-SPACED					/	/		
*TLE1540A	POWER AMPLIFIER (100-WATT) WIDE-SPACED							/	/
KXN1024A	CHANNEL ELEMENT, TRANSMITTER/RECEIVER	12	4	12	4	12	4	12	4
*TFE6210A	EXCITER OUTPUT FILTER	2	2	2	2	2	2	2	2
*TFE6220A	ANTENNA SWITCH/HARMONIC FILTER (470-512 MHz)	/	/	/	/	/	/	/	/
*TFE6330A	ANTENNA SWITCH/HARMONIC FILTER (406-470 MHz)							/	/
TLN4926A	POWER CONTROL BOARD	X	X	X	X	X	X	X	X
*TRE1200BA	RECEIVER BOARD	/	/	/	/	/	/	/	/
TLN4930C	INTERCONNECT CONTROL BOARD	X	X	X	X	X	X	X	X
TRN6540A	AUDIO & SQUELCH BOARD	X	X	X	X	X	X	X	X
TLN4290B	AUDIO POWER AMPLIFIER BOARD	X	X	X	X	X	X	X	X
TRN6112A	DECODER HARDWARE KIT	X	X	X	X	X	X	X	X
TLN4931B	HARDWARE KIT PL/DPL	X	X	X	X	X	X	X	X
TLN5097B	HARDWARE KIT (WIDE-SPACED) 450-512 MHz	/	/	/	/	/	/	/	/
TLN5096B	MODEL HARDWARE KIT (STANDARD) 450-512 MHz								
TLN5662A	MODEL HARDWARE KIT (WIDE-SPACED) 406-420 MHz			/	/			/	/
TLN5048A	TUNING TOOL KIT	0	0	0	0	0	0	0	0
TLN4934A	12-FREQUENCY MATRIX BOARD	X		X		X		X	
TLN5729A	"DIGITAL PL" DECODER	X	X	X	X	X	X	X	X
TLN5726A	"DIGITAL PL" ENCODER	X	X	X	X	X	X	X	X
TRN6005A	CODE PLUG KIT	X	X	X	X	X	X	X	X
TRN6332A	CODE DISABLE PLUG KIT	X	X	X	X	X	X	X	X
TLN5664A	HARDWARE KIT (STANDARD) 406-420 MHz								
THN6367A	HOUSING KIT	X	X	X	X	X	X	X	X

EPS-18115- C

PACKAGE RADIO MODELS
"DIGITAL PRIVATE-LINE"
LATER VERSIONS

MOTOROLA

MODEL CHART

FOR

406-420 MHz AND 450-512 MHz "MICOR" FM TWO-WAY RADIO

PACKAGE RADIO SET MODELS

WITH "DIGITAL PRIVATE-LINE" CODED SQUELCH AND

STANDARD-SPACED AND WIDE-SPACED TRANSMITTER

CODE:

[X] = ONE ITEM SUPPLIED.

[/] = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY RANGE.

* = REFER TO THE BASIC RADIO SET MODEL CHART FOR MODEL COMPLEMENT.

MODELS WITH STANDARD TRANSMITTER

ITEM	DESCRIPTION	T34RTA-6000AK	T34RTA-6800AK	T34RTA-6900AK	T44RTA-6000AK	T44RTA-6800AK	T44RTA-6900AK	T54RTA-6000AK	T54RTA-6800AK	T54RTA-6900AK	T74RTA-6000AK	T74RTA-6800AK	T74RTA-6900AK
	INCLUDES BASIC RADIO MODEL*	T34RTA-6000AA	T34RTA-6800AA	T34RTA-6900AA	T44RTA-6000AA	T44RTA-6800AA	T44RTA-6900AA	T54RTA-6000AA	T54RTA-6800AA	T54RTA-6900AA	T74RTA-6000AA	T74RTA-6800AA	T74RTA-6900AA
	NUMBER OF FREQUENCIES	1	12	4	1	12	4	1	12	4	1	12	4
	TRANSMITTER RF POWER	25 W	25 W	25 W	45 W	45 W	45 W	75 W	75 W	75 W	100 W	100 W	100 W
TCN1091B	CONTROL HEAD (1-FREQ.)	X			X			X			X		
TCN1092B	CONTROL HEAD (MULTI-FREQ.)			X			X			X			X
TCN1119A	CONTROL HEAD (12-FREQ.)		X			X			X			X	
TKN6456A	POWER CABLE, CONTROL HEAD	X	X	X	X	X	X	X	X	X	X	X	X
TKN6457A	CABLE & FUSE KIT (25-WATT)	X	X	X									
TKN6458A	CABLE & FUSE KIT (45/75/100-WATT)				X	X	X	X	X	X	X	X	X
TKN6454B	CABLE, RADIO SET (18-FT.) 1-4 FREQ.	X		X	X		X	X		X	X		
TKN6606A	CABLE, RADIO SET (18-FT.) 12-FREQ.		X			X			X			X	
TMN6054A	MICROPHONE	X	X	X	X	X	X	X	X	X	X	X	X
TLN5181A	MICROPHONE HANG-UP BOX	X	X	X	X	X	X	X	X	X	X	X	X
TSN6010B	SPEAKER	X	X	X	X	X	X	X	X	X	X	X	X
TLN4347A	INSTALLATION KIT	X	X	X	X	X	X	X	X	X	X	X	X
TAE6061B	ANTENNA, GAIN (406-420 MHz)				/	/	/				/	/	/
TAE6062B	ANTENNA, GAIN (450-470 MHz)	/	/	/	/	/	/	/	/	/	/	/	/
TAE6094B	ANTENNA, GAIN (470-494 MHz)	/	/	/	/	/	/	/	/	/	/	/	/
TAE6095B	ANTENNA, GAIN (494-512 MHz)	/	/	/	/	/	/	/	/	/	/	/	/

MODELS WITH WIDE-SPACED TRANSMITTER

ITEM	DESCRIPTION	T34RTA-6803AK	T34RTA-6903AK	T44RTA-6803AK	T44RTA-6903AK	T54RTA-6803AK	T54RTA-6903AK	T74RTA-6803AK	T74RTA-6903AK
	INCLUDES BASIC RADIO MODEL*	T34RTA-6803AA	T34RTA-6903AA	T44RTA-6803AA	T44RTA-6903AA	T54RTA-6803AA	T54RTA-6903AA	T74RTA-6803AA	T74RTA-6903AA
	NUMBER OF FREQUENCIES	12	4	12	4	12	4	12	4
	TRANSMITTER RF POWER	25 W	25 W	45 W	45 W	75 W	75 W	100 W	100 W
TCN1091B	CONTROL HEAD (1-FREQ.)								
TCN1092B	CONTROL HEAD (MULTI-FREQ.)		X		X		X		X
TCN1119A	CONTROL HEAD (12-FREQ.)	X		X		X			
TKN6456A	POWER CABLE, CONTROL HEAD	X	X	X	X	X	X	X	X
TKN6457A	CABLE & FUSE KIT (25-WATT)	X	X	X					
TKN6458A	CABLE & FUSE KIT (45/75/100-WATT)			X	X	X	X	X	X
TKN6454B	CABLE, RADIO SET (18-FT.) 1-4 FREQ.		X		X		X		X
TKN6606A	CABLE, RADIO SET (18-FT.) 12-FREQ.	X		X		X		X	
TMN6054A	MICROPHONE	X	X	X	X	X	X	X	X
TLN5181A	MICROPHONE HANG-UP BOX	X	X	X	X	X	X	X	X
TSN6010B	SPEAKER	X	X	X	X	X	X	X	X
TLN4347A	INSTALLATION KIT	X	X	X	X	X	X	X	X
TAE6061B	ANTENNA, GAIN (406-420 MHz)			/	/			/	/
TAE6062B	ANTENNA, GAIN (450-470 MHz)	/	/	/	/	/	/	/	/
TAE6094B	ANTENNA, GAIN (470-494 MHz)	/	/	/	/	/	/	/	/
TAE6095B	ANTENNA, GAIN (494-512 MHz)	/	/	/	/	/	/	/	/

EPS-18116-B

PACKAGE RADIO MODELS
CARRIER AND "PRIVATE-LINE"
LATER VERSIONS

MOTOROLA

"PACKAGE" RADIO MODEL CHART

FOR

406-420 MHz AND 450-512 MHz

"MICOR"

FM TWO-WAY MOBILE RADIO SETS

WITH ACCESSORIES

1-FREQUENCY, 4-FREQUENCY AND

12-FREQUENCY OPERATION

CODE:

[X] = ONE SUPPLIED.

[O] = ONE SUPPLIED; CHOICE DEPENDENT ON OPERATING FREQUENCY

*SEE BASIC RADIO SET MODEL CHART FOR ITEMS WITHIN THE RADIO SET.

≠ RF POWER OUTPUT REQUIRED FOR ERP OF 50, 100, 150 AND 200 W; ASSUMES 10 FEET OF COAXIAL CABLE (0.95 dB LOSS, MOTOROLA PART NUMBER 30C82921H01) BETWEEN RADIO OUTPUT CONNECTOR AND 5 dB GAIN ANTENNA.

Accessory items (description):

Accessory Item	Description
TCN1091B	CONTROL HEAD, 1-FREQUENCY
TCN1092B	CONTROL HEAD, 4-FREQUENCY
TCN1119A	CONTROL HEAD, 12-FREQUENCY
TKN6454A	CONTROL CABLE, 4-FREQUENCY
TKN6606A	CONTROL CABLE, 12-FREQUENCY
TKN6456A	CABLE KIT, POWER "ON-OFF"
TKN6457A	CABLE KIT, POWER FEED (25 W)
TKN6458A	CABLE KIT, POWER FEED (45, 75 & 100 W)
TSN6016B	SPEAKER
TLN4347A	INSTALLATION KIT
TLN5181A	"PL" HANG-UP SWITCH BOX
TMN6054A	MICROPHONE
TAE6061A	ANTENNA (406-420 MHz)
TAE6062A	ANTENNA (450-470 MHz)
TAE6094A	ANTENNA (470-494 MHz)
TAE6095A	ANTENNA (494-512 MHz)

"PACKAGE" MODEL	NO. OF FREQS.	TYPE OF SQUELCH SYSTEM	TRANSMITTER RF POWER 406-420 MHz	450-512 MHz	470-512 MHz ≠	*INCLUDES BASIC RADIO SET MODEL	TCN1091B	TCN1092B	TCN1119A	TKN6454A	TKN6606A	TKN6456A	TKN6457A	TKN6458A	TSN6016B	TLN4347A	TLN5181A	TMN6054A	TAE6061A	TAE6062A	TAE6094A	TAE6095A
MODELS WITH STANDARD TRANSMITTER																						
T34RTA-1000BK	1	CARRIER		25 W	19 W	T34RTA-1000BA	X			X		X	X		X	X		X		O	O	O
T44RTA-1000BK	1	CARRIER	45 W	45 W	39 W	T44RTA-1000BA	X			X		X		X	X	X		X	O	O	O	O
T54RTA-1000BK	1	CARRIER		75 W	59 W	T54RTA-1000BA	X			X		X		X	X	X		X		O	O	O
T74RTA-1000BK	1	CARRIER	100 W	100 W	78 W	T74RTA-1000BA	X			X		X		X	X	X		X	O	O	O	O
T34RTA-3000BK	1	"PL"		25 W	19 W	T34RTA-3000BA	X			X		X	X		X	X	X	X		O	O	O
T44RTA-3000BK	1	"PL"	45 W	45 W	39 W	T44RTA-3000BA	X			X		X		X	X	X	X	X	O	O	O	O
T54RTA-3000BK	1	"PL"		75 W	59 W	T54RTA-3000BA	X			X		X		X	X	X	X	X		O	O	O
T74RTA-3000BK	1	"PL"	100 W	100 W	78 W	T74RTA-3000BA	X			X		X		X	X	X	X	X	O	O	O	O
T34RTA-1900BK	4	CARRIER		25 W	19 W	T34RTA-1900BA		X		X		X	X		X	X		X		O	O	O
T44RTA-1900BK	4	CARRIER	45 W	45 W	39 W	T44RTA-1900BA		X		X		X		X	X	X		X	O	O	O	O
T54RTA-1900BK	4	CARRIER		75 W	59 W	T54RTA-1900BA		X		X		X		X	X	X		X		O	O	O
T74RTA-1900BK	4	CARRIER	100 W	100 W	78 W	T74RTA-1900BA		X		X		X		X	X	X		X	O	O	O	O
T34RTA-3900BK	4	"PL"		25 W	19 W	T34RTA-3900BA		X		X		X	X		X	X	X	X		O	O	O
T44RTA-3900BK	4	"PL"	45 W	45 W	39 W	T44RTA-3900BA		X		X		X		X	X	X	X	X	O	O	O	O
T54RTA-3900BK	4	"PL"		75 W	59 W	T54RTA-3900BA		X		X		X		X	X	X	X	X		O	O	O
T74RTA-3900BK	4	"PL"	100 W	100 W	78 W	T74RTA-3900BA		X		X		X		X	X	X	X	X	O	O	O	O
T34RTA-1800BK	12	CARRIER		25 W	19 W	T34RTA-1800BA			X		X	X	X		X	X		X		O	O	O
T44RTA-1800BK	12	CARRIER	45 W	45 W	39 W	T44RTA-1800BA			X		X	X		X	X	X		X	O	O	O	O
T54RTA-1800BK	12	CARRIER		75 W	59 W	T54RTA-1800BA			X		X	X		X	X	X		X		O	O	O
T74RTA-1800BK	12	CARRIER	100 W	100 W	78 W	T74RTA-1800BA			X		X	X		X	X	X		X	O	O	O	O
T34RTA-3800BK	12	"PL"		25 W	19 W	T34RTA-3800BA			X		X	X	X		X	X	X	X		O	O	O
T44RTA-3800BK	12	"PL"	45 W	45 W	39 W	T44RTA-3800BA			X		X	X		X	X	X	X	X	O	O	O	O
T54RTA-3800BK	12	"PL"		75 W	59 W	T54RTA-3800BA			X		X	X		X	X	X	X	X		O	O	O
T74RTA-3800BK	12	"PL"	100 W	100 W	78 W	T74RTA-3800BA			X		X	X		X	X	X	X	X	O	O	O	O
MODELS WITH WIDE-SPACED TRANSMITTER																						
T34RTA-1903BK	4	CARRIER		25 W	19 W	T34RTA-1903BA		X				X	X		X	X		X		O	O	O
T44RTA-1903BK	4	CARRIER	45 W	45 W	39 W	T44RTA-1903BA		X				X		X	X	X		X	O	O	O	O
T54RTA-1903BK	4	CARRIER		75 W	59 W	T54RTA-1903BA		X				X		X	X	X		X		O	O	O
T74RTA-1903BK	4	CARRIER	100 W	100 W	78 W	T74RTA-1903BA		X				X		X	X	X		X	O	O	O	O
T34RTA-3903BK	4	"PL"		25 W	19 W	T34RTA-3903BA		X				X	X		X	X	X	X		O	O	O
T44RTA-3903BK	4	"PL"	45 W	45 W	39 W	T44RTA-3903BA		X				X		X	X	X	X	X	O	O	O	O
T54RTA-3903BK	4	"PL"		75 W	59 W	T54RTA-3903BA		X				X		X	X	X	X	X		O	O	O
T74RTA-3903BK	4	"PL"	100 W	100 W	78 W	T74RTA-3903BA		X				X		X	X	X	X	X	O	O	O	O
T34RTA-1803BK	12	CARRIER		25 W	19 W	T34RTA-1803BA			X			X	X		X	X		X		O	O	O
T44RTA-1803BK	12	CARRIER	45 W	45 W	39 W	T44RTA-1803BA			X			X		X	X	X		X	O	O	O	O
T54RTA-1803BK	12	CARRIER		75 W	59 W	T54RTA-1803BA			X			X		X	X	X		X		O	O	O
T74RTA-1803BK	12	CARRIER	100 W	100 W	78 W	T74RTA-1803BA			X			X		X	X	X		X	O	O	O	O
T34RTA-3803BK	12	"PL"		25 W	19 W	T34RTA-3803BA			X			X	X		X	X	X	X		O	O	O
T44RTA-3803BK	12	"PL"	45 W	45 W	39 W	T44RTA-3803BA			X			X		X	X	X	X	X	O	O	O	O
T54RTA-3803BK	12	"PL"		75 W	59 W	T54RTA-3803BA			X			X		X	X	X	X	X		O	O	O
T74RTA-3803BK	12	"PL"	100 W	100 W	78 W	T74RTA-3803BA			X			X		X	X	X	X	X	O	O	O	O

EPS-17174-B

x

BASIC RADIO MODELS
EARLIER VERSIONS

MOTOROLA

BASIC RADIO SET MODEL CHART
FOR 406-420 MHz AND 450-512 MHz "MICOR"
FM TWO-WAY MOBILE RADIO SETS
NORMAL-SPACE AND WIDE-SPACE TRANSMITTER
1- TO 4-FREQUENCY AND 1- TO 12-FREQUENCY
(WHEN USED WITH APPROPRIATE NUMBER OF CHANNEL ELEMENTS)

CODE:

[X] = ONE SUPPLIED.

[+] = ONE SUPPLIED FOR SINGLE-FREQUENCY USE. ADDITIONAL QUANTITY CAN BE USED AS REQUIRED.

[0] = ONE SUPPLIED PER FIVE RADIO SETS (OR LESS).

[2] = INDICATES QUANTITY SUPPLIED.

*REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL NUMBER ON THE UNIT CORRESPONDS WITH A SPECIFIC CARRIER-FREQUENCY RANGE. REFER TO APPROPRIATE SECTION OF THIS MANUAL FOR DETAILS.

≠RF POWER OUTPUT REQUIRED FOR ERP OF 50, 100, 150 AND 200 W; ASSUMES 10 FEET OF COAXIAL CABLE (0.95 dB LOSS, MOTOROLA PART NO. 30C82921H01) BETWEEN RADIO OUTPUT CONNECTOR AND 5 dB GAIN ANTENNA.

NOTE: TLE8045A EXCITER PROVIDED FOR 450-470 MHz MODELS WITH OPTION W184.

RADIO SET MODEL	TRANSMITTER RF POWER 406-420 MHz	TRANSMITTER RF POWER 450-470 MHz	TRANSMITTER RF POWER 470-512 MHz ≠	NO. OF FREQS.	TYPE OF SQUELCH SYSTEM	*TRE1200A RECEIVER RF & IF BOARD	KXN1024A CHANNEL ELEMENT, RECEIVER/TRANSMITTER	*TLE8040A (NOTE) EXCITER (STANDARD) BOARD	*TLE8050A EXCITER (WIDE-SPACE) BOARD	*TFE6210A EXCITER OUTPUT FILTER	*TLE1470A POWER AMPLIFIER (25W, STANDARD)	*TLE1480A POWER AMPLIFIER (45W, STANDARD)	*TLE1490A POWER AMPLIFIER (75W, STANDARD)	*TLE1500A POWER AMPLIFIER (100W, STANDARD)	*TLE1510A POWER AMPLIFIER (25W, WIDE-SPACE)	*TLE1520A POWER AMPLIFIER (45W, WIDE-SPACE)	*TLE1530A POWER AMPLIFIER (75W, WIDE-SPACE)	*TLE1540A POWER AMPLIFIER (100W, WIDE-SPACE)	TLN4926A POWER CONTROL BOARD (TRANSMITTER)	*TFE6220A ANTENNA SWITCH/HARMONIC FILTER	TLN4930C CONTROL (INTERCONNECT) BOARD (FORMERLY TLN4930A & B)	TLN4289B AUDIO & SQUELCH BOARD (FORMERLY TLN4289A)	TLN4290B AUDIO POWER AMPLIFIER BOARD	TLN4934A "12-FREQUENCY" MATRIX BOARD	TLN4928A "PL" ENCODER BOARD	TLN4294B "PL" DECODER BOARD	*KLN6210A "VIBRASENDER" RESONANT REED (FORMERLY TLN6824A)	TLN8381A "VIBRASPONDER" RESONANT REED	TLN5096A HARDWARE KIT (STANDARD TRANSMITTER, CARRIER SQUELCH)	TLN4931A HARDWARE KIT (STANDARD TRANSMITTER, "PRIVATE-LINE")	TLN5097A HARDWARE KIT (WIDE-SPACED TRANSMITTER, CARRIER SQUELCH)	TLN4932A HARDWARE KIT (WIDE-SPACED TRANSMITTER, "PRIVATE-LINE")	TLN5048A TUNING TOOLS
MODELS WITH STANDARD TRANSMITTER																																	
T34RTA-1800AA		25 W	19 W	12	CARRIER	X	+	X		X	X								X	X	X	X	X	X					X				0
T34RTA-1900AA		25 W	19 W	4	CARRIER	X	+	X		X	X								X	X	X	X	X						X				0
T34RTA-3800AA		25 W	19 W	12	"PL"	X	+	X		X	X								X	X	X	X	X	X	X	X	X	X		X			0
T34RTA-3900AA		25 W	19 W	4	"PL"	X	+	X		X	X								X	X	X	X	X		X	X	X	X		X			0
T44RTA-1800AA	45 W	45 W	39 W	12	CARRIER	X	+	X		X		X							X	X	X	X	X	X					X				0
T44RTA-1900AA	45 W	45 W	39 W	4	CARRIER	X	+	X		X		X							X	X	X	X	X						X				0
T44RTA-3800AA	45 W	45 W	39 W	12	"PL"	X	+	X		X		X							X	X	X	X	X	X	X	X	X	X		X			0
T44RTA-3900AA	45 W	45 W	39 W	4	"PL"	X	+	X		X		X							X	X	X	X	X		X	X	X	X		X			0
T54RTA-1800AA		75 W	59 W	12	CARRIER	X	+	X		X		X	X						X	X	X	X	X	X					X				0
T54RTA-1900AA		75 W	59 W	4	CARRIER	X	+	X		X		X	X						X	X	X	X	X						X				0
T54RTA-3800AA		75 W	59 W	12	"PL"	X	+	X		X			X						X	X	X	X	X	X	X	X	X	X		X			0
T54RTA-3900AA		75 W	59 W	4	"PL"	X	+	X		X			X						X	X	X	X	X		X	X	X	X		X			0
T74RTA-1800AA	100 W	100 W	78 W	12	CARRIER	X	+	X		X				X					X	X	X	X	X	X					X				0
T74RTA-1900AA	100 W	100 W	78 W	4	CARRIER	X	+	X		X				X					X	X	X	X	X						X				0
T74RTA-3800AA	100 W	100 W	78 W	12	"PL"	X	+	X		X				X					X	X	X	X	X	X	X	X	X	X		X			0
T74RTA-3900AA	100 W	100 W	78 W	4	"PL"	X	+	X		X				X					X	X	X	X	X		X	X	X	X		X			0
MODELS WITH WIDE-SPACED TRANSMITTER																																	
T34RTA-1803AA		25 W	19 W	12	CARRIER	X	+		X	2					X				X	X	X	X	X	X							X		0
T34RTA-1903AA		25 W	19 W	4	CARRIER	X	+		X	2					X				X	X	X	X	X								X		0
T34RTA-3803AA		25 W	19 W	12	"PL"	X	+		X	2					X				X	X	X	X	X	X	X	X	X	X				X	0
T34RTA-3903AA		25 W	19 W	4	"PL"	X	+		X	2					X				X	X	X	X	X		X	X	X	X				X	0
T44RTA-1803AA	45 W	45 W	39 W	12	CARRIER	X	+		X	2						X			X	X	X	X	X	X							X		0
T44RTA-1903AA	45 W	45 W	39 W	4	CARRIER	X	+		X	2						X			X	X	X	X	X								X		0
T44RTA-3803AA	45 W	45 W	39 W	12	"PL"	X	+		X	2						X			X	X	X	X	X	X	X	X	X	X				X	0
T44RTA-3903AA	45 W	45 W	39 W	4	"PL"	X	+		X	2						X			X	X	X	X	X		X	X	X	X				X	0
T54RTA-1803AA		75 W	59 W	12	CARRIER	X	+		X	2							X		X	X	X	X	X	X							X		0
T54RTA-1903AA		75 W	59 W	4	CARRIER	X	+		X	2							X		X	X	X	X	X								X		0
T54RTA-3803AA		75 W	59 W	12	"PL"	X	+		X	2							X		X	X	X	X	X	X	X	X	X	X				X	0
T54RTA-3903AA		75 W	59 W	4	"PL"	X	+		X	2							X		X	X	X	X	X		X	X	X	X				X	0
T74RTA-1803AA	100 W	100 W	78 W	12	CARRIER	X	+		X	2								X	X	X	X	X	X	X							X		0
T74RTA-1903AA	100 W	100 W	78 W	4	CARRIER	X	+		X	2								X	X	X	X	X	X								X		0
T74RTA-3803AA	100 W	100 W	78 W	12	"PL"	X	+		X	2								X	X	X	X	X	X	X	X	X	X	X				X	0
T74RTA-3903AA	100 W	100 W	78 W	4	"PL"	X	+		X	2								X	X	X	X	X	X		X	X	X	X				X	0
MODELS WITH STANDARD TRANSMITTER (SINGLE FREQ.)																																	
T34RTA-1000AA		25 W	19 W	1	CARRIER	X	+	X		X	X								X	X	X	X	X						X				0
T44RTA-1000AA	45 W	45 W	39 W	1	CARRIER	X	+	X		X		X							X	X	X	X	X						X				0
T54RTA-1000AA		75 W	59 W	1	CARRIER	X	+	X		X			X						X	X	X	X	X						X				0
T74RTA-1000AA	100 W	100 W	78 W	1	CARRIER	X	+	X		X				X					X	X	X	X	X						X				0
T34RTA-3000AA		25 W	19 W	1	"PL"	X	+	X		X	X								X	X	X	X	X		X	X	X	X		X			0
T44RTA-3000AA	45 W	45 W	39 W	1	"PL"	X	+	X		X		X							X	X	X	X	X		X	X	X	X		X			0
T54RTA-3000AA		75 W	59 W	1	"PL"	X	+	X		X			X						X	X	X	X	X		X	X	X	X		X			0
T74RTA-3000AA	100 W	100 W	78 W	1	"PL"	X	+	X		X				X					X	X	X	X	X		X	X	X	X		X			0

EPS-9360-K

PACKAGE RADIO MODELS
EARLIER VERSIONS

MOTOROLA

"PACKAGE" RADIO MODEL CHART

FOR

406-420 MHz AND 450-512 MHz

"MICOR"

FM TWO-WAY MOBILE RADIO SETS

WITH ACCESSORIES

1-FREQUENCY, 4-FREQUENCY AND

12-FREQUENCY OPERATION

CODE:

☒ = ONE SUPPLIED.

[O] = ONE SUPPLIED; CHOICE DEPENDENT ON OPERATING FREQUENCY

*SEE BASIC RADIO SET MODEL CHART FOR ITEMS WITHIN THE RADIO SET.

≠RF POWER OUTPUT REQUIRED FOR ERP OF 50, 100, 150, AND 200 W; ASSUMES 10 FEET OF COAXIAL CABLE (0.95 dB LOSS, MOTOROLA PART NUMBER 30C82921H01) BETWEEN RADIO OUTPUT CONNECTOR AND 5 dB GAIN ANTENNA.

"PACKAGE" MODEL	NO. OF FREQS.	TYPE OF SQUELCH SYSTEM	TRANSMITTER RF POWER 406-420 MHz	450-512 MHz	470-512 MHz ≠	*INCLUDES BASIC RADIO SET MODEL	CONTROL HEAD, 1-FREQUENCY TCN1091B	CONTROL HEAD, 4-FREQUENCY TCN1092B	CONTROL HEAD, 12-FREQUENCY TCN1119A	CONTROL CABLE, 4-FREQUENCY TKN6454A	CONTROL CABLE, 12-FREQUENCY TKN6606A	CABLE KIT, POWER "ON-OFF" TKN6456A	CABLE KIT, POWER FEED (25W) TKN6457A	CABLE KIT, POWER FEED (45, 75 & 100W) TKN6458A	SPEAKER TSN6016B	INSTALLATION KIT TLN4347A	"P-L" HANG-UP SWITCH BOX TLN5181A	MICROPHONE TMN6054A	ANTENNA (406-420 MHz) TAE6061A	ANTENNA (450-470 MHz) TAE6062A	ANTENNA (470-494 MHz) TAE6094A	ANTENNA (494-512 MHz) TAE6095A
MODELS WITH STANDARD TRANSMITTER																						
T34RTA-1000AK	1	CARRIER		25 W	19 W	T34RTA-1000AA	X			X		X	X		X	X		X		O	O	O
T44RTA-1000AK	1	CARRIER	45 W	45 W	39 W	T44RTA-1000AA	X			X		X		X	X	X		X	O	O	O	O
T54RTA-1000AK	1	CARRIER		75 W	59 W	T54RTA-1000AA	X			X		X		X	X	X		X		O	O	O
T74RTA-1000AK	1	CARRIER	100 W	100 W	78 W	T74RTA-1000AA	X			X		X		X	X	X		X	O	O	O	O
T34RTA-3000AK	1	"PL"		25 W	19 W	T34RTA-3000AA	X			X		X	X		X	X	X	X		O	O	O
T44RTA-3000AK	1	"PL"	45 W	45 W	39 W	T44RTA-3000AA	X			X		X		X	X	X	X	X	O	O	O	O
T54RTA-3000AK	1	"PL"		75 W	59 W	T54RTA-3000AA	X			X		X		X	X	X	X	X		O	O	O
T74RTA-3000AK	1	"PL"	100 W	100 W	78 W	T74RTA-1000AA	X			X		X		X	X	X	X	X	O	O	O	O
T34RTA-1900AK	4	CARRIER		25 W	19 W	T34RTA-1900AA		X		X		X	X		X	X		X		O	O	O
T44RTA-1900AK	4	CARRIER	45 W	45 W	39 W	T44RTA-1900AA		X		X		X		X	X	X		X	O	O	O	O
T54RTA-1900AK	4	CARRIER		75 W	59 W	T54RTA-1900AA		X		X		X		X	X	X		X		O	O	O
T74RTA-1900AK	4	CARRIER	100 W	100 W	78 W	T74RTA-1900AA		X		X		X		X	X	X		X	O	O	O	O
T34RTA-3900AK	4	"PL"		25 W	19 W	T34RTA-3900AA		X		X		X	X		X	X	X	X		O	O	O
T44RTA-3900AK	4	"PL"	45 W	45 W	39 W	T44RTA-3900AA		X		X		X		X	X	X	X	X	O	O	O	O
T54RTA-3900AK	4	"PL"		75 W	59 W	T54RTA-3900AA		X		X		X		X	X	X	X	X		O	O	O
T74RTA-3900AK	4	"PL"	100 W	100 W	78 W	T74RTA-3900AA		X		X		X		X	X	X	X	X	O	O	O	O
T34RTA-1800AK	12	CARRIER		25 W	19 W	T34RTA-1800AA			X		X	X	X		X	X		X		O	O	O
T44RTA-1800AK	12	CARRIER	45 W	45 W	39 W	T44RTA-1800AA			X		X	X		X	X	X		X	O	O	O	O
T54RTA-1800AK	12	CARRIER		75 W	59 W	T54RTA-1800AA			X		X	X		X	X	X		X		O	O	O
T74RTA-1800AK	12	CARRIER	100 W	100 W	78 W	T74RTA-1800AA			X		X	X		X	X	X		X	O	O	O	O
T34RTA-3800AK	12	"PL"		25 W	19 W	T34RTA-3800AA			X		X	X	X		X	X	X	X		O	O	O
T44RTA-3800AK	12	"PL"	45 W	45 W	39 W	T44RTA-3800AA			X		X	X		X	X	X	X	X	O	O	O	O
T54RTA-3800AK	12	"PL"		75 W	59 W	T54RTA-3800AA			X		X	X		X	X	X	X	X		O	O	O
T74RTA-3800AK	12	"PL"	100 W	100 W	78 W	T74RTA-3800AA			X		X	X		X	X	X	X	X	O	O	O	O
MODELS WITH WIDE-SPACED TRANSMITTER																						
T34RTA-1903AK	4	CARRIER		25 W	19 W	T34RTA-1903AA		X				X	X		X	X		X		O	O	O
T44RTA-1903AK	4	CARRIER	45 W	45 W	39 W	T44RTA-1903AA		X				X		X	X	X		X	O	O	O	O
T54RTA-1903AK	4	CARRIER		75 W	59 W	T54RTA-1903AA		X				X		X	X	X		X		O	O	O
T74RTA-1903AK	4	CARRIER	100 W	100 W	78 W	T74RTA-1903AA		X				X		X	X	X		X	O	O	O	O
T34RTA-3903AK	4	"PL"		25 W	19 W	T34RTA-3903AA		X				X	X		X	X	X	X		O	O	O
T44RTA-3903AK	4	"PL"	45 W	45 W	39 W	T44RTA-3903AA		X				X		X	X	X	X	X	O	O	O	O
T54RTA-3903AK	4	"PL"		75 W	59 W	T54RTA-3903AA		X				X		X	X	X	X	X		O	O	O
T74RTA-3903AK	4	"PL"	100 W	100 W	78 W	T74RTA-3903AA		X				X		X	X	X	X	X	O	O	O	O
T34RTA-1803AK	12	CARRIER		25 W	19 W	T34RTA-1803AA			X			X	X		X	X		X		O	O	O
T44RTA-1803AK	12	CARRIER	45 W	45 W	39 W	T44RTA-1803AA			X			X		X	X	X		X	O	O	O	O
T54RTA-1803AK	12	CARRIER		75 W	59 W	T54RTA-1803AA			X			X		X	X	X		X		O	O	O
T74RTA-1803AK	12	CARRIER	100 W	100 W	78 W	T74RTA-1803AA			X			X		X	X	X		X	O	O	O	O
T34RTA-3803AK	12	"PL"		25 W	19 W	T34RTA-3803AA			X			X	X		X	X	X	X		O	O	O
T44RTA-3803AK	12	"PL"	45 W	45 W	39 W	T44RTA-3803AA			X			X		X	X	X	X	X	O	O	O	O
T54RTA-3803AK	12	"PL"		75 W	59 W	T54RTA-3803AA			X			X		X	X	X	X	X		O	O	O
T74RTA-3803AK	12	"PL"	100 W	100 W	78 W	T74RTA-3803AA			X			X		X	X	X	X	X	O	O	O	O

EPS-9387-E

FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, revision suffix numerals are added to the affected kit model number. For example, a TLN4448A becomes a TLN4448A-1 with the first revision, TLN4448A-2 with the second revision, etc.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced when the suffix number changed. With this information, the technician can find the information for the current version, and any previous version, of the equipment covered by the manual.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 800 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Division
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Division products.

Orders for all parts *except* crystals, active filters, code plugs, channel elements, and "Vibrasender" ® and "Vibrasponder" ® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications and Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road
Schaumburg, Ill. 60196
Phone: 312-576-7322
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 301-796-8600
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
P.O. Box 85036
San Diego, California 92138
Phone: 714-578-2222
TWX: 910-335-1634

GULF STATES AREA PARTS
8550 Katy Freeway
Suite 128
Houston, Texas 77024
Phone: 713-932-8955

SOUTHWESTERN AREA PARTS
P.O. Box 34290
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P.O. Box 368
Decatur, Georgia 30031
Phone: 504-981-9800
TWX: 810-766-0876

5.3 CANADIAN ORDERS

CANADIAN MOTOROLA ELECTRONICS COMPANY
National Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 416-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC. OR MOTOROLA AMERICAS, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-0869
Telex: 722443 or 722424
Cable: MOTOL PARTS

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

ALL MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131

DESCRIPTION

1. ELECTRICAL FEATURES

a. General

Motorola UHF "Micor" mobile FM two-way radios are fully solid state units incorporating integrated circuits and monolithic crystal filters. A "YIG" three-port circulator is used in the antenna network of each radio. In addition, both the transmitter and receiver frequency is developed by circuitry using a single channel element. The radio sets are available in "Private-Line" or carrier squelch models with up to twelve channels of operation. RF power output is 25, 45, 75 or 100 watts in the 450-470 MHz range. In the 470-512 MHz range, the effective radiated power is 50, 100, 150 and 200 watts assuming a 5 dB gain antenna and 10 feet of coaxial cable (0.95 dB loss) between radio output connector and 5 dB gain antenna. In addition, wide-space transmitter models are available. Optional accessories include receiver preamplifier, positive or negative ground plug in kits, time-out-timer, and all system-90 optional accessories.

The 406-420 MHz version of the Motorola UHF "Micor" mobile FM two-way radio is essentially the same as the 450-512 MHz version. The exciter is the only part of the radio set that has been significantly changed. All options available for the 450-512 MHz "Micor" Radio Set can be used with the 406-420 MHz "Micor" Radio Set. The rated transmitter power output for 406-420 MHz "Micor" radio sets is either 45 or 100 watts.

b. Power Source

The radio set does not include or require a power supply. The highest voltage anywhere in the radio set can be furnished directly from a 12-volt vehicle battery. This type of operation provides greater efficiency and less power consumption.

The radio set operates from a negative or positive ground electrical system. For positive ground operation, an optional positive ground converter and power cable are required. The converter may be ordered factory-installed or purchased separately for field installation later.

c. Receiver

The receiver is a single conversion design and delivers 10 watts of audio power at less than 5% distortion. A majority of the receiver audio circuitry is contained in integrated circuits. A squelch control automatically turns off the receiver audio except when an incoming signal is present. The receiver board contains the common channel element oscillator and injection train which is used by both the receiver and transmitter. The transmit frequencies are developed by taking the injection frequency from the receiver and adding to it, an appropriate offset oscillator frequency in the transmitter mixer. The transmitter power amplifiers feature broadband circuitry requiring no tuning. The rf circuitry is constructed using thick film microstrips upon alumina (ceramic) substrates and internally matched rf power transistors. In addition, all stages of the power amplifiers interface at 50 ohms for ease of servicing.

d. Frequency Selection

Frequency selection in some multi-channel radio sets is accomplished through the use of a diode matrix on the control (interconnect) board (channels F1 through F4) and a diode matrix board (channels F5 through F12). On other multi-channel radio sets frequency selection is accomplished by using an optional universal switching board. The frequency selection system used in a particular radio set is chosen before manufacture, depending on the required transmit and receive frequency pairing for each channel.

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

e. Antenna Switching

The transmitter and receiver are connected to the antenna through the antenna switching network. Within the antenna switching network is a "YIG" three port circulator through which the transmitter and receiver connect to the antenna. The transmitter is connected to the antenna via the circulator at all times. The receiver is connected to the antenna only during receive operation. Highly reliable reed switches are used in the antenna switching network for the rf switching. The circulator provides maximum protection for the transmitter power amplifier transistors, enables optimum transmitter power under all conditions of antenna mismatch, and significantly improves transmitter intermodulation performance.

f. "Private-Line" Models

The UHF "Micor" radio sets are also available in "Private-Line" models. This type of operation permits private communications on crowded radio communication channels. Several "Private-Line" (PL) networks can use the same rf carrier frequency in the same area if each network uses a different PL tone frequency. The PL tones are in the 67-192.8 Hz range, which is below the 300-3000 Hz voice frequency range used in radio communication equipment.

The transmitters are modulated by a continuous sub-audible PL tone in addition to the voice modulation. The tone is generated by a PL encoder, which is a plug-in circuit board in the transmitter. The receivers accept only signals that are modulated with the specific PL tone frequency. Signals without the tone or with a different tone are not heard. Only messages from your own PL network are heard. A PL decoder, which is also a plug-in circuit board in the receiver, disables the audio circuits of the receiver until the proper tone is received. A filter blocks the tone from the speaker.

The PL decoder may be bypassed, if desired, to monitor all on-frequency signals. Since the operator cannot hear all on-frequency signals unless he monitors the channel, it is necessary to do so before transmitting to avoid interfering with other users. In PL radios, this happens automatically when the microphone is removed from the hang-up bracket. A monitor switch on the side of the bracket also allows monitoring when the microphone is in the hang-up bracket.

NOTE

The Motorola Systems Engineering Department assigns the PL tone frequencies to prevent duplicate or interfering tones from being used in the same area. Consult them before changing tones or adding new ones. All "Private-Line" users will enjoy better performance.

g. "Digital Private-Line" Models

UHF "Micor" radio sets are available with "Digital Private-Line" (DPL) binary-coded squelch. The receiver in a DPL-equipped radio set unsquelches only when a signal with the proper DPL binary code is received.

The distinctive DPL binary code for transmission and reception is determined by a code plug on the DPL encoder board. If all radio sets in a 2-way radio system are equipped with code plugs having the same identifying number, the receivers in that system will unsquelch for signals from within that radio system only.

During reception, the DPL decoder board keeps the receiver audio circuits muted until a properly-coded signal is received. The DPL decoder board plugs into the receiver audio & squelch circuit board.

During transmission the DPL encoder and decoder boards work together to modulate the transmitter continuously with a distinctive 23-bit binary code word. The DPL encoder board plugs into the exciter circuit board.

The DPL decoder may be bypassed, if desired, to monitor all on-frequency signals. Since the operator cannot hear all on-frequency signals unless he monitors the channel, it is necessary to do so before transmitting to avoid interfering with other users. In DPL radios, this happens automatically when the microphone is removed from the hang-up bracket. A monitor switch on the side of the bracket also allows monitoring when the microphone is in the hang-up bracket.

2. MECHANICAL FEATURES

Virtually all components are mounted on circuit boards which are easily removed and replaced without unsoldering leads. A control circuit board runs the length of the radio in the center. Other circuit boards plug directly into the control board, which provides interconnections via circuit board plating instead of wiring. The few remaining wire connections may be unplugged and reconnected easily; no unsoldering and resoldering is required. The transmitter circuits are on one side of the radio set (side with the heat sink) and receiver circuits are on the opposite side. Transmitter signals are generated at the back of the radio and are progressively routed toward the front of the radio set where the final transmitter output signal is taken from the antenna connector. The receiver signals are likewise routed from back to front of the radio set. The final audio output is developed at the front of the radio. The audio power amplifier's transistor board is mounted to the side of the radio set for good heat dissipation.

The radio is contained in a rugged steel housing which is unvented to keep out dust and contaminants. The heat sink fins along the side of the radio form part of the heavy duty, yet lightweight aluminum casting which nounts the transmitter power amplifiers. Heat is conducted to the fins and radiated for efficient cooling.

The radio set is normally installed in the trunk compartment of a vehicle with the control head, speaker, and microphone mounted under the dashboard. The control head includes the controls required for operating the radio such as the on-off switch, volume and squelch controls, and frequency selector switch (mult-frequency models). A cable connects from the radio set to the control head for remote control of the radio. The cable also connects to the vehicle battery for power to operate the radio. The speaker and microphone connect directly to the control head. A coaxial cable connects from the radio set to the antenna. Of course, the radio may be mounted in a station wagon, truck or almost any other type vehicle or in a fixed location if powered by a 12-volt battery.

The bottom cover of the radio set is usually mounted permanently to a flat surface using four mounting holes, or to an uneven surface by using the alternate three-point mounting. The rest of the radio set slides onto the bottom cover and is locked in position. The handle on the front latches the radio to the bottom plate, latches the top in place and secures the cable connector. A key lock guards against theft or tampering. When the handle is unlocked and pulled forward to the first detent, the cable connector is released and the radio can be removed from the vehicle. When the handle if pulled fully open, the top may be removed. The handle latching mechanism allows close quarters mounting such as under the seat of a truck.

The control head, speaker and microphone are safety designed to reduce or prevent injury in collisions. The housings are constructed of impact absorbing plastic, all knobs and switches are recessed, and there are no sharp corners or projections. In addition, the control head may be breakaway mounted so that it will give way under impact.

3. SERVICING FEATURES

Many of the items listed under electrical and mechanical features are also servicing features. For example:

--Integrated Circuits - Fewer components and more reliable components mean less servicing.

--Few Wires - Broken and loose wire connections are eliminated as a source of trouble.

--Modular Construction - Circuit boards can be removed and replaced in seconds. Spare circuit boards may be carried by a technician and defective boards replaced to quickly return radios to service.

--All power amplifier stages interface at 50 ohms for ease of troubleshooting.

--Removable top - The top can be removed with the radio still in the vehicle. Most servicing can be performed from the top of the radio.

--Locking Handle - The locking handle provides quick release of the top, cable and radio set.

In addition, other important service considerations include.

--Five Metering Receptacles - Metering receptacles in the exciter, power amplifier, power control board, receiver and control board allow a Motorola portable test set to check over 20 major test points for rapid isolation of trouble. A microphone may be connected to the test set and the speaker in the test set used for operation of the radio set during testing.

--Alignment - All receiver and transmitter alignment is performed from the top of the radio set. Crystal filters in the receiver i-f section eliminate most i-f alignment adjustments. Transmitter power output may be measured on a Motorola portable test set.

--Servicing in the Vehicle - A combination of features such as the removable top, accessibility, multiple metering points, and operation of the radio from a portable test set means that most servicing can be performed in the vehicle. Such testing is performed under actual operating conditions, with the normally used control head, antenna, and power source included in the test.

4. REQUIRED ACCESSORIES

In addition to the basic radio set, certain accessories are required to complete the installation. Such items include a control head, microphone, speaker, cable kit, and antenna. Complete package models are available which include the basic radio set and the most commonly used group of accessories for a complete installation. Refer to the model chart at the front of this manual for a listing of all items included in the package models. Accessory items are also available individually to allow selection of alternate items, if required, for specific installations.

The control head contains the operator controls such as the on-off switch, volume and squelch controls, and frequency selector switches in multi-frequency models. Models are available in single-frequency and multi-frequency

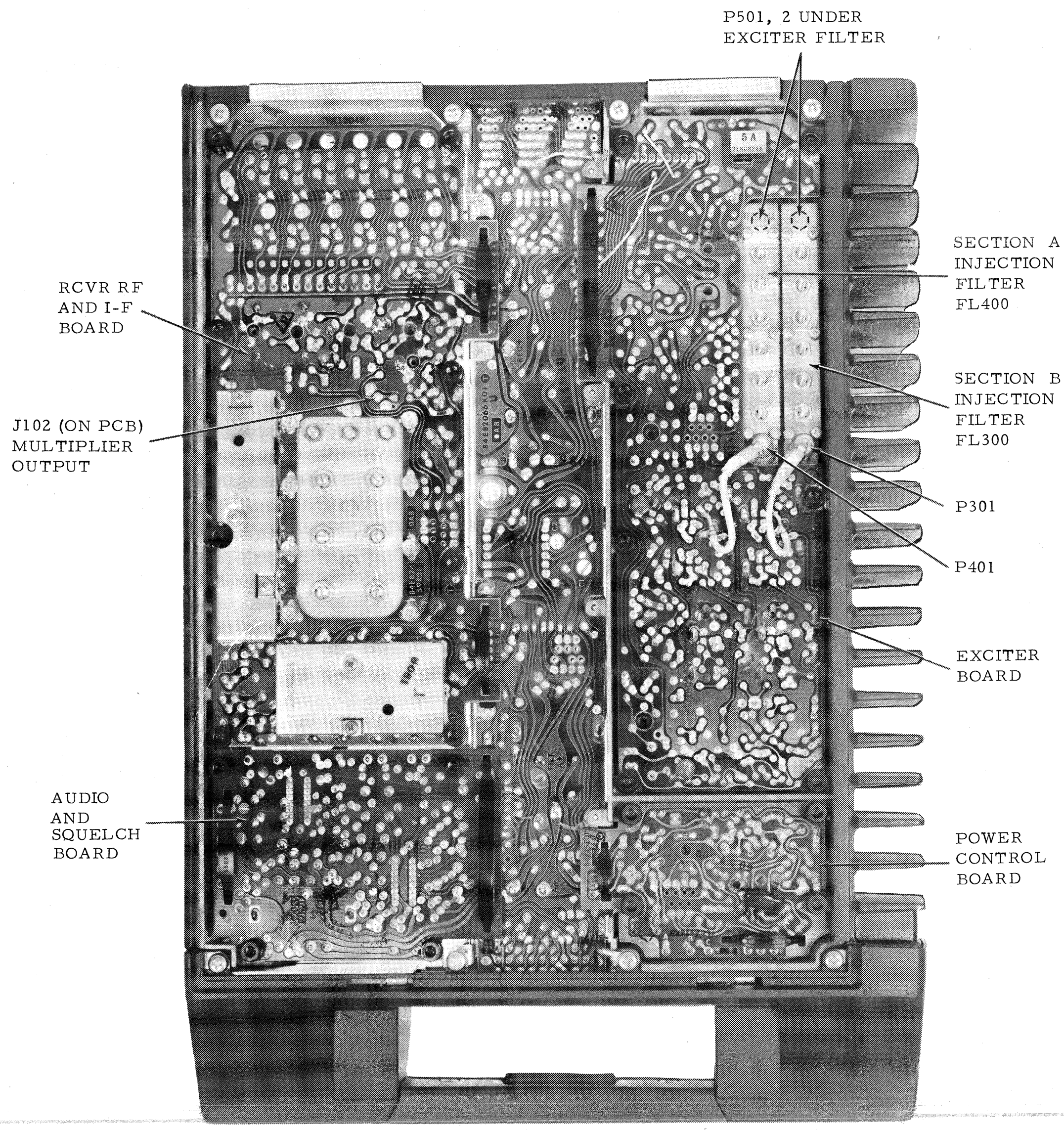

Figure 1.
Major Component Location Detail, Top View of Radio

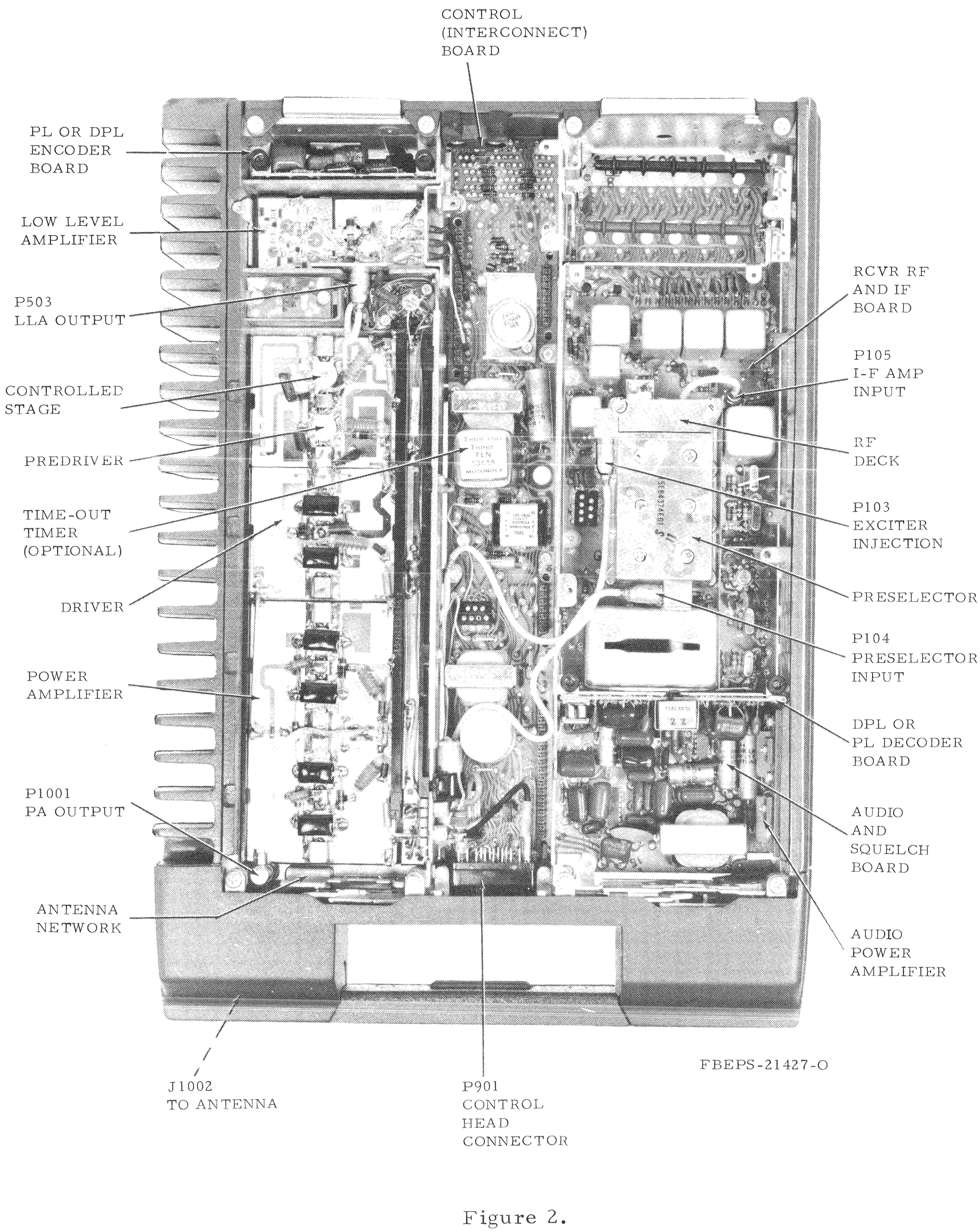

Figure 2.
Major Component Location Detail, Bottom View of Radio

versions. A plastic housing, recessed controls, and breakaway mounting are safety features. A double-pivoting trunnion bracket allows mounting at almost any angle. The controls are illuminated for visibility at night. A red "transmit" indicator lights when the transmitter is keyed.

An 18-foot cable connects the radio set to the control head and the vehicle battery. It is long enough to facilitate installation in most vehicles. However, a 22-foot cable is available for special installation requirements. Separate versions of 18-foot and 22-foot cables are used for multi-frequency radio sets.

A plastic case dynamic microphone with a built-in transistorized preamplifier is used. It includes a retractable coiled cord and a hang-up clip which permits vertical or horizontal installation. "Private-Line" models use a hang-up switch/bracket. The push-to-talk switch on the microphone keys the transmitter. The microphone plugs directly into the control head.

The mobile speaker handles the full 10 watts of receiver audio output at low distortion. It plugs into the control head and is housed in a plastic case. A trunnion bracket for vertical or horizontal mounting and a wall-mount bracket for use where space is limited are included. A hang-up clip on the rear of the speaker and a long cable permit the speaker to be hung on the vehicle window for reception of calls when the operator is outside the vehicle.

5. OPTIONAL ACCESSORIES

Additional accessories are available for the "Micor" radio set. These items may be factory installed if purchased at the same time as the radio set or added later. Other accessories will become available after the printing of this manual; consult your Motorola sales representative for a complete list of currently available accessory items.

a. High Stability Channel Elements

The standard channel elements (KXN1024A) shipped with the radio provide a transmitter frequency stability of ±.0005% and a receiver frequency stability of ±.0002% with automatic frequency control.

Optional channel elements (KXN1029A) provides a transmitter frequency stability of ±.0002% and a receiver frequency stability of ±.0002% without automatic frequency control.

b. Time-Out Timer

The Model TLN1361A Time-Out Timer is a plug-in module which can be inserted into the "Micor" radio set without additional modifications. It turns off the transmitter after approximately 60 seconds continuous operation. An alert tone in the speaker warns the operator that the transmitter has turned off. The timer is immediately reset when the transmitter is unkeyed.

c. Positive Ground Converter

The Positive Ground Converter allows the "Micor" radio set to operate from 12-volt positive ground vehicle electrical systems. The unit mounts inside the radio.

CAUTION

Certain leads must be reversed in the radio set cable for positive ground operation or a TKN6470B Positive Ground Cable must be used.

d. Long Cables

Cables 22-feet long are available for interconnecting the radio to the control head and battery where extra length is required.

e. RF Preamplifier

The RF Preamplifier increases receiver sensitivity by 6 dB.

f. Universal Switching Board

The universal switching board allows independent selection of any transmitter and receiver frequency for each control head channel selector switch position. The universal switching board may be used to select any of the channel elements and either offset oscillator thereby permitting operation with transmitter and receiver frequency pairings that are not separated by the standard or wide-spaced offset oscillator frequencies. The board is available in both four-frequency (TLN5575A) and twelve-frequency (TLN5477A) models.

1. PRE-INSTALLATION INSTRUCTIONS

a. Before Unpacking

The package "Micor" radio set models are completely connected for pre-installation testing. Complete removal from the shipping carton is not required. The basic "Micor" radio sets can be checked before installation using a benchtest set-up with permanently-installed cabling, control facilities and proper power supply or the check can be made after the installation is complete.

CAUTION

Observe the polarity and power supply instructions below.

b. Reverse Polarity

A label on the plug of the cable which connects to the front of the radio set identifies the cable as a negative ground or positive ground device. The plug must be removed to read this label. For negative ground cables, connect the red lead to the positive (+) terminal and the black lead to the negative (-) terminal of the power source. For positive ground cables, connect the red lead to the negative (-) terminal and the black lead to the positive (+) terminal of the power source. (Internal protection prevents damage to the radio in the event that voltage of the wrong polarity is applied).

c. Selecting a Bench Power Supply

The poor regulation and/or transient response of many bench power supplies can apply excessive voltage to high power radios when going from the transmit to receive condition. Avoid using these supplies or damage to the radio may result. The following bench supplies are approved for testing the "MICOR" radio:

Motorola R1011 High Current Power Supply.

Motorola T1261A Transistorized 24-volt to 12-volt Converter driven by Motorola T1012A Power Supply.

12-volt automotive battery with Motorola T1012A Power Supply used as a battery charger. The power supply will provide sufficient power to maintain the voltage under full load conditions, and the battery will absorb the over-voltage upon dekeying.

d. Excerpts From FCC Regulations

(1) Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

(2) The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

(a) When the transmitter is initially installed.

(b) When any change is made in the transmitter which may increase the power input.

(c) At intervals not to exceed one year.

(3) Frequency and deviation of a transmitter must be checked:

(a) When it is initially installed.

(b) When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.

(c) At intervals not to exceed one year.

e. Pre-Operational Checks

Although the equipment has been accurately aligned at the factory, it is possible that mishandling in transit may have disturbed some of the adjustments. In addition, FCC regulations require transmitter frequency and deviation to be checked at installation. It is essential therefore, that a pre-operational check be made to assure proper operation. For complete check-out, follow the sequence of tests present below. Complete information for performing the tests are fully outlined in the ADJUSTMENT section of this instruction manual.

(1) Measure the 20 dB quieting signal level.

(2) In PL models, measure the PL sensitivity.

(3) Check the receiver frequency and realign if necessary.

(4) Measure the transmitter power output.

(5) Measure the transmitter deviation.

(6) Check the transmitter frequency and adjust if necessary.

(7) Check the antenna VSWR after installation in the vehicle.

2. ANTI-SKID BRAKING PRECAUTIONS

The following recommended transmitter installation and test procedures are suggested for vehicles with electronic anti-skid braking systems.

a. Installation Suggestions

Locate the braking modulator box in the vehicle. The braking modulator box is located in the trunk in Chrysler Corporation cars and either in the trunk or under the dash in General Motors and Ford Corporation automobiles. A service manual may be helpful to aid in the location of the braking modulator box. Perform transmitter installation in accordance with the following recommended procedures.

(1) If the braking modulator box is mounted on the right side of the vehicle, mount the transmitter on the left side of the trunk to give it as much space as possible between the braking modulator box and the transmitter. If the braking modulator box is mounted on the left side, reverse the procedure.

(2) Use the shortest practical length of Motorola coaxial cable.

(3) The antenna should be mounted on the opposite side of the car trunk from the braking modulator box.

(4) Route all cables along the center or on the opposite side of the vehicle from the braking modulator box.

(5) Do not operate the transmitter while the vehicle is in motion with the trunk lid open.

b. Check Test

This test is divided to cover several different types of interference. Disturbance of the electronic anti-skid device can usually be detected in several different ways concerning the vehicle's braking system, i.e., by the lights, any irregular audible sounds, any change in the performance of the braking system itself, etc.

During checks (1) thru (5), however, none of the above conditions should be observed.

(1) With car stationary (gear selector in PARK) and the engine running at a fast idle, key (turn the carrier on and off) the transmitter with and without modulation with your foot off of the brake pedal.

(2) Repeat the preceding with your foot on the brake pedal.

(3) When making this test, while the car is stationary, allow at least 2 car lengths and possibly even more of clear area in front of the vehicle. With your foot on the brake with just enough pressure to keep the vehicle from moving, place the car in a forward gear with the engine at a fast idle, then key the transmitter with and without modulation.

NOTE: Disruption of the anti-skid braking system may cause the vehicle to move forward in addition to the lights and audible sounds mentioned above.

(4) Driving at a moderate speed (15-25 mph) with your foot off of the brake pedal, have an assistant key the transmitter with and without modulation.

(5) Repeat step d with foot lightly on the brake pedal to turn on the brake lights.

(6) While making a moderate deceleration stop from 25-30 mph, have an assistant key the transmitter with and without modulation.

NOTE: Severe disruption of the electronic anti-skid braking system may cause loss of control of the vehicle during the following test.

(7) While making "panic" stops from 20 mph have an assistant key the transmitter with and without modulation.

If no interference or disruption is noticed, repeat by making "panic" stops from 30 mph.

If no malfunctions are observed after the above tests are performed, it can be assumed no apparent problem exists and release the car to the customer.

If any of the above tests result in a brake malfunction, contact the car manufacturer service department as soon as possible and remove the radio from the vehicle. Do not complete installation.

3. INSTALLATION INSTRUCTIONS

CAUTION

In positive ground vehicles, an optional ground converter is required and a positive ground cable kit must be used. A negative ground cable kit can be converted for positive ground operation if required. Refer to Figure 3 for conversion details.

STEP 1

CABLE ROUTING (Refer to Figures 1, 2, and 3.)

CAUTION

Before the cable is routed (after unpacking) four leads must be removed from the black connector block that connects to the control head. Remove the green and orange fused power leads and the two PL leads from the hang-up switch box.

Determine the position that the radio set will occupy in the trunk compartment and leave enough lack cable to permit the plug to be easily connected or disconnected from the radio set as shown in Figure 1.

Work from the trunk space forward. In some cars there is enough room below the fiberboard trunk partition to admit the cables. If this is not the case, make an opening through the partition. Remove the back seat.

The control head end of the multi-conductor cable kit is terminated in either one black (single frequency models) or one black and one blue (multi-frequency models) connector housings. If the leads must be removed from the connector housings to permit passage of the cable, use the following procedure.

--Each cable kit has a contact removal tool (Motorola Part No. 66C84699B01) taped to it. Slide the small end of the tool into the front of the individual contact position so that the tab of the female contact is pushed up and the contact may be removed from the housing by carefully pulling it out with the wire. Repeat this operation until all wires are removed from each connector housing.

--Tape the female contacts into a small bundle. Pass it and the long red power cable into the passenger compartment. After reaching the control head position re-insert the female contacts into the proper contact positions in the connector housings as indicated in Figure 3.

Pull the cables into the back seat area, under the floor mats and front seat, out to the top of the floor mat under the dash. Where no specific channel is provided, route the cables under the floor mat along the side of the drive-shaft tunnel. Pull the control head end of the multi-conductor cable to the approximate location of the control head. Route the red power cable into the engine compartment through any convenient hole already in the firewall. If necessary, make a 1/2-inch diameter hole elsewhere in the firewall, install the supplied grommet, and route the cable through the grommet.

Figure 1.
Typical Radio Placement

Pull the red power cable into the engine compartment. A cable fuse kit has been supplied with a ring tongue lug on one end and an in-line fuse holder on the other. A small section of heat-shrinkable tubing is supplied with each cable. Any excess red cable length should be trimmed at this time. Slide the heat-shrinkable tubing over the red power lead from the radio. Slide the stripped portion of the red cable into the end of the in-line fuse holder and crimp the joint as shown in Figure 4 using a Burndy Model Y10B (indent "U" crimp). If this tool is not available, soldering is required.

Slide the heat-shrinkable tubing over the connection and shrink the tubing using a Motorola Model ST697 Heat Gun or equivalent heated air source. Remove the fuse from the fuseholder and reconnect the holder. Fasten the ring-tongue lug on the end of the cable to the battery's ungrounded terminal or to some point directly connected to the ungrounded terminal of the battery (such as the starter solenoid). Move the in-line fuseholder to a convenient location on one of the sheet metal parts of the engine compartment. Center punch and drill a 9/64" (.140") hole through the mounting surface. Then use the supplied #10-16-3/4" self tapping sheet metal screw to mount the bracket. Do not replace the fuse until the entire installation of the radio set is complete.

The control head power cable kit contains two separate wires, each equipped with an in-line fuse. The orange wire is 69 inches long and the green wire is 100 inches long. Taped to the lugless end of each cable are a crimp-on type ring tongue lug and a crimp-on type spade lug. The spade lug allows connection to hot leads at the fuse block of the vehicle and the ring tongue lug permits attachment to screws or terminals. Determine from Table A of Figure 3 which radio functions are to be switched through the vehicle ignition switch. A typical hook-up provides for ignition switch control of the transmitter function

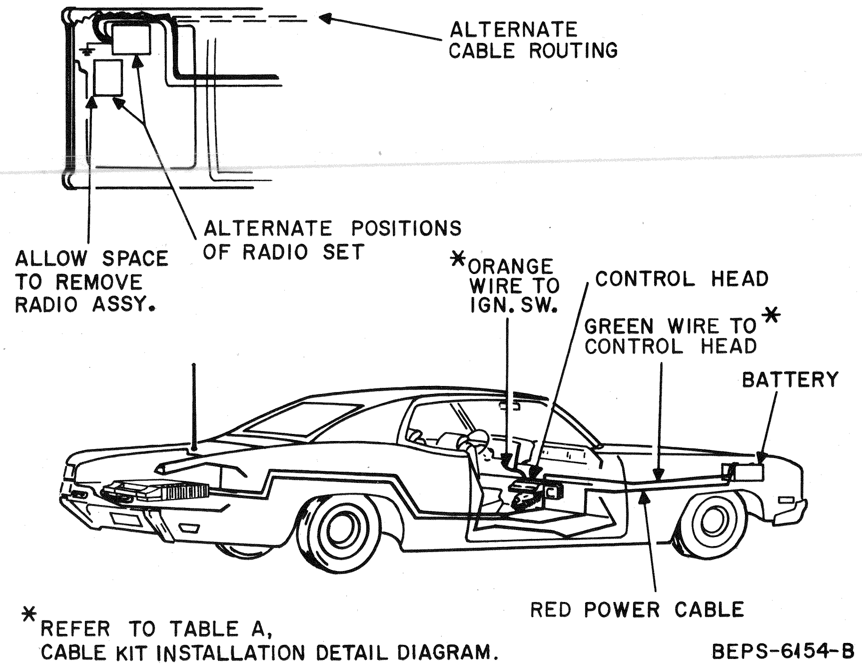

Figure 2.
Typical Mobile Radio Cable
Routing

WARNING

SEE SPECIAL INSTRUCTIONS CONCERNING INSTALLATION IN VEHICELS WITH ELECTRONIC ANTI-SKID BRAKING SYSTEMS.

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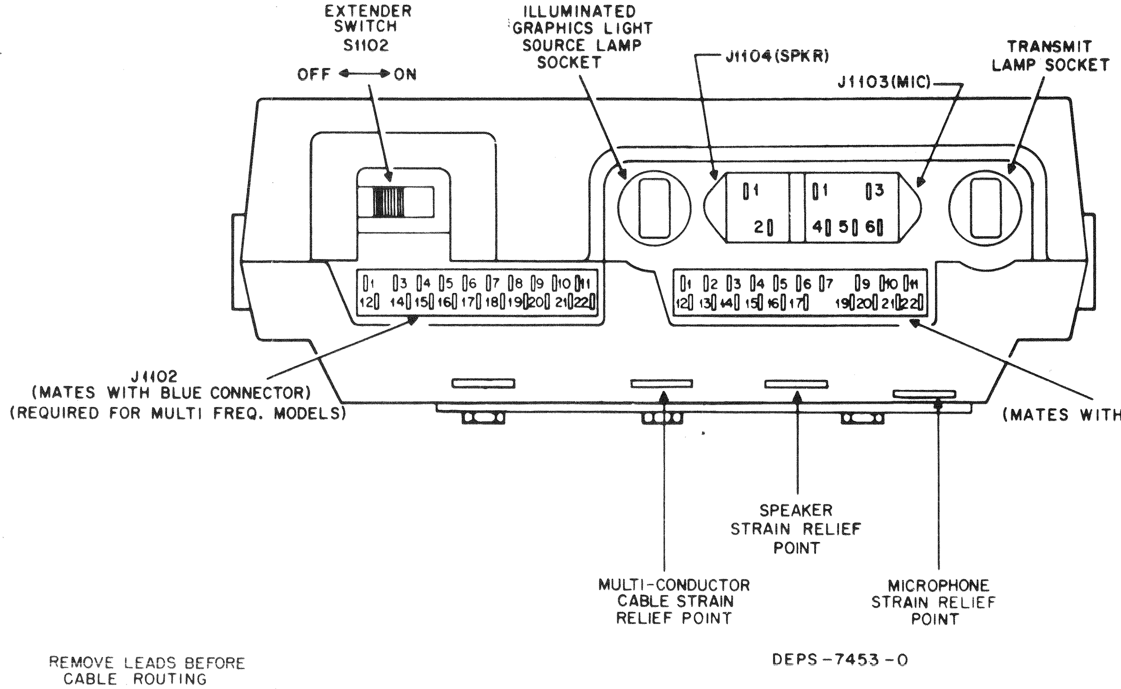
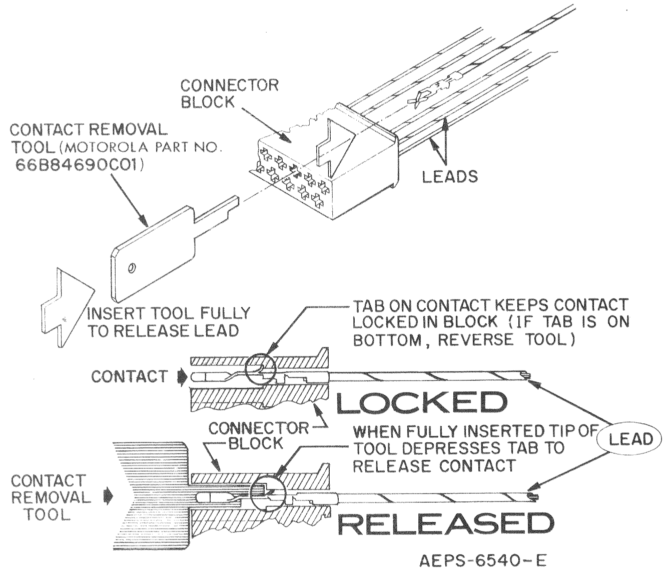
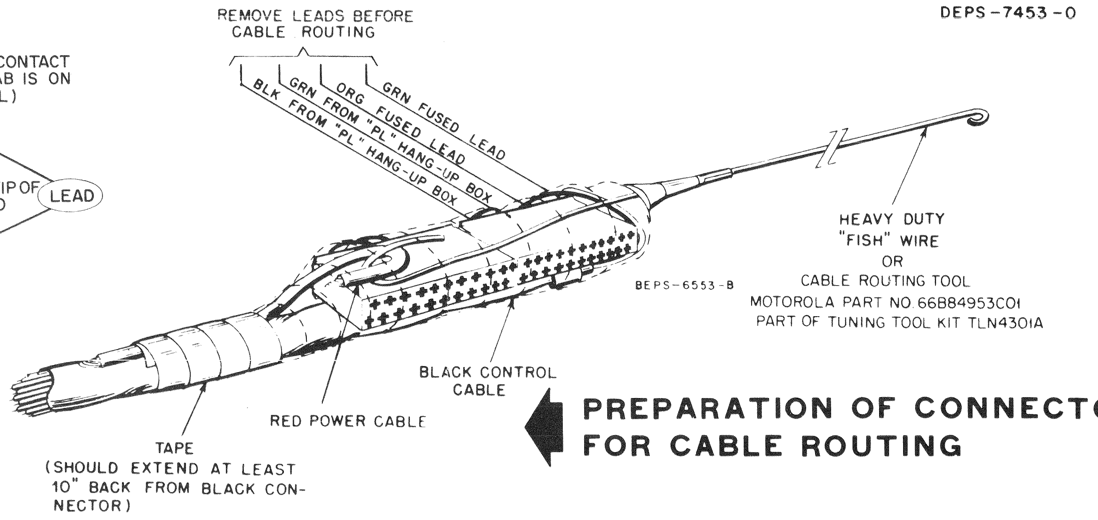
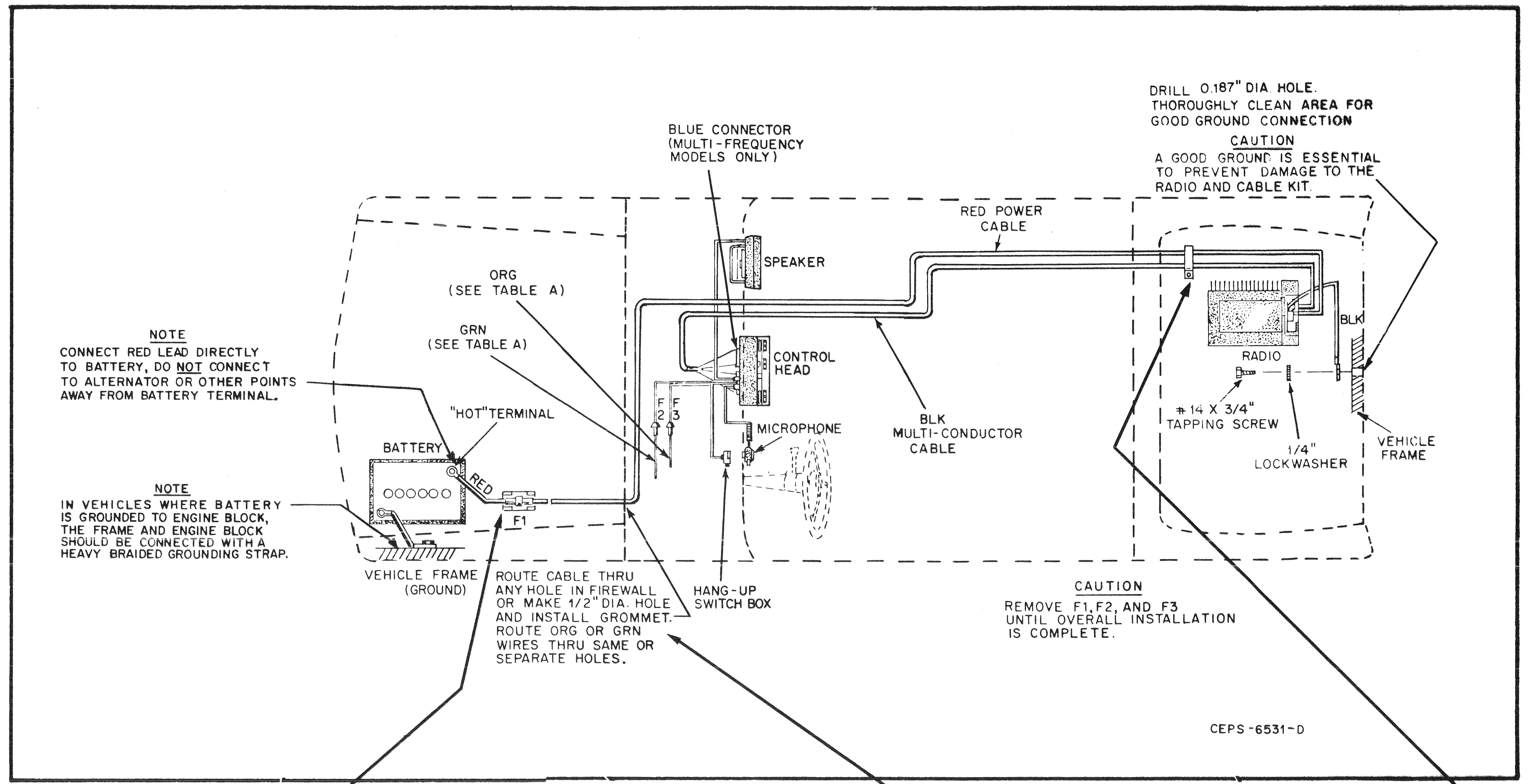


CONTROL HEAD (REAR VIEW)





PREPARATION OF CONNECTOR(S) FOR CABLE ROUTING



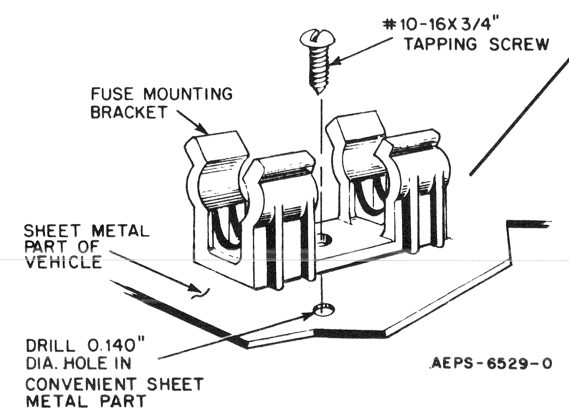
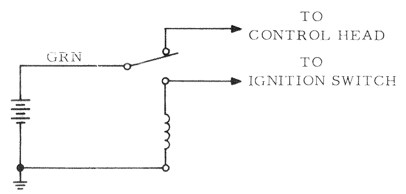
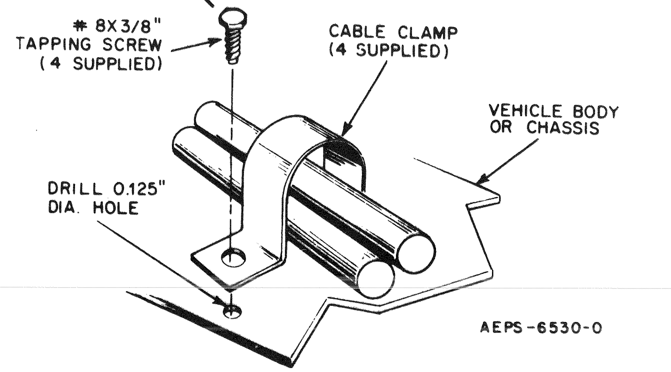


TABLE A

CONDUCTOR	GREEN	ORANGE	GREEN	ORANGE	GREEN	ORANGE
CONNECTED TO BATTERY	●	●	●			
CONNECTED TO IGNITION SWITCH				●	NOTE 1	●
IGNITION SWITCH CONTROLS	NO SWITCH CONTROL		XMTR SWITCH CONTROLLED		COMPLETE RADIO SWITCH CONTROLLED	
IN ANY APPLICATION, TRIM AND STRIP WIRES. CRIMP ON RING LUG FOR BATTERY CONNECTIONS. FOR IGNITION SWITCH CONNECTIONS, CRIMP ON RING OR SPADE LUG (WHICHEVER IS REQUIRED).						

NOTE 1: IN CASES WHERE ALTERNATOR WHINE OR OTHER INTERFERENCE IS A PROBLEM, THE GREEN LEAD CAN BE ISOLATED WITH A RELAY (MOTOROLA PART NO. 59-813674).





ALL UHF "MICOR" RADIO SET MODELS

POS.	P1102 MULTI-FREQ. MODELS ONLY WIRE COLOR	TERMINATION	P1101 WIRE COLOR	TERMINATION	POS.
1	GRAY	F3 SELECT	YEL	SW BATT (HOT)	1
2	--	KEYING BLANK	EMPTY	**	2
3	BLK	F4 SELECT	ORG	SPKR AUDIO INPUT (+)	3
4	WHT-BLK	F5 SELECT	BLK-BLU	"PL" SELECT	4
5	WHT-GRAY	EXTRA WIRE****	VIO	EXTRA WIRE (N.C. EITHER END)	5
6	WHT-VIO	F12 SELECT	GRN	SPKR AUDIO OUTPUT (-)	6
7	WHT-ORG	F8 SELECT	BLK-GRAY	EXTENDER SELECT	7
8	WHT-YEL	F9 SELECT	---	KEYING BLANK	8
9	WHT-RED	F7 SELECT	BLK-VIO	(GROUND)	9
10	WHT-BLU	F11 SELECT	SHIELD	SHIELD (SPIRAL) (GROUND)	10
11	BLU	F1 SELECT	BLK-YEL	MIC AUDIO OUTPUT	11
12	RED	HANDSET SW BOX***	GRN***	BATT HOT (SEE TABLE A)	12
13	---	KEYING BLANK	ORG***	BATT HOT IGN SW (SEE TABLE A)	13
14	WHT-BRN	F6 SELECT	BLK-RED	SW BATT (HOT)	14
15	EMPTY	**	GRN* & ***	"PL" HANG-UP SWITCH BOX	15
16	EMPTY	**	BLK-BRN	DISCR. EMIT. FOLLOWER OUTPUT	16
17	RED-BLU	EXTRA WIRE****	BRN	SQUELCH	17
18	EMPTY	**	---	KEYING BLANK	18
19	WHT-GRN	F10 SELECT	BLK* & ***	"PL" HANG-UP SWITCH BOX	19
20	YEL	HANDSET SW BOX***	BLK-GRN	VOLUME	20
21	BRN	HANDSET SW BOX***	SHIELD	SHIELD (3 CONDUCTOR) GROUND	21
22	WHT	F2 SELECT	BLK-ORG	PUSH-TO-TALK	22

*"PL" MODELS ONLY
**FOR EXTRA DASH ACCESSORIES
***SEPARATE WIRE - NOT PART OF THE MULTI-CONDUCTOR CABLE
****NO CONNECTION ON RADIO END

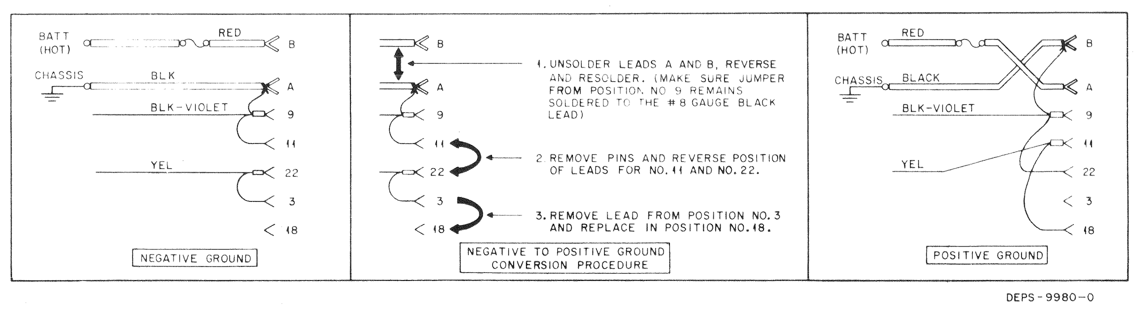
EPS-8852-O

NOTE

CONNECTOR POSITIONS DO NOT CORRESPOND TO WIRE COLOR CODE NUMBERS.

CAUTION

IN POSITIVE GROUND VEHICLES, AN OPTIONAL GROUND CONVERTER IS REQUIRED AND A POSITIVE GROUND CABLE KIT MUST BE USED. A NEGATIVE GROUND CABLE KIT CAN BE CONVERTED FOR POSITIVE GROUND OPERATION AS FOLLOWS.



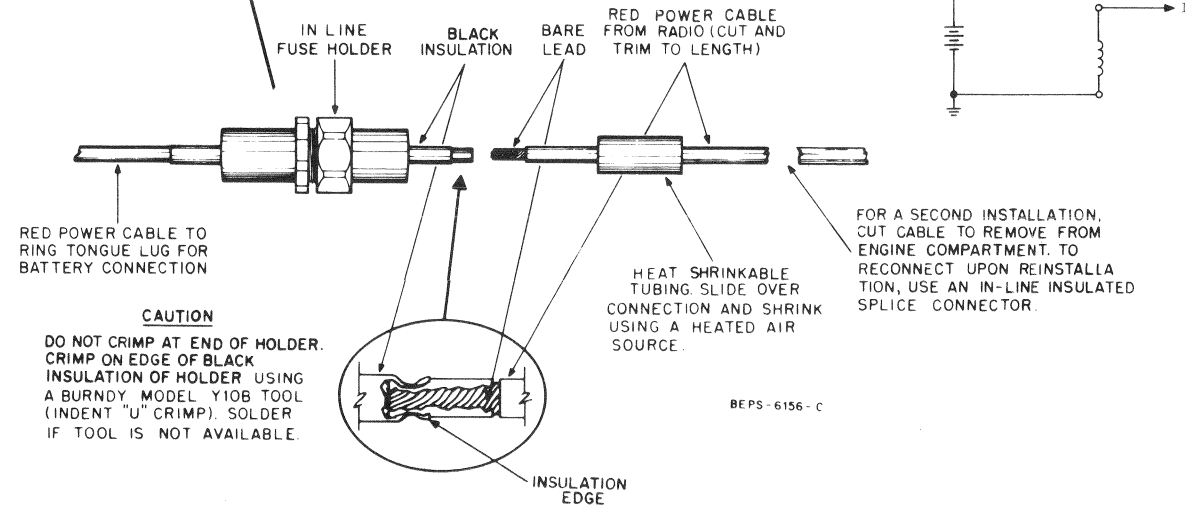


Figure 3.
Cable Installation Detail

only, thus permitting the receiver to operate whenever the radio set is turned on. In this case, the orange wire is connected to the accessory terminal of the ignition switch and the green wire will be connected-directly to the ungrounded terminal of the battery or starter solenoid.

CAUTION

Do NOT connect either lead to the ungrounded terminal of the battery at this time.

If either wire is to be connected in the engine compartment, pass the lugless end of the wire through the same firewall hole that the red power cable uses, trim to length and crimp on the ring lug. If directed to a point within the passenger compartment, route cable to the point, leaving some extra length, trim; strip and crimp on either the spade or the ring tongue lug whichever is required. As an extra precaution the wire and lug may be soldered after crimping.

Do not dress the wires at this time, but proceed with step 2.

STEP 2

RADIO INSTALLATION (Refer to Figures 5 and 6.)

WARNING

See special instructions concerning installation in vehicles with electronic anti-skid braking systems.

Choose a location where the mounting screws are not directly above the gas tank, gasline, or other vital parts. The bottom cover of the radio set is usually mounted permanently to a flat surface using four mounting holes or to an uneven surface using the alternate three point mounting. The raised shelf in some car trunk compartments makes a good mounting place. Place the radio at one side to allow space for luggage. Leave at least six inches in front of the radio set, so that the handle can be opened and the radio assembly can be removed from the bottom plate. The radio must be located so that the black ground lead in the trunk can reach a good chassis ground point in the trunk. When the final position is determined, unlock the radio, open the handle and lift the radio assembly away from the bottom plate (pull forward and upward to release the radio assembly). The bottom plate can be used as a template to mark the location for drilling the four mounting holes in the trunk floor. Use a #11 drill. Mount the bottom plate as illustrated in Figures 5 and 6.

When the radio set is securely mounted to the trunk floor in some vehicles, the front panel will be pressing against the floor or floor cushioning. Also, in some vehicles where it is necessary to mount the radio set directly over the gas tank, the mounting screws may penetrate the tank (always make a preliminary check to see how far the

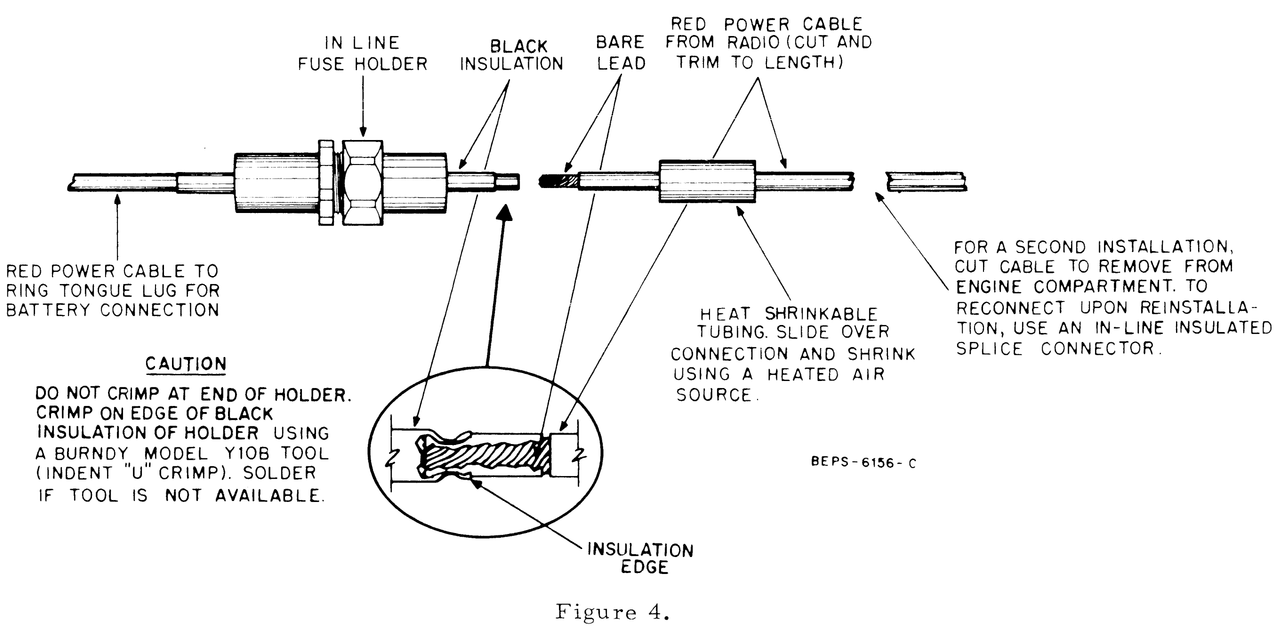


Figure 4.
Power Lead Connection

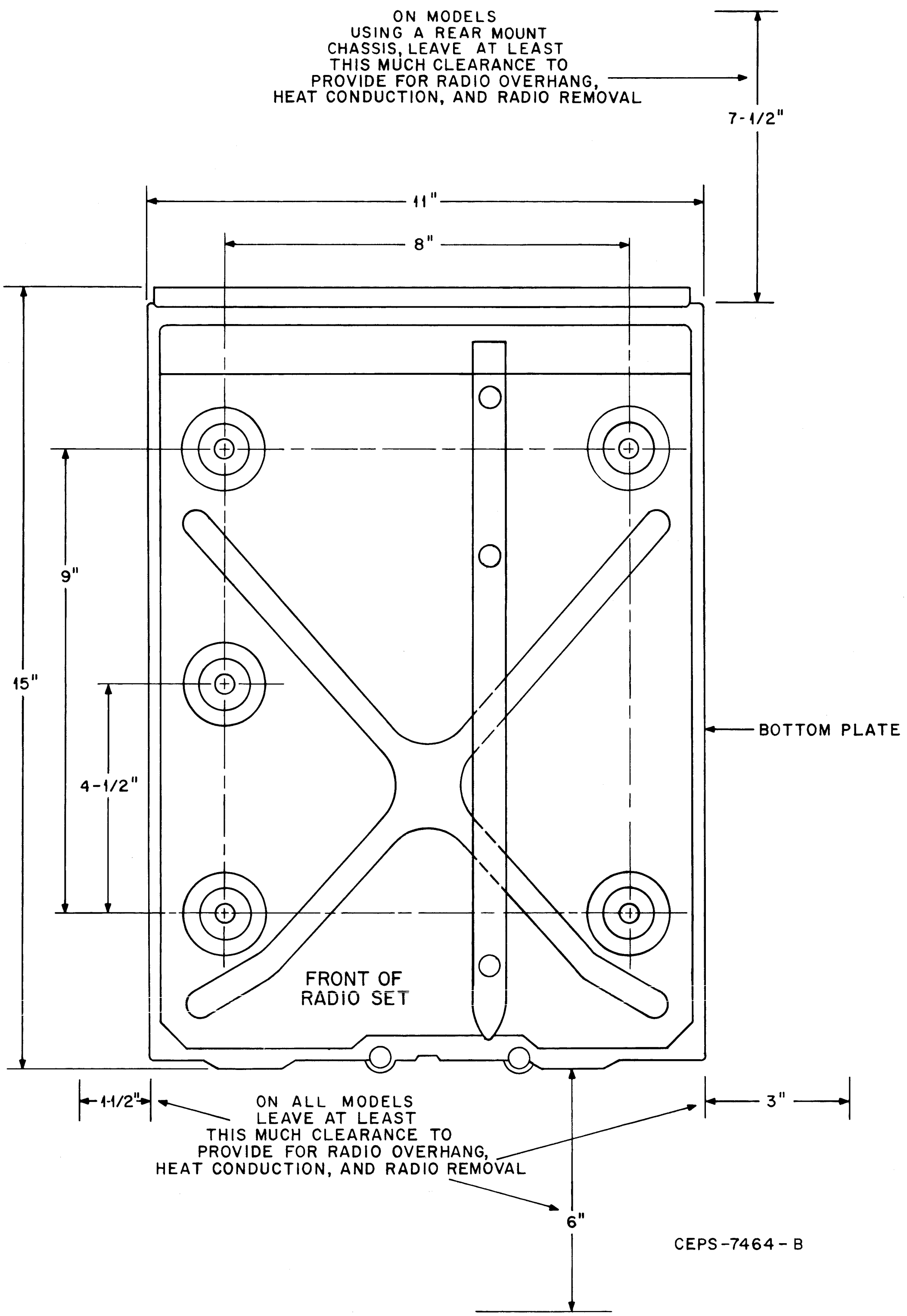


Figure 5.
"Micor" Bottom Plate (Top View)

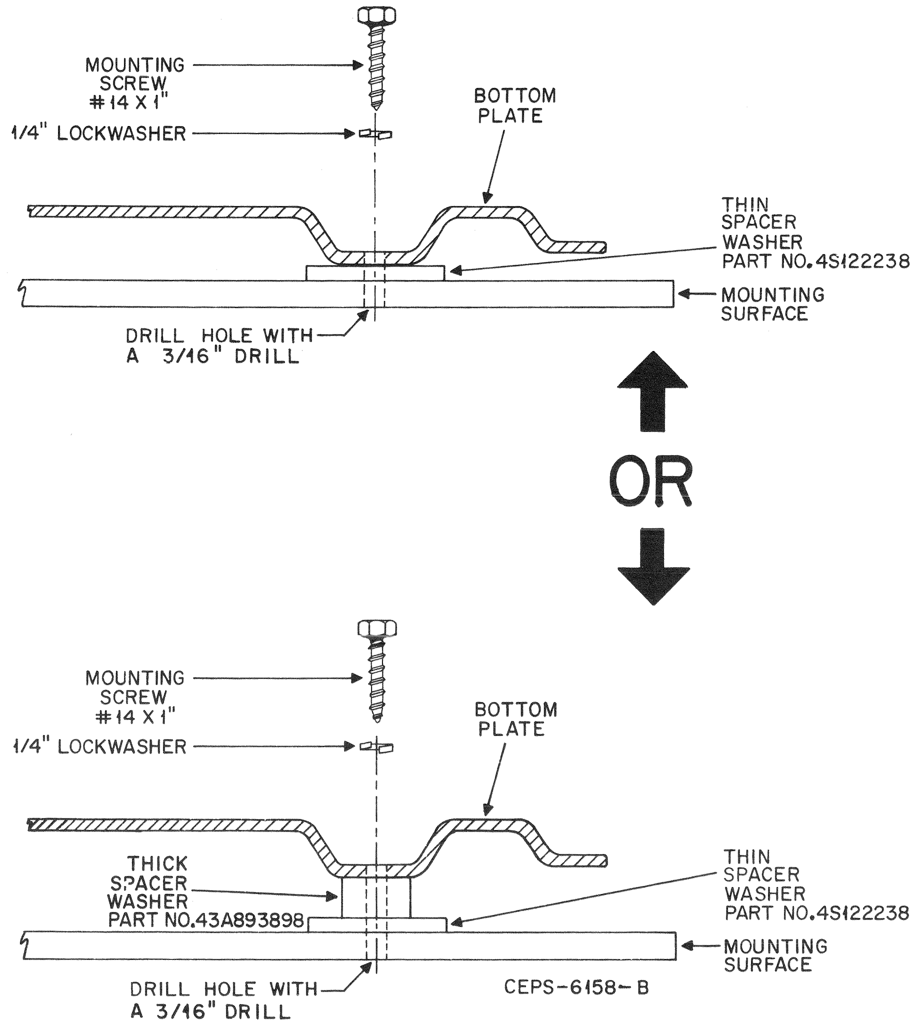


Figure 6.
Bottom Plate Installation Detail

screws will extend below the trunk floor. If either condition exists, insert one of the thick spacer washers between the bottom of the bottom plate and the thin spacer washer, at each of the four mounting holes. The washers help to keep the radio set level, especially when the floor is covered with a "spongy" mat such as soft rubber. Replace the radio assembly by sliding the radio assembly onto the flange at the rear of the bottom plate using the raised track to align the assembly. With the handle open, seat the back end of the upper cover and lower the front to the radio set. Seat the multi-conductor cable plug onto the pins in the front of the radio. (Refer to Figure 7.) Push down on the top cover and close the handle. The handle locks the radio to the bottom plate, the top cover to the radio and the multi-conductor plug to the radio. Lock the radio set by rotating the key 180° counterclockwise. When removing the radio, reverse the procedure.

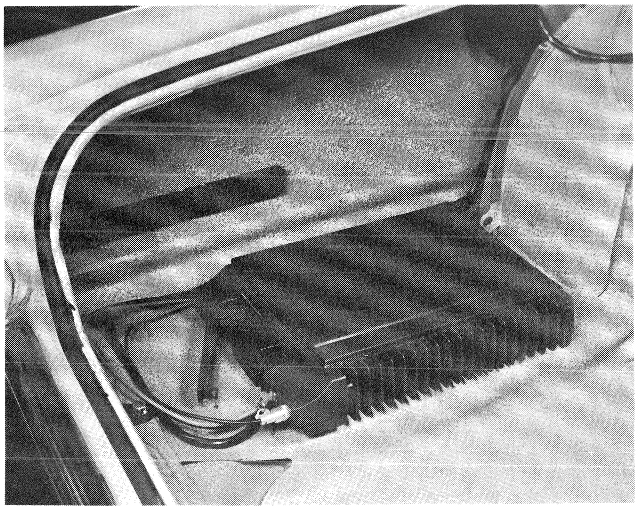


Figure 7.
Radio Removal and
Replacement Procedure

Connect the black ground cable lug to a convenient location on the trunk floor. Thoroughly clean the trunk floor surface before proceeding. Center punch and drill a 3/16" (.187") hole through the mounting surface. Use the supplied #14 x3/4" self-tapping screw and 1/4" lockwasher to mount the cable lug.

CAUTION

A good ground connection of the black cable is essential for radio operation and to prevent damage to the radio and cable kit. Grounding to the vehicle frame is desirable. On some late-model automobiles the ground connection between the vehicle chassis and engine block is inadequate for good mobile radio operation. DO NOT compensate for this problem by connecting the radio set ground directly to the battery. Connect a flexible metal ground strap between the engine block and a vehicle chassis point common to the radio set ground. Be sure the strap is heavy enough to carry maximum transmitter supply current.

The finished installation of the radio should look like the unit shown in Figure 8. All cables (including the antenna lead-in) should be dressed out of the way as much as possible to prevent damage and the radio heat sink should be placed to have the largest available supply of air possible for cooling.

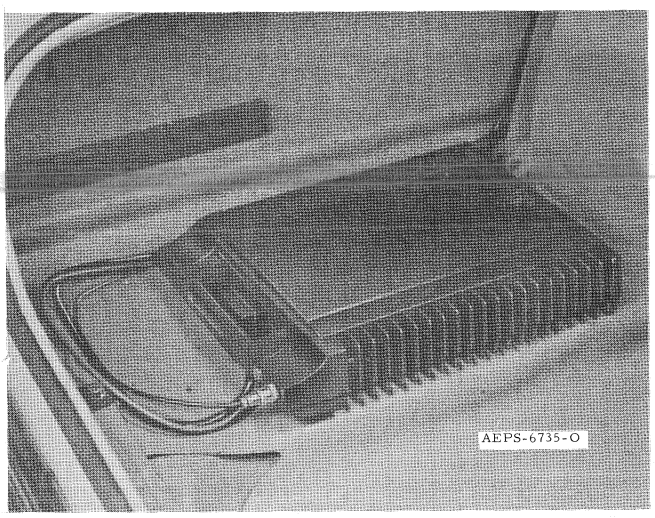


Figure 8.
Typical "Micor" Radio Set Installation

STEP 3

CONTROL HEAD INSTALLATION

a. General

The control head must be installed within the reach of the operator. Pull more control cable into the area, if necessary. At this time, insert the female contacts from the green and orange fused wires into the proper position in the black connector housing. (Refer to Figure 3 for location of these two wires in the connector housing.) Be sure that all wires are clear of the instrument panel where holes are to be drilled.

b. Installation Procedure (Refer to Figure 9)

(1) Determine the location for mounting the control head.

(2) Remove the trunnion bracket and retainer assembly from the control head by removing the two trunnion side screws.

CAUTION

Care must be taken in removing the trunnion bracket from the control head. After removing the side screws from the trunnion bracket, spread the bracket slightly to prevent damage to the circular friction action between the cup on the control head and the clutch facing on the bracket.

(3) Disassemble the retainer and breakaway disc assembly from the trunnion bracket by using a 5/16" nut driver to remove the #10-32 x 1/2" lockscrew.

(4) Remove the tapping screws and lockwashers from the control head retainer. (Discard the paper retainers.)

(5) Remove the backing from the self-adhesive mounting template and fasten the template at the location where the control head is to be mounted.

NOTE

This template locates the mounting holes for drilling and should be left in place to show the re-assembly of the trunnion bracket if the installation is changed at a later date.

(6) Center punch and drill two 0.157" (#22 drill) holes at the position located on the template.

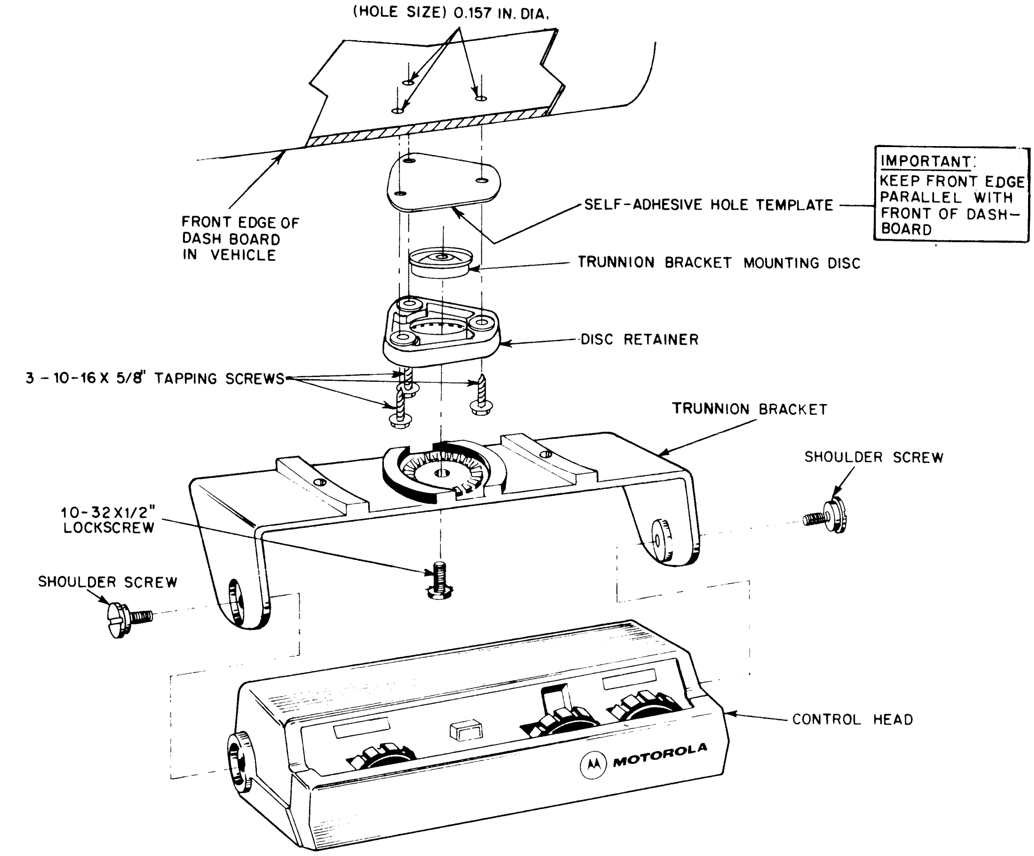
(7) Mount the control head retainer and breakaway disc assembly with the supplied hardware (two #10 x 5/8" tapping screws and #10 lockwashers) using a 5/16" nut driver.

(8) Mount the trunnion bracket to the control head retainer assembly using the #10-32 x 1/2" lockscrew removed in step (3).

NOTE

Before tightening the lockscrew, rotate the trunnion bracket to the desired horizontal position; then tighten the lockscrew.

(9) Insert the connector housings into the proper locations on the back of the control head



OR

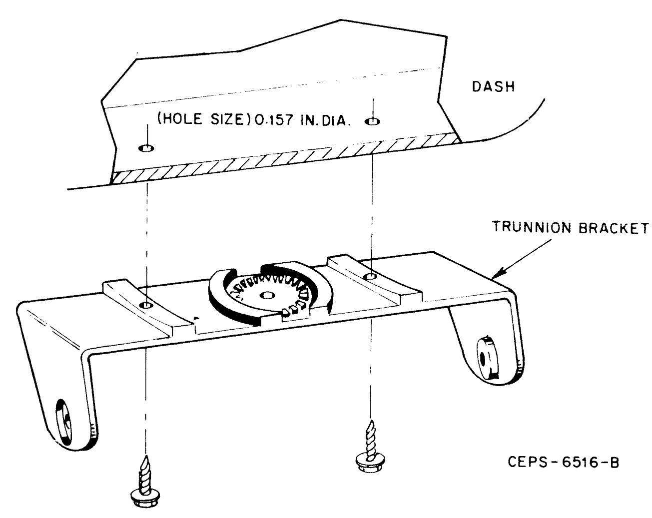


Figure 9.
Control Head Installation

(refer to Figure 3). Now connect the control cable "S" hook to the proper hole in the cable strain relief bracket on the rear of the control head.

(10) Reassemble the control head to the trunnion bracket using caution as advised in step (2).

NOTE

Before tightening the two trunnion side screws, rotate the control head into the desired vertical position.

Pilot bulbs can be replaced from the rear of the control head. Merely rotate the socket counterclockwise 45° and withdraw from the circuit board. Use the fingers to remove the wedge-type bulb by pulling straight out of the socket.

STEP 4

MICROPHONE INSTALLATION

a. General

The microphone bracket must be within a comfortable arm's reach of the operator. Measure this distance before actually mounting the microphone bracket or the "Private-Line" hang-up switch box. Since both the bracket and hang-up switch box have a positive detent action, the microphone can be mounted in almost any position. Mounting the bracket or hang-up box to the bottom of the control head will provide a breakaway feature for the microphone also. After installation, connect the microphone plug to the receptacle on the control head as shown in Figure 3. Make sure that the clip on the control head firmly engages the plug. Connect the microphone cable "S" hook to the proper hole in the strain relief clip on the rear of the control head.

b. Installation Procedure (Refer to Figure 10)

(1) Remove the hang-up clip from its taped position on the microphone.

(2) Remove the two paper retainers and screws from the clip.

(3) Determine the location for installation.

(4) Using the clip as a template, mark the location of the two mounting holes.

(5) Center punch and drill a 0.144" diameter hole at each location.

(6) Mount the clip securely using the supplied screws.

STEP 5

MICROPHONE HANG-UP SWITCH BOX INSTALLATION

a. General ("Digital Private-Line" and "Private-Line" Models Only.)

The hang-up box provides a PL disable switch as well as an automatic PL disable function when the microphone is removed. The hang-up box has a positive detent action that permits it to retain the microphone regardless of the mounting position. The positive detent action and the fact that the hang-up box requires no external grounding of the housing permits the hang-up box to be mounted anywhere, in any attitude, that is convenient and permits the two-circuit connector cable to reach the control head.

b. Installation Procedure (Refer to Figure 10)

(1) Remove the paper retainers and screws from the mounting flanges on the hang-up box.

(2) Determine the mounting location and using the hang-up box as a template, mark the location for both screw holes.

(3) Center punch and drill a 0.144" diameter hole at each location.

(4) Securely fasten the hang-up box to the mounting surface with the supplied screws.

(5) Connect the hang-up box to the control head as indicated in Figure 3. Tape or tie up the extra cable.

HANDSET HANG-UP SWITCH BOX INSTALLATION

The handset hang-up unit can be mounted either with a trunnion bracket or flush against a flat surface.

a. Trunnion Mount

To install the hang-up unit with a trunnion bracket proceed as follows:

(1) Remove the three protective caps and screws from the trunnion bracket.

(2) Place a handset in the hang-up unit.

(3) Choose a location which offers both operator convenience and allows the handset to clear the floor or transmission tunnel.

(4) Lightly mark this location.

(5) Remove the handset from the hang-up unit.

(6) Loosen the two screws securing the hang-up unit to the trunnion bracket and remove the trunnion bracket.

(7) Using the trunnion bracket as a template, mark the location of the three mounting holes.

(8) Center punch and drill a 0.175" diameter hole at each location.

(9) Mount the trunnion bracket using the screws supplied.

(10) Reinstall the hang-up unit in the trunnion bracket and tighten the two screws.

(11) Remove the escutcheon backing and press the escutcheon firmly into place.

(12) Connect the hang-up box wires to P1101 (black connector) and P1102 (blue connector) as indicated in Figure 3.

b. Flush Mounting

To install the hang-up unit in a flush mount configuration proceed as follows:

(1) Remove the trunnion bracket, two screws, and two flat washers. Retain this hardware for future use.

(2) Place a handset in the hang-up unit.

(3) Select a location which affords operator convenience and allows the handset to clear the floor or transmission tunnel.

(4) Use the hang-up unit as a template and mark the location of the two holes to be drilled.

(5) Remove the handset from the hang-up unit.

(6) Lay the unit aside. Center punch and drill a 0.128" diameter hole at each location.

(7) Secure the hang-up unit to the surface with two 1-3/4" sheet metal screws provided.

NOTE

Dress the cable through the elongated hole before tightening the sheet metal screws.

(8) Remove the escutcheon backing and press the escutcheon firmly into place.

(9) Connect the hang-up box wires to P1101 (black connector) and P1102 (blue connector) as indicated in Figure 3.

STEP 6

SPEAKER INSTALLATION

a. General

The speaker kit includes a trunnion bracket, hanger bracket, and wall mount bracket, which permits the speaker to be mounted in a variety of ways. Refer to Detail A of the Speaker Installation Detail. The trunnion bracket provides a large variety of permanent mountings (dashboard and accessible firewall areas) for the speaker while permitting it to be tilted or angled for best results. The hanger bracket (already attached to the speaker) alone permits temporary mounting on projections such as automobile windows, etc. In this case, the trunnion bracket must be removed. The wall mount bracket can be used for permanent mountings if the trunnion bracket is too large to fit in some inaccessible areas. In this case, the trunnion bracket is removed and the speaker is attached to the wall mount bracket by the hanger bracket.

b. Trunnion Bracket Installation Procedure
(Refer to Figure 11, Detail A)

(1) Remove the trunnion bracket by loosening the two wing screws.

(2) Remove the three paper retainers and screws from the trunnion bracket.

(3) Remove the wall mount bracket from its taped position on the hanger bracket (retain for future use).

(4) Determine the location for installation. If space limitations require the removal of the hanger bracket, remove the Phillips head screw and slide the bracket out of the speaker housing (the speaker housing does not require disassembly to remove the hanger bracket).

(5) Using the trunnion bracket as a template, mark the location of the three desired mounting holes.

(6) Centerpunch and drill a 0.101" diameter hole at each location.

(7) Mount the trunnion bracket using the supplied screws.

(8) Remount the speaker into the trunnion bracket and tighten the two wing-screws

(9) Tie up surplus speaker lead cable.

c. Wall Mount Bracket Installation Procedure (Refer to Figure 11, Detail B)

(1) Remove the wall mount bracket from its taped position on the hanger bracket.

(2) Remove the trunnion bracket and trunnion wing-screws (retain for future use).

(3) Remove the two paper retainers and screws from the wall mount bracket.

(4) Determine the location for installation.

(5) Using the bracket as a template, mark the location for the screws.

(6) Centerpunch and drill a 0.101" diameter hole at both locations.

(7) Mount the wall mount bracket to the surface with the supplied screws.

(8) Firmly seat the hanger bracket (attached to the speaker) in the wall mount bracket.

(9) Plug the speaker lead into the control head making sure that the plug is solidly seated.

(10) Tie up surplus speaker lead cable.

STEP 7

POWER CONNECTIONS (Refer to Figures 1 and 3)

Replace the fuse in the in-line fuse holder of the red power cable coming from the radio in the trunk. Also connect the green (and/or orange) fused wire(s) coming from the control head to the ungrounded terminal (or source) of the battery.

Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis using the cable clamps supplied. To secure the clamps four tapping screws (#8-3/8") and four lockwashers (#1/4) are used. A 1/8" (0.125") hole is needed for the tapping screws. Make certain that all in-line fuses are installed.

STEP 8

ANTENNA INSTALLATION

A diagram and complete installation instructions are supplied with each antenna ordered. Refer to these installation instructions for all information pertaining to the antenna.

STEP 9

NOISE REDUCTION

Noise reduction kits consist of resistive and bonding cables, capacitors, and mounting hardware. Installation of these items reduces noise generated by the electrical system of the vehicle. A TLN8845A RF Noise Reduction Kit may be obtained as an optional accessory item for mobile two-way radio equipment.

The instruction booklet supplied with this kit outlines in detail, the various types of noise interference and possible noise reduction methods.

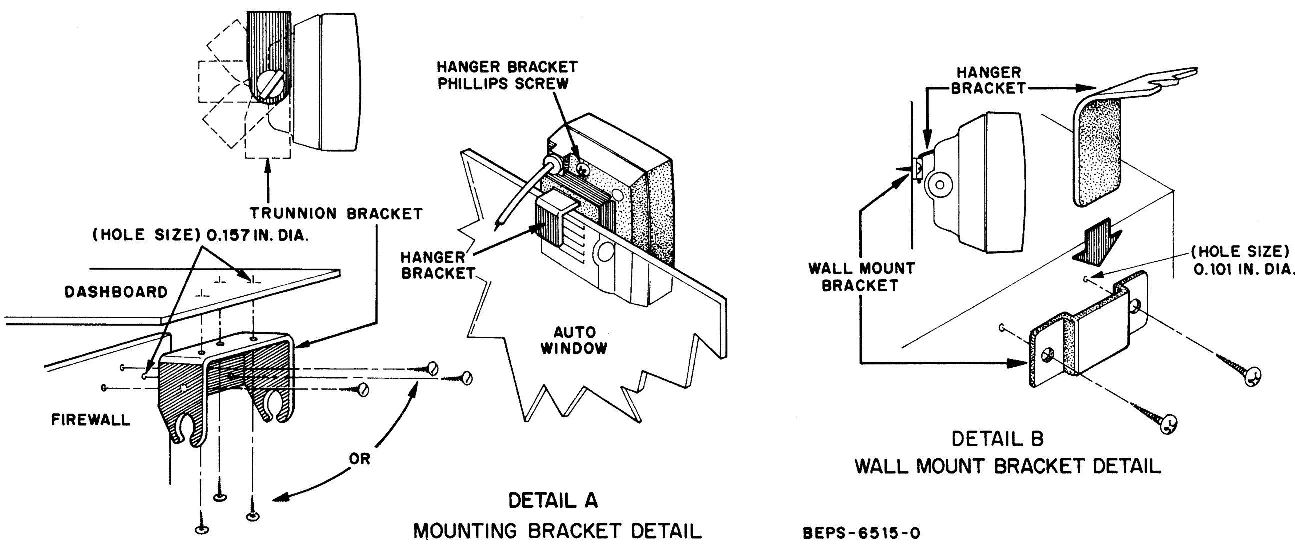


Figure 11.
Speaker Installation Detail

ALTERNATOR WHINE REDUCTION

IN THE UHF "MICOR"® MOBILE RADIO

1. GENERAL

1.1 Alternator whine is the general term for the noise which results from the alternator output being rectified but not filtered before being used to charge the vehicle battery. The ripple frequency enters the radio and appears as an audio-rate frequency in various stages of the radio. Most commonly, it appears as a whine heard in the speaker of the mobile radio. Alternately, it may appear on the carrier transmitted by the mobile radio, or both on the carrier and at the speaker.

1.2 Alternator whine is easily identified, since it will be present only while the engine is running, and will vary with engine speed.

1.3 The only interference with which it could be confused is interference from the ignition system. Ignition noise is more of a buzzing sound, and also varies with engine speed. Ignition noise is beyond the scope of this section. Information on rf noise reduction is provided in the instruction sections packed with the two rf noise-reduction kits (TLN8845A for Alternator-equipped vehicles and TLN6252A for generator-equipped vehicles).

2. ALTERNATOR WHINE ENTRY PATHS

2.1 FROM DC POWER SUPPLY

2.1.1 <u>Red and Black Leads</u>

2.1.1.1 In all "Micor" mobile radios, a 660 microfarad electrolytic capacitor is connected between the red A+ lead and the black A- lead. This capacitor provides voltage-transient protection, and a low-impedance across the dc supply.

2.1.1.2 Since the capacitor is always across the supply leads, and has a low impedance to alternator whine frequencies, any alternator whine voltage appearing across the battery creates a current flow down the red lead into the radio, through the radio chassis, and out any ground returns to the vehicle chassis. If any portion of a ground-return path is common with the ground return of sensitive circuits within the radio, alternator whine may be imposed on either the transmitter carrier or the receiver audio. These ground returns can be numerous. For example;

2.1.1.3 Through the radio mounting.

2.1.1.4 Through the black A- lead which normally connects directly to the vehcile chassis.

2.1.1.5 Through the antenna coax to the vehicle chassis at the antenna mounting base.

2.1.1.6 Through the PL hangup box, if an older model hangup box (one of those without chassis isolation) is used in place of the isolated hangup box shipped with UHF "Micor" radios.

2.1.2 <u>Green and Orange Leads</u>

2.1.2.1 The green and orange leads can also have alternator whine voltage impressed on them. However, under normal circumstances, alternator whine on these leads does not create a problem in "Micor" radios.

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2.1.2.2 The orange lead operates only the whine-insensitive push-to-talk circuits, and the green lead is adequately-filtered in the radio except when connected to a point in the vehicle which has an unusually-high whine level.

2.2 FROM CHANNEL-ELEMENT SWITCHING CIRCUITRY

The channel element(s) in the UHF "Micor" radio is (are) sensitive to spurious signals on its (their) dc switching lead(s). A change has been made in the "Micor" control head to minimize alternator whine pickup on this lead. Because of this change, the control head as originally shipped with the low-band and VHF "Micor" radios cannot be used with the UHF "Micor" radios unless modified. In these control heads, the ground return of the frequency selector switch is wired to pin 5 of the black connector. This pin is the ground return for the pilot lamp, and was grounded (within the radio) to a section of the radio chassis which is hot in respect to alternator whine current. In all "Micor" control heads manufactured after September, 1972 the frequency selector switch ground has been moved to pin 21 of the black plug. This pin is used as a ground connector for the volume control and for the microphone shield. It returns to the cold side of the radio chassis (in respect to alternator whine current).

3. ELIMINATING ALTERNATOR WHINE

3.1 DEFINING THE ENTRY PATH(S)

3.1.1 The easiest transmitted whine path to isolate is that involving the red lead of the cable kit.

3.1.2 Remove the fuse from the red lead. Operate the mobile close to the base station (or a monitor receiver), the exciter radiation is sufficient to quiet the receiver and determine whether the whine is still present. If the whine disappears or decreases, then the whine is entering the radio on the red lead. If not, then it is in the exciter.

3.1.3 If Alternator Whine is still present with the fuse removed from the red lead, and is noticed only during a received signal, the entry path is through either the green lead, the channel element switching leads, or a combination of both.

3.2 TYPES OF ALTERNATOR WHINE

3.2.1 Receiver Types

3.2.1.1 Present only when receiving a carrier, and varies with the volume control setting.

3.2.1.2 Present only when receiving a carrier, and does not vary with the setting of the volume control.

3.2.1.3 Always present at the speaker, and does not vary with the volume control setting.

3.2.2 Transmitter Types

3.2.2.1 Present on the exciter output with the power amplifier disabled (by removing the fuse in the red lead).

3.2.2.2 Present only when the power amplifier is operating.

3.2.2.3 Present at the speaker only during transmit.

3.3 WHINE ELIMINATION

3.3.1 During Reception

3.3.1.1 General

3.3.1.1.1 The radio green lead is normally connected to the ignition switch so that the receiver will be turned off by the ignition switch. The whine voltage present at the ignition switch is significantly greater than at the battery. Should a whine problem be present, moving the green-lead connection directly to the battery terminal may remove it. If this solves the whine problem, and it is necessary that the ignition switch control the receiver power, a relay must be used. The green lead is run to the battery through the relay contacts, with the relay energized by the ignition switch.

3.3.1.1.2 If significant alternator whine voltage is present across the battery, it may indicate a battery with high internal resistance. Such a battery can be the cause of other troubles as well, and should be replaced.

3.3.1.1.3 In some vehicles with high current requirements (a fire truck, for example), multiple-battery installations with involved interconnections and battery switching may be used. Since problems in such installations may become more involved, a complete electrical diagram of the vehicle may be necessary. The point of lowest whine voltage should be directly across the battery.

3.3.1.2 Whine that is present only while the receiver is unsquelched, and which varies with the setting of the volume control generally is entering the radio on the channel element switching leads. Multiple ground paths associated with the control head are the most common sources of this whine problem.

3.3.1.3 Whine that is present only while the receiver is unsquelched, but which does not vary with the setting of the volume control indicates the whine voltage is reaching the audio board. This can be caused by faulty grounding of the audio board to the radio.

3.3.1.4 Whine which is present regardless of whether the receiver is squelched or unsquelched, and is not affected by the setting of the volume control is generally caused by whine voltage reaching the Class B audio output stage, or by unbalance in the output stage due to a defective transistor.

3.3.2 <u>During Transmission</u>

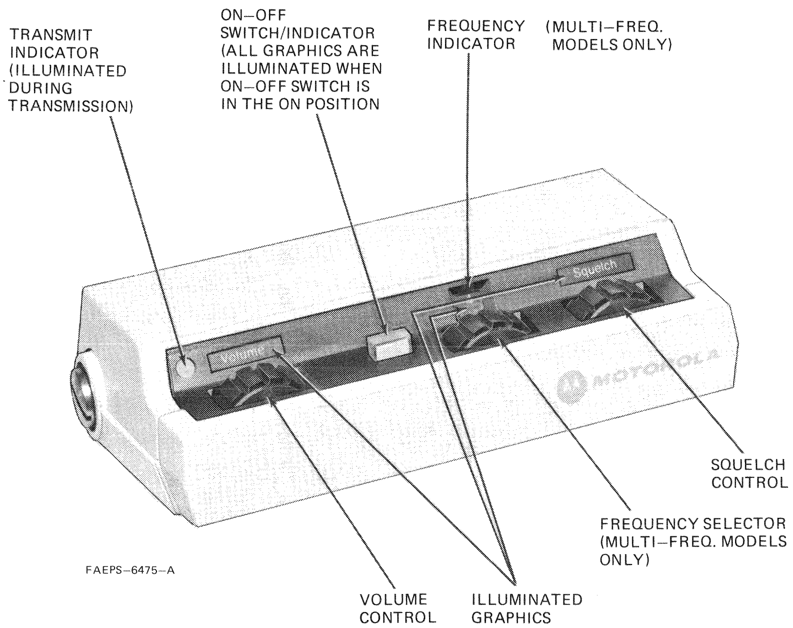
3.3.2.1 Whine present on the transmitted carrier while the power amplifier is disabled generally indicates that the whine voltage is present on the channel element switching leads. Multiple ground paths associated with the control head are the most common sources of this whine problem.

3.3.2.2 Whine which is present on the transmitted carrier only when the power amplifier is operating indicates that significant whine voltage is getting into the power amplifier transistor stages to cause spurious carrier phase modulation by amplitude modulation of the supply voltage. This can be eliminated or minimized by using a power line filter kit in series with the red lead to the battery. Two kits are available; the TLN5277A/B Model is used for negative-ground installations, and the TLN5278A/B Model is used for positive-ground installations. Instructions for their installation are packed with each kit.

3.3.3 <u>Alternator Whine in "Micor" "System • 90" Accessories</u>

Usually, whine in the "Micor System • 90" accessories enter on the green lead. A choke in series with the green lead with a capacitor from the green lead to ground should reduce the whine to an acceptable level. Be sure the ratings of the choke and capacitor are sufficient to handle the current.

OPERATORS INSTRUCTIONS



1. TO TURN "ON" THE EQUIPMENT

Apply power to the radio set by pressing upward on the ON-OFF power switch actuator projecting from the bottom of the control head. The green frontal area of the actuator will appear and the graphics will be illuminated (only during dim ambient light conditions), indicating that power has been applied to the radio. On multi-frequency models place the frequency selector switch in the desired position.

2. TO RECEIVE

Perform the following operations on existing controls:

NOTE

Omit steps a. and e. for radio sets without "Private-Line" operation. When using a handset, audio is heard in the speaker only when the handset is in the hang-up box.

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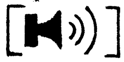
a. To hear all on-frequency signals, set the switch (on the side of the hang-up switch box) in the PL disable position. 

b. Turn the SQUELCH control to the full counterclockwise position.

c. Turn the VOLUME control clockwise until noise is heard.

d. With no signal being received, adjust the SQUELCH control by turning the control slowly clockwise until the noise is just squelched (cuts out).

e. To hear "Private-Line" signals only, set the "Private-Line" switch on the hang-up switch box in the operate position and place the microphone in the hang-up box.

f. Set the VOLUME control to the desired listening level with a received signal.

3. TO TRANSMIT

a. "Digital Private-Line" and "Private-Line" Radio Sets

Turn "on" the radio set. Turn "on" the vehicle ignition switch (if required). To conserve the battery, the engine should be running while transmitting.

Lift the microphone out of the hang-up switch box. Listen for other stations which may be transmitting. If signals are heard, wait until the communication channel is clear before proceeding. Hold the microphone about one inch from the lips and turned about 30° away from the face. Press the push-to-talk button. The red transmit indicator will illuminate and the radio will transmit a carrier. Speak slowly and clearly across the microphone in a normal or slightly louder-than-normal voice. At the end of the message, release the push-to-talk button and replace the microphone. This returns the radio receiver to DPL binary-coded squelch or to PL tone-coded squelch operation.

b. Carrier Squelch Radio Sets

Turn "on" the radio set. Turn "on" the vehicle ignition (if required). To conserve the battery the engine should be running while transmitting.

Remove the microphone from the hang-up bracket. Hold the microphone about one inch from the lips and turned about 30° away from the face. Press the push-to-talk button. The red transmit indicator will illuminate and the radio will transmit a carrier. Speak slowly and clearly across the microphone in a normal or slightly louder-than-normal voice. At the end of the message, release the push-to-talk button and replace the microphone.

4. TO TURN "OFF" THE EQUIPMENT

Depress the ON-OFF switch actuator until the green frontal area of the actuator disappears and the light illuminating the graphics goes out.

THEORY OF OPERATION

1. INTRODUCTION

The radio set can be broken down into the following sections.

- --Injection
- --Transmitter
- --Receiver
- --Antenna Network
- --DC Switching, Regulation, and Filtering
- --Frequency Selection
- --Accessories

The following explanation refers to the block and schematic diagrams in the DIAGRAMS section of this instruction manual.

2. INJECTION

Refer to the receiver schematic diagram in the DIAGRAMS section of this instruction manual. The radio set obtains its transmitter and receiver oscillator frequency from a common injection train. Thus, the need for two oscillator circuits (channel elements) is eliminated. This injection train consists of a crystal controlled oscillator (channel element) and three doubler circuits. The injection train is located on the receiver rf and i-f circuit board.

a. Oscillator (Channel Elements)

Channel elements are highly stable crystal-controlled oscillators. They use unheated crystals in an oscillator circuit that is temperature compensated over the entire temperature range of -30° to +60°C (-22° to +140°F). A variable warp capacitor for fine frequency adjustment in the base of each channel element is accessible through holes in the rf and i-f circuit board. Each channel element is a factory sealed, plug-in module.

The rf and i-f circuit board accepts up to twelve channel elements. In single-channel radio sets, only one channel element is required and the dc ground path is continuously applied. In multi-channel radio sets, one channel element is required for each channel. The external control head channel selector switch completes the dc ground path to the desired oscillator. Only one channel may be selected at a time; that is, one transmit frequency and one receive frequency. Operation is possible on as many as twelve separate channels. Operation of the selected channel element may easily be checked with a Motorola portable test set on selector switch position 1.

b. Multipliers

The third harmonic of the crystal controlled channel element is selected by the input tuned circuits of the first doubler. The signal is then multiplied eight times by three doubler stages before being applied to the injection filter on the rf deck casting. The output frequency is below (low side injection) the rf carrier frequency. The injection filter has two outputs. One output connects directly to the receiver mixer. The other output connects via an rf connector and coaxial cable to the transmitter mixer.

3. TRANSMITTER

Two kinds of transmitter are available for the mobile UHF "Micor" radio sets. These are referred to as "standard" or "wide-spaced", depending on whether the transmit frequency is the same as the receive frequency (T=R) or not (T≠R). The terms are defined differently in different frequency bands, as shown in the following table:

FREQUENCY RANGE	T/R FREQUENCY RELATIONSHIP	TRANSMITTER TYPE
406-420 MHz	T=R	Standard
	T≠R	Wide-Spaced
450-512 MHz	T=R	Wide-Spaced
	T≠R	Standard

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The different definitions of the terms "standard" and "wide-spaced" result from the fact that the two frequency ranges indicated are administered by two different government agencies (406-420 MHz, Office of Telecommunications Policy; 450-512 MHz, Federal Communications Commission).

The Transmitter used in 406-420 MHz "Micor" FM radio sets may be either a standard channel or a wide-spaced channel model. Wide-spaced channel model exciters make the radio set adaptable to communications systems in which the transmit and receive frequencies differ by a given offset, as in some repeater systems. Radio sets equipped with wide-spaced exciters can also communicate directly with other mobiles without going through a repeater. This is done by switching the radio set into the "standard" mode, in which the transmit and receive frequencies are the same.

a. "Private-Line" Encoder

(1) Tone Oscillator

The tone oscillator operates continuously when power is applied to the radio set. The outputs of the differential amplifier, formed by Q701 and Q702, are identical but 180° out of phase. The amplitudes of these collector signals are independent of frequency. A positive feedback signal is coupled through C701 and R708 to sustain oscillation. When the radio is turned on, C710 begins to charge through R728 which biases Q710 on through R727. To quickly bring the tone output up to full output, Q710 acts as a shunt around R708, which increases the positive feedback. After approximately 1.5 seconds (voltage across C710 reaches 9.0 volts) Q710 turns off and has no further effect on circuit operation. The output of Q701 is applied to feedback amplifier Q708 through C704 and R712. When the signal level exceeds a fixed amount, Q708 is biased into operation. It provides a negative feedback signal which keeps the oscillator out of limiting, thus providing a sinusoidal wave output. The "Vibrasender" resonant reed is the frequency determining device of the oscillator. It acts as a very high Q, narrow bandpass transformer, coupling only its resonant frequency and blocking all others. At its resonant frequency, the reed vibrates to couple energy from the primary to the secondary winding.

The "Vibrasender" resonant reed is a precision built device which maintains its frequency within ±0.15% of that specified. It consists of a tuned cantilever reed of special steel mounted on a rugged base with a coil and two permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. The design of the reed eliminates the need for servicing throughout its useful life. The reed is a plug-in device which may be easily removed and replaced for circuit testing or to change frequencies. Reeds are available in specific frequencies in the 67-210 Hz range. No circuit adjustments are required when changing reeds.

NOTE

"Private-Line" tone frequencies are assigned by Motorola Systems Engineering to prevent duplication or interference between tones in the same area. Consult them before changing frequencies.

(2) Reverse Burst Timing Circuit

In the unkeyed transmitter condition, delay generator, Q706, is forward biased through CR703 and R719 to A- placing A+ across R721. This voltage is coupled to the base of the delayed turn-off switch (Q707) by R722, and Q707 is biased "off".

When the P-T-T button is closed, keyed filtered A+ is applied to R716 and turns on the keying switch, Q705. With Q705 acting as a short circuit:

--Q707 is biased "on" through R723, CR702 and Q705 to A-.

--Keyed, filtered A+ is applied through Q707 to turn on the transmitter.

--C708 charges from the filtered A+ line through Q706 base-emitter junction, CR703 and R718.

--The PL switch gate, Q709, is turned on by bias current through R726 and Q705. This action turns off PL tone gate, Q703.

Note that Q706 has not changed states and is still turned on by bias current through R719.

When the P-T-T button is released, the keyed, filtered A+ bias is removed from Q705 and it turns off. The transmitter continues to receive A+ from Q707 during the following sequence of events; with Q705 turned off:

--The PL switch gate, Q709, is turned off, activating the PL tone gate, Q703, which passes the reverse burst tone signal.

--C708 discharges through R718, R719, R721, R722 and R723, back biasing CR703 and turning off Q706.

--With Q706 off, Q707 remains on by receiving base bias through R722 and R721.

--After approximately 150 milliseconds, the voltage across C708 decreases to the point where Q706 turns on again and applies A+ across R721.

--The A+ across R721 turns off Q707 which removes the delayed keyed filtered A+ from the transmitter.

(3) Tone Output Circuit

When the transmitter is keyed, PL gate switch Q709 is turned on. Q709, in turn, gates 9.6 volts to PL tone gate Q703, turning it off. When Q703 is turned off, only the output of Q701 is coupled to emitter follower Q704. When the transmitter is unkeyed, Q709 is turned off and Q703 is turned on which completes the tone path from Q702 to C703. The two tone signals 180° out of phase, combine through the phase shift capacitors to produce a signal to the emitter follower that is 240° out of phase with the original tone. Emitter follower Q704 provides impedance matching in a low impedance output and isolates the tone oscillator from the external circuit to which the tone output is applied.

b. "Digital Private-Line" Encoder

The theory of operation for the "Digital Private-Line" (DPL) encoder is part of the DPL encoder schematic diagram. During transmitter operation the DPL encoder and decoder boards work together to modulate the transmitter continuously with a distinctive 23-bit binary code word.

c. Exciter, 450-512 MHz

(1) Functional Description

Refer to the block diagram in the DIAGRAMS section of this instruction manual. Voice audio from the microphone is applied to the IDC circuit which clips all voice peaks over a certain level to a constant amplitude. The IDC adjustment sets the desired amount of deviation produced by the voice audio. This signal is then amplified and applied to the offset oscillator to accomplish direct frequency modulation. In "Private-Line" (PL) radios, the "PL" tone is also applied to the offset oscillator and provides a constant amount of "PL" tone modulation. The frequency-modulated offset oscillator signal is applied to a dual gate MOS FET mixer, along with the receiver derived high frequency injection frequency to generate the transmitter signal. The mixer output is amplified and the transmitter signal selected from the mixer spectrum by the exciter output filter. Two oscillator mixer-amplifier channels are required in the exciter for wide-spaced transmitters. A dc switching circuit automatically selects the correct exciter channel when a frequency is selected by the operator at the control head.

(2) Transmitter Frequency Stability

The standard transmit frequencies are developed by the use of a 16.7 MHz offset oscillator in the 450-470 MHz band and by the use of a 14.7 MHz offset oscillator in the 470-512 MHz band. On models in the 450-470 MHz band with option W184, a standard 11.7 MHz offset oscillator is used. The wide spaced models use an 11.7 MHz offset oscillator for the full 450-512 MHz band. The overall transmitter carrier frequency is defined by the following formula:

$$f_t = 24 f_c + f_o$$

where

f_t = transmitter frequency

f_c = channel element frequency

f_o = offset oscillator frequency

The offset oscillator frequency (f_o) is either 11.7 MHz, 14.7 MHz, or 16.7 MHz, while the multiplied channel element frequency (24 f_c) is equal to the receiver frequency minus 11.7 MHz. For the 450-512 MHz range, 24 f_c will vary from 438.3 MHz (receiver frequency of 450 MHz) to 497.3 MHz (receiver frequency of 509 MHz). Since 24 f_c is much greater than f_o, the transmitter frequency is much more sensitive to the channel element frequency error than to the offset oscillator frequency error. This fact permits the use of a relatively low stability offset oscillator (approximately 10 to 15 PPM) to be combined with the stable injection frequency to generate the highly stable transmit frequency. The contribution of the offset oscillator to the transmitter carrier frequency error is never more than 0.5 PPM.

(3) IDC circuit

The Motorola IDC circuit processes the microphone audio to prevent over-deviation while giving the modulator the proper audio drive for full deviation over a wide range of audio amplitudes. It does so over the entire 300-3000 Hz voice communications audio range with a very low amount of distortion.

The transistorized microphone requires a dc supply voltage for operation. This voltage is provided by the exciter through a voltage divider network from the keyed +9.6-volt input. The dc voltage to the microphone and the audio signal from the microphone are carried on the same conductor.

The microphone audio is coupled through a pre-emphasis network which couples 300 to 3000 Hz audio signals and provides a 6 dB per octave pre-emphasis characteristic; that is, as frequency doubles the amplitude increases 6 dB. The pre-emphasis network shapes the typical speech signals for more equal amplitude of lows and highs before their application to the clipper amplifier.

In the clipper amplifier portion of the integrated circuit IC301, the voice signal is amplified and all voice peaks which exceed a fixed limiting level are clipped. In normal operation, some voice peaks have sufficient amplitude to be clipped. Clipping of the voice peaks will produce undesired harmonics which are greatly attenuated by the splatter filter portion of IC301. The output of IC301 is further filtered and amplified with discrete component circuitry. The IDC potentiometer adjusts the maximum level of audio coupled to the modulator thus setting the amount of deviation. Additional audio voltage is supplied to the varactor modulator by coupling the signal from the audio amplifier emitters to the varactor anode. This signal is not influenced by the IDC potentiometer and results in a residual deviation of about 1.5 kHz when the IDC is set for minimum deviation (counter-clockwise from the foil side of board).

In "Private-Line" radios, a low amplitude "PL" tone is continuously injected into the "IDC" amplifier from the "PL" encoder. This tone, which is a specific frequency in the 67 to 210 Hz range, will produce between 0.5 to 1.0 kHz deviation.

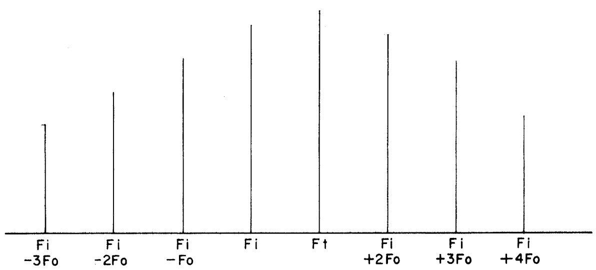
In "Digital Private-Line" radios a low-amplitude binary-coded signal is continuously applied to the "IDC" amplifier by the DPL encoder and decoder. The distinctive 23-bit binary code is determined by a code plug on the DPL decoder board.

(4) Offset Oscillator, Modulator, and Amplifier

The audio output of the IDC circuit is applied to the modulator directly frequency modulating the offset oscillator. Modulation is accomplished by using the IDC audio output swing to vary the potential across a reverse-biased varactor diode in the oscillator feedback circuit. The capacitance of the varactor varies at an audio rate causing the oscillator frequency to vary at the same audio rate. The amount of frequency deviation is limited by the amount of audio swing applied to the varactor. The larger the swing, the larger the deviation. Without modulation, the frequency of the oscillator is set by the adjustment of a slug-tuned inductor in series with the varactor. The oscillator output is coupled to an N-channel junction FET in the source follower configuration. The high input impedance of the FET minimizes loading on the oscillator. A bipolar transistor follows the FET and feeds the mixer through a low-pass filter to reduce oscillator harmonics. The output of the bipolar transistor is sampled and detected for use at meter position 4.

(5) Offset Mixer Amplifier, and Output Filter

A dual gate MOS FET is used for the mixer because of its high gain, stability at UHF frequencies, and absence of higher order non-linearities in its transfer characteristics. These characteristics significantly reduce the generation of spurious outputs. Gate 2 of the FET is at 3.8 volts dc and rf ground while the output of the oscillator amplifier low-pass filter and injection frequency are applied at gate 1. The output circuit of the FET is a narrow band tuned circuit which is coupled to a wide band two stage 20 dB amplifier. Due to the nature of the mixer, the output spectrum of the FET will consist of a band of frequencies as shown in the EXCITER OUTPUT SPECTRUM diagram.



Exciter Output Spectrum

This spectrum is defined by $f_i \pm N f_o$ where

f_i = injection frequency

f_o = offset oscillator frequency

N = any integer

The desired overall transmit carrier frequency f_t is defined by the following formula

when N = 1

$f_t = f_i + f_o$

It is at f_t to which the FET output circuit is tuned. The entire spectrum of frequencies is amplified by the 20 dB amplifier and coupled to the exciter output filter by the cable on the foil side of the exciter printed circuit board.

The exciter output filter is a six-section filter which is tuned to the transmit frequency (f_c) and provides at least 85 dB rejection of other frequencies generated in the mixer. The output of the filter is approximately 1 mW at the transmit frequency and is coupled to the following low level amplifiers. At the input to the filter the signal is detected and measured at meter 2 (standard channel) or meter 3 (wide-space channel).

d. Exciter, 406-420 MHz

(1) Transmitter Frequency Development

In all "Micor" radio sets the transmitter frequency depends on the selected channel element frequency in the receiver and the frequency of the crystal in the offset oscillator.

The offset oscillator in a standard transmitter uses an 11.7 MHz crystal, making the transmitter carrier frequency the same as that of the receiver. A carrier frequency for a wide-spaced transmitter may be from 3 MHz below to 14 MHz above the receiver frequency. Therefore, an offset oscillator crystal frequency in wide-spaced channel models will be between 8.7 MHz and 25.7 MHz.

The transmitter carrier frequency is defined by the following formula:

$$f_t = 24 f_c + f_o$$

where

f_t = transmitter frequency

f_c = channel element frequency

f_o = offset oscillator frequency

The offset oscillator frequency (f_o) is either 11.7 MHz or 8.7 MHz to 25.7 MHz, while the multiplied channel element frequency (24 f_c) is equal to the receiver frequency minus 11.7 MHz. For the 406-420 MHz range, 24 f_c will vary from 394.3 MHz (receiver frequency of 406 MHz) to 408.3 MHz (receiver frequency of 420 MHz). Since 24 f_c is much greater than f_o, the transmitter frequency is much more sensitive to the channel element frequency error than to the offset oscillator frequency error. This fact permits the use of relatively low stability offset oscillators (approximately 10 to 15 PPM) to be combined with the stable injection frequency to generate a highly stable transmit frequency. The contribution of the offset oscillator to the transmitter carrier frequency error is never more than 0.5 PPM.

Selection of the correct receiver channel element and offset oscillator crystal for a given transmit-receive frequency pairing is accomplished either through the universal switching board, or the control (interconnect) board and a diode matrix board. Refer to the FREQUENCY SELECTION portion of THEORY OF OPERATION section for a detailed description of the selection process.

(2) IDC Circuit

The theory of operation for the IDC circuit from the microphone to the IDC control is the same in 406-420 MHz model "Micor" radio sets as that in 450-512 MHz models.

In standard 406-420 MHz exciters, the IDC potentiometer adjusts the maximum level of audio applied to the modulator. Additional audio voltage is supplied to the varactor modulator by coupling the signal from the audio amplifier emitters to the varactor anode. This signal is not influenced by the IDC potentiometer and results in a residual deviation of about 1.5 kHz when the standard IDC is set for minimum deviation (counter-clockwise from the foil side of board).

In wide-spaced 406-420 MHz exciters, an inverter is added to supply the higher level audio needed to drive the modulator. Unlike standard exciters, there is no residual deviation in wide-spaced exciters when the wide space IDC control is set for minimum deviation.

In "Private-Line" radios, a low amplitude "PL" tone is continuously injected into the "IDC" amplifier from the "PL" encoder. This tone, which is a specific frequency in the 67 to 210 Hz range, will produce between 0.5 to 1.0 kHz deviation.

In "Digital Private-Line" radios a low-amplitude binary-coded signal is continuously applied to the "IDC" amplifier by the DPL encoder and decoder. The distinctive 23-bit binary code is determined by a code plug on the DPL decoder board.

(3) Offset Oscillator, Modulator, and Amplifier

The audio output of the IDC circuit is applied to the modulator directly frequency modulating the offset oscillator. Modulation is accomplished by using the IDC audio output swing to vary the potential across a reverse-biased varactor diode in the oscillator feedback circuit. The capacitance of the varactor varies at an audio rate causing the oscillator frequency to vary at the same audio rate. The amount of frequency deviation is limited by the amount of audio swing applied to the varactor. The larger the swing, the larger the deviation. Without modulation, the frequency of the oscillator is set by the adjustment of a slug-tuned inductor in series with the varactor. The oscillator output is coupled to an N-channel junction FET in the source follower configuration. The high input impedance of the FET minimizes loading on the oscillator. A bipolar transistor follows the FET and feeds the mixer. The output of the bipolar transistor is sampled and detected for use at meter position 4.

(4) Offset Mixer Amplifier, and Output Filter

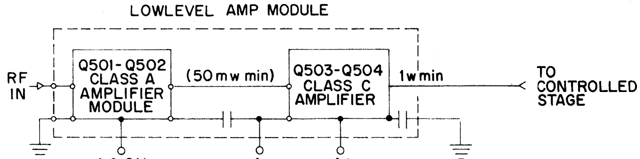
A dual gate MOS FET is used for the mixer because of its high gain, stability at UHF frequencies, and absence of higher order non-linearities in its transfer characteristics. These characteristics significantly reduce the generation of spurious outputs. Gate 2 of the FET is at 3.8 volts dc and rf ground while the output of the oscillator amplifier and the injection frequency signal are applied at gate 1. The output circuit of the FET is a narrow band tuned circuit which is coupled to a wide band two stage 20 dB amplifier on standard exciters.

In wide-spaced exciters the selectivity of the two-stage 20 dB amplifier is increased by the use of an additional tuned circuit.

The exciter output is coupled to a six-section filter which is tuned to the transmit frequency (f_t) and provides at least 85 dB rejection of other frequencies generated in the mixer. The output of the filter is approximately 1 mW at the transmit frequency and is coupled to the following low level amplifiers. At the input to the filter the signal is detected and measured at meter 3 (standard exciters) or meter 2 (wide-space exciters).

e. Low Level and Power Amplifiers

Refer to the following LOW LEVEL AMPLIFIERS diagram and to the block and schematic diagrams in the DIAGRAMS section of this instruction manual.



Low Level Amplifiers

In standard transmitter model radio sets, the low level amplifiers are fed directly from the standard channel exciter filter. In wide-space transmitter model radio sets, the low level amplifiers are fed from a combiner network used to combine the output from the two exciter filters. In both cases, the low level amplifiers require 1 milliwatt input from the exciter. This input is amplified by two stages of class A amplifiers, Q501 and Q502, to reach a saturated 50 milliwatt level. The amplifier saturation stabilizes signal level to the following stages and removes exciter amplitude modulation. The output of Q502 is then amplified by two low level class C stages, Q503 and Q504, to reach a 1.3 watt level at the low level amplifier output connector. All low level amplifier input and output impedances are 50 ohms.

All power amplifier deck circuits (Q506 through Q513) use quarter-wave microstrip transmission line matching. This steps up the device impedance to the 50 ohm input and output impedance of each stage.

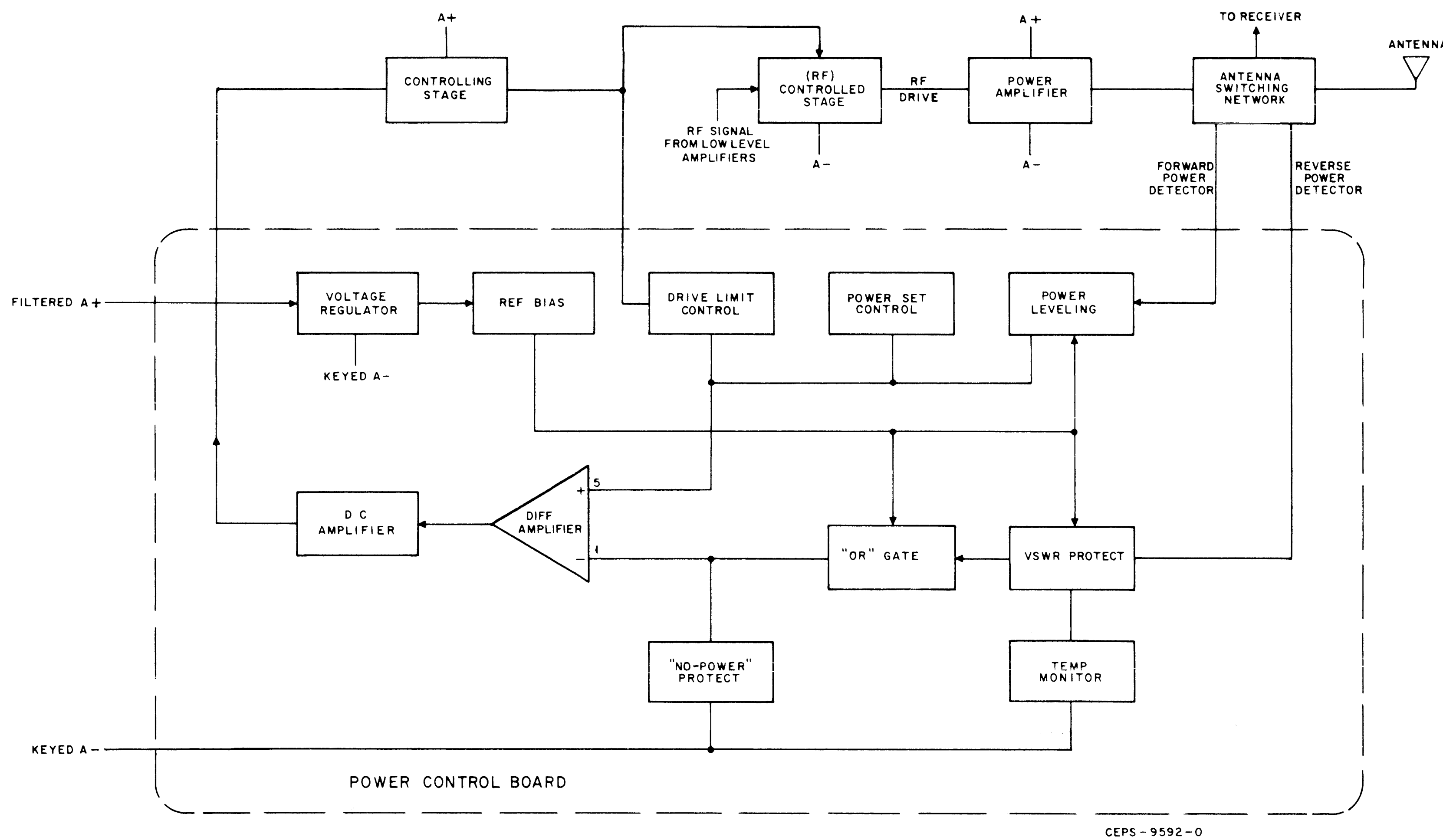
The output of Q504 is fed to the controlled amplifier stage, Q506. The transmitter power control circuit controls the gain of this stage by its dc input to Q505. Q505 is located in the collector of Q506 and determines the collector voltage of Q506. The output of controlled stage Q506 is fed to pre-driver stage Q507 for additional amplification.

On 25 watt models, the pre-driver output is amplified by a single-stage power amplifier, before being fed to the antenna network. This single stage amplifier is also used as the driver for the 75 watt models.

On 45 watt models, the pre-driver output is fed to a two-device direct parallel amplifier, Q508 and Q509. These amplifiers are used as the final power amplifier in the 45 watt models and as the driver in the 100 watt model.

The final power amplifier for the 75 watt and 100 watt power amplifier use four devices directly in parallel, Q510 through Q513.

The service metering receptacle monitors the following functions. Pin 1 monitors dc current to the low level class C amplifier Q503 and Q504. Pin 2 monitors the dc current to the pre-driver Q507. Pin 3 monitors current to the driver in the 75 and 100 watt models. Pin 5 monitors the voltage difference between A+ and the voltage at the controlled stage collector. A lower reading on meter 5 will correspond to a higher collector voltage and thereby higher power output from the controlled stage. Reference po-



Power Control Circuit Block Diagram

sition A on the portable test set uses pin 7 of the metering socket as an A+ reference against which the outputs of pins 1, 2, 3, and 5 are checked. The power amplifier output stage current in all models is monitored by the meter socket on the power control board.

f. Power Control

(1) Function Description

Refer to the POWER CONTROL CIRCUIT block diagram. The power control circuitry provides drive regulation and protection for the transmitter power amplifier transistors. Six functions are provided; power leveling, VSWR protection, drive limiting, temperature protection, forward and reverse power metering, and no power output protection circuitry.

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. The output of the integrated circuit differential amplifier, amplified by the dc amplifier, is the controlling input for the control transistor in the power amplifier section.

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.

When the impedances of the antenna circuitry (load) provide a good match to the power amplifier (low VSWR), and the heat sink temperature is below 80°C, a bias voltage produced by the dc reference bias circuitry is placed on the inverting input (pin 1 which is also called the reference input) of the differential amplifier.

When the transmitter is keyed, the forward (output) power from the final stages of the power amplifier is fed through the antenna switching network 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 in the antenna switching network 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 control transistor collector voltage and therefore the output of the power amplifier.

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.

Any power reflected back from the antenna circuit is detected by the reverse power sampling circuit. Reverse power causes a bias in the antenna switching network which 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.

Temperature increases detected by the temperature monitoring circuit will also decrease the reference level at the inverting input of the differential amplifier, reducing the output power as the heat sink temperature increases above a safe operating point for the power transistors. The higher the temperature, the more the decrease in power out. If the output has been reduced due to temperature, the VSWR circuit becomes more sensitive to reverse power, thus providing further protection for the rf power amplifier transistors.

(2) Circuit Description

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. Under normal operating conditions (normal heat sink temperature; 1:1 VSWR; 100% rated power out) the bias on the differential amplifier inputs are developed as described in the following paragraphs.

(a) Voltage Regulator and Main Divider Line

The A+ supply to the board is regulated by a series regulator circuit providing a nominal voltage of 8.0 volts. The Zener diode CR602 holds the base of the series pass transistor Q602 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 R611 and R612 and the diode CR607 provides the proper voltage tap points for the secondary voltage divider networks. All 36 pF capacitors in the board are used as rf bypasses.

(b) Reference Bias Circuit

The reference bias is developed (with normal heat sink temperature and a low VSWR) by the voltage divider made up of two resistors R604 and R612 and a diode CR606 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 C613 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.

(c) Forward Power Bias and Detection Circuit

The forward power reference voltage divider comprised of three resistors and a potentiometer R607 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 dc bias value will be determined by the power amplifier output and, with low reflected power 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.

(d) Drive Limit Circuit

The drive limit circuit, consisting of R608, R607 and CR603, is a secondary path of the power control board loop. This secondary loop acts as a clamp on the voltage of the controlled rf stage. When properly set, the circuit will have no effect on the normal power control functions. If for some reason the controlled loop tries to place excessive voltage on the controlled rf stage, such as when a power amplifier transistor failure occurs, diode CR603 conducts increasing the current into pin 5 reducing the collector voltage of the controlled stage. When the collector voltage decreases, CR603 turns off. The loop clamps at the drive limit point that was set. See the transmitter alignment procedure for correct setting of the drive limit control.

(e) No-Power-Output Protection Circuit

If less than 7 to 10 watts is detected at the input of the antenna switching unit, the no power output protection circuit turns off the controlled rf stage. Turn off occurs within a few milliseconds after the transmitter is keyed. The circuit protects the power amplifier devices against any malfunction which causes a no power output condition such as an unconnected power output cable to the antenna switching unit.

When the transmitter is keyed, capacitor C611 pulls the gate of the programable unijunction transistor (anode gate SCR) CR604 up to 8 volts which is above the 5.2 volts at its anode. The detected voltage from the forward power is divided by R620 and R621 and will keep the gate above 5.2 volts and CR604 off unless the forward power detected is less then 7 to 10 watts. If power does not come up to 7 to 10 watts before C611 charges to the cirtical voltage, CR604 will turn on. When CR604 turns on, it connects pin 1 of IC601 to A-. Grounding pin 1 turns off the controlled stage which turns off the transmitter.

(f) VSWR - Reverse Power Detection Circuit

With the power control board 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 output in the following manner.

The components of the reverse power detector circuit function the same as those in the forward power detector. The voltage divider R610 and R613 develops a bias voltage that is not quite enough to forward bias the diode CR605 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.

(g) Temperature Protection Circuit

When the heat sink temperature rises above approximately 80°C, the thermistor in parallel with the lower half of the VSWR voltage divider reaches a value of resistance which allows a more negative potential to be applied through the diode "OR" gate to the inverting input of the differential amplifier. The temperature protection decreases the level of the reference and therefore the power output of the power amplifier board.

(h) DC Level Output Amplification

The output of the differential amplifier is applied to the base of non-inverting transistor amplifier Q601 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 base-emitter voltage is less and the output control current decreases.

4. RECEIVER

Refer to the receiver schematic diagram in the DIAGRAMS section of this instruction manual. The following circuit theory covers the entire receiver except for the oscillator injection. The injection train which consists of an oscillator (channel elements) and three doubler circuits is fully covered in the INJECTION paragraphs of this section.

a. Receiver RF and IF

(1) RF Preselector

RF preselector selectivity prevents receiver degradation from the mixer image frequency and other high level off-channel signals. The rf preselector consists of six low loss, highly selective helical resonant cavities. The bandpass of the preselector is characterized by a flat acceptance bandwidth (preselector response within its bandpass does not vary) and a steep skirt response (attenuation of signals rapidly increases as their separation from the bandpass range increases).

Carrier signals received at the antenna are routed through the preselector cavities to the following mixer stage to be heterodyned with the injection frequency signal.

(2) Mixer

The mixer uses a field effect transistor with low noise level and high conversion gain. The circuit heterodynes the signal from the rf preselector with the injection signal from the multiplier to produce the intermediate frequency (i-f) of 11.7 MHz. Frequency relationships for the 450-512 MHz ranges are expressed as follows.

$$f_c = 24f_o + 11.7 \text{ MHz}$$

$$f_o = \frac{f_c - 11.7 \text{ MHz}}{24}$$

Where:

f_o = channel element frequency

f_c = rf carrier frequency

24 = channel element harmonic

11.7 MHz = mixer output frequency (i-f frequency)

(3) First Four-Pole Crystal Filter

This filter and the other four-pole crystal filter are the major factors in determining final receiver bandwidth and selectivity characteristics by greatly attenuating signals outside the predetermined receiver bandpass range.

The first four-pole filter consists of two dual-resonator, mode-coupled monolythic crystals and associated impedance matching circuitry. The output of mixer is coupled to the input of the filter by an adjustable matching network.

Refer to the SIMPLIFIED PIEZOELECTRIC COUPLING diagram. Each crystal blank produces mechanical vibrations at the crystal input when an electrical intermediate frequency signal is applied. These vibrations occur due to the inherent piezoelectric property in the crystal material and are propagated throughout the crystal. This same piezoelectric property converts the mechanical vibrations back to an electrical intermediate frequency signal at the output electrodes. The high "Q" of the crystals creates the narrow bandpass of the filter which results in excellent off-channel signal rejection.

The output of the first four-pole crystal filter is coupled to the first i-f amplifier through a fixed-tuned matching network.

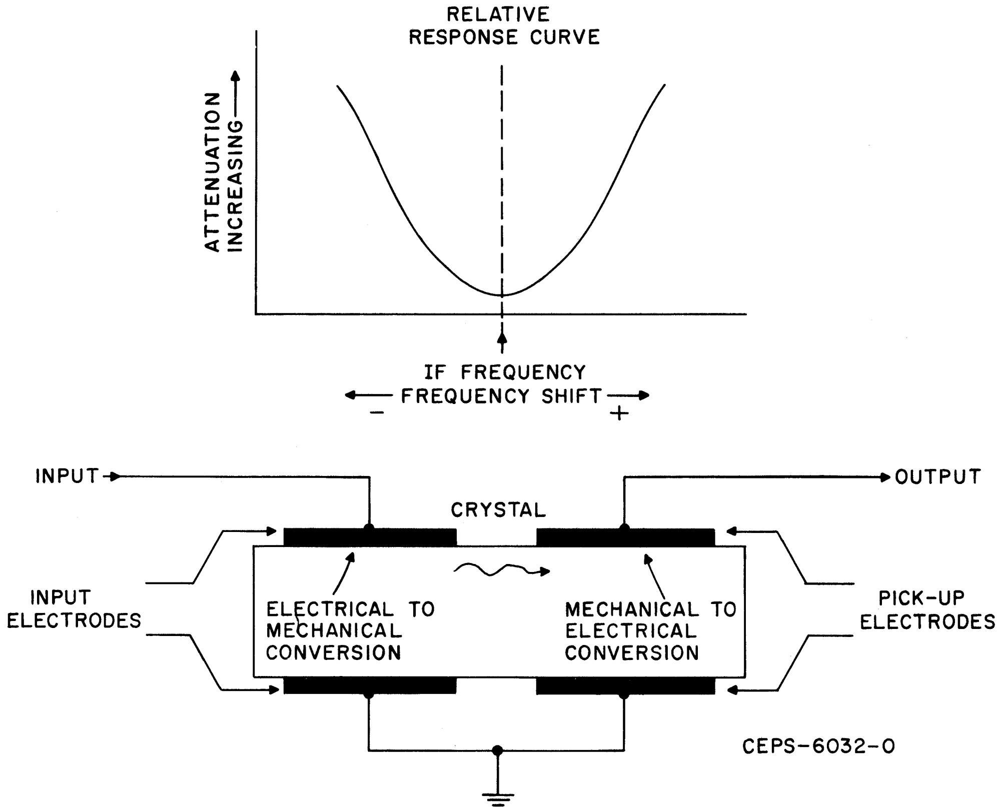
(4) First IF Amplifier

This circuit consists of an integrated circuit with associated discrete components to provide approximately 70 dB of gain to the i-f signal.

The IC contains three differential amplifier stages that are internally voltage regulated and temperature compensated. Isolation between the three stages is provided internally within the IC. The output of the IC is applied to the input of the second four-pole crystal filter.

(5) Second Four-Pole Crystal Filter

The crystals in this filter operate in a manner identical to that of the crystals in the first four-pole crystal filter described previously. Final receiver selectivity is established at this



Simplified Piezoelectric Coupling Diagram

filter. The output of this filter is coupled to the second i-f amplifier and limiter stage by a fixed-tuned matching network.

(6) Second IF Amplifier and Limiter

The second i-f amplifier and limiter consists of an integrated circuit with associated discrete components and performs two functions: (1) amplification and (2) limiting.

This stage is similar to the first i-f amplifier in that it has internal voltage regulation and temperature compensation. However, it employs four differential amplifier stages instead of three. The first two differential amplifier stages provide approximately 55 dB of gain to the i-f signal. The output of the second stage is used to provide metering (Meter 5). Its output is applied to the third differential amplifier stage which along with the fourth stage becomes overdriven to provide excellent symmetrical limiting characteristics.

Full limiting occurs with weak or strong signals or no signal (noise only).

The limited output of this IC provides a signal of constant amplitude to the discriminator. This is necessary since the discriminator would respond to a change in amplitude as well as to a change in frequency.

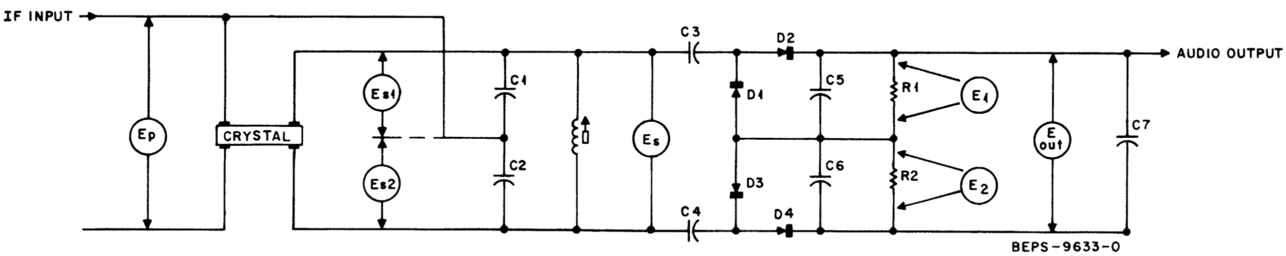
(7) Crystal Discriminator

The discriminator used is a phase discriminator. The operation is dependent upon a 90° phase shift which occurs at resonance between the input and output voltages of the dual-resonator crystal, (similar to a double-tuned, inductive coupled transformer).

Crystals inherently have a much more rapid change in phase shift than coils due to their high Q. Therefore, the steeper slope of a crystal discriminator will produce a much greater audio output voltage than a coil discrimintor for given deviation in frequency.

Refer to the SIMPLIFIED DISCRIMINATOR CIRCUIT diagram. The component reference symbol letters do not correspond to the components shown on the schematic diagram but are used to simplify the discussion. The tuned circuit formed by L and series connected C_1 and C_2 is resonant at 11.7 MHz.

When the frequency of the applied primary voltage (E_P) is changed, the phase angle between E_P and E_S (secondary voltage) changes from that at resonance. This changes the relative magnitude of E1 and E_2. The phase relationships are shown in the DISCRIMINATOR PHASE RELATIONSHIPS diagram.



Simplified Discriminator Circuit

Diodes D1 through D4 form a voltage doubling detector. The output voltages from the detector are developed across R1 and R2. The circuit is such that the output voltage (E_{OUT}) is equal to the difference between these two separate voltages. This means that when the frequency of the carrier, after conversion in the mixer, is exactly equal to the 11.7 MHz intermediate-frequency, no output will be obtained from the diodes because the voltage drops are equal and opposite (zero adjustment in the receiver alignment procedure). As the signal deviates from the intermediate frequency of 11.7 MHz, an output voltage will appear at E_{OUT}, as shown in the simplified discriminator circuit. The polarity of the voltage depends upon the magnitude of the voltages across R1 and R2. For the diode polarity shown, the discriminator output is positive below 11.7 MHz, where the phase angle changes and E_1 is greater than E_2, as shown in the phase relationships diagram. Above 11.7 MHz, the phase shift makes E_2 greater than E_1 and the output is negative.

b. Audio and Squelch

(1) Emitter Follower Circuit

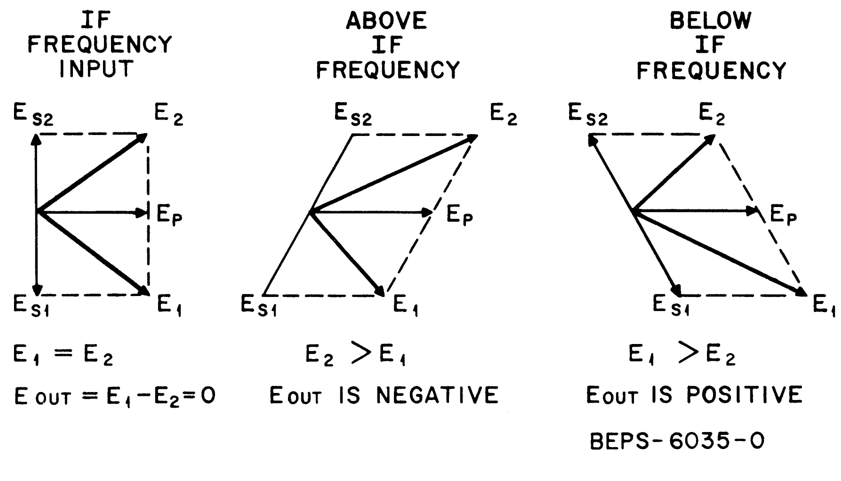
The emitter follower circuit provides a low impedance output which isolates the high impedance discriminator output from the following squelch and audio circuitry.

The output of the discriminator is capacitively coupled to the emitter follower input at IC201-1 and may consist of noise, audio signals, and/or PL tones. The output of the emitter follower at IC201-2 is routed to (1) external VOLUME and SQUELCH controls through coupling capacitor C203 and (2) a PL decoder in "Private-Line" tone-coded squelch radios.

(2) Audio Amplification Circuit

The signal from the VOLUME control is returned to the audio and squelch board at P903-5.

In "Private-Line" tone-coded squelch radios, jumper JU201 is removed to route audio to a PL filter on the PL decoder. Audio returned from this filter is free of PL tones, preventing the tone from being heard at the speaker. C204 and C205 prevent any dc potential from the audio channel from affecting the squelch shunt switch at that point.



Discriminator Phase Relationships

The preamplifier amplifies the low-level audio signal to provide the required drive to the differential amplifier. Negative feedback around the preamplifier is provided by C206 to attenuate audio signals above 3000 Hz. Further rolloff is provided by R205 and C233, and by R208 and C209. Capacitors C210 and C211 dc isolate the preamplifier output and the differential amplifier input from the squelch shunt switching.

The differential amplifier, output provides drive for the complementary amplifier. Resistors R216 and R217 form a bias network that biases the differential amplifier at exactly one-half of the supply voltage. Capacitor C212 eliminates the effect of any transient voltage that may be applied to the differential amplifier.

Final audio amplification on the audio and squelch board occurs in the complementary amplifier. Its output provides drive for the audio power amplifiers which are mounted on a separate board. Complementary amplifier emitter resistors R211 and R212 are external to the IC due to heat dissipation requirements.

Audio returned to the audio and squelch board from the audio power amplifier transistors is applied to the output transformer primary windings. This transformer consists of four windings -- two input primaries, an output secondary, and a feedback secondary. The output secondary winding couples audio power to an external 8-ohm speaker which can be driven with up to 10 watts at less than 5% distortion. Negative feedback from the output transformer winding through C208 and across R207 gives 6 dB per octave de-emphasis (roll-off) to the audio which has been pre-emphasized 6 dB per octave in the transmitter. Below 300 Hz, feedback from R209 and across C207 increases giving low frequency de-emphasis. Capacitor C235 supplies a light load to the audio power amplifier during certain situations such as the use of a headset. Capacitor C219 and C220 are rf bypass capacitors that shunt injection transients on the A+ and A- lines to ground.

Audio from T201 secondary is applied via intercabling to the control head. Jumpers JU1 and JU2 are used in conjunction with either the microphone or handset. If the handset is used, without receiver muting, JU2 is disconnected so that audio is heard in the handset as well as the speaker. If a speaker muting switch is used with the handset, JU1 and JU2 are both disconnected. The audio path is then through the hang-up box speaker mute switch so that audio is applied either to the speaker or handset (but not both).

(3) <u>Noise Activated Squelch Circuit</u>

(a) Squelch Input Circuit

The input signal from the SQUELCH control may consist of noise, audio message, and/or PL tones.

An input shaping network precedes IC202 that passes high frequencies and attenuates low frequencies. Use of high frequencies eliminates the effect of voice and PL tones and results in more sensitive threshold squelch action.

The first amplifier and limiter is driven into limit by its input signal and prevents audio from squelching (disabling) the audio channel on voice signals. Amplified, limited noise is then passed through a coupling network to the second amplifier. This coupling network is also a high pass filter which further attenuates voice and PL tone signals to the second amplifier.

The second amplifier amplifies the noise signal and applies it through an RC coupling network to the detector. C227 and R223 form another high pass filter that attenuates the low frequencies. Capacitor C228 is used to produce a peak-to-peak detector action from the noise detector, and thus, generate twice the output voltage of a peak detector. This capacitor does not affect frequency response.

(b) Detector and Switching Circuit

The detector output level is a function of received signal strength and the setting of the SQUELCH control. The detector develops the dc output voltage across filter capacitor C229. The lowest dc output voltage corresponds to a no signal input (maximum noise) condition. The output voltage increases as the received rf carrier signal level increases (noise decreases). The voltage may be used in PL radios to give an indication of on-channel usage even though the following noise squelch circuitry is inhibited. A voltage higher than approximately 2.8 volts dc indicates that the channel is being used, although not necessarily heard due to PL selection.

The primary function of the detector output, however, is the control of shunt switching. This is done as follows.

The detector output is applied to three squelch control circuits simultaneously:

- long "squelch-tail" circuit
- long "squelch-tail" defeat switch
- carrier squelch switching logic

With no received rf carrier signal (maximum noise condition), the long "squelch-tail" circuit and long "squelch-tail" defeat switch are "off" and the carrier squelch switching logic is "on". The audio channel is subsequently disabled unless the squelch control logic is overriden by other circuitry.

As the input signal level increases (noise decreases), the detector output voltage increases. A detector output voltage above 2.8 volts dc results in enabling of the long "squelch-tail" circuit. The long "squelch-tail" circuit produces a voltage at IC202-12 of 5.5 volts dc; this voltage causes the carrier squelch switching logic circuit to turn off and enable the audio channel. Capacitor C231 and resistor R224 provide a rapid rise, slow decay time constant to the voltage applied to the carrier squelch switching logic circuit. This permits a weak signal to immediately enable the audio channel, yet delays the audio channel shut-off if the signal is in a "flutter" condition. The voltage necessary to disable the carrier squelch switching logic is approximately 3.8 volts dc or greater.

A voltage greater than 5 volts dc at the detector output (rf carrier signal level that produces 20 dB quieting, or better), turns on the long "squelch tail" defeat switch. This disables the long "squelch-tail" circuit and the 150-millisecond delay function. Audio channel disabling now occurs immediately after the rf carrier disappears.

(c) Squelch Output Circuit

The squelch control logic circuit directly controls the shunt switching.

The output of the squelch control logic circuit depends upon the output of the preceding carrier squelch switching logic circuit and three additional input functions. With no additional inputs and the carrier squelch switching logic circuit "off", the squelch control logic circuit will turn off the shunt switches, allowing a message to be heard. If the carrier squelch switching logic is "on", the squelch control circuit will turn on the shunt switches, disabling the audio channel.

Two of the three additional functions that may affect squelch control logic output are associated with "Private-Line" tone-coded squelch operation. "PL" ON-OFF (IC202-14), which may be either shorted to ground or open, is connected to the hang-up box in PL operation. When an open is present at pin 14, (OFF), a received signal with or without a PL tone will be heard from the speaker. When at ground potential (ON), the output of the carrier squelch switching logic circuit is inhibited. When the proper PL tone is received, a positive 9.5 volts dc from the PL decoder to IC202-8 turns "off" the squelch control logic circuit. This turns off the squelch shunt switches and allows a message to be heard.

The third additional function (mute) takes priority over all other squelch functions and mutes the audio channel via the squelch shunt switches when the radio set is in the transmit mode. While the transmitter is keyed, 9.6 volts dc is applied to P903-7 and coupled to IC202-11 to turn on the squelch shunt switches and disable the audio channel.

The squelch control logic output at IC202-10 supplies a digital output voltage to permit an indication that the receiver is unsquelched (audio channel enabled).

Audio disabling is performed by shunting two points of the audio circuit through a low impedance path to ground. When the two solid-state shunt switches are turned on, signals developed across resistors R225 and R226 are shunted to ground. This prevents any signals from being heard from the speaker. Conversely, when the shunt switches are "off", a message may be heard from the speaker. Both shunt switches are simultaneously either "on" or "off", and provide a total of 90 dB of attenuation to any signal in the audio channel when "on".

c. "Private-Line" Decoder

(1) General

(a) "PL" Tone Present

With PL tone present on the input signal to the decoder, the PL filter passes low frequency

PL tones and attenuates voice and noise signals above 300 Hz. The noise switch shorts out high frequency noise signals. The tone from the PL filter is amplified by the PL amplifier and limited to a fixed level by the amplifier/clipper. The tone is applied to the "Vibrasponder" resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the device acts as a transformer and couples the tone from primary to secondary. The tone is amplified in the next stage and applied to a detector. When tone is present, the detector develops a dc output which activates the output switch. When the output switch is activated, 9.5 volts is present at its output to enable the audio circuits. The output also activates the noise switch.

The separate audio filter which is located on the PL decoder board is a high pass filter which allows voice signals above 300 Hz to pass but blocks PL tones. This filter is connected in series with the audio signal path in "Private-Line" radios to prevent the PL tone from being heard in the speaker.

(b) "PL" Tone Absent

When no PL tone is present, or a tone other than that required to activate the reed is present, no signal is coupled through the "Vibrasponder" resonant reed. No detector output is developed, thus the output switch is off. The output voltage is 0 volts at this time which inhibits the squelch circuit to prevent an audio output to the speaker. The noise switch is off at this time which allows high frequency noise to bypass the PL filter. The presence of high frequency noise desensitizes the amplifiers and acts as an "anti-falsing" feature to prevent a random low-frequency noise signal from activating the resonant reed.

(2) Decoder Input Circuits

The receiver discriminaton output signal is routed through an emitter follower stage on the receiver audio & squelch board. The emitter follower output is applied as the input to the PL decoder. The signal consists of noise only when no carrier signal is being received. With a carrier signal input to the receiver, the noise is reduced and voice audio or voice audio and PL tone added.

These input signals are routed through the low pass filter and noise gate circuit. A receiver input signal that is modulated ±0.5 kHz with PL tone produces a nominal 60 millivolts rms signal at the input to the decoder. The low pass filter consisting of L801, C802, C803 and C805 attenuates sharply all signals above 300 Hz. Thus, voice and noise signals above 300 Hz are blocked, but PL tones are passed. High pass filter C801, R803, and C807 presents a parallel path for high frequency noise whenever the decoder is not activated. This condition is desirable so that low frequency noise (only) will not falsely activate the decoder. When the proper tone has been received and the decoder is activated, noise switch Q807 acts as a short and grounds all high frequency signals before they reach amplifier Q801.

(3) Input Amplifier Circuits

Amplifier Q801 amplifies noise and PL tone signals which are coupled to amplifier/clipper Q802. Diode CR801 and the base emitter junction of Q802 limit both the positive and negative swing of the signal to a maximum amplitude. The amplified output of Q802 provides a constant amount of drive even though the amount of PL tone deviation from various transmitters is not constant. It also limits the noise signals to prevent oversensitivity to noise signals which could falsely operate the "Vibrasponder" resonant reed. "Vibrasponder" driver Q803 operates as an emitter follower to provide current drive to the low impedance "Vibrasponder" resonant reed.

(4) "Vibrasponder" Resonant Reed

The "Vibrasponder" resonant reed is the frequency determining device of the decoder. When the input tone from the "Vibrasponder" driver is the same frequency as the reed's resonant frequency, the reed vibrates. At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding. The reed is a precision built device consisting of a tuned cantilever reed of special steel mounted on a rugged base with a coil and permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. Its design eliminates the need for servicing throughout its useful life. The plug-in unit is easily removed and replaced.

The reed is sensitive to within 1 Hz of its resonant frequency. Specific tones in the 67 to 210 Hz range are used.

(5) Output Circuit

When the proper PL tone is applied to the reed, it develops a sinusoidal wave output at its resonant frequency. This sinusoidal wave is amplified by Q804. Negative feedback through C810 maintains the sinusoidal waveform. The amplified signal is coupled to detector Q805 which converts the signal to a dc potential. Q805 is cut off with its collector voltage of 9.6 volts until the tone is applied. With tone applied, the positive most portion of the sinusoidal wave is clamped at approximately .6 volt. The positive swing of each cycle causes momentary conduction of Q805 and the collector voltage drops to near zero volts. C813 charges during the conduction period and discharges through R820 and R821 to develop a filtered dc potential which forward biases output switch Q806. With Q806 activated, 9.6 volts is gated to the output which unsquelches the receiver. Noise switch Q807 is also activated which places a short across the noise gate as explained in paragraph (b).

(6) Audio Filter

Audio and PL tone from the VOLUME control are routed through an audio filter consisting of C814-C817 and L802 and L803. The filter is electrically separate from the decoder but physically mounted on the same board. This filter is high-pass type which blocks the PL tone and passes the audio to the audio & squelch board.

d. "Digital Private-Line" Decoder

The "Digital Private-Line" (DPL) decoder keeps the receiver audio circuits muted until a signal containing the proper binary code is received. During transmitter operation the DPL decoder generates the binary-coded signal that is processed by the DPL encoder and then modulates the transmitter. The description of the DPL decoder theory of operation is part of the DPL decoder schematic diagram.

5. ANTENNA NETWORK

Refer to the following SIMPLIFIED ANTENNA NETWORK diagram. The antenna network provides the following functions.

--Connects the transmitter final power amplifier stage to the radio antenna connector at al. times.

--Provides the transmitter final power output stage with a low VSWR 50-ohm load during transmit independent of the load presented to the radio antenna connector.

--Attenuates all transmitter carrier hormonics to a level of at least -85 dB below the carrier.

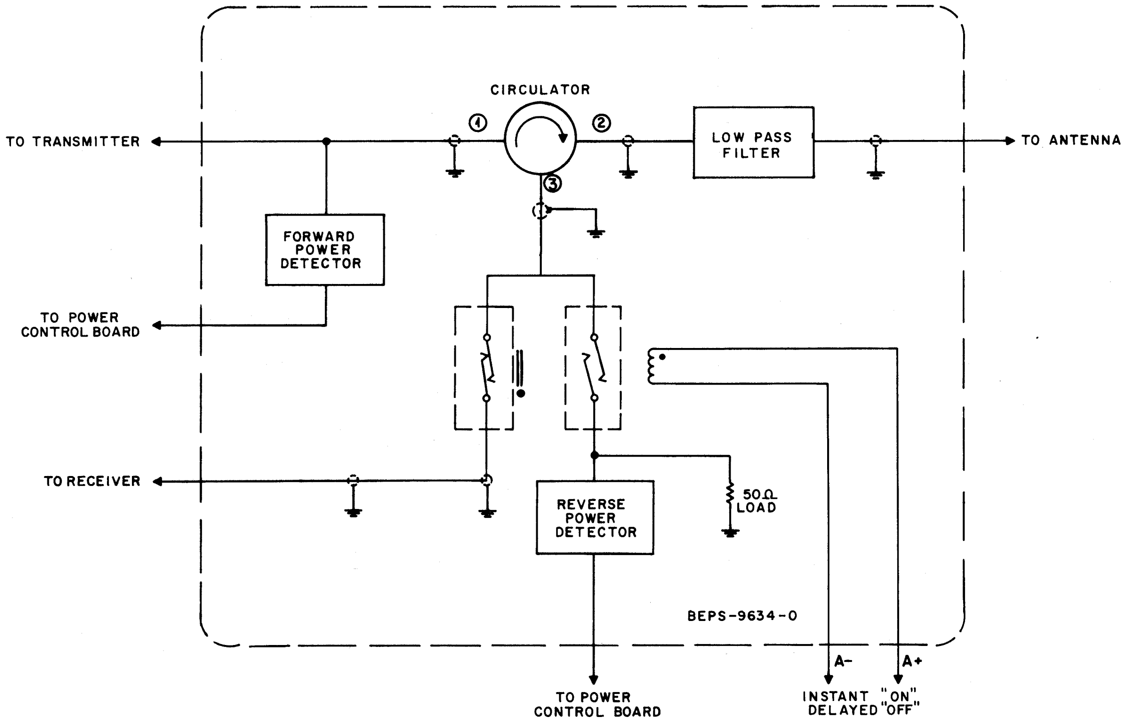
--Connects the receiver to the radio antenna connector during receive operation.

--Provides dc voltages proportional to forward and reverse power appearing at the antenna connector.

a. Circulator

The circulator is a 3-Port device which takes advantage of the unique magnetic properties of yttrium iron garnet (YIG). By subjecting a transmission line circuit sandwiched between two YIG discs to a critical value of static magnetic field, a device can be made which is non-reciprocal in nature. That is, a signal entering port 1 of the circulator leaves at port 2 and a signal entering port 2 leaves at port 3. In general a signal entering any port will leave at an adjacent port (in the direction of the arrow). This characteristic is used to advantage in the antenna switching network. The transmitter is always connected to the circulator at port 1 and the antenna is always connected to port 2 of the circulator. During transmit, port 3 is connected to a 50-ohm, 50-watt load through a reed switch. This circuit arrangement provides the transmitter power amplifier output stage with a low VSWR 50-ohm load independent of the condition of the load connected to the antenna connector. Whenever a mismatched load appears at the antenna connector, the reflected power from the mismatched load enters port 2 of the circulator and is routed to port 3 and to the 50 ohm load inside the unit.

During receive, the reed switch to the 50-ohm load is open and the receiver is connected to port 3 of the circulator. The received signal enters the antenna connector, through the low pass filter and into port 2 and is routed through the circulator and out port 3. The signal is then connected to the receiver via the reed switch.



Simplified Antenna Network

b. Power Detectors

To provide an input to the power control board indicating the power level out of the transmitter, a peak voltage detector is coupled through a capacitive divider to the coaxial line at the transmitter input port of the circulator. This detector provides a dc output voltage proportional to the square root of the power entering port 1 of the circulator.

A peak voltage detector is also used to sense the peak voltage across the 50-ohm load in the unit. Under most normal operating conditions, the power dissipation in the load is only a few watts. However, under extreme conditions of antenna mismatch and a high power radio, the reflected power could approach the power dissipation (50 watts) capability of the load. To protect the load against such a condition, the rf voltage across the load is sensed and a dc voltage proportional to the rf voltage is fed back to the power control board. When the rf voltage across the load starts to increase beyond the normal safe range, the power control decreases the power output of the transmitter to maintain a safe dissipation in the 50 ohm load.

c. 50-Ohm Load

The 50-ohm load is required to have a low VSWR in the UHF band. It should be able to absorb the maximum reflected power from the antenna while monitoring this VSWR. To accomplish this, the load is constructed using thick-film techniques and is mounted on a beryllia block to achieve good thermal conduction of the dissipated power to the heat sink.

6. DC SWITCHING, REGULATION, AND FILTERING

The control board (center-interface board) provides dc switching, regulation and filtering for the radio set. Specifically the functions are

- Power distribution and filtering.
- A 9.6-volt regulator.
- Push-to-talk switching and sequencing.
- Reverse polarity protection.
- Interconnection between circuits of the radio set.
- Frequency selection routing for four-frequency radios.
- Interconnections for options (Time-Out Timer, etc.).
- Metering

Receptacles on the control board mate with pins on the transmitter and receiver circuit boards to distribute desired functions from outside the radio and from board to board inside the radio. The double sided board routes the signals and eliminates the need for most wires. The few wires used, are terminated in removable female pin tip connectors to mate with pins in the circuit board. Additional pins in the board are provided for connecting accessory items such as a positive ground converter. The 37-pin connector at the end of the circuit board mates with the cable to the control head and battery. A control socket allows a Motorola portable test set with a TEK-37 Adapter Cable to control the radio set for testing. For the following circuit operation, refer to the control board schematic diagram in the DIAGRAMS section of this manual.

a. Power Distribution and Filtering

Vehicle battery voltage is applied at various pins of P901. Due to the high current requirements of the power amplifier, A+ and A- for the power amplifier are brought in at P901-A and -B which are large diameter pins that mate with plug-on cables from the power amplifier. A+ is also applied at J901-22 and filtered by L901 and C901. The "filtered A+" is routed to the exciter and the audio & squelch circuit boards and made available to reed switch K901, which is closed when the push-to-talk function is activated. A- is supplied to J901-11 as reference voltage to the exciter, audio & squelch board and reed switch K902.

Reverse polarity protection diode CR909 connects between A+ and A-. The diode is reverse biased when the input power is of the proper polarity and has no effect. If reverse polarity is applied, the diode short circuits and blows the fuse to protect the circuits in the radio set.

In negative ground installations, "battery (+)" is applied to P901-3 and filtered by L902 and C902. For positive ground operation, there is no input at pin 3; instead "battery (-)" is applied at P901-18 and routed to a positive ground converter. The (+) output of the converter is applied to the junction of L902 and C902. With either type of operation, a "filtered B+" voltage is available at this point for distribution to the receiver and the 9.6-volt regulator.

The circuit-board mounted control socket allows a portable test set to be connected for various tests. The speaker audio can be monitored between pins 1 and 2, and microphone audio or microphone dc at pin 7. Pin 5 monitors push-to-talk keying. If the push-to-talk function is not present, pin 5 will be at the battery voltage. Pin 3 is omitted, +9.6 V is present on pin 4 (not directly measurable on test set), and pin 6 is ground reference.

b. 9.6-Volt Regulator Circuit

Filtered A+ is applied to a 9.6-volt regulator circuit which provides regulation within ±100 millivolts for input voltages from 10.5 to over 16 volts. Automatic shutdown occurs if the output becomes overloaded or shorted.

The regulated output voltage is developed across Zener diode CR911, diode CR912 and the resistors in the base of output voltage sensor Q903. Since the voltage across the Zener diode is constant, almost the entire variation is applied to the base of Q903. It amplifies and inverts the variation, developing a negative feedback which is applied to the base of driver Q902. Driver Q902, in turn, controls the base current drive to series regulator Q901. Total load current flows through Q901 which acts as a controlled series resistance in response to drive from Q902. The complete negative feedback path causes the resistance of Q901 to counteract output voltage variations.

Drive to Q901 is relatively independent of input voltage since drive to Q903 is derived from the regulated output. Therefore, its collector current and the drive to Q902 are also derived from the regulated output.

Diode CR910 protects the circuit from extreme overload such as a short. If the 9.6-volt output is shorted or overloaded, it drops toward zero. Q903 would tend to cut off. However, when the output voltage drops .6 volt below the voltage at the collector of Q903, diode CR910 conducts. This occurs if the output current exceeds 450 milliamps (normal load current is approximately 250 milliamps, plus the current for any optional accessory items operating from 9.6 volts). This action limits the amount of forward bias on Q902, and the emitter resistor limits maximum collector current of Q902. Since collector current of Q902 is the base drive current for Q901, it is limited to this same low value and Q901 shuts down.

The output voltage of the regulator is a nominal 9.6 volts. Some radios may be as low as 9.1 volts and others may be as high as 9.9 volts. However, the regulation for a given radio is ±100 millivolts from the regulated value over the entire range of input voltage, load, and temperature.

The output of the regulator develops the "9.6 volts continuous" which is applied to reed switch K902 and to some receiver and PL encoder circuits. In the receive mode, "switch 9.6 volts" is applied to certain receiver circuits. In the transmit mode, the "switched 9.6 volts" is removed and the "keyed 9.6 volts" is applied to the exciter board.

c. Push-to-Talk Switching and Sequencing Circuit (Refer to P-T-T Sequencing Diagram)

The push-to-talk switching and sequencing circuits control the application of dc power to the transmitter and control the sequencing so the receiver is disconnected from the circulator before the transmitter rf output is applied and the 50 ohm load is connected to the circulator in the antenna network. Sequencing during transmitter turn-off assures that rf power output is ended before the receiver is switched back to the circulator.

(1) Transmitter Turn-On

The following sequence of actions occurs to turn on the transmitter:

--Transmitter keying is initiated by closing the push-to-talk switch on the microphone.

--Closing the push-to-talk switch grounds one side of the 1st P-T-T reed Switch K901 coil. The other side is connected to "battery hot" and the reed switch energizes, closing the contacts. The switch operates equally well from negative ground or positive ground electrical systems.

--"Keyed A+" from K901 is routed through the exciter (and the PL encoder in "Private-Line" radios) to the second P-T-T reed switch K902.

--Initially, current flows through both coils of K902, producing opposite and cancelling magnetic fields. The reed switch does not energize at this time.

--"Keyed A+" is routed through diode CR913 to the antenna switch. The antenna switch energizes and removes the receiver from the circulator and connects the 50 ohm load.

--After approximately 10 milliseconds delay, C904 becomes charged and current through coil 2 of K902 decreases to the point where full magnetic cancellation no longer occurs. K902 energizes and applies "keyed A-" and "keyed 9.6 volts" to the exciter which allows rf output to be developed. At the same time "switched 9.6 volts" is removed from the receiver.

(2) Transmitter Turn-Off

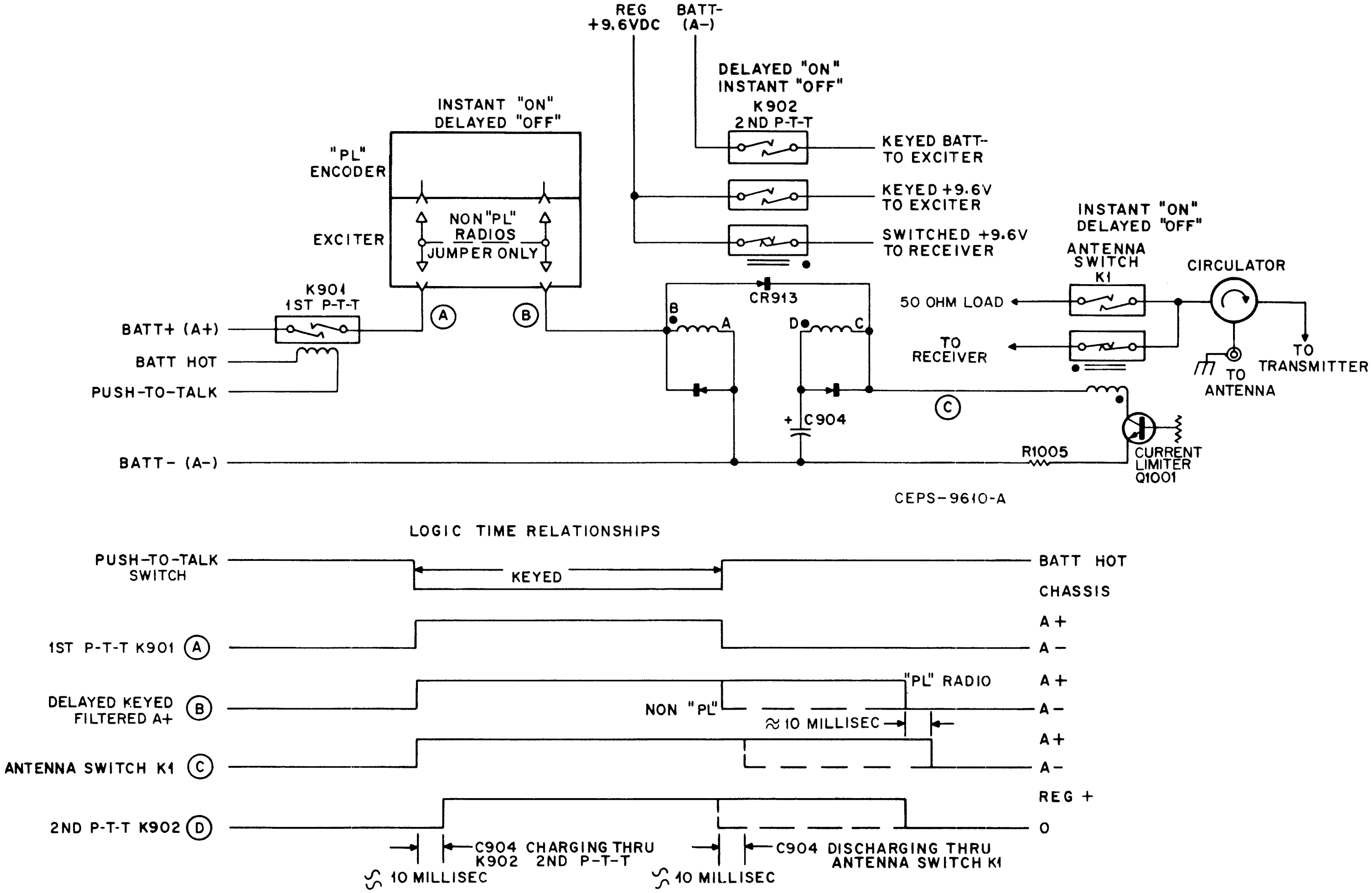
When the push-to-talk switch on the microphone is released, the following sequence of actions occurs:

--K901 de-energizes immediately.

--In "Private-Line" radios, "Keyed A+" continues for approximately 150 milliseconds after unkeying. This delay is produced by the PL encoder. In non-"Private-Line" radios, "keyed A+" is removed as soon as K901 de-energizes.

--K902 de-energizes immediately upon loss of "keyed A+", removing power from the transmitter.

--C904 discharges through the antenna switch coil. Sufficient current is available to produce approximately 10 milliseconds delay before the antenna reed switch de-energizes. This allows transmitter rf power output to go to zero before the receiver is connected back to the circulator.



P-T-T Sequencing Diagram

7. FREQUENCY GENERATION

Throughout this manual, the terms "standard" and "wide-spaced" are used in discussions of the frequency generation circuitry. These terms are defined differently in the 406-420 MHz range and in the 450-512 MHz range. For clarity, the less ambiguous terms "T = R" (transmit and receive on the same frequency) and "T ≠ R" (transmit and receive on different frequencies) are used in the following section. The correlation between these terms is as shown below:

FREQUENCY RANGE	NEW TERM	OLD TERM
406-420 MHz	T = R	Standard
	T ≠ R	Wide-Spaced
450-512 MHz	T = R	Wide-Spaced
	T ≠ R	Standard

7.1 THEORY OF OPERATION

7.1.1 General

7.1.1.1 The UHF "Micor" radio is available in one-, four-, and twelve-channel models. The receive and transmit frequencies are determined by channel elements on the receiver RF and IF board. A switching matrix is used to select the appropriate channel element for transmit and receive for each channel selector switch position. The channel selection circuitry is programmed for the desired set of transmit-receive frequency pairings as described in section 7.2, Channel Programming.

7.1.1.2 In radios not equipped with a Universal Switching Board, the receive and transmit frequencies for a given channel selector switch position are derived from the same channel element. In radios that are equipped with a Universal Switching Board, the receive and transmit frequencies for a given channel selector switch psotion may be generated by different channel elements.

7.1.1.3 For clarity, the following terms are defined as shown:

T	Transmit Frequency
R	Receive Frequency
T - R	Transmit-Receive Spacing
T = R	Transmit and Receive on same frequency
T ≠ R	Transmit and Receive on different frequencies

NOTE

The transmit-receive spacing, T-R, will be positive when the transmit frequency is higher than the receive frequency, and negative when it is lower.

7.1.2 Functional Description - radios without a Universal Switch Board

7.1.2.1 In radios not equipped with a Universal Switching Board, the first four channels are selected by a diode matrix on the Control Board. The remaining eight channels (on twelve-channel radios) are selected by another diode matrix on a Diode Matrix Board, WHICH PLUGS INTO THE RECEIVER RF/IF BOARD.

7.1.2.2 Figure 1 is a functional diagram of the frequency selection circuitry in a twelve-channel radio equipped with a Diode Matrix Board. The channel selector switch on the control head places a ground on one of twelve channel select lines, designated CH1 through CH12. Lines CH1 through CH4 go to the Control Board; lines CH5 through CH12 go to the Diode Matrix Board PLUGGED INTO THE RECEIVER.

7.1.2.3 Offset oscillator select jumpers JU1 through JU4 on the Control Board and JU5 through JU12 on the Diode Matrix Board are used to select either T ≠ R or T = R operation for a given channel selector switch position. If the jumper is in, the T ≠ R offset oscillator is enabled when the corresponding channel is selected. If the jumper is out, the T = R offset oscillator is enabled instead.

7.1.2.4 The channel elements are located on the receiver RF/IF board. The frequency of the selected channel element is defined as f_c. A tuned circuit at the channel element output acts as a bandpass filter, passing only the third harmonic $3f_c$. A series of doublers provides an additional eightfold frequency multiplication to $24f_c$. This signal is fed to the receiver mixer, resulting in a receive frequency of:

$$R = 24f_c + 11.7 \text{ MHz}.$$

7.1.2.5 The 24 f_c signal is also routed to the exciter board, where it is fed to two separate mixers which are driven by two separate offset oscillators. Operating power (+9.6 V) is supplied to only one of the two offset oscillator-

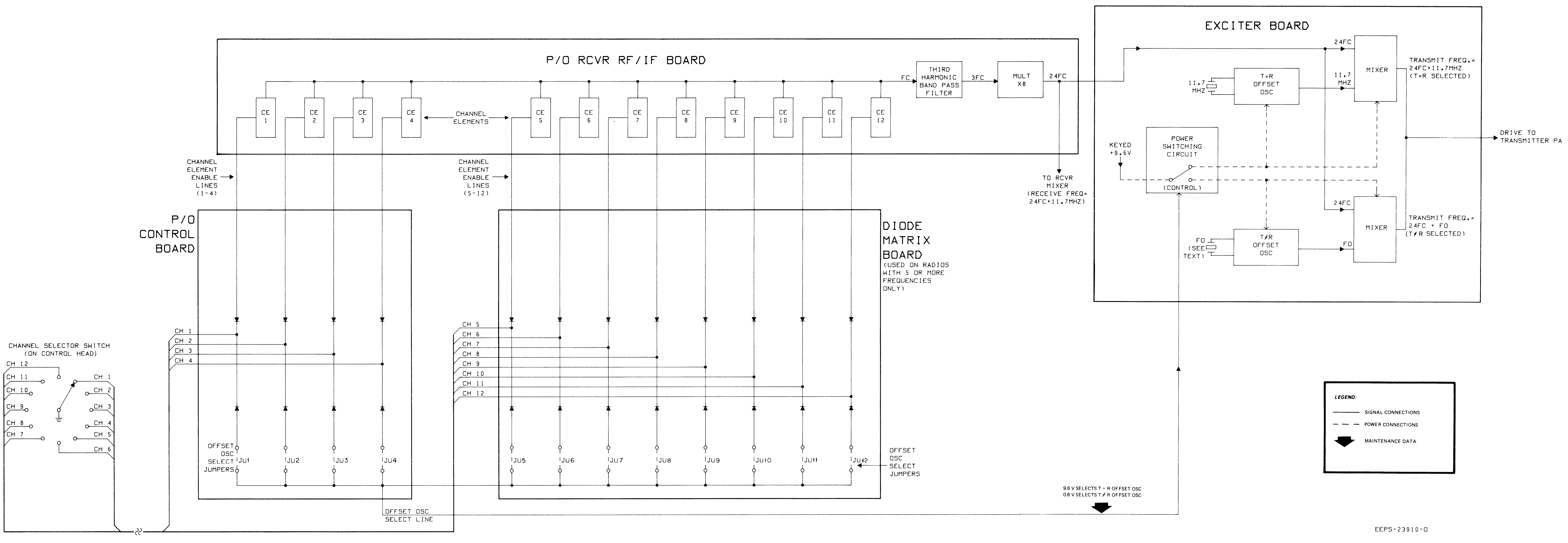


Figure 1.
Functional Diagram,
Frequency Selection Circuitry
(Diode Matrix Board)

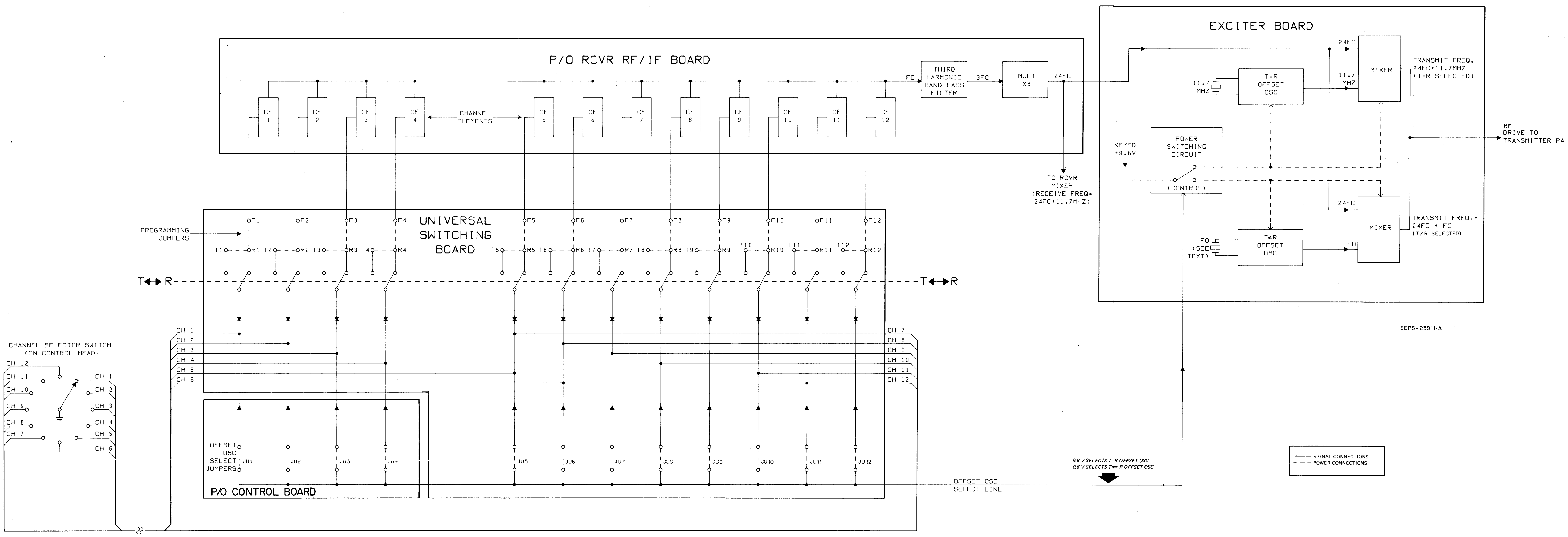


Figure 2.
Functional Diagram,
Frequency Selection Circuitry
(Universal Switching Board)

mixer combinations, depending on the position of the channel selector switch and the programming of the offset oscillator select jumpers (see paragraph 7.1.2.3).

NOTE

Certain radio models are capable of T = R operation only, or T ≠ R operation only. These radios have only one offset oscillator-mixer combination which is always enabled by jumper JU302 or JU402.

7.1.2.6 If enabled, the T = R offset oscillator provides an output signal at 11.7 MHz. When combined with the $24f_c$ signal from the RF/IF board, this produces a transmit frequency of:

$$T = 24f_c + 11.7 \text{ MHz}$$

The same as the receive frequency. Similarly, the T ≠ R offset oscillator, if enabled, provides an output signal at frequency f_o. When combined with the $24f_c$ signal from the RF/IF board, this produces a transmit frequency of:

$$T = 24f_c + f_o$$

The T ≠ R offset oscillator frequency f_o is determined in advance to provide the desired transmit-receive spacing (T-R) for those channels on which T ≠ R operation is desired. If f_o = 14.7 MHz, for example, the transmit frequency is:

$$T = 24f_c + 14.7 \text{ MHz}$$

This will provide a transmit frequency 3 MHz higher than the receive frequency whenever the T ≠ R offset oscillator is enabled. (The T ≠ R offset oscillator is enabled on all channels for which the corresponding offset oscillator select jumper on the Control Board or Diode Matrix Board is in.)

7.1.2.7 The transmit-receive frequency spacing (T-R) is the same for all channels for which T ≠ R. This spacing depends on the frequency of the T ≠ R offset oscillator (f_o) in the following way:

$$(T-R) = f_o - 11.7 \text{ MHz}$$

If f_o is less than 11.7 MHz, the spacing is negative, indicating that the transmit frequency is lower than the receive frequency. If more than a single non-zero transmit-receive frequency spacing is required, a Universal Switching Board must be used.

7.1.3 Functional Description - radios with a Universal Switching Board

7.1.3.1 On radios equipped with a Universal Switching Board, all channel element selection takes place on that board. The Universal Switching Board can be programmed to select different channel elements on transmit and receive, providing more than one non-zero transmit-receive frequency spacing. Detailed information on programming the Universal Switching Board is provided in section 7.2, Channel Programming.

NOTE

FCC regulations governing T ≠ R operation require a spacing (T-R) of +5 MHz in the 450-470 MHz range, and a +3 MHz in the 470-512 MHz range. In the 406-420 MHz range, spacings from -3 to +14 MHz are permitted. Applications using more than one non-zero spacing require a Universal Switching Board (T = R operation is permitted in all three ranges.)

7.1.3.2 Figure 2 is a functional diagram of the frequency selection circuitry in a twelve-channel radio equipped with a Universal Switching Board. The channel selector switch, RF/IF Board, and Exciter Board operate in the same manner as previously described. Twelve jumpers on Control Board (JU1-JU4) and the Universal Switching Board (JU5-JU12) are used to select either the T = R offset oscillator (jumper out) or the T ≠ R offset oscillator (jumper in) for each channel as before. The only difference in operation is the manner in which channel elements are enabled.

7.1.3.3 The enable lines to the channel elements terminate in eyelets on the Universal Switching Board. These eyelets, used for connecting programming jumpers, are designated F1 through F12 for channels 1 through 12 respectively. A 24-transistor programmable switching matrix handles the selection of channel elements for receive and transmit. The transistor matrix may be represented as twelve spdt switches acting in unison (see Figure 2). The "normally closed" (receive) contact of each "switch" is connected to an eyelet on the circuit board. These eyelets, used for connecting programming jumpers are designated R1 through R12 for channels 1 through 12 respectively. Similarly, the "normally open" (transmit) contacts are connected to eyelets T1 through T12. The transistor matrix "switches" change state whenever the radio is changed from receive to transmit mode or vice versa.

7.1.3.4 Depending on the position of the channel selector switch, one of the channel select lines will be grounded. This ground appears at the common pole of the transistor matrix "switch" associated with that channel by way of the diode matrix. In receive mode, the corresponding R eyelet becomes grounded; in transmit mode, the corresponding T eyelet becomes grounded. For example, if channel 5 is selected on the channel selector switch, eyelet R5 (and no other R eyelet) goes low during receive, and eyelet T5 (and no other T eyelet) goes low during transmit. Programming the board consists of interconnecting the F eyelets (from the channel elements) with the appropriate R and T eyelets to enable the desired channel element on transmit and receive for each channel.

7.2 CHANNEL PROGRAMMING

7.2.1 Introduction

7.2.1.1 Each "Micor" radio is configured and programmed by the factory to operate on the transmit-receive frequency pairs specified by the customer for each channel. Depending on the number of channels and the frequency pairings desired, the radio may be supplied equipped with a Diode Matrix Board or a Universal Switching Board (or neither). The T ≠ R offset oscillator frequency (f_o) is determined by the desired transmit-receive frequency spacing(s). All programming jumpers are prewired at the factory.

7.2.1.2 It is not normally necessary to change the configuration or programming of the frequency generation circuitry after the radio is put into service. However, if any changes in the operating frequencies of the radio are to be made, re-programming is required. Step-by-step programming instructions are provided in this section.

7.2.2 Programming Considerations

7.2.2.1 The programming procedures presented below are similar to those used by the factory. A "start from scratch" approach is taken in order to cover all cases in a single discussion, so it is necessary to follow the entire procedure even if only a minor change in operating frequencies is required.

7.2.2.2 The programming procedure is divided into four subsections:

- --Pre-programming Procedure (Sec. 7.2.3)
- --Programming - Control Board Only (Sec. 7.2.4)
- --Programming - Diode Matrix Board (Sec. 7.2.5)
- --Programming - Universal Switching Board (Sec. 7.2.6)

The pre-programming procedure is used to determine which of the three configurations (Control Board only, Diode Matrix Board, or Universal Switching Board) is required for the transmit-receive frequency pairs desired. Depending on the results of this determination, you will be directed to perform the steps listed in one of the Three Programming sections.

7.2.2.3 Each programming procedure is presented as a series of numbered steps. A step may be a specific operation to be performed, or it may be a "decision" step which directs the programmer to another later step in the procedure. For proper results, it is important that the programmer follow the steps in numerical order unless directed to do otherwise.

NOTE

The following procedure does not apply to one-channel radios.

7.2.2.4 A Frequency Assignment Table is provided for use in conjunction with the programming procedures. This table, filled out by the programmer as directed in the steps, provides a permanent record of each re-programming. It also permits the programmer to keep track of his progress through the procedure.

NOTE

In the remainder of this section, it is assumed that the radio being programmed contains all circuitry required for both T = R and T ≠ R operation.

7.2.3 Pre-Programming Procedure

Perform the steps in this section first, before beginning to program the radio.

Step 1. Make a duplicate copy of Table 1, the Frequency Assignment Table. Fill in the desired transmit frequency (T) and receive frequency (R) for each position of the channel selector switch to be used.

Step 2. Is the full number of channel selector switch positions available (4 on four-channel radios, 12 on twelve-channel radios) being used?
YES: Go to Step 4.
NO: Go on to Step 3.

TABLE 1.
FREQUENCY ASSIGNMENT TABLE

CHANNEL SELECTOR SWITCH POSITION	TRANSMIT FREQ IN MHz (T)	RECEIVE FREQ IN MHz (R)	FREQ SPACING IN MHz (T-R)	TX ONLY ELEMENT
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

MOST COMMON SPACING

| MHz |

CALCULATED f_o

| MHz |

RESULTANT SPACING

| MHz |

PRESENT f_o

| MHz |

RADIO UNIT ____________________

PROGRAMMER ____________________

DATE ____________________

Step 3. For the remaining available channel selector switch positions in the table, fill in the same transmit and receive frequencies as in the last (highest numbered) switch position used. Enter dashes in the Frequency Spacing column opposite these added "channels".

Step 4. For each channel selector switch position to be used, subtract the receive frequency (R) from the transmit frequency (T) and fill in the result in the Frequency Spacing (T-R) column. (If R is greater than T, a negative number will result.)

Step 5. Determine the non-zero frequency spacing which occurs most frequently in the Frequency Spacing (T-R) column and enter it in the box labeled "Most Common Spacing" at the bottom of the table. If there is no non-zero spacing, put an "X" in the box. If two spacings occur equally often, either may be entered.

Step 6. Calculate the offset oscillator frequency f_o as follows:

$$f_o = 11.7 \text{ MHz} + \text{Most Common Spacing}$$

(If the Most Common Spacing is negative, f_o will be below 11.7 MHz.) Write the result in the box labeled "Calculated f_o" at the bottom of the table. If there is an "X" in the "Most Common Spacing" box, enter an "X" in the "Calculated f_o" box as well.

Step 7. Is there more than one non-zero frequency spacing in the Frequency Spacing (T-R) column of the table?

YES: Your radio requires a Universal Switching Board. Perform the programming steps listed in section 7.2.6.

NO: Go on to Step 8.

Step 8. Are you working with a four-channel radio or a twelve-channel radio?

Four-Channel: Your radio will be programmed on the Control Board only. (No Diode Matrix Board or Universal Switching Board is required.) Perform the programming steps listed in section 7.2.4.

Twelve-Channel: Your radio requires a Diode Matrix Board. Perform the programming steps listed in section 7.2.5.

7.2.4 Programming - Control Board Only

Perform the steps in this section if the pre-programming procedure in section 7.2.3 indicates that your radio is to be programmed on the Control Board only.

Step 1. The channel element sockets, designated F1 through F12, are on the receiver RF/IF Board. Only sockets F1 through F4, corresponding to channels 1 through 4 respectively, are used on four-channel radios. The channel elements themselves are labeled with their receive frequencies. Refer to the receive frequency (R) column of the Frequency Assignment Table. Beginning with channel 1 and proceeding through channel 4, install a channel element in the socket corresponding to each new receive frequency encountered on your list.

Step 2. Each channel selector switch position has one channel element select diode associated with it, as shown in Table 2.

Table 2. Control Board Diodes

CHANNEL SELECTOR SWITCH POSITION	CHANNEL ELEMENT SELECT DIODE
1	CR905
2	CR906
3	CR907
4	CR908

These diodes are located on the Control Board, at the end of the board farthest from the front panel connector. Referring to Table 2 and the receive frequency (R) column of the Frequency Assignment Table, interconnect the anodes of each group of diodes associated with channels sharing a common receive frequency. Solder pads are provided on the Control Board for these jumpers.

Step 3. Each of the four channel selector switch positions has one offset oscillator select jumper associated with it, as shown in Table 3.

Table 3. Control Board Jumpers

CHANNEL SELECTOR SWITCH POSITION	OFFSET OSCILLATOR SELECT JUMPER
1	JU1
2	JU2
3	JU3
4	JU4

These jumpers are located on the Control Board, near the jumpers programmed in Step 2. Referring to Table 3 and the Frequency Assignment Table, remove the offset oscillator select jumper associated with any channel which has a frequency spacing (T-R) of 0 MHz. This completes the programming of the Control Board. DO NOT PERFORM ANY FURTHER PROGRAMMING STEPS.

7.2.5 Programming - Diode Matrix Board

> Perform the steps in this section if the pre-programming procedure in section 7.2.3 indicates that your radio requires a Diode Matrix Board.

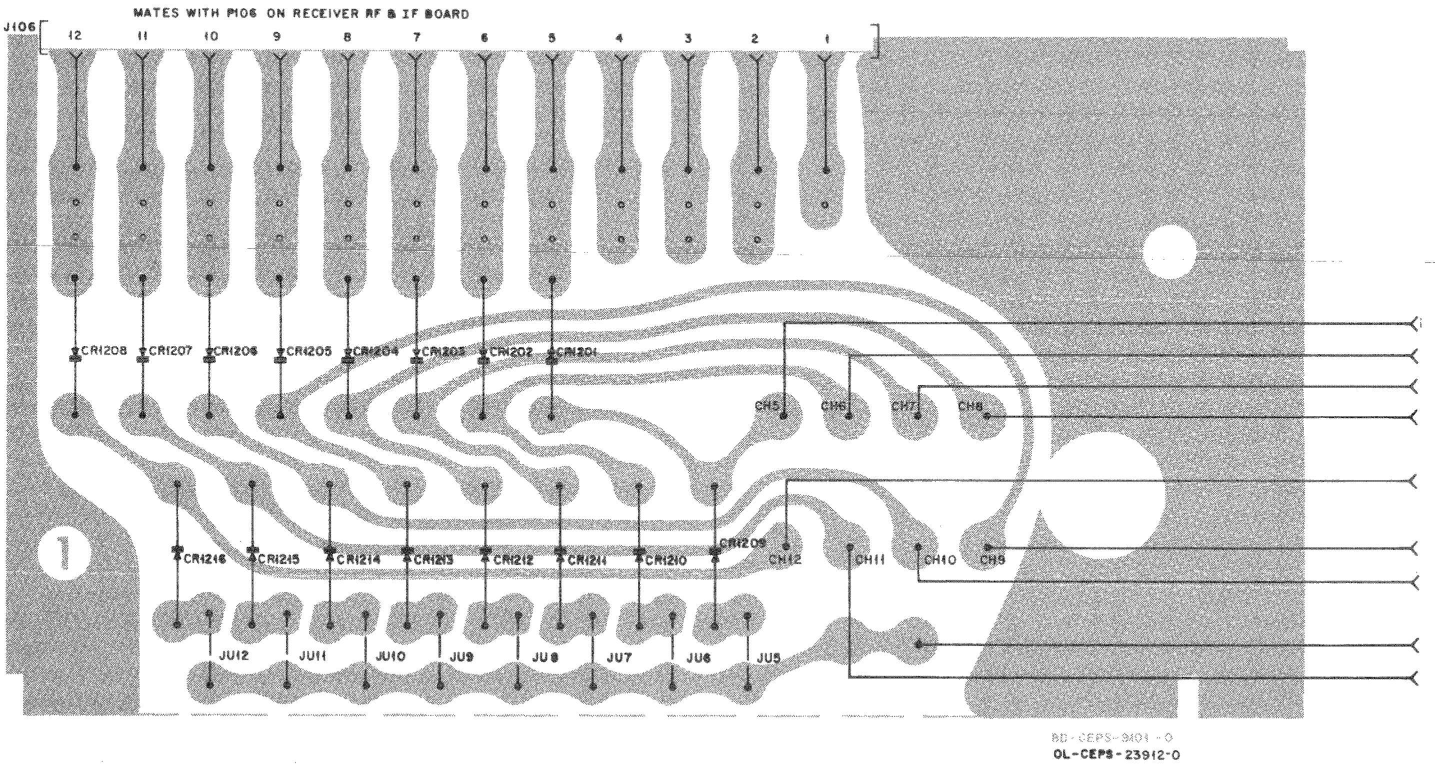
Step 1. The channel element sockets, designated F1 through F12, are on the receiver RF/IF board. The channel elements themselves are labeled with their receive frequencies. Refer to the receive frequency (R) column of the Frequency Assignment Table. Beginning with channel 1 and proceeding through channel 12, install a channel element in the socket corresponding to each new receive frequency encountered on your list.

Step 2. Refer to the circuit board detail of the Diode Matrix Board shown in Figure 3. Pins 1 through 12 of the connector shown along the top edge of the board are associated with channels 1 through 12 respectively. Each of the pins is connected to two circuit board pads immediately below it, except for pin 1, which has a single pad. Referring to the receive frequency (R) column of the Frequency Assignment Table, use jumpers to interconnect each group of pins associated with channels sharing a common receive frequency.

Step 3. Each of the twelve channel selector switch positions has one offset oscillator select jumper associated with it, as shown in Table 4.

Table 4. Control Board/Diode Matrix Board Jumpers

CHANNEL SELECTOR SWITCH POSITION	OFFSET OSCILLATOR SELECT JUMPER	LOCATION OF JUMPER
1	JU1	CONTROL BOARD
2	JU2	
3	JU3	
4	JU4	
5	JU5	DIODE MATRIX BOARD
6	JU6	
7	JU7	
8	JU8	
9	JU9	
10	JU10	
11	JU11	
12	JU12	



SHOWN FROM COMPONENT SIDE

Figure 3. Circuit Board Detail, Diode Matrix Board

Referring to Table 4 and the Frequency Assignment Table, remove the offset oscillator select jumper associated with any channel which has a frequency spacing (T-R) of 0 MHz.

Step 4. Install the Diode Matrix Board in the radio. The edge connector on the board mates with P106 on the receiver RF/IF board.

This completes the programming of the Control Board and Diode Matrix Board. DO NOT PERFORM ANY FURTHER PROGRAMMING STEPS.

7.2.6 Programming - Universal Switching Board

> Perform the steps in this section if the pre-programming procedure in section 7.2.3 indicates that your radio requires a Universal Switching Board.

Step 1. Remove diodes CR905, CR906, CR907, and CR908 on the Control Board. These diodes are located at the end of the board farthest from the front panel connector.

Step 2. In this step, the "Present f_o" box on the Frequency Assignment Table will be filled in. The frequency to be entered in the box depends on the frequency range and model type of the radio being programmed. See Table 5.

Table 5. Present f_o

FREQ RADIO (MHz)	RADIO MODEL	FREQUENCY TO BE ENTERED IN "PRESENT f_o" BOX (MHz)
470-512	Standard or Wide-Spaced	14.7
450-470	Standard or Wide-Spaced	16.7
406-420	Standard	11.7
	Wide-Spaced	See Text

On Wide-Spaced model radios operating in the 406-420 MHz frequency range, it is necessary to locate the T ≠ R offset oscillator crystal Y301. Write the frequency marked on the crystal in the "Present f_o" box.

Step 3. Subtract 11.7 MHz from the number found in the "Present f_o" box on the Frequency Assignment Table. Enter the result in the box labeled "Resultant Spacing".

Step 4. The channel element sockets, designated F1 through F12, are on the receiver RF/IF Board. The channel elements themselves are labeled with their receive frequencies. Refer to the receive frequency (R) column of the Frequency Assignment Table. Beginning with channel 1 and proceeding through channel 12, install a channel element in the socket corresponding to each new receive frequency encountered on your list.

Step 5. Make a copy of the Programming Chart shown in Figure 4. This chart represents the jumper programming area of the Universal Switching Board. Jumpers will be drawn on the chart in the following procedure; the Universal Switching Board will then be programmed directly from the chart.

Step 6. Interconnect the F and R pads on the chart corresponding to each channel for which a channel element was installed on the receiver RF/IF board.

Step 7. Refer to the Frequency Spacing (T-R) column of the Frequency Assignment Table. Interconnect the R and T pads on the chart corresponding to each channel having a spacing of 0 MHz or the number found in the "Resultant Spacing" box on the Frequency Assignment Table.

Step 8.

> Perform this step for each T pad except T1, starting with T2 and proceeding through T12. If it is necessary to connect a jumper to a T pad whose eyelets are both filled, trace the wiring away from the channel element involved to a T or R pad with an open eyelet.

Connect the T pad you are working on to the T pad of the nearest lower numbered channel which uses the same transmit frequency as the channel you are working on. If there is no such channel, connect the T pad you are working on to the T pad of the nearest lower numbered channel whose transmit frequency is equal to the transmit frequency of the channel you are working on MINUS the spacing found in the "Resultant Spacing" box.

NOTE

If the "Resultant Spacing" box contains a negative number, subtracting it will result in a larger number.

If there is no such channel, leave the T pad unconnected for now.

Step 9. Starting at the left side of the Programming Chart, locate the first channel whose R pad is not connected to anything. Referring to the Frequency Assignment Table, connect the R pad corresponding

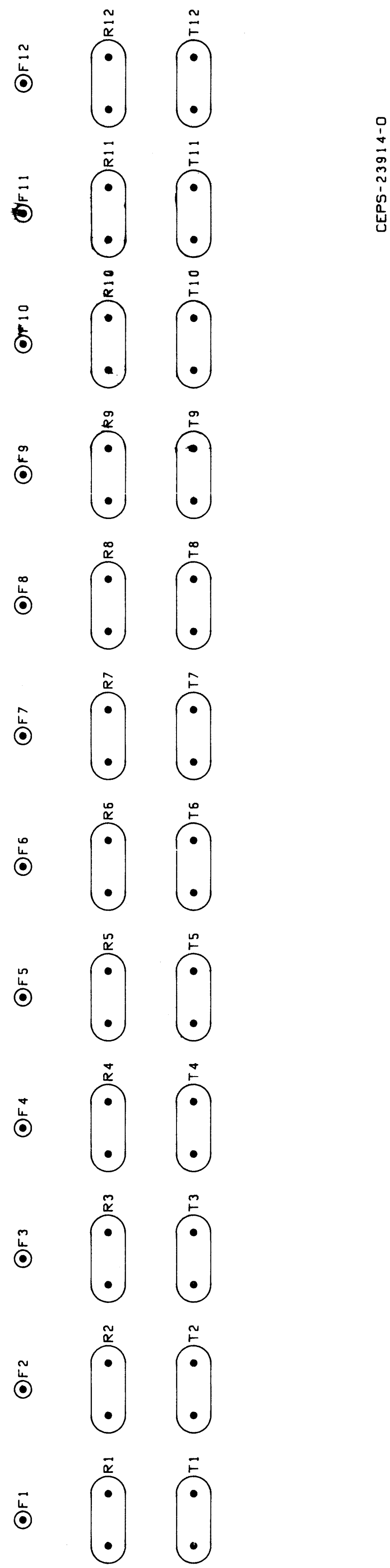


Figure 4. Programming Chart

to this channel to the R pad of the nearest lower numbered channel using the same receive frequency. Proceed toward the right side of the Programming Chart and repeat this step for each channel whose R pad is unconnected. (If it is necessary to connect a jumper to an R pad whose eyelets are both filled, trace the wiring away from the channel element involved to a T or R pad with an open eyelet.)

Step 10. Referring to the Programming Chart, start with T1 and proceed through T12, tracing the wiring connected to each T pad. Make sure that each T pad is connected to one and only one channel element. If the T pad associated with a particular channel is not connected to any channel element, enter an "X" in the "TX Only Element" column opposite that channel on the Frequency Assignment Table.

NOTE

The column heading refers to the fact that an additional "transmit only" channel element is required for each of these channels. This element is installed in the following steps.

> Perform steps 11, 12, and 13 for each channel for which an "X" has been entered in the "TX Only Element" column on the Frequency Table.

Step 11. Obtain a new channel element marked with frequency F, which is calculated from one of the following equations:

(1) If the Frequency Spacing (T-R) of the channel is larger than 1 MHz:

F = (desired transmit frequency) - (contents of "Resultant Spacing" box)

(2) If the Frequency Spacing (T-R) of the channel is 1 MHz or less:

F = desired transmit frequency

Step 12. Install the new channel element on the receiver RF/IF Board in an empty socket as close as possible to the socket corresponding to the channel you are working on. (If there are no empty sockets, the radio cannot be programmed to operate on the set of transmit-receive frequency pairings listed on the Frequency Assignment Table.)

Step 13. Connect the F pad corresponding to the socket used for the new channel element to the T pad of the channel you are working on.

Step 14. The Programming Chart now shows how the upper portion of the Universal Switching Board must be programmed to select the desired transmit-receive frequency pairings. Remove and/or add wire jumpers as required on your board to make it conform to the Programming Chart. The offset oscillator select jumpers are programmed in the following step.

Step 15. Each of the twelve channel selector switch positions has one offset oscillator select jumper associated with it, as shown in Table 6.

Table 6. Control Board/Universal Switching Board Jumpers

CHANNEL SELECTOR SWITCH POSITION	OFFSET OSCILLATOR SELECT JUMPER	LOCATION OF JUMPERS
1	JU1	CONTROL BOARD
2	JU2	
3	JU3	
4	JU4	
5	JU5	UNIVERSAL SWITCHING BOARD
6	JU6	
7	JU7	
8	JU8	
9	JU9	
10	JU10	
11	JU11	
12	JU12	

Referring to Table 6 and the Frequency Assignment Table, remove the offset oscillator select jumper associated with any channel which has a frequency spacing (T-R) of less than 1 MHz. Refer to the Universal Switching Board Circuit Board Detail (found in the "Receiver Control Boards" section) for the locations of jumpers JU5 through JU12.

Step 16. Install the Universal Switching Board in the radio. The edge connector on the board mates with P106 on the receiver RF/IF board.

This completes the programming of the Control Board and Universal Switching Board. DO NOT PERFORM ANY FURTHER PROGRAMMING STEPS.

8. ACCESSORIES

The control head and cables are described in separate sections of this instruction manual. A description of the "Private-Line" circuitry is included with the transmitter and receiver. The receiver pre-amplifier, time-out timer and positive ground converter are described.

9. RECEIVER PREAMPLIFIER

The preamplifier is a single stage grounded gate FET (field effect transistor) rf amplifier which connects between the antenna switch and receiver rf deck. It improves receiver sensitivity 6 dB from the specified receiver 20 dB quieting sensitivity of .5 microvolt.

The signal from the antenna is coupled directly into the input tuned-line of the preamplifier. This tuned-line passes the desired signal and matches the relatively low FET input impedance to the 50-ohm input line. The signal is capacitively coupled to the output tuned-line. The output tuned-line is a high Q tank circuit. It passes the desired signal and matches the relatively high FET output impedance to the 50-ohm output line.

10. TIME-OUT TIMER

a. Timing and Switching Circuit

When the transmitter is keyed, forward bias is applied to the base of the N-P-N inverter transistor Q1 and turns it on. The collector voltage of Q1 decreases and the N-P-N timer reset transistor turns off. This allows C1 to begin charging through R5, increasing the anode voltage of the programmable unijunction transistor Q3.

A programmable unijunction transistor is a diode that will not conduct in the forward direction until the voltage on the anode exceeds the voltage applied to the gate by 0.6 volt. When that point is reached, the programmable unijunction transistor conducts until capacitor C1, is completely discharged. It takes about one minute for the charge on C1 to exceed by 0.6 V, the gate voltage determined by the divider resistors R6 and R7.

The conduction of Q3 fires the time-out switch SCR1 causing it to conduct and ground the transmitter modulator through CR1. The time-out switch will continue to conduct as long as the keyed 9.6 volts is present.

b. Alert Tone Circuit

When SCR1 conducts, forward bias is applied to the base of the P-N-P alert tone switch transistor Q4, turning it on. The unijunction alert tone oscillator Q5 produces a tone whose frequency is determined by R12 and C5.

The unijunction transistor Q5 has three leads; emitter, base 1 and base 2. When C5 charges to approximately 60% of the voltage from base 2 to base 1, the emitter begins to conduct, and capacitor C5 is discharged across R14. When the capacitor is discharged, current flow stops and charging begins again through R12. Thus a pulse appears across R14 at a 1 kHz rate.

The N-P-N isolation switch Q6 turns on passing the alert tone to the audio/squelch board. When the alert oscillator is not in operation, Q6 presents an open circuit to the audio circuit.

The time-out timer resets itself whenever the transmitter is unkeyed. If the time-out switch has not been turned on when the transmitter is unkeyed the charge accummulated on C1 is discharged through R4 and Q2 to ground. If the alert tone is already on, it is shut off as soon as the transmitter is unkeyed, because the keyed 9.6 V which supplies power to the switches, oscillator, and the time-out switch is removed. Any charge on C1 will be discharged by the timer reset and ensure the full time interval on the next transmission.

11. POSITIVE GROUND CONVERTER

a. General

The positive ground converter operates from a negative 12-volt battery input with reference to radio chassis potential. It converts that input to a positive 12-volt output with reference to the chassis. This is accomplished by a chopper which develops an approximate 7 kHz alternating voltage, then rectifies the alternating voltage to produce a positive dc output. A short-circuit protector prevents excessive current if the output voltage becomes shorted.

b. Chopper

The chopper is a free running multivibrator which operates at approximately 7 kHz. The circuit consists of transistors Q1 and Q2, saturable core toroid transformer T1 and associated components. The negative polarity of the input voltage is applied to the emitters of Q1 and Q2; the positive polarity is applied to the collectors through transformer T1. The starting voltage is applied to both transistors, but slight imbalance will cause one transistor to conduct before the other. Assume Q1 conducts first. The resulting increase in Q1 collector current through the primary of the transformer induces a voltage in the feedback winding of the correct polarity to cause Q1 to be driven to saturation and Q2 to be driven to cutoff. As the transformer saturates, causing no change in flux density, the drive to the base of Q1 is reduced and its collector current begins to decrease. This causes a change in flux density in the opposite direction that drives Q1 into cutoff and Q2 into saturation. The action repeats with Q1 and Q2 alternately conducting, thus developing an alternating voltage across the secondary (output) winding of transformer T1.

Diode CR2 and resistors R1 and R2 form the starting and running bias circuit. Diode CR2 is reverse biased when power is first applied, thus the full supply voltage is applied through R2 and the feedback winding of T1 to the bases of Q1 and Q2 as forward bias. Once started, the feedback voltage forward biases CR2, and R1 and R2 form a voltage divider to establish a lower running bias. Capacitor C3 provides a path for the 7 kHz alternating voltage to decrease the switching time of the chopper.

c. Input Filter

Input filter C1, C2 and L1 filter out transients that may be present on the input and prevents coupling of the 7 kHz alternating voltage into the input circuit. Diode CR1 is a reverse polarity protection device for the converter. No input current flows if opposite polarity power is applied, and the transistors are protected.

When a radio with a positive ground converter is used with a negative ground electrical system, the negative ground cable routes battery voltage to different pins of the radio set connector. The negative ground cable provides positive voltage (BATT+) directly to the control board input filter instead of negative voltage (BATT-) to the positive ground converter input. This leaves the converter inactive; however, positive voltage (B+) is provided at the output of the control board filter. This point in the circuit is normally supplied with B+ voltage by the converter output when the converter is used with the positive ground cable. Therefore, the radio can be used interchangeably with positive or negative ground electrical systems; no adjustments inside the radio set are required.

d. Rectifier

Diodes CR3 and CR4 form a full wave rectifier which converts the 7 kHz alternating voltage from transformer T1 into a positive dc voltage. Capacitive filtering by C4 removes the ac ripple. The dc output voltage of the rectifier varies directly with the input voltage; that is, the output voltage of the converter increases when the input voltage increases, and vice versa.

e. Short Circuit Protector

The short-circuit protector consist of transistors Q3 and Q4 and associated components which operate as an electronic switch. During normal operation the switch is "on" and allows the rectifier output to be applied to the load. In a short-circuited or overloaded condition the switch turns "off" and blocks the rectifier output from the load. Thus the circuit protects the converter from damage by excessive current.

The circuit uses Q4 as a short-circuit detector to control the drive to the base of saturated switching transistor Q3. Resistors R3 and R4 form a voltage divider which establishes the voltage at the emitter of Q4. Resistors R6 and R7 form another voltage divider which establishes the voltage at the base of Q4. The emitter voltage reference is determined by the input voltage to the circuit and the base voltage reference is determined by the output voltage. In normal operation, Q4 is forward biased to provide base current to Q3. This current is sufficient to drive Q3 into saturation causing it to appear as a closed switch. The output voltage in that condition is virtually the same as the input voltage. Any variations in voltage causes both reference points to increase or decrease at the same ratio and the forward bias is maintained.

A short or overload in the output circuit causes the voltage at the base of Q4 to drop. If the overload is great enough to cause the base-to-emitter voltage of Q4 to drop below 0.6 volt, Q4 turns off and removes base drive current from Q3. In turn, Q3 also turns off and appears as an open switch. The only current available in this condition is through resistor R5, which limits the output current to about 10% of normal.

Resistor R5 also functions as the turn-on resistor for the protection circuit after the overload is removed, and as the starting resistor each time power is initially applied to the circuit. When Q3 is in the "off" condition, resistors R5, R6 and R7 form a voltage divider that provides forward bias to Q4. This circuit initially switches Q3 "on" or switches Q3 back "on" after an overload condition is removed.

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Communications Division

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SERVICING INFORMATION INDEX

1. INTRODUCTION

Three basic maintenance approaches may be used for localizing and repairing trouble in these radio sets.

- Replace the entire radio set with a spare and return the defective radio set to a maintenance shop for repair. This approach is well suited for fleet users with several identical radios. Operational testing of the radio after replacement is necessary to assure that the radio and its microphone, speaker, control head, antenna, cable connections, etc. are operating properly.

- Replace the defective circuit board with a spare and return the defective board to a maintenance shop for repair. This approach is recommended for maintenance facilities that maintain several similar radio sets. Testing must be performed after board replacement to assure that all troubles have been corrected. Realignment must be performed if the board contains alignment adjustments.

NOTE

Check jumper connections on replacement boards to make sure they are the same as originally in the radio.

- Isolate and repair the trouble on the spot. This approach must be used if spares are not available. A few simple tests will isolate the trouble to a specific board. Then detailed troubleshooting of the defective board may be performed.

To find the theory of operation of a particular circuit or to locate a circuit board detail, schematic diagram, or part list, refer to the servicing information index at the front of this section.

2. TEST EQUIPMENT

a. Portable Test Set

The most important pieces of test equipment required for servicing the "Micor" radio are a Motorola portable test set and Motorola Model TEK-37 or TEK-37A Test Set Adapter, or a Motorola Model TEK-5D Meter Panel, or a TEK-5B or C Meter Panel that has been modified by the addition of a TEK-40 Conversion Kit. Speedy, efficient, servicing is not possible without this equipment. Therefore, all servicing procedures in this manual assume that the maintenance technician uses these items. The portable test set can also be used for servicing most other Motorola two-way radio equipment; the TEK-37 or TEK-37A Test Set Adapter allows the test set to be used with the 7-pin metering receptacles on this radio equipment.

The radio set is equipped with metering receptacles for the exciter, power amplifier, power control board, receiver, and control board. The test set and adapter connect to these metering receptacles to allow rapid checking of over 20 major test points in the radio set for testing, alignment, and troubleshooting. The portable test set is also used to operate the radio during testing; that is, the transmitter may be keyed, a microphone may be connected to the test set to voice modulate the transmitter signal, and the speaker in the test set may be used for reception of incoming signals.

The test set adapter includes two cables terminated in a red plug and white plug respectively. These plugs mate with the metering receptacles on the radio set. The red "control" plug always connects to the receptacle on the control board.

The white "metering" plug connects to the receptacle on the exciter, power amplifier, power control board, or receiver (as required) for measuring the performance at each point critical to performance and alignment.

When the function selector switch on the test set is in the RCVR position, the transmitter cannot be keyed. This prevents inadvertent keying of the transmitter into a signal generator during receiver testing. The REF A-B switch on the adapter allows two meter references to be used if necessary (such as chassis ground, A- or A+). The earlier Model TEK-37 Test Set Adapter includes a SENS switch which provides two meter sensitivities of 100 millivolts or 1 volt full scale. The later Model TEK-37A Test Set Adapter does not have a SENS switch.

Instructions for using the test set to service the "Micor" radio are given on the troubleshooting charts in this section of the manual.

IMPORTANT

All portable test sets built before the introduction of "Micor" radio must be modified for compatibility with the TEK-37 or TEK-37A Test Set Adapter. These test sets are identified by the

IMPORTANT (CONT'D.)

stamping on the chassis. Those units stamped SLN6056A-3 or earlier require modification. Those stamped SLN6056A-4 later do not require modification; they were built to be compatible with the adapter. Once the portable test set is modified, the original metering cable must also be modified to allow continued usage of the test set for servicing other Motorola radio equipment. The SKN6013A Metering Cable, which was supplied with the test set (20-pin connector on one end which plugs into the test set and 11-pin plug on the other); and the SKN6012A Metering Cable, (20-pin connector on one end which plugs into the test set and 12-pin miniature plug on the other end) require modification. The SKN6012B and SKN6013B Metering Cables do not require modification. These are the cables that have been supplied since the introduction of "Micor" radio.

(1) Using the Portable Test Set

For testing radios in a vehicle, the VOLUME and SQUELCH controls may be preset and the radio operated from the portable test set. This allows the technician to make measurements with the radio in actual operating conditions. When the "metering" plug is connected to the receiver metering receptacle, the function selector switch may be placed in either the XMTR or RCVR position. In the RCVR position, the transmitter cannot be keyed. This position should be used when a signal generator is connected to the antenna receptacle for testing. In the XMTR position, the transmitter can be keyed and unkeyed to send and receive test messages. All receiver meter readings are the same in the XMTR position as they are in the RCVR position, except that position 4 reads 0 to +50 uA full scale instead of ±25 uA either side of 0 center scale.

(2) Measuring Transmitter Output Power with the Portable Test Set

When the "metering" plug is connected to the power control board and the selector switch is set to position 1, the test set meter measures transmitter output power; a wattmeter is not required. Each radio set is factory calibrated and affixed with a label which shows the test set meter reading which corresponds to the rated power output. This reading is in the range of 15 to 50 uA. The specific value varies from radio to radio depending upon circuit characteristics in the forward power metering circuit.

NOTE

1. There is no conversion from uA to watts at readings other than the calibrated value. Power readings are non-linear and may be used only to show whether power output is high, low, or normal.
2. If the power control board is replaced with a spare or repairs are made in the forward power metering circuit the meter reading must be recalibrated.

TO CALIBRATE FORWARD POWER METER READING

1. Use a wattmeter to measure the transmitter power output.
2. Adjust the POWER SET control for rated transmitter power output.
3. Read the test set meter. This is the reference value (in uA) which corresponds to the rated power output.
4. Fill in this value on the calibration label.

When the "metering" plug is connected to the power control board and the selector switch is in position 2, the test set meter measures reflected power. A dc bias voltage is also present at this point which causes a meter reading with no reflected power. The technician should record this value for reference. The value should be measured with the transmitter terminated in a 50-ohm dummy load (no reflected power). The readings will fall in the following ranges:

T34 models	9 to 12 uA
T44 models	10 to 13 uA
T54 models	11 to 14 uA
T74 models	12 to 15 uA

If there is an antenna problem, the meter reading will be much higher. Virtually all antenna problems cause a high reflected power which can be checked easily with this feature.

TABLE OF RECOMMENDED TEST EQUIPMENT

TYPE OF EQUIPMENT OR TYPE OF MEASUREMENT	EQUIPMENT CHARACTERISTICS	RECOMMENDED TYPE
All	Select battery operated test equipment where available, for versatility. Battery operated equipment permits testing in the vehicle or on the bench.	See your Motorola sales representative before ordering test equipment. He will analyze your requirements and help you select the latest available equipment to suit your individual needs. He can also advise you of new servicing equipment which becomes available after the printing of this manual.
Power Supply for Bench Testing	Transmit: 13.4 V dc @ 35.5A (T74 model transmitter) 13.4 V dc @ 27.5A (T54 model transmitter) 13.6 V dc @ 15.9A (T44 model transmitter) 13.6 V dc @ 10.5A (T34 model transmitter) Receive (standby): 13.8 V dc @ .500A CAUTION Excessive voltage may cause damage to the radio.	Motorola Model R1011 Regulated Power Supply 12-volt vehicle battery (or bank of parallel batteries) with adjustable battery charger or power supply to maintain required terminal voltage with transmitter keyed. For T34 models only, the Motorola T1012A Power Supply may be used. CAUTION Do not use inductive filter with power supply.
Test Harness for Bench Testing	Must simulate conditions of installation in vehicle including fusing, volume and squelch controls, frequency selection, speaker loading.	"Micor" cables, control head, microphone and speaker, or TEK-25A Universal Control Panel and TEKA-50 Adapter Cable
Portable Test Set or Bench Meter Panel	No equivalent. Use only recommended type.	Motorola S1056B to S1059B Series (or Model TU546) Portable Test Set with TEK-37A Test Set Adapter Motorola TEK-5B or TEK-5C Meter Panel modified with TEK-40 Conversion Kit TEKA-74 Microphone Adapter allows "Micor" microphone to be used with test set.
Transmitter Frequency Measurement	Frequency - 406 to 512 MHz Accuracy - ±0.0005% or better	Any of the following items of Motorola Test Equipment: Model R1200A Series Service Monitor Model S1343 Series Digital Freq. Meter Model S1344 Series Digital Freq. & Deviation Meter
Transmitter Deviation Measurement	Peak reading type for voice or sinusoidal wave; scales for accurate reading of ±5 kHz deviation (and ±1 kHz deviation for "Private-Line" models)	Any of the following items of Motorola Test Equipment: Model R1200A Series Service Monitor Model R1007 Series Deviation Meter Model S1344 Series Digital Frequency & Deviation Meter Model S1059B Portable Test Set
Transmitter Power Output Measurement and Interstage Testing	406-512 MHz; 50 ohms; at least 0-150 watts for T74 and T54 model transmitters; at least 0-75 watts for T44 and T34 model transmitters. Adapter cables for PA interstage power output check. 50-ohm dummy load; at least 150 watts	Motorola S1056B to S1059B Portable Test Set Motorola Model S1350 Wattmeter with Motorola PK-700A Test Cable Set Motorola Model T1013A RF Load Resistor
RF Signal Generator for receiver testing	406 to 512 MHz; FM; high-stability (±.0002% or better); adjustable output 0 to 1000 microvolts	Motorola Model R1200A Series Service Monitor Motorola S1329B Series Solid-State FM Signal Generator
Audio Voltage Measurements	High impedance (10 megohm); dBm scale	Motorola Model S1053C Solid-State AC Voltmeter
Audio Signal Generator for audio circuit testing in receiver and transmitter	Variable amplitude 0 to 1 volt; 1000 Hz tone (300 to 3000 Hz preferred); sinusoidal wave	Motorola Model S1067B Solid-State Audio Oscillator Motorola Model TEK-1A Tone Oscillator Motorola Model R1200A Series Service Monitor
DC Voltage Measurements, Resistance Measurements, RF Voltage Measurements	High impedance (11 megohm) dc multimeter	Motorola S1063B Solid-State DC Multimeter with SLN6055A RF Probe Motorola Model T1048A Digital Multimeter
Waveform Measurements	Oscilloscope: Audio circuit measurements.	General Purpose Oscilloscope
"Private-Line" tone injection for PL decoder circuit measurements	"Private-Line" tone generator using "Vibrasender" resonant reed for frequency accuracy; or audio oscillator with frequency counter for accurate setting of oscillator.	Motorola Model S1333B Audio Synthesizer Motorola Model SLN6221A "Private-Line" Tone Generator
"Digital Private-Line" Code Generation and Decoding for DPL encoder and decoder testing	"Digital Private-Line" test set capable of generating and decoding DPL binary code signals.	Motorola Model SLN6413A "Digital Private-Line" Test Set
Antenna Switching Network Loss Measurements	406-512 MHz; 50 ohms; at least 0-150 watts for T74 and T54 model transmitters; at least 0-75 watts for T44 and T34 model transmitters. 50-ohm dummy load; at least 150 watts. adapter cables for measuring input and output power of antenna switching network.	Motorola Model S1350A Wattmeter with appropriate element. Motorola T1013A RF Load Resistor Motorola PK700A Test Cable Kit

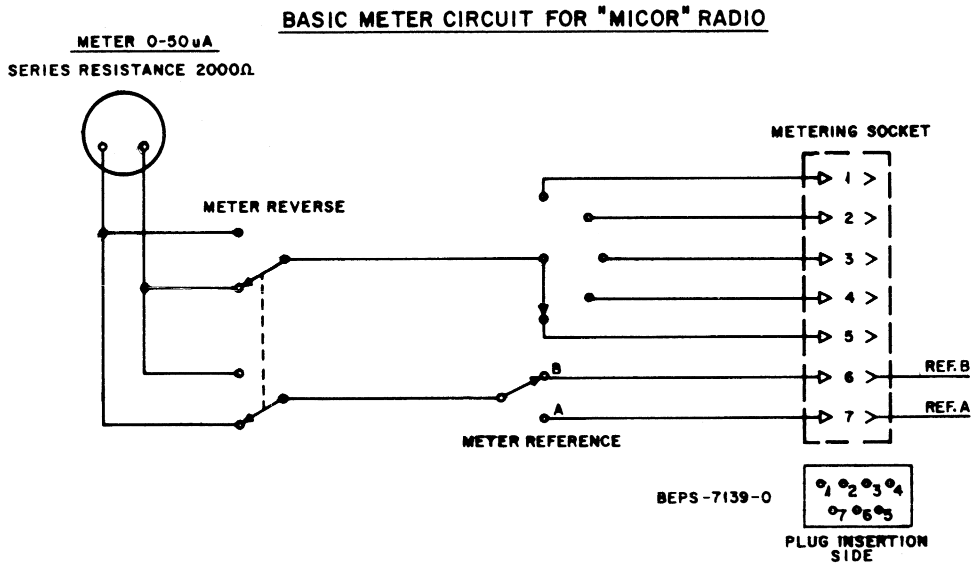


Figure 1.
Basic Meter Circuit for "Micor" Radio

b. Substitution for Portable Test Set

If a Motorola Portable Test Set or Meter Panel is not available, metering may be accomplished with a 0-50 uA meter (with 2000 ohms series resistance). The following table identifies connection points for such metering checks.

METERING TEST POINTS FOR TEST SET SUBSTITUTE

CIRCUIT	TEST POINT PIN # 406-420 MHz	TEST POINT PIN # 450-512 MHz	POLARITY	REFERENCE PIN #	REFERENCE LOCATION
EXCITER					
No Connection	1	1	Neg.	7	Chassis
Standard Channel Output	3	2	Neg.	7	Chassis
Wide Space Channel Output	2	3	Neg.	7	Chassis
Offset Osc. Output (406-420 MHz)	4	-	Neg.	7	Chassis
Standard Offset Osc. Output (450-512 MHz)	-	4	Neg.	7	Chassis
Wide-Spaced Offset Osc. Output (450-512 MHz)	-	4	Pos.	7	Chassis
1st Low Level Amplifier	5	5	Neg.	6	Keyed 9.6 V
PA SERVICE METER					
Low Level Amp Output	1		Neg.	6 or 7	A+
Pre-Driver Current	2		Neg.	6 or 7	A+
Driver Current	3		Neg.	6 or 7	A+
No Connection	4		Neg.	6 or 7	A+
Control Voltage	5		Neg.	6 or 7	A+
POWER CONTROL BOARD					
RF Output	1		Pos.	7	+5.3 V*
RF Reflected	2		Neg.	7	+5.3 V*
Control Voltage	3		Neg.	6	A+
No Connection	4				
PA Current	5		Pos.	6	A+

METERING TEST POINTS FOR TEST SET SUBSTITUTE (CONT'D.)

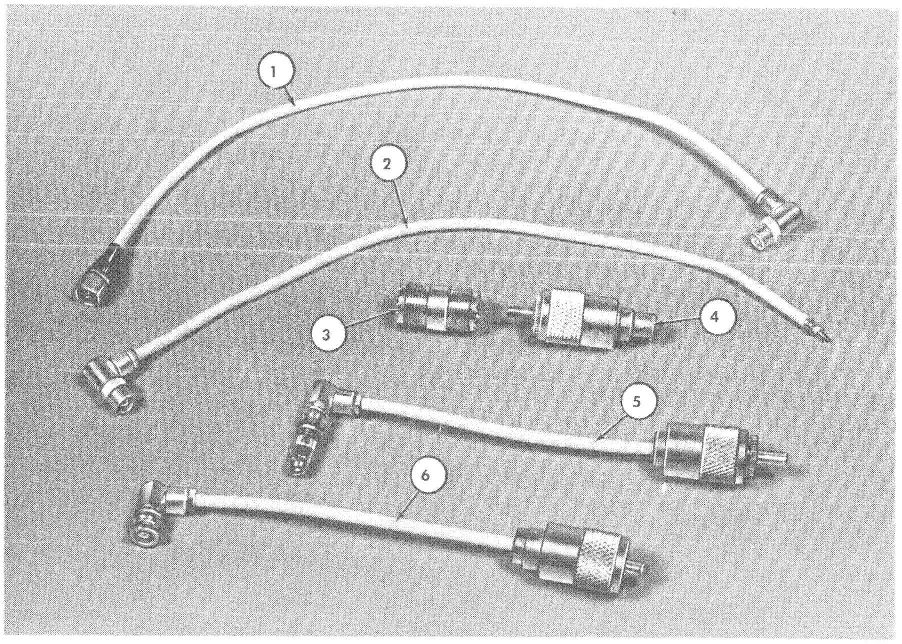
<table>
<tr><th rowspan="3">CIRCUIT</th><th colspan="3">TEST POINT</th><th colspan="2" rowspan="2">REFERENCE</th></tr>
<tr><th colspan="2">PIN #</th><th rowspan="2">POLARITY</th></tr>
<tr><th>406-420 MHz</th><th>450-512 MHz</th><th>PIN #</th><th>LOCATION</th></tr>
<tr><td>RECEIVER</td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>Channel Element</td><td colspan="2">1</td><td>Neg.</td><td>6 or 7</td><td>Chassis</td></tr>
<tr><td>First Doubler Output</td><td colspan="2">2</td><td>Neg.</td><td>6 or 7</td><td>Chassis</td></tr>
<tr><td>Second Doubler Output</td><td colspan="2">3</td><td>Neg.</td><td>6 or 7</td><td>Chassis</td></tr>
<tr><td>Discriminator</td><td colspan="2">4</td><td>Neg.</td><td>6 or 7</td><td>Chassis</td></tr>
<tr><td>IF</td><td colspan="2">5</td><td>Neg.</td><td>6 or 7</td><td>Chassis</td></tr>
<tr><td>CONTROL BOARD (INTERFACE)</td><td colspan="2"></td><td></td><td></td><td></td></tr>
<tr><td>Receiver Audio</td><td colspan="2">1</td><td></td><td>2</td><td></td></tr>
<tr><td>Receiver Audio</td><td colspan="2">2</td><td></td><td>1</td><td></td></tr>
<tr><td>No Connection</td><td colspan="2">3</td><td></td><td></td><td></td></tr>
<tr><td>9.6 V Regulated</td><td colspan="2">4</td><td>Pos.</td><td>6</td><td>Chassis</td></tr>
<tr><td>Transmitter Key (PTT)</td><td colspan="2">5</td><td></td><td>6</td><td>Chassis</td></tr>
<tr><td>Chassis Ground</td><td colspan="2">6</td><td></td><td></td><td></td></tr>
<tr><td>Transmitter Audio</td><td colspan="2">7</td><td></td><td>6</td><td>Chassis</td></tr>
</table>

* with respect to A-

c. Other Test Equipment

Refer to the accompanying RECOMMENDED TEST EQUIPMENT TABLE for a list of the test equipment items necessary for complete servicing of the "Micor" radio.

The Model PK700A Cable Kit is highly recommended for rf power amplifier interstage testing and antenna switching network loss measurements. This cable kit consists of the items shown in Figure 2.



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REFERENCE	DESCRIPTION	APPLICATION
1	Miniature BNC to phono coaxial cable.	Connecting Low-Level Amplifier output to antenna matching network.
2	Miniature BNC to bare conductor coaxial cable.	Connecting the output of any PA stage to the antenna matching network.
3	UHF through connector	Connecting a signal generator to the exciter input.
4	Antenna adapter connector	
5	UHF to male miniature BNC coaxial cable.	Measuring antenna switching network insertion loss.
6	UHF to female miniature BNC coaxial cable.	

Figure 2.
PK700A Cable Kit

3. TESTING AND TROUBLESHOOTING

CAUTION

The poor regulation and/or transient response of many bench power supplies can apply excessive voltage to high power radios when going from the transmit to receive condition. Avoid using these supplies or damage to the radio may result. The following bench supplies are approved for testing the "Micor" radio:

Motorola R1011 High Current Power Supply

Motorola T1261A Transistorized 24-volt to 12-volt Converter driven by Motorola T1012A Power Supply.

12-volt automotive battery with Motorola T1012A Power Supply used as a battery charger. The power supply will provide sufficient power to maintain the voltage under full load conditions, and the battery will absorb the over-voltage upon dekeying.

a. Bench Testing Positive-Ground Radios

Radios which are removed from a positive ground vehicle for bench testing may be serviced using a negative ground cable and a power source without removing or disabling the positive ground converter. Only the cable (which remains in the vehicle) is different for positive ground operation. The positive ground converter is automatically deactivated when the radio is connected to a negative ground cable.

b. Operational Check

An operational check of the radio will often isolate the cause of a problem to one or two circuit boards. The block diagram in the DIAGRAMS section of this manual provides a guide to the overall design of the radio and the location of various circuits.

c. Individual Circuit Board Metering

The individual circuit board metering feature in UHF "Micor" Mobile FM Radios provides a way to determine which suspected circuit board is actually defective. The table of test set procedures and readings provides metering information for each circuit board in the radio.

d. Testing Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced unless it is definitely indicated that the IC is the defective component. Before replacing an IC, make sure that the external components in the circuit are normal.

Signal tracing is the preferred IC testing method. A less effective method is dc voltage checks. Integrated circuit voltage tables are given in various places in the servicing text, on troubleshooting charts, and on schematic diagrams.

4. CONTROL (INTERFACE) BOARD

a. Introduction

Several overall radio checks can be made with a Motorola portable test set connected to the control board. These checks are particularly useful when the radio must be checked in the vehicle.

b. Speaker Audio Measurement

To measure the level of the audio at the radio speaker, use the following procedure:

(1) Connect a TEK-37A Test Set Adapter Cable to the 20-pin receptacle on the front of the portable test set.

(2) Connect the adapter cable red "control" plug to the receptacle on the control board.

(3) Set the test set mode selector switch to the RCVR position.

(4) Set the test set meter selector switch to position 11.

(5) Set the test set meter reversing switch to the OFF position.

(6) Set the test set multiplier switch to the 0.2 V AC or the 2 V AC position, as needed.

c. Microphone Audio Measurement

To measure the microphone audio level, use the following procedure:

(1) Connect a TEK-37A Test Set Adapter Cable to the 20-pin receptacle on the front of the Motorola portable test set.

TEST SET PROCEDURES AND READINGS FOR COMPLETE RADIO

SELECTOR SWITCH POSITION		METER REVERSE SWITCH	REF SWITCH	FUNCTION SELECTOR	FUNCTION METERED	READING (Note 7)	NOTES
CONTROL BOARD (red "control" plug connected to control board)							
10		OFF (Meter Rev. for Pos. Gnd. Operation)	A or B	XMTR or RCVR	A+	13V	
11		OFF	A or B	RCVR	speaker audio	-	Note 1
				XMTR	mic. audio	-	Note 1
12		OFF	A or B	XMTR or RCVR	mic. dc	6V	Note 4
13		OFF	-	-	test set battery	6V	
RECEIVER (white "metering" plug connected to receiver)							
B*	1	OFF	A or B	RCVR or XMTR	channel element	15 uA	
	2	OFF	A or B	RCVR or XMTR	first doubler	15 uA	
	3	OFF	A or B	RCVR or XMTR	second doubler	15 uA	
	4	OFF	A or B	RCVR	discriminator	0±2 uA	Note 2, reading is maximum
	5	OFF	A or B	RCVR or XMTR	i-f	10 uA	Note 2
EXCITER (white "metering" plug connected to exciter)							
B*	2	OFF	A	XMTR	*standard output	Range 10-40 uA	Note 5
	3	OFF	A	XMTR	**wide-spaced output	Range 10-40 uA	Note 5
	4	OFF	A	XMTR	standard offset osc. output	17 uA	Note 9
		ON			wide-space offset osc. output		
	5	OFF	B	XMTR	first low-level ampl.	15 uA	

*For 406-420 MHz this is wide spaced output.
**For 406-420 MHz this is standard output.

TEST SET PROCEDURES AND READINGS FOR COMPLETE RADIO (Continued)

SELECTOR SWITCH POSITION		METER REVERSE SWITCH	REF SWITCH	FUNCTION SELECTOR	FUNCTION METERED	READING (Note 7)	NOTES
POWER AMPLIFIER (white "metering" plug connected to PA service meter)							
B*	1	OFF	A or B	XMTR	low-level ampl. output	15 uA	
	2	OFF	A or B	XMTR	pre-driver current	35 uA	reading is maximum
	3	OFF	A or B	XMTR	driver current	not used (T34 and T44) 27 uA (T54) 45 uA (T74)	reading is maximum
	5	OFF	A or B	XMTR	control voltage	Range 0-25 uA	Note 10
POWER CONTROL BOARD (white "metering" plug connected to power control board)							
E*	1	METER REV	A	XMTR	output power	see calibration label	
	2	OFF	A	XMTR	reflected power	9-15 uA	Note 3, reading is maximum
	3	OFF	B	XMTR	control voltage	Range 0-25 uA	Note 10
	5	METER REV	B	XMTR	final current	24/18 uA (T34) 37/32 uA (T44) 29/26 uA (T54) 43/34 uA (T74)	Note 6

NOTES:

1. Reading varies with audio level.
2. No signal input condition.
3. With a 50-ohm load attached to radio antenna connector.
4 6 V minimum reading when keyed from mic;
   9 V reading when keyed from xmtr "on" button.
5. Exciter output is checked in meter position 2 for standard channel spacing and in meter position 3 for wide channel spacing. Reading is used in alignment procedure and should not be used as an indication of performance.
6. First reading is for radios in the 450-470 MHz band and is maximum. Second reading is for radios in the 470-512 MHz band and reading is typical.
7. All readings are minimum values unless otherwise noted.
8. *Indicates selector switch position on TEK-5 Meter Panel that has been modified with a TEK-40 Conversion Kit. The listed selector switch position numbers correspond to meter position numbers on the TEK-5 Meter Panel.
9. Minimum reading is 9 uA when a TEK-5 meter panel is used.
10. **Reading varies with voltage drop on controlling stage (Q505). A high reading indicates low controlling stage collector voltage, and vice-versa.**

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(2) Connect the adapter cable red "control" plug to the receptacle on the control board.

(3) Set the test set mode selector switch to the XMTR position.

(4) Set the test set meter selector switch to position 11.

(5) Set the test set meter reversing switch to the OFF position.

(6) Set the test set meter multiplier switch to the 0.2 V AC position.

(7) Connect the microphone to the radio set control head or to the MICROPHONE jack on the test set, using a TEK-74A Microphone Adapter.

(8) Be sure the radio set antenna connector is connected to an antenna or a 50-ohm resistive dummy load.

(9) Press the microphone PTT switch and speak into the microphone. The test set meter indicates the microphone audio level.

This procedure can be used when a radio must be checked in the vehicle. An on-the-air check of the radio transmitter can be made using the microphone connected to the test set.

d. Vehicle Battery Voltage Measurement

To measure vehicle battery voltage:

(1) Connect a TEK-37A Test Set Adapter Cable to the 20-pin receptacle on the front of the portable test set.

(2) Connect the red control plug to the receptacle on the control board.

(3) Set the selector switch to position 10. Do not key the transmitter.

(4) Set the meter reversing and oscillator switch to the OFF position for negative ground operation and to METER REV. for positive ground operation.

(5) Read the radio set input voltage on the 15-volt scale of the meter. Normal reading should be 12 to 15 volts.

(6) Key the radio transmitter and read the radio input voltage on the 15-volt scale of the meter. Normal reading is 12 to 15 volts.

NOTE

Depending on the installation, the vehicle may have to be running before the radio set transmitter can be keyed.

e. Measuring Keyed 9.6 Volts

To measure keyed 9.6 volts:

(1) Connect a dc voltmeter to pin 4 of the control socket on the control board (chassis reference).

(2) The meter should read 9.3 to 9.9 volts.

(3) If the 9.6 volt output is abnormal measure the dc voltages in the regulator circuit. Refer to the schematic diagram for typical values.

5. RECEIVER RF AND IF BOARD

CAUTION

Do not remove the channel element by exerting force through the hole provided for access to the channel warp capacitor. Excessive pressure will damage the capacitor. A small access hole is provided adjacent to the one for channel warp. Use a tuning tool (Motorola Part No. 66D84387C01) to push out element.

a. Introduction

This section provides maintenance procedures for the receiver rf and i-f board. The procedures consist of bench tests which include measurements with a Motorola test set, and testing and troubleshooting procedures that include integrated circuit checks.

NOTE

The receiver rf and i-f board must be installed in a radio set for testing to provide the necessary power, ground, control and signal connections. The board should always be secured in place with all mounting screws for operation and testing to provide a good rf ground to all stages of the receiver.

b. Performance Tests

Use the following tests to determine if the receiver rf and i-f board is operating properly. If either of the tests produces unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart for a procedure to isolate the defective stage.

(1) No-Signal Test Set Meter Reading Check

(a) The receiver rf and i-f board must be installed in a complete receiver for testing. Make sure the rf and i-f circuit board mounting screws are all secure and that all connections to the board are properly made.

(b) Be sure the receiver shield is in place.

(c) Turn on the radio.

(d) Using a TEK-37 Adapter Cable, connect a Motorola portable test set or meter panel to the radio as follows:

-- Connect the adapter cable 20-pin connector to the receptacle on the front of the test set or meter panel.

-- Connect the adapter cable red "control" plug to the receptacle on the control board.

-- Connect the adapter cable white "metering" plug to the metering receptacle on the receiver rf and i-f board.

(e) Set the portable test set switches as follows:

-- Set the function switch to the RCVR position.

-- Set the meter reversing switch to the OFF position.

-- Set the adapter cable SENS switch to the 100 mV position. If the adapter cable has no SENS switch, the unit operates at 100 mV all of the time.

-- Set the adapter cable reference switch to position A or position B.

(f) Refer to the following meter reading table. Set the test set selector switch to the positions called for in the table and observe the test set meter. Notice that the meter readings given in the table are minimums.

MINIMUM RECEIVER RF & IF METER READINGS TABLE
(No Input Signal Applied)

SELECTOR SWITCH POSITION	READING (MICRO-AMPS)	CIRCUIT METERED
1	15	Channel element output
2	15	First Doubler output
3	15	Second Doubler output
4	0 ±2	Discriminator output
5	10	Second i-f amplifier and limiter

(2) 20 dB Quieting Sensitivity Test

(a) Set up the radio and portable test set or meter panel as described in steps (a) through (e) of the no-signal test set meter reading check.

(b) Set the portable test set MULT switch to the 2 V AC position.

(c) Set the portable test set selector switch to position 11 (audio).

(d) Set the test set SPKR switch to the LOAD position and disconnect the radio speaker if you want to silence the radio speaker during the test.

(e) On "Private-Line" radios, remove the microphone from its hang-up box or set the PL MONITOR switch on the hang-up box to the OFF position. This disables the PL decoder.

(f) Set the radio SQUELCH control fully counterclockwise.

(g) Adjust the radio VOLUME control so the test set meter reads 2 volts AC.

(h) Connect an rf signal generator to the radio antenna connector.

(i) Set the signal generator controls as follows:

-- Set up the signal generator to produce a CW or unmodulated signal.

-- Set the generator output level to maximum.

-- Set the signal generator output frequency to the selected channel receive frequency. To set the signal generator on frequency without a frequency counter, adjust the generator frequency control until test set meter position 4 reads exactly zero.

(j) With the portable test set selector switch in meter position 11 (audio), slowly decrease the signal generator output level until the test set meter reads 0.2 volts AC. Move the portable test set MULT switch to the 0.2 V AC position if necessary.

NOTE

The output frequency of some signal generator will be "pulled" when the output level is near maximum. It may be necessary to reset the generator frequency as the output level is reduced.

(k) Note the signal generator output level. If the receiver rf and i-f board is functioning properly, this level should be 0.5 uV or less for a radio without an rf preamplifier, or 0.25 uV or less for a radio with an rf preamplifier.

c. Troubleshooting

(1) Visual Inspection

The first step in the troubleshooting procedure should be a thorough visual inspection of the radio and, in particular, the receiver rf and i-f board. Corrosion and burned or damaged components are usually easily seen and may be the cause or a symptom of the receiver malfunction. Loose circuit board mounting screws, or a loose or improperly installed receiver shield are other easily found problems that can cause a considerable degradation in receiver performance.

After the "obvious" problems have been corrected, repeat the receiver rf and i-f board performance tests. If the tests still produce unsatisfactory results, refer to the receiver rf and i-f troubleshooting chart. The troubleshooting chart provides a systematic procedure for isolation of the defective stage and component.

As much information as possible has been included on the troubleshooting chart. However, you will have to refer occassionally to the receiver rf and i-f schematic diagram and circuit board detail. Detailed procedures for AFC troubleshooting, receiver gain measurements, and crystal dip tests follow in the text of this section of the manual.

(2) Troubleshooting the AFC

To check AFC operation, perform the following test:

(a) Connect the Motorola test set to monitor the discriminator output (meter position 4).

(b) Connect an rf signal generator to the radio antenna connector. Set up the generator to provide about 100 uV of unmodulated signal at the selected receive channel frequency.

(c) Insert a screwdriver or other shorting device through the AFC OFF hole in the receiver shield, shorting the plating beneath the hole to the receiver shield, and adjust the input signal frequency for a discriminator meter indication on the test set of approximately 6 uA off zero center scale.

(d) Remove the short. The test set meter indication should return to within 3 uA of zero center scale. If it does not, the AFC is malfunctioning.

(e) If the AFC is malfunctioning, either components on the receiver rf and i-f board or AFC circuitry in the channel element may be defective. The board may be checked by tracing the AFC error voltage from the discriminator output to the channel element. Performing step (c) and removing the short should produce an error voltage of approximately 0.6 V dc (+ or - with respect to chassis, depending upon direction of the zero center offset) when measured with a voltmeter which has a minimum of 11 megohms input impedance. Check for this error voltage at P904-15, P904-14, P904-7 and at the AFC OFF plating near the channel element.

The AFC channel element may be checked by substituting a known good channel element.

(3) Receiver Gain Measurements

NOTE

Before making any receiver gain measurements, make sure the case of every filter crystal has a good conductive path to ground. An ohmmeter test should indicate less than 1 ohm between the crystal case and the

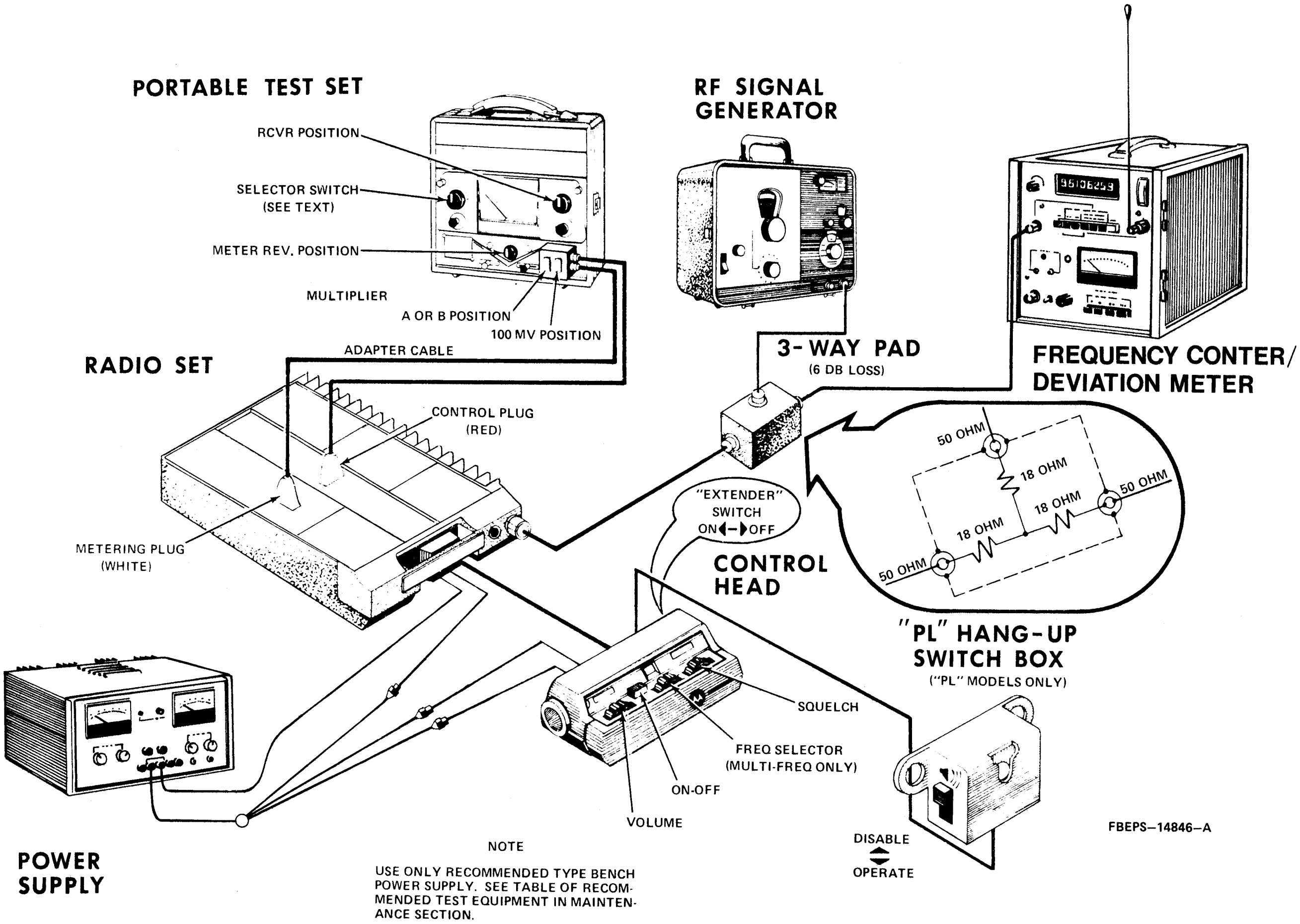


Figure 3.
Test Equipment Set-Up for Receiver Gain Measurements and Crystal Dip Tests

NOTE (CONT'D.)

receiver circuit board ground plating. A bad ground connection may cause errors in gain measurements.

(a) Set up the test equipment as shown in Figure 3.

(b) Connect the 20-pin plug of the adapter cable to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve the test set battery. The plug acts as an on-off switch completing the battery circuit.

(c) Set the meter reversing switch on the portable test set to OFF. On adapter cable: set the SENS switch to the 100 mV position; the REF switch may be placed in either the A or B position.

NOTE

An adapter cable without a SENS switch operates at 100 mV all of the time.

(d) Connect the red "control" plug of the adapter cable to the control circuit board receptacle on the radio set. Connect the white "metering" plug of the adapter cable to the receiver rf and i-f board metering receptacle.

(e) Proper receiver alignment is essential to this procedure. Complete receiver rf and i-f alignment is given in the ADJUSTMENTS section of this instruction manual.

(f) Refer to the following table of receiver gain measurements, the receiver rf and i-f schematic diagram, and the receiver rf and i-f circuit board detail.

NOTE

Receiver rf input voltages given in the table are those at the radio set antenna connector. If a pad or other attenuator is connected between the signal generator and the radio set rf input, the signal generator output control must be set to compensate for the loss in the pad.

EXAMPLES:

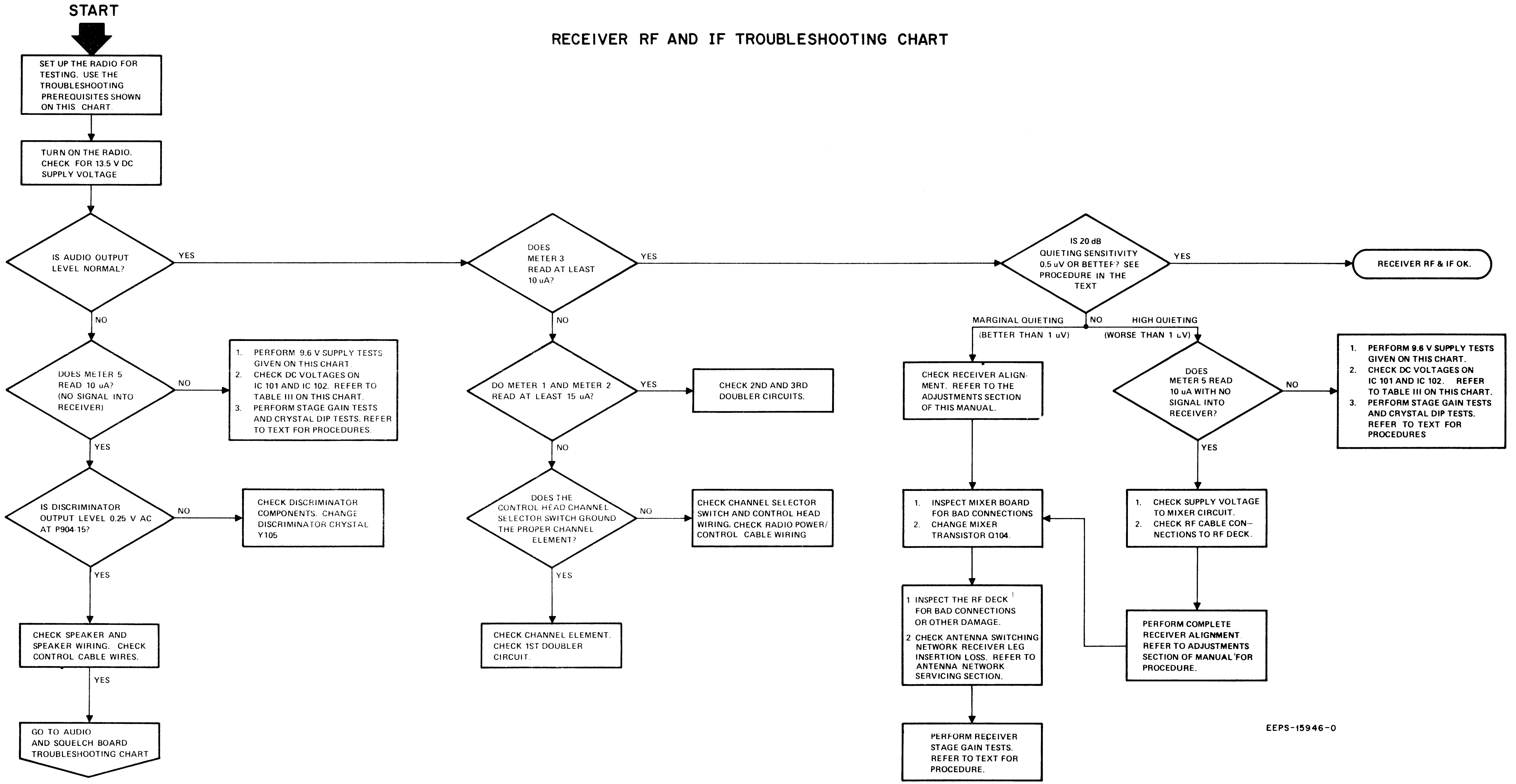
6 dB loss means V out of the pad = 1/2 V into the pad.

20 dB loss means V out of the pad = 1/10 V into the pad.

RECEIVER RF AND IF TROUBLESHOOTING CHART

TROUBLESHOOTING PREREQUISITES

1. THE RECEIVER RF & IF BOARD MUST BE INSTALLED IN A COMPLETE RECEIVER FOR TESTING. BE SURE ALL CIRCUIT BOARD MOUNTING SCREWS ARE SECURE AND THAT ALL CONNECTIONS TO THE BOARD ARE PROPERLY MADE.
2. CONNECT THE RADIO TO A 13.5 VOLT DC POWER SOURCE THAT IS ABLE TO SUPPLY AT LEAST 2.6 AMPS.
3. USING A TEK-37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET OR METER PANEL TO THE RADIO AS FOLLOWS:
   - A. CONNECT THE ADAPTER CABLE 20-PIN CONNECTOR TO THE RECEPTACLE ON THE FRONT OF THE TEST SET OR METER PANEL.
   - B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE RECEPTACLE ON ON THE CONTROL BOARD.
   - C. CONNECT THE WHITE "METERING" PLUG TO THE METERING RECEPTACLE ON THE RECEIVER RF AND IF BOARD.
4. SET PORTABLE TEST SET SWITCHES AS FOLLOWS:
   - A. FUNCTION SWITCH TO THE RCVR POSITION
   - B. METER REVERSING SWITCH TO OFF POSITION
   - C. ADAPTER CABLE SENS SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE CABLE HAS NO SENS SWITCH, THE UNIT OPERATES AT 100 mV ALL OF THE TIME.
   - D. ADAPTER CABLE REFERENCE SWITCH TO POSITION A OR B.
   - E. SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
5. ON "PRIVATE-LINE" RADIOS, DISABLE THE PL DECODER BY REMOVING THE MICROPHONE FROM ITS HANG-UP BOX OR BY SETTING THE PL SWITCH TO THE OFF POSITION.
6. SET THE SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
7. SET THE VOLUME CONTROL FOR A COMFORTABLE LISTENING LEVEL.



9.6 V SUPPLY TESTS

1. CHECK CONTROL (INTERCONNECT) BOARD CONNECTIONS
2. CHECK K302 ON CONTROL (INTERCONNECT) BOARD
3. CHECK 9.6 VOLT REGULATOR VOLTAGES
4. CHECK 9.6 VOLT SUPPLY LINES

TABLE I
MINIMUM RECEIVER RF & IF METER READINGS TABLE
(NO INPUT SIGNAL APPLIED)

SELECTOR SWITCH POSITION	READING (MICRO AMPS)	CIRCUIT METERED
1	15	CHANNEL ELEMENT OUTPUT
2	15	FIRST DOUBLER OUTPUT
3	15	SECOND DOUBLER OUTPUT
4	0±2	DISCRIMINATOR OUTPUT
5	10	SECOND I-F AMPLIFIER AND LIMITER

TABLE II
RECEIVER RF & IF DC INPUT VOLTAGES

TEST POINT	DESCRIPTION
P904-9	B+ CONTINUOUS (+13.8 V DC WITH REFERENCE TO CHASSIS)
P904-11	9.6 V DC SWITCHED (WITH REFERENCE TO CHASSIS) (±0.5 V)
P904-8	9.6 V DC CONTINUOUS (WITH REFERENCE TO CHASSIS) (±0.5 V)

TABLE III
NOMINAL RECEIVER INTEGRATED CIRCUIT DC VOLTAGES
(ALL READINGS ARE IN VOLTS DC, MEASURED WITH RESPECT TO CHASSIS)

PIN NO.	IC101 VOLTAGE	IC102 VOLTAGE
1	GND	2.8
2	GND	GND
3	2.8	2.8
4	6.6	6.6
5	9.3	9.3
6	7.2	7.2
7	6.4	6.4
8	2.8	2.8
9	2.8	2.8
10	GND	GND

NOTE: ALL VOLTAGES MAY VARY ±10% FROM NOMINAL READINGS SHOWN.

Receiver RF & IF Troubleshooting Chart
Motorola No. EEPS-15946-O
12/4/74-UP

RECEIVER GAIN MEASUREMENTS

TEST POINT (See rf & i-f circuit board detail)	RECEIVER INPUT VOLTAGE (preset)	TEST POINT VOLTAGE ±6 dB	REMARKS
A	16 mV	100 mV	IC101 saturated output
B	8 mV	50 mV	
C	10 mV	50 mV	
D	15 mV	50 mV	
E	12 mV	50 mV	
F	15 mV	50 mV	
G	10 mV	600 mV	
H	6 uV	100 mV	IC102 saturated output
I	9 uV	100 mV	
J	12 uV	100 mV	
K	11 uV	100 mV	
L	20 uV	100 mV	
M	1 uV	750 mV	

(g) Set the signal generator output frequency to the receiver channel frequency (center meter 4 on the test set). Adjust the signal generator output to provide the required receiver input voltage for a particular test point as listed in the table. Then, using an rf voltmeter, measure the rf signal voltage between the test point and a nearby chassis ground point. At every test point the measured voltage should be within ±6 dB of the value given in the table.

(h) A high or low test point voltage measurement may indicate that the crystal at or ahead of the test point is defective. However, it may also indicate that an associated circuit component is defective. The extremely high-Q crystals used in "Micor" solid state mobile radio sets are very sensitive to associated circuit components. For example, if L125 is defective, it might appear that Y102 is bad. To isolate the defective component, perform the crystal dip tests described in the following procedure.

(4) Crystal Dip Test

A defective crystal in the i-f selectivity portion of the radio can be located by measuring receiver gain voltages and performing crystal dip tests.

The monolithic crystals used in "Micor" receivers are made up of two separate resonators on a single quartz blank. Each crystal has a pair of characteristic operating frequencies. One way to find the characteristic frequencies of each crystal is to short the crystal output to chassis ground, then monitor the crystal input voltage with an rf voltmeter while varying the signal generator frequency across the bandpass of the radio set. Low voltage points will occur at each of the crystal characteristic frequencies.

Figures 4 and 5 are plots of typical rf voltmeter readings obtained while testing good crystals. Note that the horizontal scales are calibrated in frequency, with f_o the channel frequency of the receiver. The vertical scales represent relative rf voltmeter readings. The bottom line is zero and the top line is maximum. Notice that each plot has a sharp minimum point above f_o and another below f_o. The table of crystal dip frequencies at the end of this section lists the frequencies at which these dip points should appear.

Procedure:

(a) Leave the test equipment set up as shown in Figure 3 for the receiver gain measurements.

(b) If the radio uses AFC, disable the AFC by connecting a jumper between test point "N" and chassis ground.

(c) Set the signal generator to f_o, the receiver channel frequency (center test set meter 4). Adjust the generator output control for at least 50 mV at the radio set antenna connector.

(d) Refer to the crystal dip frequency table. To test a particular crystal, find it in the table, ground the indicated test point, and connect an rf voltmeter between the monitored test point and a nearby chassis ground point.

(e) Starting at f_o, slowly increase the signal generator frequency while watching for a dip in the rf voltmeter reading. This dip should be sharp, so increase the signal generator frequency very slowly and watch the rf voltmeter closely. When the dip is found, write down the frequency counter reading.

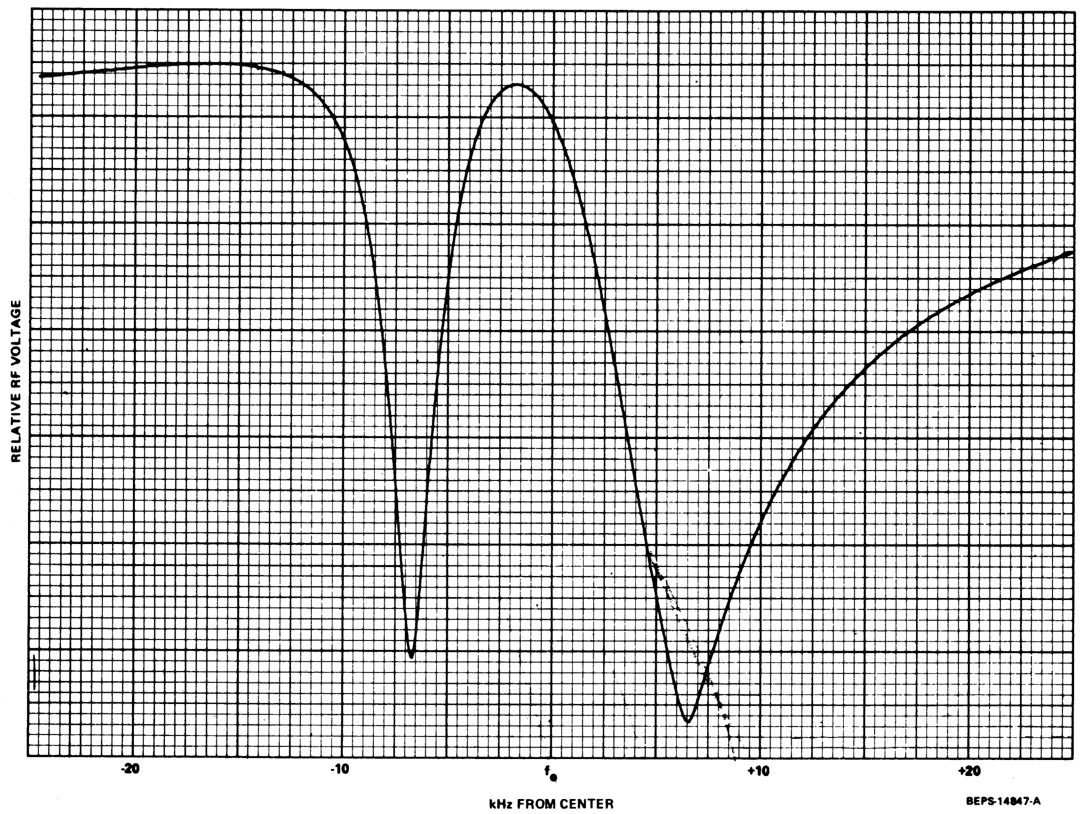


Figure 4.
Typical Plot of a Known Good Crystal in Position Y101 or Y103

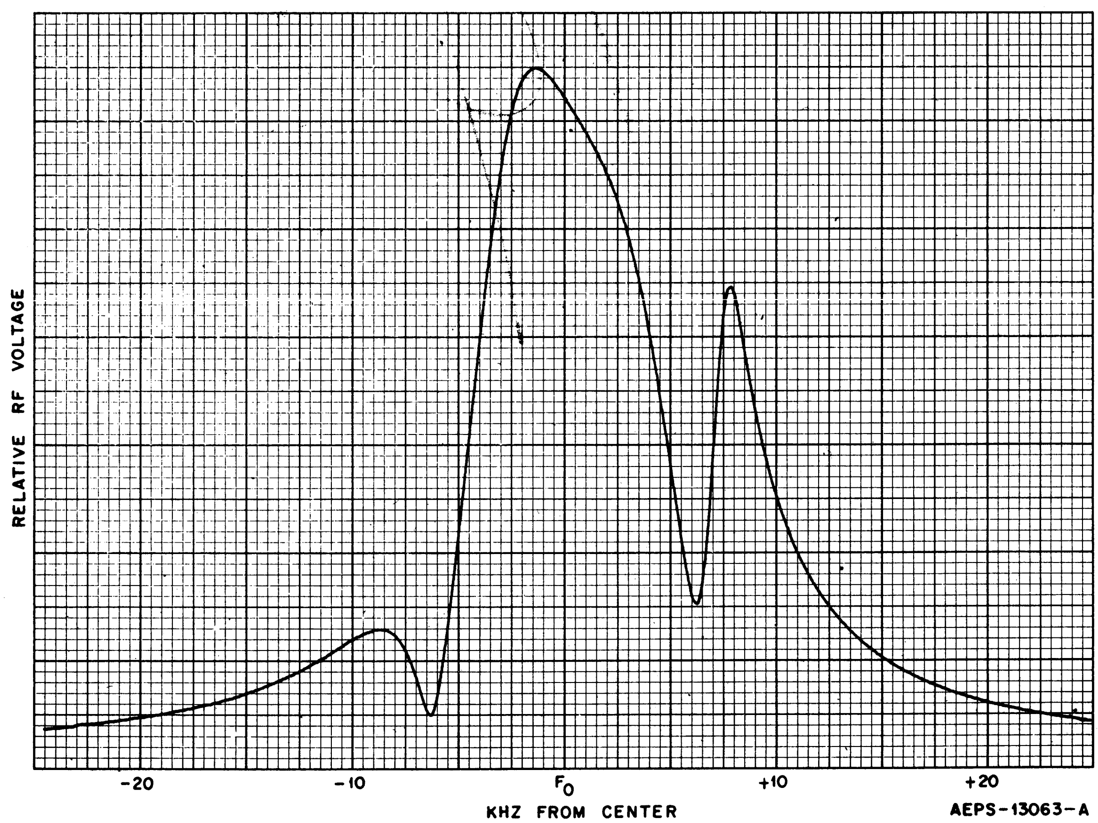


Figure 5.
Typical Dip Plot of a Known Good Crystal in Position Y102 or Y104

CRYSTAL DIP FREQUENCIES

CRYSTAL	TEST POINT GROUNDED	TEST POINT MONITORED	+ FREQUENCY DIP (kHz) ±2.5 kHz	- FREQUENCY DIP (kHz) ±2.5 kHz
Y101	C	B	6.0	7.0
Y102	E	D	6.5	6.5
Y103	I	H	6.0	7.0
Y104	K	J	6.5	6.5

(f) Return the signal generator to f_o. Then watch the rf voltmeter while slowly decreasing the signal generator frequency. When the dip is found, write down the frequency counter reading.

(g) Compare your test results with the frequencies and tolerances listed in the table for the crystal you have tested. If the measured dips fall outside the tolerances listed in the table, the crystal may be defective. Continue with this procedure to isolate the bad component.

(h) FOR TEST PURPOSES ONLY, exchange the suspected crystal with another from the receiver. Be sure you note the polarity of the crystal when you make the change. Repeat the receiver gain measurement and crystal dip test on the suspected crystal in the new location. If the suspected crystal tests bad again, consider it defective and replace it. If the crystal tests good, look for defective associated components at the original crystal location.

(i) When the tests are completed, be sure all jumpers connected during the test are removed and that any moved crystals are returned to their original locations. Refer to the parts list and circuit board detail for correct part location. Note crystal polarity when replacing crystals.

6. AUDIO AND SQUELCH BOARD

NOTE

The audio and squelch board must be installed in a radio set for testing to provide the necessary power and ground connections.

a. Introduction

If there is no receiver audio output, or the audio quality is poor, use the following procedure to determine whether the malfunction is in the receiver rf and i-f circuits or in the audio and squelch circuits.

(1) Turn the SQUELCH control fully counterclockwise (minimum). In "Private-Line" radio sets, disable the PL decoder by either removing the microphone from the microphone hang-up box or by setting the PL monitor switch to the OFF position.

(2) Connect an rf signal generator to the radio set antenna connector or the receiver rf input. Set the generator to the appropriate channel carrier frequency and set the generator output level to 1000 uV. Using a 1000 Hz modulating tone, set the signal generator modulation deviation to ±3.3 kHz.

(3) Connect a high impedance AC voltmeter or oscilloscope between P903-2 and chassis ground to measure the discriminator audio output.

(4) If the discriminator audio output reading is greater than 250 millivolts rms and the audio output is bad, the problem is in the audio and squelch board circuits. If the discriminator audio output reading is less than 250 millivolts, the receiver rf and i-f board is at fault. If the above test indicates that a problem exists in the audio and squelch board, thoroughly inspect the circuit board before proceeding with more detailed troubleshooting. Continue the troubleshooting procedure only after all visually obvious problems have been corrected.

b. Performance Tests

The performance tests may be used for troubleshooting to isolate the point of abnormal operation. They may also be used after repair to assure that the board is operating properly before it is returned to service.

(1) Audio Amplification Test

(a) Specifications

The audio section of the audio and squelch board combined with the separate audio power amplifier transistors will provide at least a 10-watt audio output with less than 5% distortion when an on-frequency signal modulated with a 1 kHz tone at 3 kHz deviation is applied to the radio set antenna receptacle.

(b) Procedure

1. Replace the speaker with an 8-ohm, 15-watt non-inductive resistor.

2. Set the SQUELCH control fully counterclockwise (unsquelched). "Private-Line" radios must also be PL disabled by removing the microphone from the hang-up box or placing the PL monitor switch in the off position.

3. Connect an rf signal generator to the radio set antenna receptacle and adjust the generator to the receiver frequency.

4. Adjust the signal generator for 1000-microvolt output, modulated with 1000-Hz tone at ±3 kHz deviation.

5. Connect an ac voltmeter across the 8-ohm resistor that replaces the speaker.

6. Adjust the VOLUME control until 9.0 volts ac rms is read on the ac voltmeter (this represents 10 watts).

7. Measure distortion at 10 watts audio output power. It should be less than 5 per cent.

(2) Squelch Control Test

(a) Specifications

1. The squelch section of the receiver audio and squelch board should enable the audio section when an rf signal level greater than 6 dB noise quieting (one-half the speaker voltage level with no signal input) is applied to the receiver with the SQUELCH control set at threshold. When the rf signal is removed from the radio set, the audio channel should become disabled after approximately 150 milliseconds. When an rf input signal greater than that required for approximately 20 dB noise quieting is removed from the radio set, the audio channel should become disabled immediately.

When the SQUELCH control is turned fully clockwise (tight squelch) an rf input signal that produces from 15 to 25 dB noise quieting should enable the audio channel.

The squelch section must inhibit audio output when no input signal is received.

2. In "Private-Line" tone-coded squelch radios, the squelch section of the receiver audio and squelch board should perform as described in the preceding step 1. while the radio set is PL disabled. PL disable is accomplished by removing the microphone from the hang-up box or placing the PL monitor switch in the off position.

In PL operation, the squelch section must inhibit audio output when the proper PL tone is not received, regardless of the input signal strength.

(b) Procedure

1. Carrier Squelch Radios

NOTE

Before proceeding measure and write down the 6 dB, 12 dB, 15 dB, 25 dB, and 30 dB noise quieting levels. These can be determined by following the 20 dB Quieting Sensitivity Test with one exception. In step (k) the meter position 11 reading should be as follows: for 6 dB, from 2 V to 1 V; for 12 dB, from 2 V to 0.5 V; for 15 dB, from 2 V to .35 V; for 25 dB, from 2 V to .11 V; and for 30 dB, from 2 V to .06 V.

a. Turn the radio set on and adjust the SQUELCH control clockwise from the full counterclockwise position until the receiver just quiets (threshold squelch).

b. Measure the resistance of IC202-6 and -7 with reference to ground. Both pins should be less than 1000 ohms. This measurement must be made with the radio turned on.

NOTE

Erroneous readings will be obtained in resistance measurements if the ohmmeter internal voltage exceeds 5.0 volts dc.

c. Connect a signal generator to the radio set antenna receptacle and adjust it to the receiver frequency. Modulate the generator output with a 1000-Hz tone at ±3 kHz deviation.

d. Increase the signal generator output slowly until the radio set just unsquelches. Remove the modulation from the signal generator. Unsquelching should occur at the 6 dB noise quieting level, or less, that was previously recorded.

e. Measure the resistances of IC202-6 and -7 with reference to ground. Pin 6 should be greater than 100k ohms and pin 7 should be greater than 45k ohms. These measurements must be made with the radio turned on.

f. Increase the signal generator output until the 12 dB noise quieting level is obtained. Remove the rf signal from the radio set input either by turning off the signal generator or by using a relay in series with the signal generator output. A long "squelch tail" should occur. If a calibrated, triggered sweep oscilloscope is available for measurement, the duration of the "squelch tail" should be approximately 150 milliseconds, measured at the speaker.

g. Increase the signal generator output to the 30 dB noise quieting level. Turn off the rf signal and note the "squelch tail" duration. It should be no more than a "click". The duration should be less than 10 milliseconds.

h. Turn the SQUELCH control fully clockwise (tight squelch).

i. Adjust the signal generator output level until the radio set just unsquelches. Unsquelching should occur at a generator output level that is between the 15 dB and 25 dB noise quieting levels that were previously written down.

j. Reset the SQUELCH control as required for normal radio operating.

2. "Private-Line" Tone-Coded Squelch Radios

a. After performing the previously described carrier squelch radio procedure, return the radio set to PL operation by placing the microphone in the hang-up box and placing the PL monitor switch in the on position.

b. Vary the rf generator output between minimum and 1000 microvolts while checking the resistances of IC202-6 and -7 with reference to ground. Both resistances should remain at less than 1000 ohms.

c. Modulate the on-frequency generator output with the correct PL tone frequency for ±0.5 to ±1 kHz deviation and 1000 Hz tone for ±3 kHz overall deviation.

d. Increase the signal generator output slowly until the radio set just unsquelches. Unsquelching should occur at the generator output that produces 6 dB quieting or less.

c. Troubleshooting

(1) Input Voltage Checks

A malfunction in the audio and squelch operation may be due to the loss of dc input voltages. This can be caused by the audio and squelch board or another section of the radio set. There are five input dc voltages applied to the audio and squelch board.

P903-4	+9.6 V dc continuous with respect to chassis.
P903-15	A- continuous (approximately -13.6 V dc with respect to A+, P903-16).
P903-16	A+ continuous (approximately -13.6 V dc with respect to A-, P903-15).
P903-1	+9.6 V dc switched with respect to chassis (present in receive mode).
P903-7	+9.6 V dc keyed with respect to chassis (present in transmit mode).

In negative ground systems, A- is at chassis potential. In positive ground system, A+ is at chassis potential.

(2) Identifying Defective Components

Performance tests and use of the audio and squelch troubleshooting chart will localize most audio and squelch malfunctions to one or two stages. The defective component can then be identified through use of the receiver audio and squelch board troubleshooting chart and the voltage, waveform, and resistance information on the schematic diagram.

(3) Stage Gain Measurements

(a) Squelch Circuitry

This troubleshooting procedure may be used to isolate a squelch malfunction

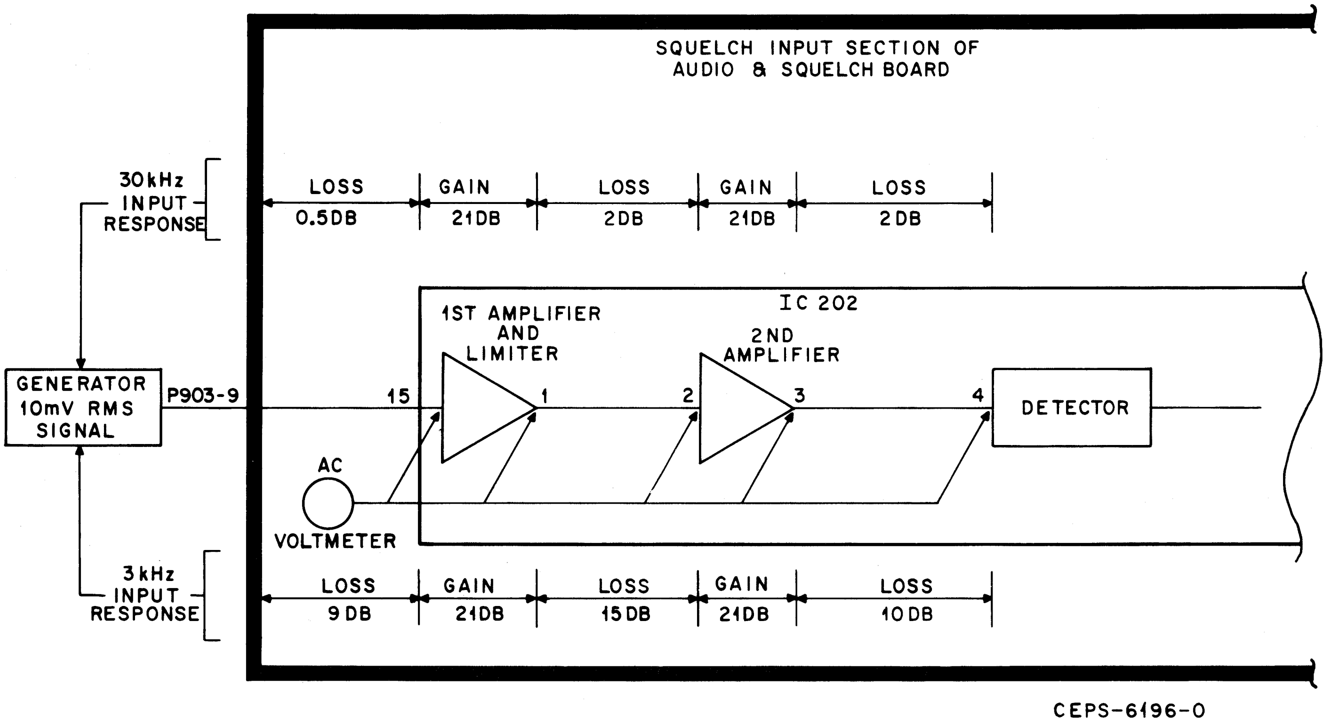


Figure 6.
Squelch Input Section Stage Gain Measurement Diagram

SQUELCH INTEGRATED CIRCUIT AC MEASUREMENTS AND STAGE GAIN

Connect AC voltmeter to IC202-Pin	3 kHz Input Signal		30 kHz Input Signal	
	AC voltage (mV rms)	Gain or loss from previous reading	AC voltage (mV rms)	Gain or loss from previous reading
P903-9	10.0	----	10.0	----
15	3.5	9 dB loss	9.5	0.5 dB loss
1	40.0	21 dB gain	110.0	21 dB gain
2	7.0	15 dB loss	85.0	2 dB loss
3	80.0	21 dB gain	950.0	21 dB gain
4	24.0	10 dB loss	750.0	2 dB loss

occurring before the detector to a specific stage. The test is performed by injecting an ac signal at the input of the squelch circuit and measuring AC voltages at various points in the circuit.

Most accurate results are obtained by determining dB loss and gain factors between points and comparing them with those given in the stage gain table. Checks of the ac voltages at the individual points may also be used to determine proper operation of the squelch input circuit but voltage checks are inadequate to prove a circuit defective. Nominal tolerance of the ac voltage readings could cause an increasing variation from the typical readings shown in the table as readings are taken further from the injected signal.

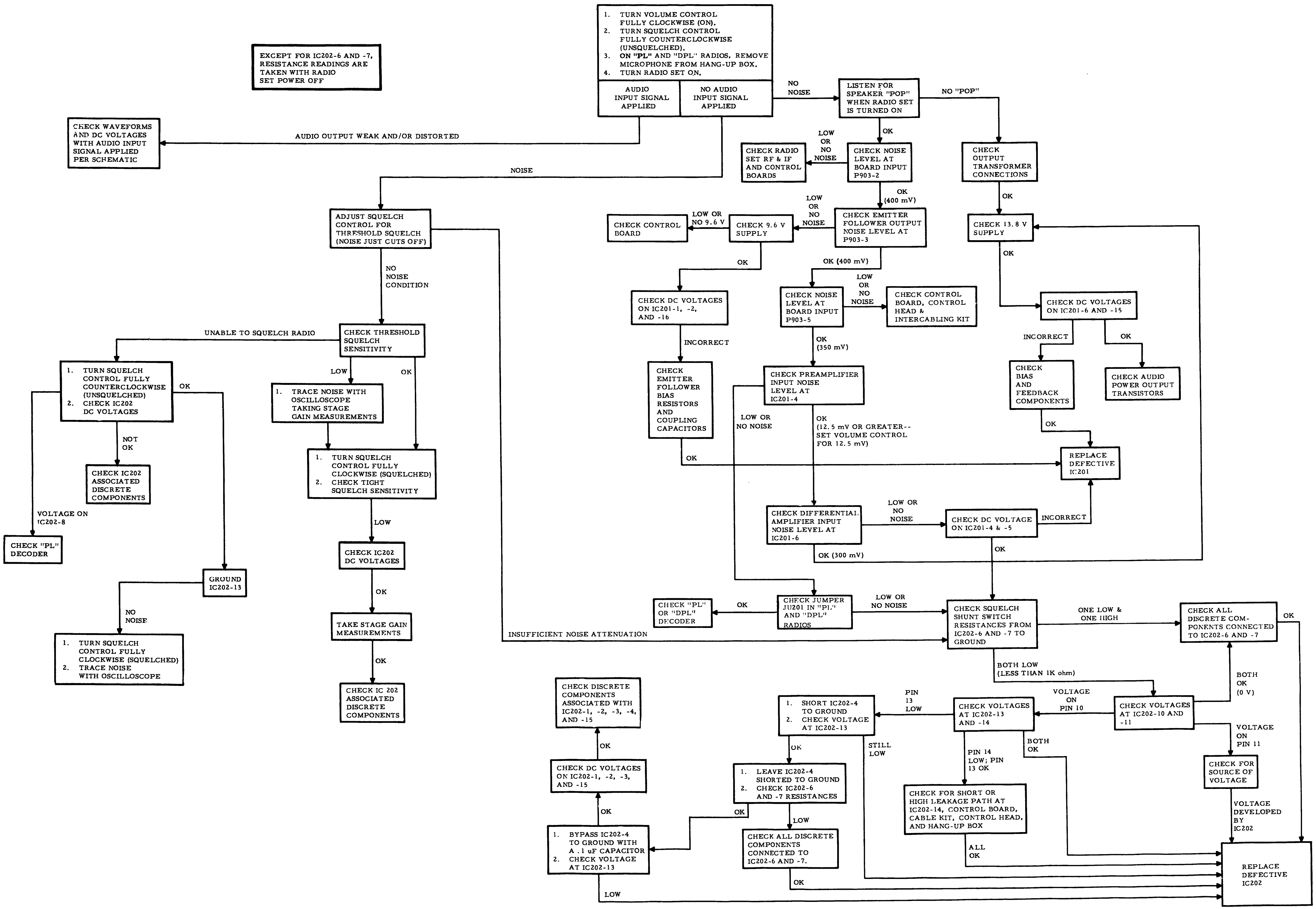
The following procedure may be used for loss and gain or signal level measurements while injecting a 3 kHz signal. In "Private-Line" tone-coded squelch radios, PL operation will not affect this test.

1. Turn the VOLUME control fully counterclockwise (minimum).

2. Turn the SQUELCH control fully clockwise (squelched) and turn the radio set on.

3. Inject a 1000-microvolt, unmodulated, on-channel signal at the radio set antenna receptacle. This "quiets" the discriminator output and prevents erroneous test readings.

RECEIVER AUDIO & SQUELCH BOARD TROUBLESHOOTING CHART



Receiver Audio & Squelch Troubleshooting Chart
Motorola No. EEPS-6224-C
8/27/76-UP

4. Inject a 3 kHz, 10 millivolt rms signal to the receiver audio & squelch board at P903-9.

5. Take loss and gain measurements or signal level measurements as required. Refer to Figure 6 and the ac measurement and stage gain table.

6. Repeat the preceding test using a 30 kHz signal in place of the 3 kHz signal in step 4.

(b) Audio Circuitry

AC voltage measurements and waveforms are given where applicable on the schematic diagram. Refer to this diagram for pertinent information when taking audio stage gain measurements.

7. AUDIO POWER AMPLIFIER

a. Performance Checks

Performance checks on this board consist of taking resistance measurements between the transistor elements. It should be noted, however, that some multimeters have insufficient voltage at the ohmmeter test probes to forward bias a transistor junction and cannot be used. A volt-ohm meter with 1000 to 20,000 ohms-per-volt sensitivity is required for these checks. Compare the resistance readings with those in the transistor resistance measurement table.

NOTE

Do not insert meter test probe tips into female connectors on the board. To do so could damage the connectors and result in poor electrical interconnection with the audio and squelch board.

b. Transistor Replacement

Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can not be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new compression washer is also included.

(1) Apply a thin, even coat of silicon grease to the metallic area of the transistor.

(2) Mount the transistor using the new compression washer. Do not solder leads at this time. Tighten the transistor mounting screw to 6 inch-pounds.

NOTE

Do not damage the transistor by over tightening the mounting screw. If no accurate method of measuring torque is available, tighten the mounting screw until it just "touches" the compression washer. Then turn the mounting screw 1/4 turn more.

(3) Solder transistor leads to printed circuit board.

8. "PRIVATE-LINE" DECODER

a. Performance Tests

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz with a proper-frequency PL tone

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(Board removed from radio - Transistors mounted on board)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	Negative Lead Connected to	PNP Transistor	NPN Transistor
Base	Emitter, then Collector	Infinite	5-30 Ohms, Both
Emitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.

should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the antenna receptacle of the radio set. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on the "Vibrasponder" resonant reed. The tone can be generated with a Motorola SLN6221A "PL" Tone Generator and a "Vibrasender" resonant reed. The "Vibrasender" reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

b. Troubleshooting

(1) Testing the "Vibrasponder" Resonant Reed

One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point 1 on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an unmodulated rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

9. "DIGITAL PRIVATE-LINE" DECODER

a. Recommended Test Equipment

(1) Motorola Model SLN6413A "Digital Private-Line" Test Set --used to encode and decode a "Digital PL" code for test purposes.

(2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.

(3) General purpose oscilloscope -- used to observe waveforms.

(4) Motorola Solid-State DC Multimeter or Digital Voltmeter -- used for dc voltage measurements.

b. Performance Tests

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz by the appropriate Digital "PL" code should unsquelch the receiver. A Digital "PL" code signal to modulate an rf signal generator can be obtained from a Motorola SLN6413A "Digital Private-Line" Test Set.

c. CMOS Integrated Circuit Handling Precautions

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even in a system.

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions:

(1) Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

(2) Whenever possible avoid touching any electrically conductive parts of the circuit module with your hands.

(3) Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

(4) When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

(5) All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

(6) If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through a resistance of approximately 100k.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

(7) When soldering, be sure the soldering iron is grounded.

(8) Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

(9) When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

(10) All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

(11) Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER USE NONCONDUCTIVE MATERIAL for packaging these modules.

d. Troubleshooting

Before beginning a troubleshooting procedure, inspect the circuit board for visible defects. If any defects are found, correct them and check the decoder performance again. If the decoder performance is still subnormal, use the following troubleshooting procedur to help you identify the defective circuit and component

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART

NOTES:

1. To obtain a test code for the following procedure apply a carrier frequency signal to the receiver rf input from an rf signal generator modulated by the code output of a Motorola SLN6413A "Digital Private-Line" Test Set. Be sure the signal generator is able to accept very low frequency modulation (less than 5 Hz).
2. Before you replace U801, use the following procedure to verify that U801 is malfunctioning:
   a. Connect U801-11 to the code input of a Motorola SLN6413A "Digital Private-Line" Test Set.
   b. Apply a carrier-frequency signal to the receiver rf input from a signal generator that is modulated by the code output of the test set.

   If proper decode is indicated, U801 must be replaced. If U801 must be replaced, refer to the CMOS handling precautions in this instruction section.

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART (Cont'd)

SYMPTOM	PROBABLE CAUSE	ACTION
No decode, but received audio is good when DPL is disabled.	1. Audio squelch is malfunctioning.	Remove the decoder board. Apply +9.6 V at P201-3 on audio & squelch board. If audio is not enabled, troubleshoot audio & squelch circuits.
	2. No 50 kHz clock.	Check U801-4 for 50 kHz clock pulses. Rise time must be $\leq$ 750 nsec.
	3. Audio enable switch is malfunctioning.	If U801-7 is high, but circuit board pin 5 is low when receiving code, replace Q810.
	4. Dump pin U801-1 is always high.	Check U801-1 - should always be 0 V.
	5. Wrong or bad code plug.	Replace with a known good code plug. Check U801-15 through U801-23 for proper octal code.
	6. No data into U801.	Check U801-11 for 0-6 V pulses. If pulses are not present, check Q806 and U802 operation.
	7. Transmit code enable input is high.	Ground U801-9. If a received code is properly decoded, check for a malfunction in the delayed transmit enable circuit on the encoder board.
	8. U801 has an internal malfunction.	If, after checking causes 1 through 7, the cause of the problem has not been isolated, replace U801. CAUTION U801 is a CMOS device and may be damaged by improper handling. Refer to the CMOS handling precautions in this instruction section.
Excessive decoder falsing when monitoring an inactive channel (noise falsing).	1. Precision current source is low or inoperative.	Measure the dc voltages in the precision current source circuits. Current to U801-8 = $\frac{(V_{BE} \text{ of Q808})(R825+R826+RT802)}{R826(R825+RT802)}$
	2. Current source disable switch is always on.	Check for 8-10 V at Q809 collector. If Q809 collector is 0 V, replace Q809.
	3. Improper 140 Hz low pass filter response.	Check dc voltages in filter circuit. Check the filter frequency response measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	4. U802 supply voltage is too high.	Check U802-10 for +10.4 V ±0.2 V dc. If voltage is high, troubleshoot the +10.4 V regulator on the decoder board.

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART (Cont'd.)

SYMPTOM	PROBABLE CAUSE	ACTION
Excessive squelch tails (approx. 500 msec noise burst) at ends of received transmissions.	1. Turn-off code not being transmitted by other radio unit.	Monitor circuit board pin 4 (DATA IN) for presence of turn-off code at ends of transmissions.
	2. U802 lock-in malfunction.	Ground Q809 collector. With a 300 mV p-p signal at circuit board pin 4 (DATA IN), the waveform at U802-4 should be locked in to the input signal up to at least 175 Hz. If proper lock-in does not occur, replace C809, then check lock-in again. If lock-in is still bad, replace U802.
	3. U801 turn-off code detector is malfunctioning.	Check U801 (Note 2).
Poor detector sensitivity in poor quieting conditions.	1. Improper 140 Hz low pass filter response response.	Check dc voltages in filter circuit. Check the filter frequency response: measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	2. Precision current source supplying too much current to U802-8.	Measure the dc voltages in the current source circuits. Current to U802-8 = $\frac{(V_{BE} \text{ of Q808})\ (R825+R826+RT802)}{R826\ (R825+RT802)}$
	3. Current source disable switch inoperative.	While detecting a valid code, check Q809 collector for 0 V dc. If 8-10 V is present, replace Q809.
Occasional squelch tail about 1 second after the end of a transmission from another radio.	Current source disable switch is staying on too long.	Check Q809 collector. Q809 collector should go from 0 V dc to 8-10 V within 1.5 seconds after loss of audio squelch disable.

10. EXCITER

a. Introduction

This section of the manual provides the maintenance procedures for the exciter. The bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting, including integrated circuit check-out.

NOTE

The exciter must be installed in a radio set for testing to provide the necessary power, ground, control, and signal connections. To provide a good rf ground to all stages of the exciter, the circuit board should always be secured in place with all mounting screws for operation and testing.

b. Test Set Meter Readings

Each time maintenance is performed on the exciter, the readings should be logged and compared with the previous set of readings. A large drop in the reading of either position 4 or 5 indicates a degradation of performance. Positions 2 and 3 are used in the alignment procedure only, and should not be used as any indicator of performance.

Table I on the exciter troubleshooting chart lists minimum test set meter readings.

c. Performance Tests

The performance tests may be used for troubleshooting to isolate the point of abnormal performance. They also may be used after repair and alignment to assure that the exciter meets all specifications before it is returned to service.

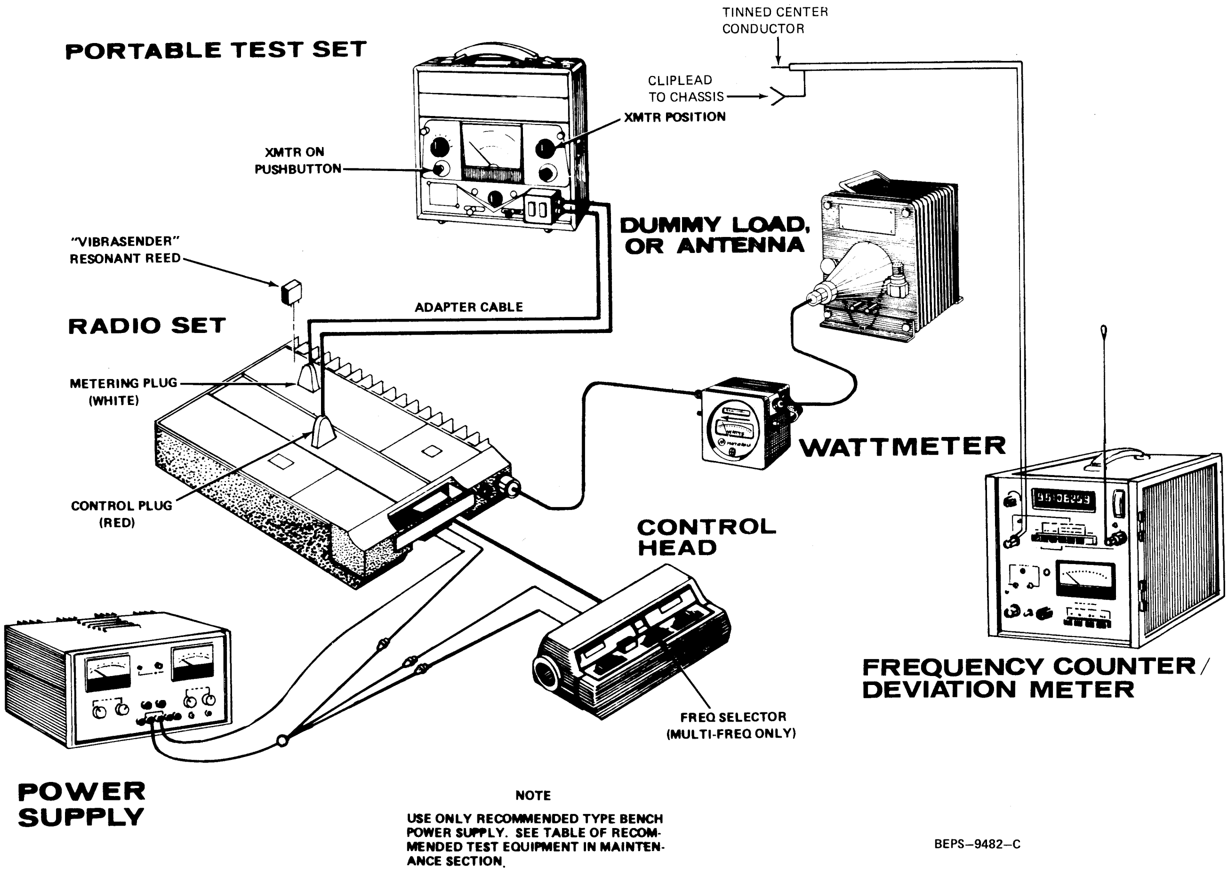


Figure 7.
Offset Oscillator Frequency Measurement Test Set-Up

(1) Offset-Oscillator Frequency Check

(a) Set up the test equipment as shown in Figure 7.

A frequency counter and/or frequency meter capable of measuring 11.7 MHz, 14.7 MHz, and 16.7 MHz to within ±10 Hz is required. Connect a coax cable with one inch tinned wire leads on one end to the frequency measuring equipment. An alligator clip is needed on the wire lead from the coax shield.

(b) Unplug the exciter input cable (at J300) from the receiver rf deck.

(c) On PL models, remove the "Vibrasender" reed from the PL encoder.

(d) On multiple-frequency transmitters with standard channel spacing, set the control head frequency selector switch to any desired channel.

-OR-

On multiple-frequency transmitters with wide channel spacing, set the control head channel selector switch to positions that will activate, in turn, each of the offset oscillator frequencies in the radio.

(e) Key the transmitter, using the XMTR ON pushbutton on the test set, rather than the microphone PTT button.

(f) On single channel transmitters or multiple-frequency transmitters with standard channel spacing, clip the frequency counter coaxial cable shield to chassis ground and touch the coax center conductor to TP302 (TP401 in

406-420 MHz models). Write down offset oscillator frequency reading.

-OR-

On multiple-frequency transmitters with wide channel spacing the frequency counter coaxial cable center conductor should be touched to TP302 or TP401, depending on whether the channel selected uses the standard or the wide-spaced offset oscillator. Write down the measured offset oscillator frequencies.

(g) The offset oscillators should be within ±50 Hz of the nominal offset frequency. Long-term offset oscillator drift should not exceed ±200 Hz. If an offset oscillator is off frequency, reset it. Refer to the procedure in the ADJUSTMENTS section of this manual. After the offset oscillator frequency is set, do not change it. The transmitter carrier frequency is set by adjusting the individual channel elements, NOT the offset oscillator.

(2) Carrier Frequency Check

Refer to Figure 8 for the test equipment set-up.

(a) Using a TEK-37 Test Set Adapter Cable, connect a Motorola Model S1056A Portable Test Set to the radio as shown in Figure 8.

(b) Set the test set function switch to the XMTR position.

(c) Connect an appropriate antenna or 50-ohm dummy load to the radio set antenna connector.

(d) In "Private-Line" radios, disable the PL encoder by unplugging the "Vibrasender" Resonant Reed.

(e) Using the XMTR ON pushbutton on the portable test set, key the transmitter to produce an unmodulated carrier signal.

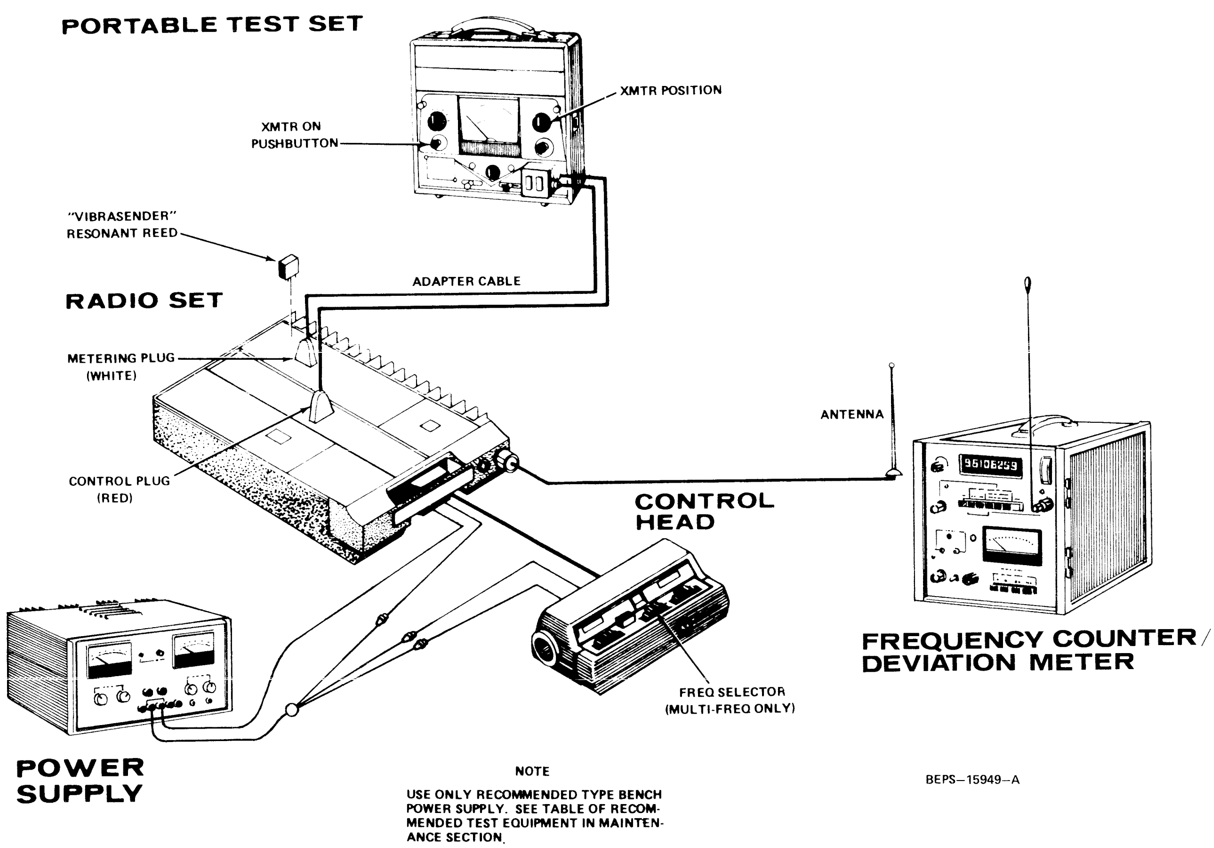


Figure 8.
Frequency Measurement Test Equipment Set-Up

NOTE

Do not key the transmitter with the microphone push-to-talk switch. The microphone will pick up ambient noise, the carrier will, therefore, be modulated, and a measurement error may result.

(f) Measure the frequency of the carrier signal with a Motorola Model S1344 Series Frequency Counter/Deviation Meter or other frequency-measuring device having an accuracy of ±0.0005% or better.

(g) For multi-frequency radio sets repeat steps (e) and (f) for each frequency.

(h) If adjustment is required, set the "warp" capacitor on the channel element (located in the receiver) for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70 to 75 degrees F) and the test equipment thoroughly warmed up. This brings the channel element to the center of its temperature-compensation range. Once set on frequency at this temperature, it can most accurately stay on frequency over the temperature range. For a complete alignment procedure refer to the ADJUSTMENTS section of this manual.

CAUTION

Always set carrier frequency by adjusting the appropriate channel element warp capacitor. DO NOT set carrier frequency by changing the offset oscillator frequency.

The carrier frequency of the transmitter shall be within ±.0005% of the assigned frequency for each channel. When high-stability channel elements are used, it should be within ±.0002%.

(3) Deviation Check

(a) Using a TEK-37 Test Set Adapter Cable, connect a Motorola Model S1056B Portable Test Set to the radio as shown in Figure 9.

(b) Set the test set function switch to the XMTR position.

(c) Connect an appropriate antenna or 50-ohm dummy load to the radio set antenna connector.

(d) In "Private-Line" radio sets reinsert the "Vibrasender" Resonant Reed if it was removed for any previous test.

(e) Using the XMTR ON pushbutton on the portable test set, key the transmitter.

(f) In "Private-Line" radio sets, the transmitter carrier signal is modulated by the "Private-Line" tone. Measure the carrier signal modulation with the deviation meter. The modulation deviation produced by the "Private-Line" tone should be between 0.5 and 1.0 kHz.

(g) Unkey the transmitter.

(h) Connect the audio oscillator output to the microphone receptacle on the portable test set. Adjust the audio oscillator to 1000 Hz and 1 volt, as measured on the ac voltmeter. The deviation meter should now indicate ±5 kHz deviation when the transmitter is keyed.

(i) Adjust the audio oscillator over the entire 300 to 3000 Hz range, keeping the audio level at approximately 1 volt. The deviation meter should never exceed ±5 kHz, nor drop below ±2.5 kHz.

(j) If any of the tests in this deviation check procedure are not met, refer to the "IDC" adjustment procedure in the ADJUSTMENTS section of this manual.

(4) Audio Sensitivity Test

(a) Connect the equipment as for the previous (deviation) test. See Figure 9.

(b) On "Private-Line" radios remove the "Vibrasender" resonant reed.

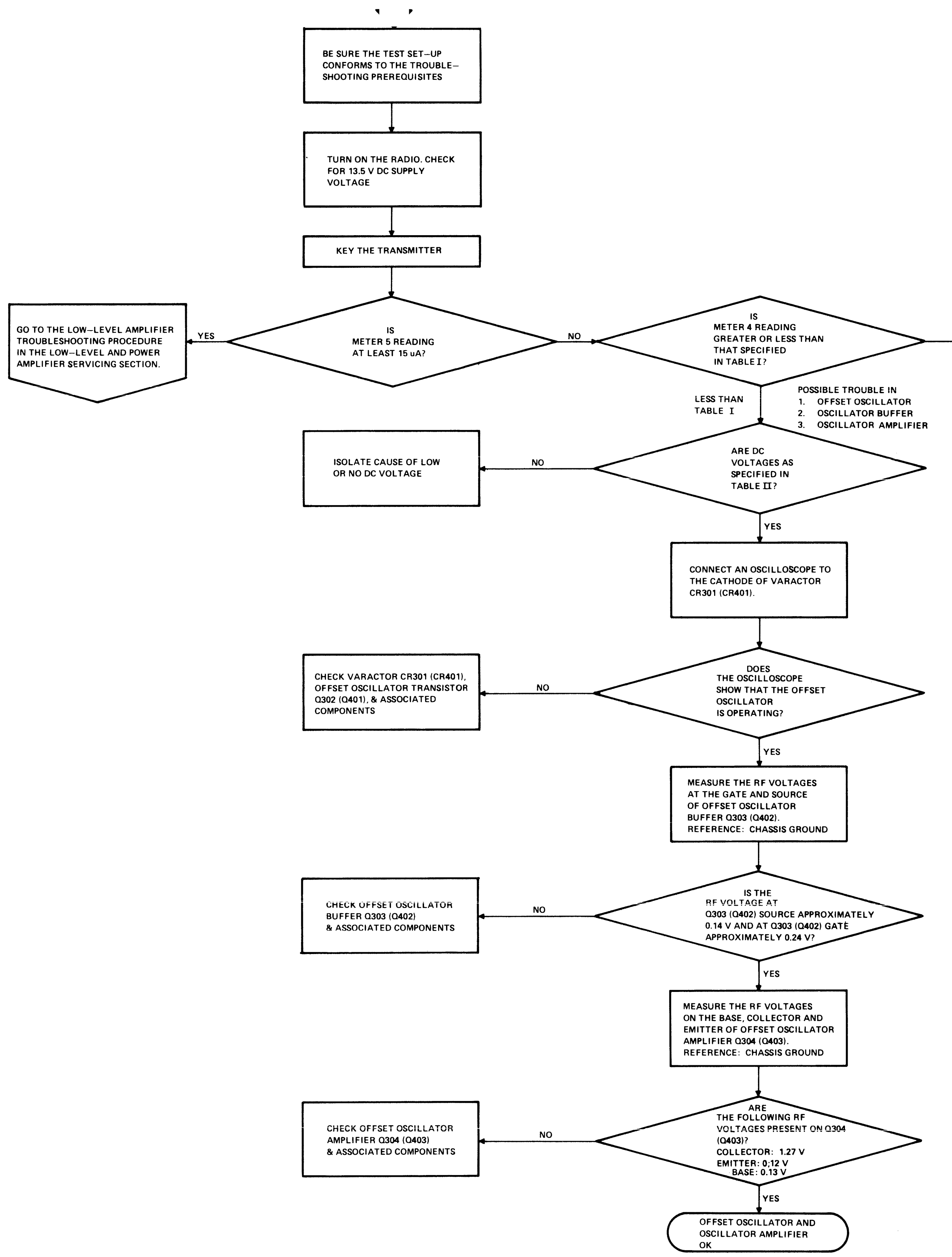
(c) After completion of the deviation test, reduce the output of the audio oscillator to 75 millivolts at 1000 Hz. The deviation meter should indicate approximately ±3.0 kHz. The tolerance for this measurement is ±3 dB.

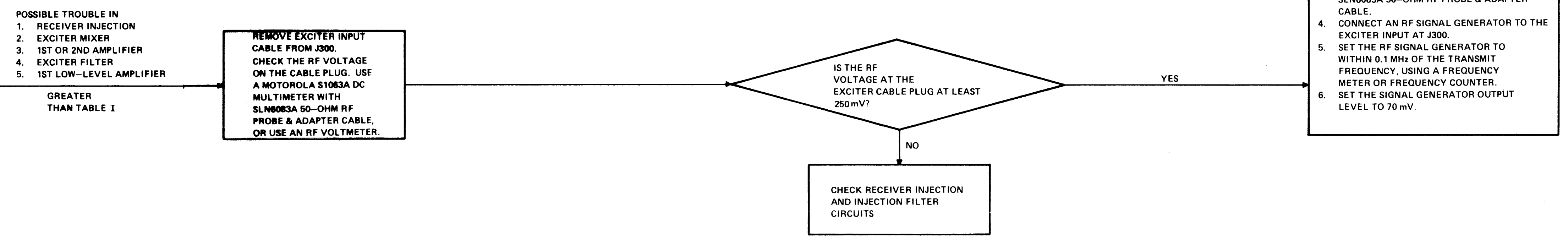
(d) On "Private-Line" radios, reinsert the "Vibrasender" resonant reed.

d. Troubleshooting

If any of the exciter performance tests produces unsatisfactory results, thoroughly inspect the exciter circuit board and check the exciter

EXCITER TROUBLESHOOTING CHART





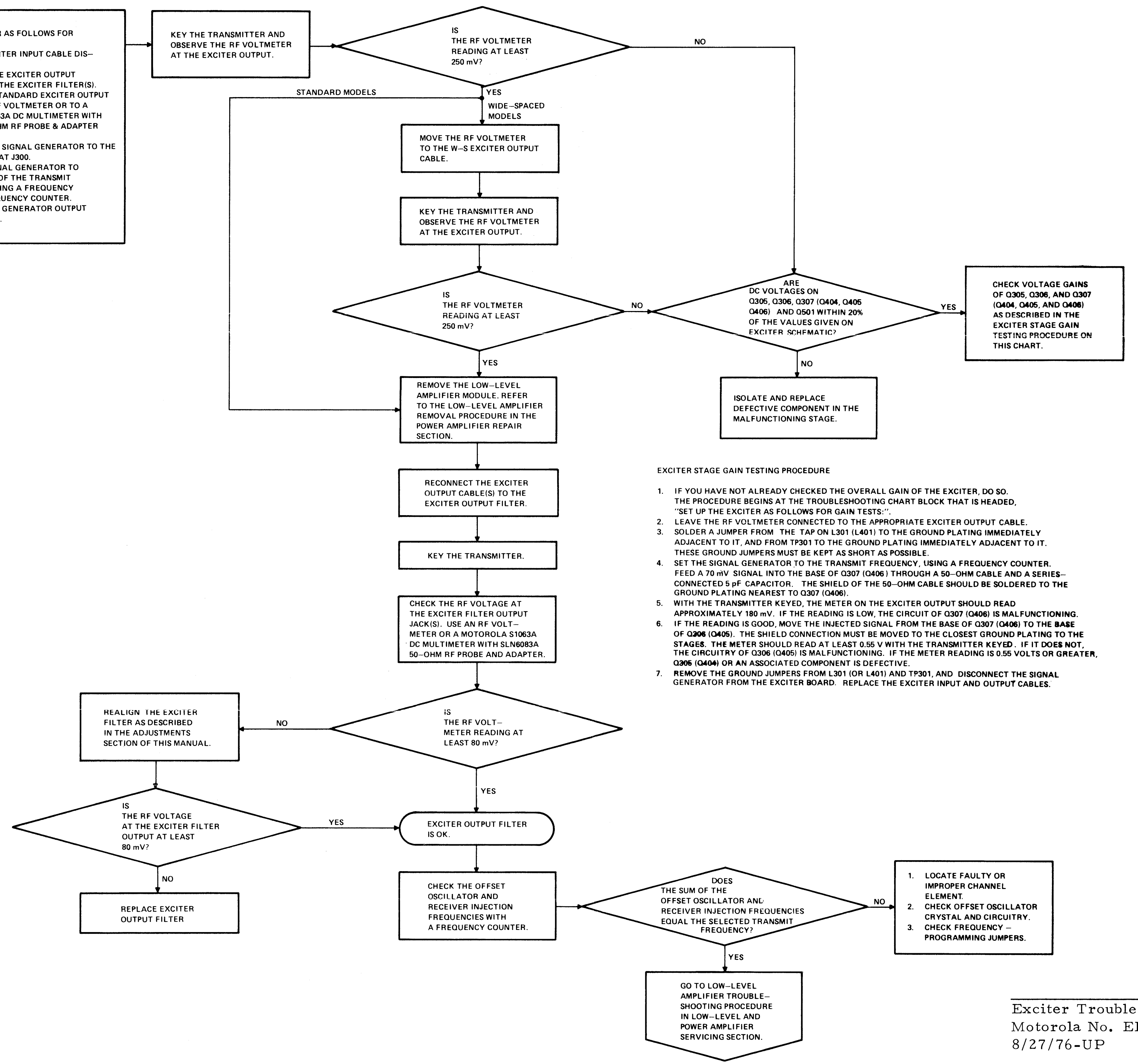


TABLE I
MINIMUM EXCITER METER READINGS

TEST SET SELECTOR SWITCH POSITION	TEST SET REFERENCE SWITCH AND METER SWITCH POSITION	METER READING, uA		CIRCUIT METERED	
		406–420 MHz	450–512 MHz	406–420 MHz	450–512 MHz
2	A–OFF	10–40	10–40	WIDE–SPACED CHANNEL EXCITER OUTPUT	STANDARD CHANNEL EXCITER OUTPUT
3	A–OFF	10–40	10–40	STANDARD CHANNEL EXCITER OUTPUT	WIDE–SPACED CHANNEL EXCITER OUTPUT
4	A–OFF	15 (NOTE 1)	17 (NOTE 2)	STANDARD OR WIDE–SPACED OFFSET OSCILLATOR OUTPUT	STANDARD OFFSET OSCILLATOR OUTPUT
	A–ON	——	17 (NOTE 2)		WIDE–SPACED CHANNEL OFFSET OSCILLATOR OUTPUT
5	B–OFF	15	15	FIRST STAGE OF LOW–LEVEL AMPLIFIER	

NOTES:
1. THE OFFSET OSCILLATOR OUTPUT READING IS 7.5 uA WHEN TEK–5 METER PANEL IS USED.
2. THE OFFSET OSCILLATOR OUTPUT READING IS 10 uA WHEN TEK–5 METER PANEL IS USED.

TABLE II
EXCITER DC INPUT VOLTAGES

TEST POINT	DESCRIPTION
P902–13	KEYED +9.6 VOLTS WITH RESPECT TO CHASSIS GROUND
P902–6	KEYED A– (APPROXIMATELY +13.6 VOLTS WITH RESPECT TO A+ P902–7).
P902–7	FILTERED A+ (APPROXIMATELY +13.6 VOLTS WITH RESPECT TO A– P902–9).

TROUBLESHOOTING PREREQUISITES

1. THE EXCITER BOARD MUST BE INSTALLED IN A COMPLETE TRANSMITTER FOR TESTING. BE SURE ALL CONNECTIONS TO THE EXCITER ARE PROPERLY MADE AND THAT THE EXCITER BOARD MOUNTING SCREWS ARE SECURELY TIGHTENED.
2. BE SURE THE EXCITER IS PROPERLY ALIGNED. REFER TO THE PROCEDURE IN THE ADJUSTMENTS SECTION OF THIS MANUAL.
3. CONNECT THE RADIO ANTENNA CONNECTOR TO A 50–OHM RESISTIVE DUMMY LOAD. POWER RATING OF THE DUMMY LOAD MUST BE GREATER THAN THE RADIO POWER OUTPUT RATING. BE SURE THE DUMMY LOAD IS USABLE IN THE 400–512 MHz RANGE.
4. CONNECT THE RADIO TO A 13.5 VOLT DC POWER SOURCE THAT IS ABLE TO SUPPLY AT LEAST THE AMOUNT OF CURRENT SPECIFIED FOR YOUR RADIO MODEL.
5. USING A TEK37 ADAPTER CABLE, CONNECT THE PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   A. CONNECT THE 20–PIN CONNECTOR OF THE TEK37 ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE PORTABLE TEST SET.
   B. CONNECT THE RED "CONTROL" PLUG TO THE RECEPTACLE ON THE CONTROL (INTERCONNECT) BOARD.
   C. CONNECT THE WHITE "METERING" PLUG TO THE EXCITER BOARD METERING RECEPTACLE.
6. SET THE PORTABLE TEST SET SWITCHES AS FOLLOWS:
   A. FUNCTION SWITCH TO XMIT
   B. METER SWITCH TO OFF
   C. REFERENCE SWITCH TO A OR B
   D. SELECTOR SWITCH AS REQUIRED IN THE TROUBLESHOOTING PROCEDURE.
7. SET THE CONTROL HEAD FREQUENCY SELECTOR SWITCH TO A STANDARD OR WIDE–SPACED CHANNEL, AS REQUIRED.
8. REFER TO THE 406–420 MHz EXCITER OR 450–512 MHz EXCITER SCHEMATIC DIAGRAM AND CIRCUIT BOARD DETAIL.

NOTE

IN 406–420 MHz EXCITERS, THE COMPONENT REFERENCE NUMBERS ARE AS FOLLOWS:
300 TO 399 – WIDE–SPACED CHANNEL CIRCUITS
400 TO 499 – STANDARD CHANNEL CIRCUITS
IN 450–512 MHz EXCITERS, THE COMPONENT REFERENCE NUMBERS ARE AS FOLLOWS:
300 TO 399 – STANDARD CHANNEL CIRCUITS
400 TO 499 – WIDE–SPACED CHANNEL CIRCUITS
IF PROBLEMS EXIST IN ONLY THE STANDARD OR THE WIDE–SPACED CHANNELS, ONLY THE COMPONENTS IN THOSE CIRCUITS NEED BE CHECKED.

EXCITER STAGE GAIN TESTING PROCEDURE

1. IF YOU HAVE NOT ALREADY CHECKED THE OVERALL GAIN OF THE EXCITER, DO SO. THE PROCEDURE BEGINS AT THE TROUBLESHOOTING CHART BLOCK THAT IS HEADED, "SET UP THE EXCITER AS FOLLOWS FOR GAIN TESTS:".
2. LEAVE THE RF VOLTMETER CONNECTED TO THE APPROPRIATE EXCITER OUTPUT CABLE.
3. SOLDER A JUMPER FROM THE TAP ON L301 (L401) TO THE GROUND PLATING IMMEDIATELY ADJACENT TO IT, AND FROM TP301 TO THE GROUND PLATING IMMEDIATELY ADJACENT TO IT. THESE GROUND JUMPERS MUST BE KEPT AS SHORT AS POSSIBLE.
4. SET THE SIGNAL GENERATOR TO THE TRANSMIT FREQUENCY, USING A FREQUENCY COUNTER. FEED A 70 mV SIGNAL INTO THE BASE OF Q307 (Q406) THROUGH A 50–OHM CABLE AND A SERIES–CONNECTED 5 pF CAPACITOR. THE SHIELD OF THE 50–OHM CABLE SHOULD BE SOLDERED TO THE GROUND PLATING NEAREST TO Q307 (Q406).
5. WITH THE TRANSMITTER KEYED, THE METER ON THE EXCITER OUTPUT SHOULD READ APPROXIMATELY 180 mV. IF THE READING IS LOW, THE CIRCUIT OF Q307 (Q406) IS MALFUNCTIONING.
6. IF THE READING IS GOOD, MOVE THE INJECTED SIGNAL FROM THE BASE OF Q307 (Q406) TO THE BASE OF Q306 (Q405). THE SHIELD CONNECTION MUST BE MOVED TO THE CLOSEST GROUND PLATING TO THE STAGES. THE METER SHOULD READ AT LEAST 0.55 V WITH THE TRANSMITTER KEYED. IF IT DOES NOT, THE CIRCUITRY OF Q306 (Q405) IS MALFUNCTIONING. IF THE METER READING IS 0.55 VOLTS OR GREATER, Q305 (Q404) OR AN ASSOCIATED COMPONENT IS DEFECTIVE.
7. REMOVE THE GROUND JUMPERS FROM L301 (OR L401) AND TP301, AND DISCONNECT THE SIGNAL GENERATOR FROM THE EXCITER BOARD. REPLACE THE EXCITER INPUT AND OUTPUT CABLES.

EEPS–15948–O

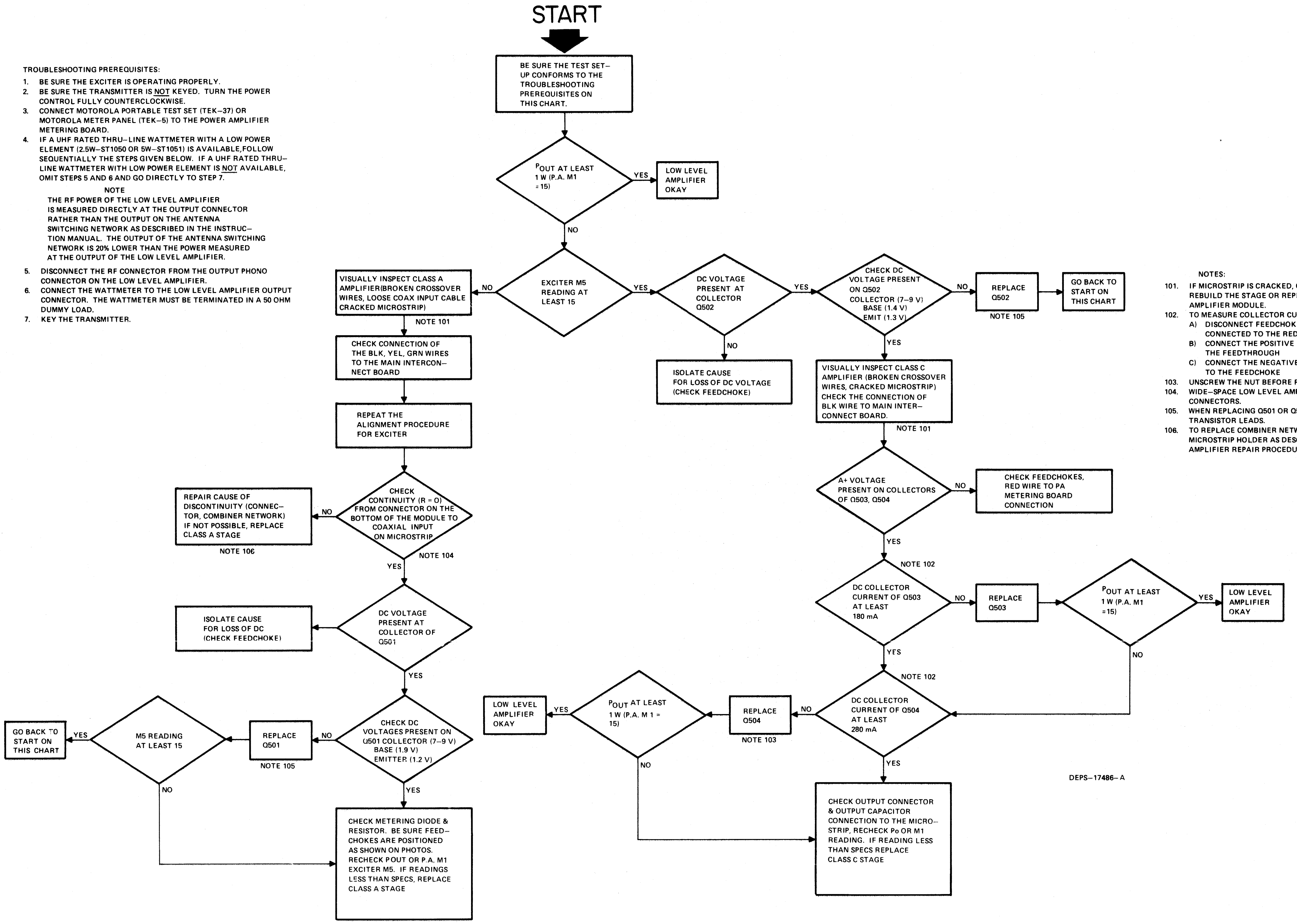
TROUBLESHOOTING PREREQUISITES:

1. BE SURE THE EXCITER IS OPERATING PROPERLY.
2. BE SURE THE TRANSMITTER IS NOT KEYED. TURN THE POWER CONTROL FULLY COUNTERCLOCKWISE.
3. CONNECT MOTOROLA PORTABLE TEST SET (TEK–37) OR MOTOROLA METER PANEL (TEK–5) TO THE POWER AMPLIFIER METERING BOARD.
4. IF A UHF RATED THRU–LINE WATTMETER WITH A LOW POWER ELEMENT (2.5W–ST1050 OR 5W–ST1051) IS AVAILABLE, FOLLOW SEQUENTIALLY THE STEPS GIVEN BELOW. IF A UHF RATED THRU–LINE WATTMETER WITH LOW POWER ELEMENT IS NOT AVAILABLE, OMIT STEPS 5 AND 6 AND GO DIRECTLY TO STEP 7.

NOTE

THE RF POWER OF THE LOW LEVEL AMPLIFIER IS MEASURED DIRECTLY AT THE OUTPUT CONNECTOR RATHER THAN THE OUTPUT ON THE ANTENNA SWITCHING NETWORK AS DESCRIBED IN THE INSTRUCTION MANUAL. THE OUTPUT OF THE ANTENNA SWITCHING NETWORK IS 20% LOWER THAN THE POWER MEASURED AT THE OUTPUT OF THE LOW LEVEL AMPLIFIER.

5. DISCONNECT THE RF CONNECTOR FROM THE OUTPUT PHONO CONNECTOR ON THE LOW LEVEL AMPLIFIER.
6. CONNECT THE WATTMETER TO THE LOW LEVEL AMPLIFIER OUTPUT CONNECTOR. THE WATTMETER MUST BE TERMINATED IN A 50 OHM DUMMY LOAD.
7. KEY THE TRANSMITTER.



NOTES:

101. IF MICROSTRIP IS CRACKED, ORDER A NEW MICROSTRIP & REBUILD THE STAGE OR REPLACE THE COMPLETE LOW LEVEL AMPLIFIER MODULE.
102. TO MEASURE COLLECTOR CURRENT OF Q503 OR Q504:
   - A) DISCONNECT FEEDCHOKE FROM THE FEEDTHROUGH CONNECTED TO THE RED WIRE
   - B) CONNECT THE POSITIVE LEAD OF A mA METER TO THE FEEDTHROUGH
   - C) CONNECT THE NEGATIVE LEAD OF THE mA METER TO THE FEEDCHOKE
103. UNSCREW THE NUT BEFORE REMOVING Q504.
104. WIDE–SPACE LOW LEVEL AMPLIFIER HAS TWO PHONO CONNECTORS.
105. WHEN REPLACING Q501 OR Q502, APPLY HEATSINK TO TRANSISTOR LEADS.
106. TO REPLACE COMBINER NETWORK, REMOVE PLASTIC MICROSTRIP HOLDER AS DESCRIBED IN THE LOW LEVEL AMPLIFIER REPAIR PROCEDURE.

Low Level Amplifier Troubleshooting Chart
Motorola No. DEPS-17486-A
4/27/77-UP

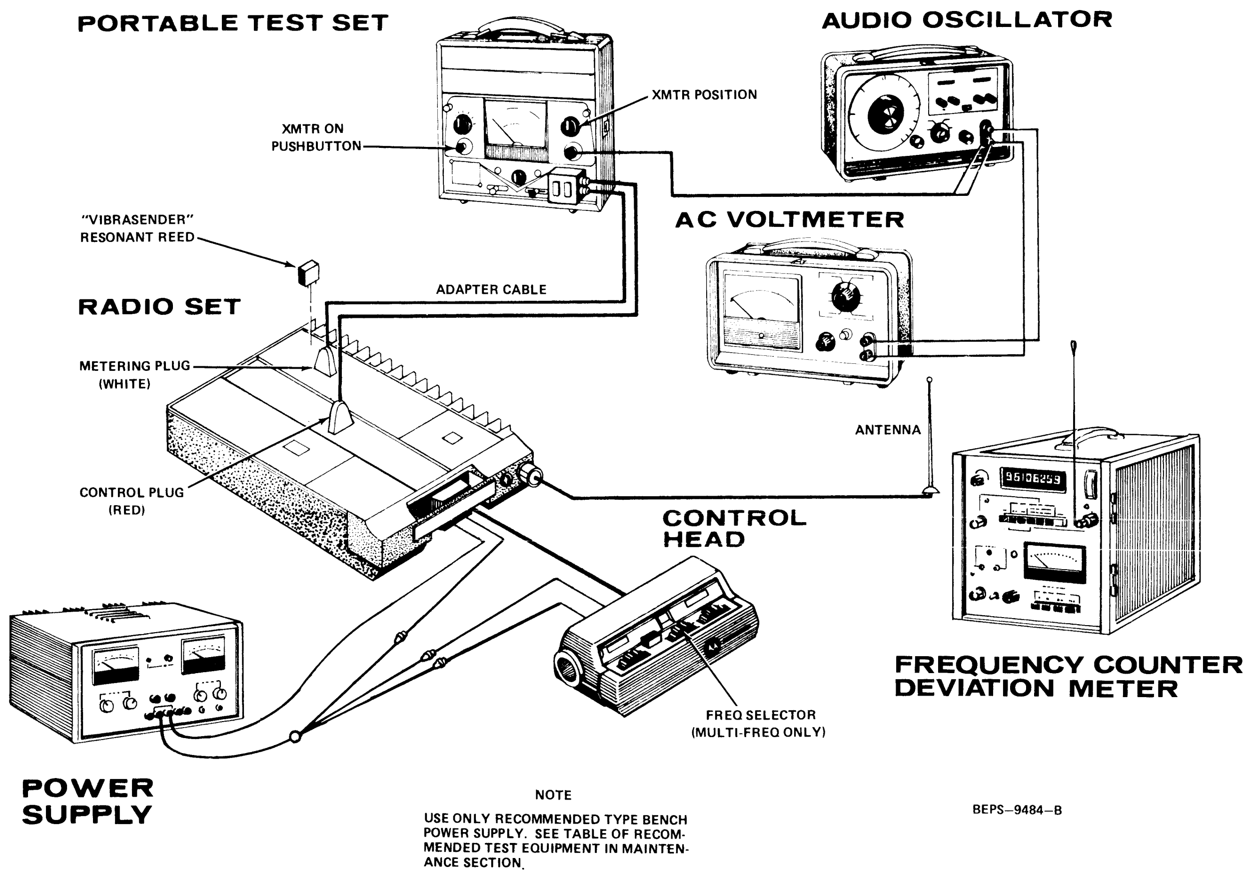


Figure 9.
Deviation Measurement Test Equipment Set-Up

alignment before starting a more detailed troubleshooting procedure. Look for loose, burned, or damaged components, and for damaged circuit board plating. Be sure all of the exciter board mounting screws are properly tightened. When the "obvious" problems revealed by this inspection have been corrected, repeat the exciter performance tests and, if necessary, follow the troubleshooting procedure given on the exciter troubleshooting chart to isolate the defective stage and component.

11. LOW-LEVEL AMPLIFIER

a. Introduction

This section provides troubleshooting and repair procedures for the transmitter low level amplifier. It is assumed that preliminary tests have localized the trouble to this section of the radio.

b. Troubleshooting

(1) Visual Checks

Visually check for obvious physical defects such as broken leads, cracked microstrips, and broken or disconnected components. These defects should be corrected before any other troubleshooting steps are taken.

NOTE

Cracked microstrips can often be found by sliding the tip of a modeling knife blade or some other sharp object along the surface of the ceramic substrate. Usually, a noticeable "bump" will be felt as the sharp object passes over the crack in the microstrip.

(2) Voltage Checks

Check for A+, A-, and keyed 9.6 V at the feedthrough connections.

CAUTION

Due to the voltage requirements of the NPN transistors in the Class C stage, all "ground plating" is at A- potential and is "hot" with respect to chassis ground in positive ground vehicles. Caution must be used to prevent connection of ground plating on the Class C stage to chassis ground, either directly or by use of test equipment ground lead. When troubleshooting the low level amplifier in a positive ground vehicle and using ac operated test equipment, the amplifier ground lead must not be electrically connected to the ac line ground lead.

(3) Troubleshooting Chart

If visual and voltage checks do not reveal the cause of subnormal performance, the procedure given on the low-level amplifier troubleshooting chart will help you to isolate the defective component.

c. Repair Procedure

(1) Low-Level Amplifier Module Removal

To remove the low-level amplifier module from the radio chassis, use the following procedure:

(a) Disconnect the rf output connector and the three push-pin leads (black, yellow and green) from the control board. Refer to Figure 10.

(b) Remove the PA metering board mounting screws and lift the circuit board up. Disconnect the red lead from the push-pin on the PA metering board as shown in Figure 10.

(c) Refer to Figure 11. Remove the three low-level amplifier module mounting screws. Remove the module by gently working it from side to side while pulling upward. Be careful not to damage the coaxial connectors on the bottom of the module.

(2) Component Identification

Refer to Figures 12 through 15 to identify the component parts of the low-level amplifier module.

(3) Class A Stage Replacement

To replace the Class A stage, remove the low level amplifier from the radio and proceed as follows:

Step 1. Disconnect the input coaxial cable from the amplifier.

Step 2. Disconnect L502 and L501 from the Class A stage.

Step 3. Disconnect the two straps connecting the two microstrips.

Step 4. Disconnect the strap between the Class A stage and the low level amplifier bracket.

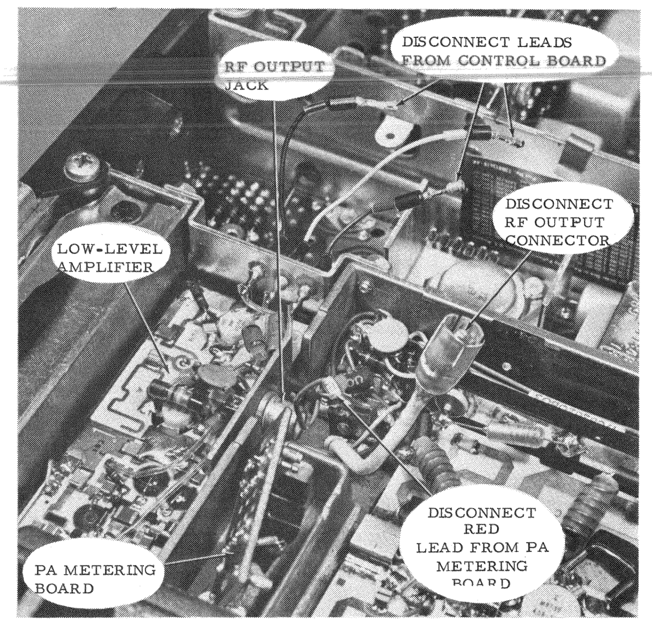


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Figure 10. Low Level Amplifier Lead Removal

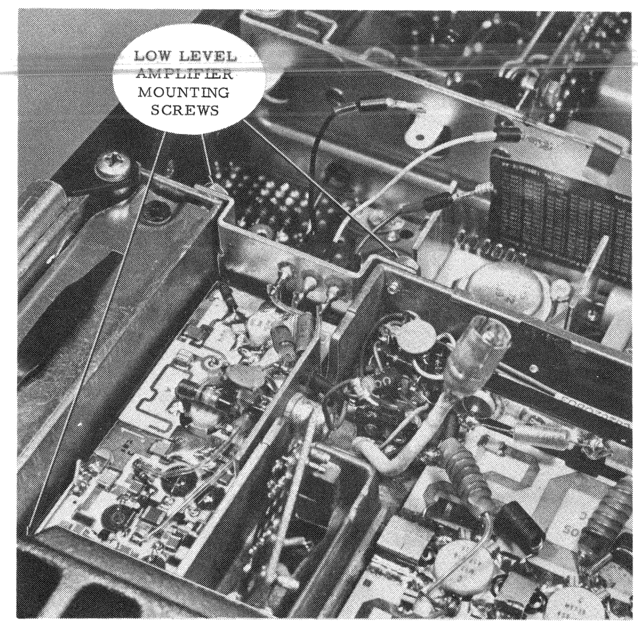

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Figure 11. Low Level Amplifier Module Mounting Screw Location

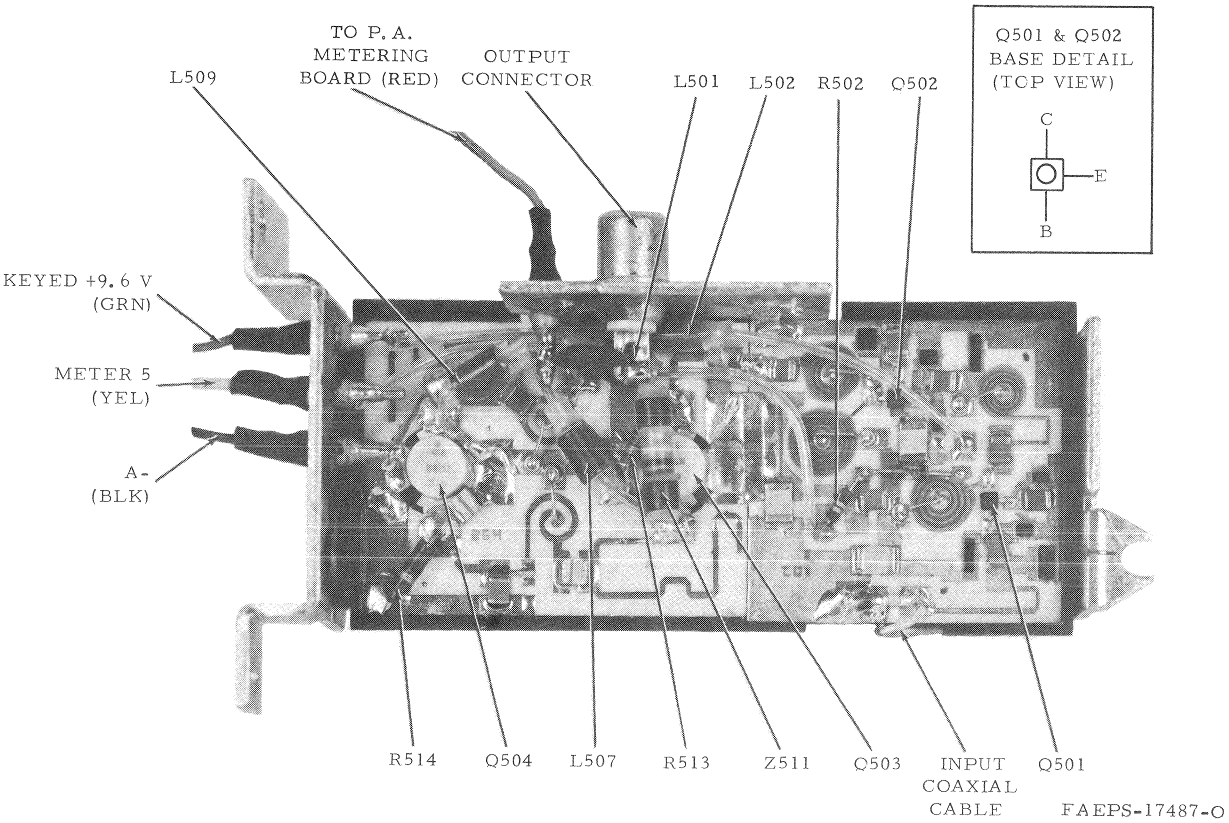


Figure 12.
Low-Level Amplifier Components
(450-512 MHz Range)

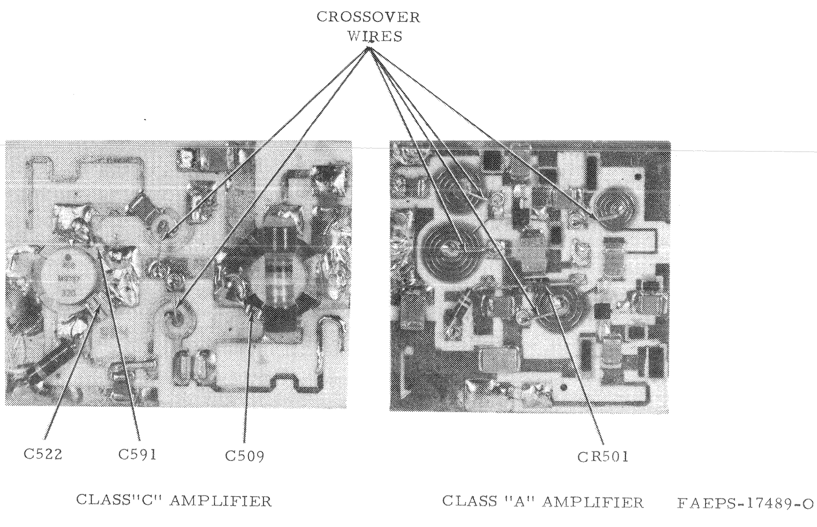


Figure 13.
Class A and Class C Amplifier Parts
(450-512 MHz Range)

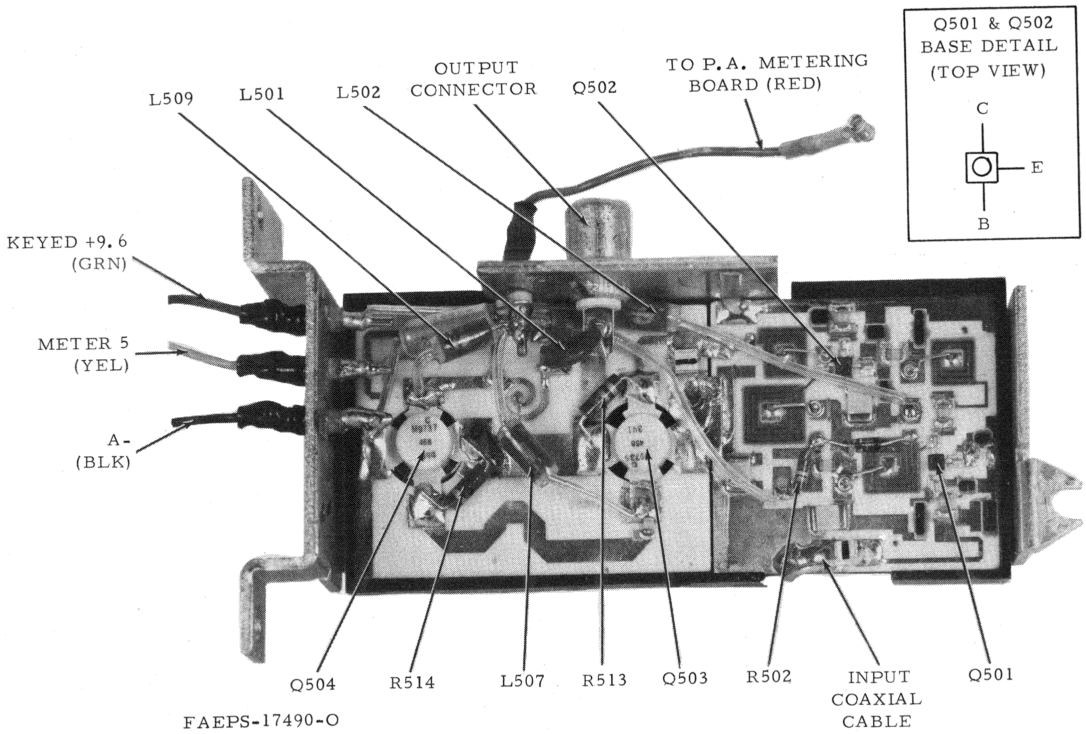


Figure 14.
Low-Level Amplifier Components
(406-420 MHz Range)

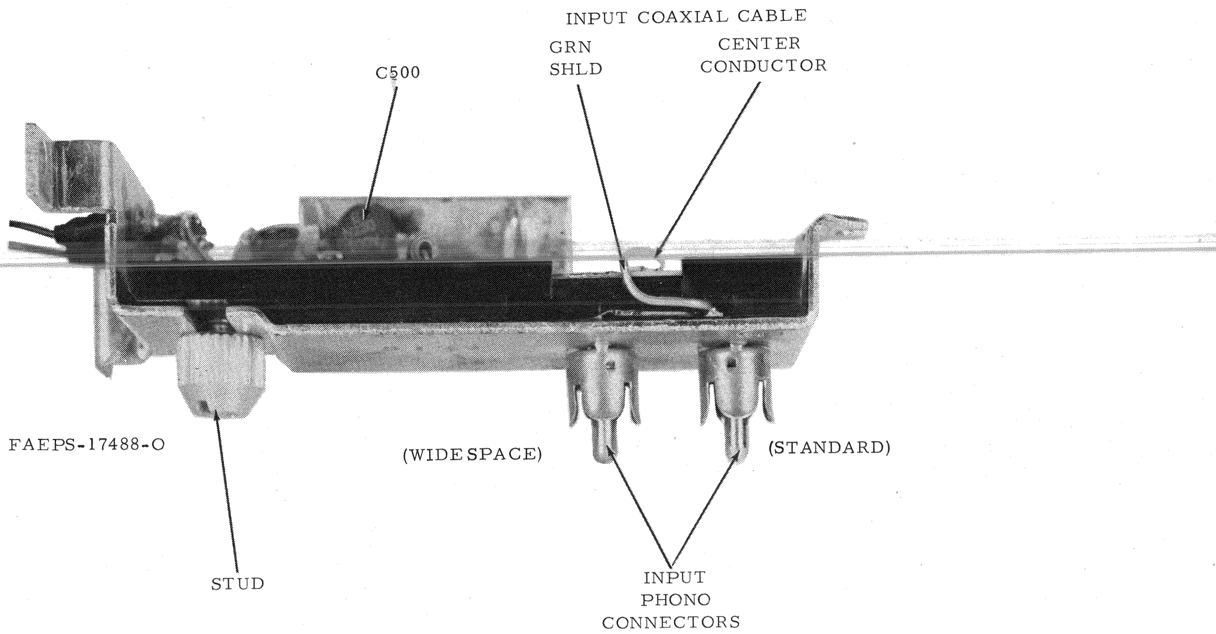


Figure 15.
Low-Level Amplifier
Side View

NOTE

Use a modeling knife or long-nose pliers for lifting each strap while applying heat with a low wattage (50 watt maximum) soldering iron. Be sure the solder is melted before lifting the strap.

Step 5. Remove the Class A stage from the plastic microstrip holder.

NOTE

A replacement Class A amplifier includes all parts shown in Figure 13. To order a complete class A amplifier stage, use the part number given in the non-referenced parts section of the low-level amplifier parts list.

Step 6. Replace the stage by inserting the microstrip into the plastic holder.

Step 7. Reconnect all components which were disconnected in steps 1 through 4.

NOTE

Make sure that L501 and L502 are repositioned as shown in Figures 12 and 14.

(4) Class C Stage Replacement

To replace the Class C stage, proceed as follows:

Step 1. Unscrew the stud on the bottom of the module.

Step 2. Remove Q504. SEE POWER TRANSISTOR REMOVAL SECTION.

Step 3. Disconnect L501, L502, L507, and L509 from the microstrip.

Step 4. Disconnect C500 and R537 from the Class C stage.

Step 5. Disconnect the strap between the Class C stage and the low level amplifier bracket.

Step 6. Disconnect the strap between the Class C stage and the feed-through capacitor.

Step 7. Disconnect the two straps between the two microstrips.

Step 8. Remove the Class C stage.

NOTE

The microstrip replacement kit for the Class C stage for each range is listed in the parts list under non-referenced items. The kit includes the crossover wires, C516, C517, C518, C523, and C524.

Step 9. Replace the stage by inserting the microstrip in the plastic holder.

Step 10. Reconnect all components which were disconnected in steps 1 through 7.

NOTE

Make sure L501, L502, L507, and L509 are repositioned as shown in Figures 12 and 14.

CAUTION

When replacing Q504, tighten the stud before soldering the leads of the transistor. For complete details of power transistor removal and replacement, refer to the instructions given later in this low-level amplifier section.

(5) Combiner Network Replacement

Combiner networks are installed in wide-spaced low level amplifiers only (TLE8071A, TLE8073A, TLE8074A, and TLE8075A). The combiner network is mounted under the plastic microstrip holder. Replace the combiner network as follows:

Step 1. Disconnect the input cable from the Class A stage.

Step 2. Disconnect L501, L502, L507, L509 from the microstrip.

Step 3. Disconnect the three ground straps between the microstrips and the low level amplifier bracket.

Step 4. Disconnect C500 and R537 between the Class C stage and the output connector.

Step 5. Unscrew the stud on the bottom of the module.

Step 6. Remove the two Phillips head screws from the bottom of the module.

Step 7. Slide out the plastic microstrip holder.

Step 8. Remove the combiner.

NOTE

The combiner network part number is listed in the low level amplifier parts list under non-referenced items.

Step 9. Replace the combiner network.

Step 10. Slide in the plastic microstrip holder and reconnect all of the components disconnected in Steps 1 through 6.

NOTE

Make sure L501, L502, L507, and L509 are repositioned as shown in Figures 12 and 15.

(6) Transistor Removal and Replacement

The following is a brief description of the transistor removal and replacement technique that should be used for the low-level amplifier. For more detailed information and illustrations, refer to the power amplifier transistor removal and replacement procedure, see Figure 16.

Class C Stage Transistor Removal:

Step 1. Unsolder all component connections at the points where the leads are soldered to the microstrip.

Step 2. Remove chip capacitors connected between transistor leads.

Step 3. Remove the excess solder from the lead area on the microstrip with a solder remover.

Step 4. Carefully lift each of the four leads using a modeling knife or long-nose pliers while applying heat. Be sure the solder has melted before trying to lift the lead.

Step 5. Remove the transistor mounting stud on the bottom of the module (Q504 only).

Step 6. Remove the transistor.

CAUTION

Chip capacitors must not be reused. Replacement chip capacitors are available individually, by part number, or as part of a kit (identified by a PK number) that includes a transistor and its associated chip capacitors. The capacitor part numbers and the PK kit numbers are listed in the low-level amplifier parts list.

Class C Stage Transistor Replacement

Step 1. Lightly pre-tin the underside of each transistor lead.

Step 2. Place the transistor on the microstrip. Position the device as shown in Figure 16.

Step 3. Carefully tighten the transistor mounting stud (Q504 only).

Step 4. One at a time, solder each transistor lead to the microstrip. Use care that the solder doesn't bridge the leads or short either the base or the collector to the microstrip ground plating.

Step 5. Install the chip capacitors between the transistor leads (See Figure 16). Place each chip capacitor as close to the transistor as possible. Reflow type soldering technique MUST be used and the soldering iron tip MUST NOT touch the chip capacitor termination.

Step 6. Reconnect all Class C stage components.

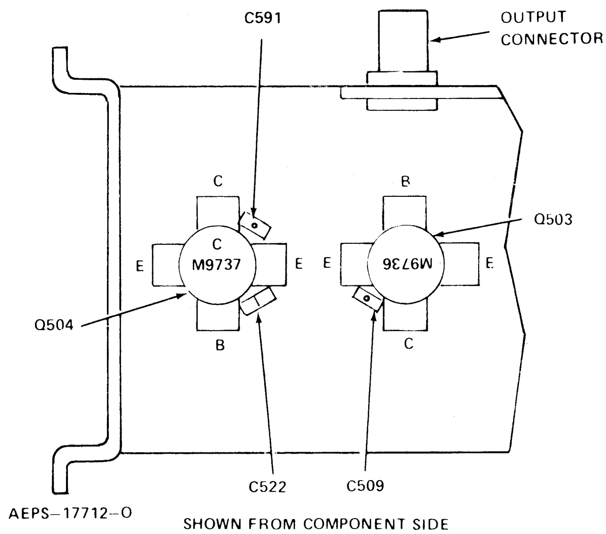


Figure 16.
Class C Amplifier Transistor Placement

Class A Stage Transistor Removal

CAUTION

Transistors in the Class A stage can be damaged by excessive heat. When a transistor is removed or replaced, its leads should be heat-sinked with tweezers or long-nosed pliers.

Step 1. Heat and carefully lift each of the transistor leads.

Step 2. Lift the transistor off the microstrip.

Class A Stage Transistor Replacement

Step 1. Place the transistor on the microstrip. Position the device as shown in Figure 15.

Step 2. Carefully solder each transistor lead to the microstrip. Be sure to heatsink each lead with tweezers or long-nosed pliers.

12. POWER AMPLIFIER

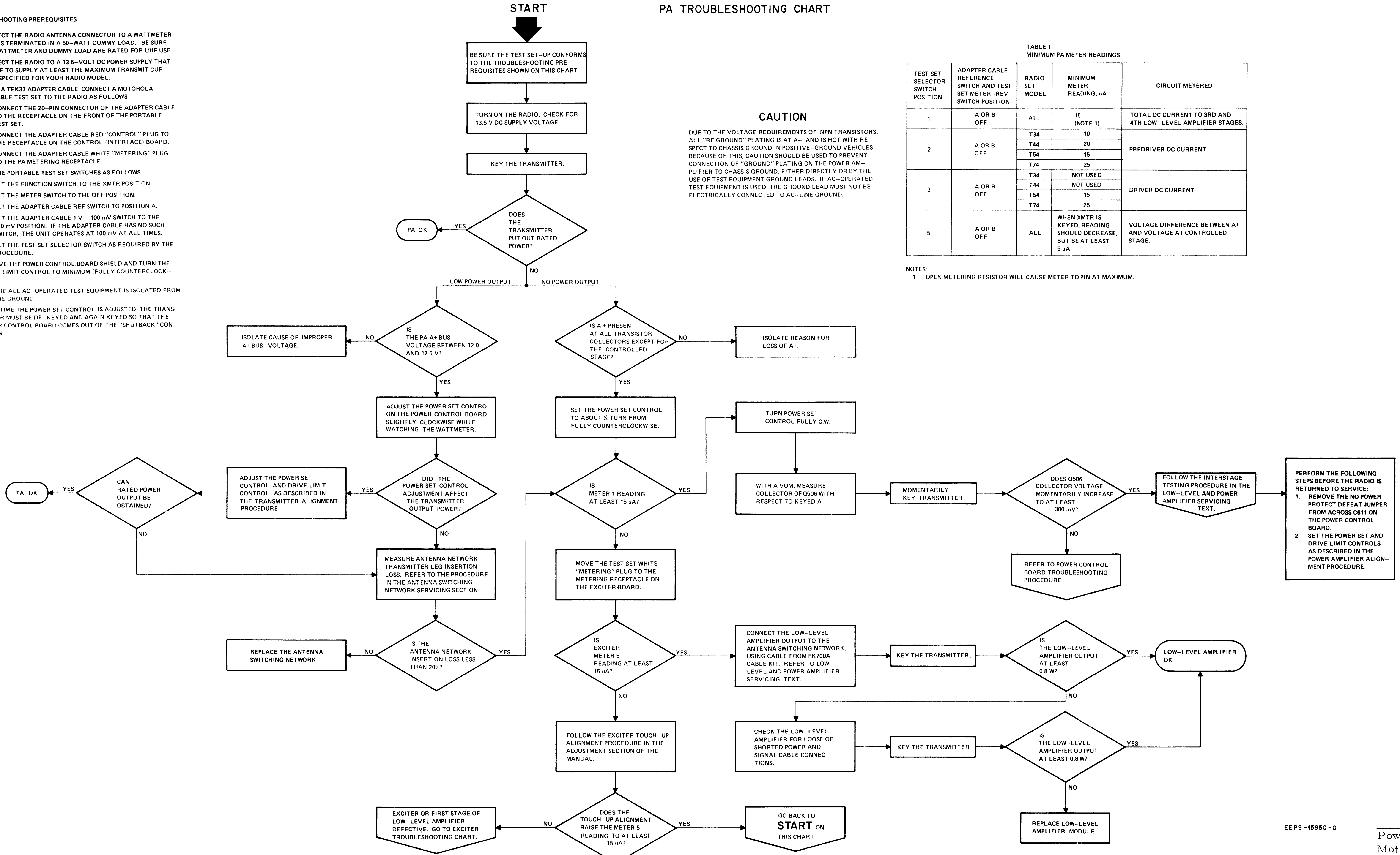
a. Introduction

This section provides maintenance procedures for the transmitter power amplifier circuits. It is assumed that preliminary tests have already localized the trouble to these sections of the radio.

PA TROUBLESHOOTING CHART

TROUBLESHOOTING PREREQUISITES:

1. CONNECT THE RADIO ANTENNA CONNECTOR TO A WATTMETER THAT IS TERMINATED IN A 50–WATT DUMMY LOAD. BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE.
2. CONNECT THE RADIO TO A 13.5–VOLT DC POWER SUPPLY THAT IS ABLE TO SUPPLY AT LEAST THE MAXIMUM TRANSMIT CURRENT SPECIFIED FOR YOUR RADIO MODEL.
3. USING A TEK37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   - A. CONNECT THE 20–PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE PORTABLE TEST SET.
   - B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE RECEPTACLE ON THE CONTROL (INTERFACE) BOARD.
   - C. CONNECT THE ADAPTER CABLE WHITE "METERING" PLUG TO THE PA METERING RECEPTACLE.
4. SET THE PORTABLE TEST SET SWITCHES AS FOLLOWS:
   - A. SET THE FUNCTION SWITCH TO THE XMTR POSITION.
   - B. SET THE METER SWITCH TO THE OFF POSITION.
   - C. SET THE ADAPTER CABLE REF SWITCH TO POSITION A.
   - D. SET THE ADAPTER CABLE 1 V – 100 mV SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SUCH SWITCH, THE UNIT OPERATES AT 100 mV AT ALL TIMES.
   - E. SET THE TEST SET SELECTOR SWITCH AS REQUIRED BY THE PROCEDURE.
5. REMOVE THE POWER CONTROL BOARD SHIELD AND TURN THE DRIVE LIMIT CONTROL TO MINIMUM (FULLY COUNTERCLOCKWISE).
6. BE SURE ALL AC–OPERATED TEST EQUIPMENT IS ISOLATED FROM AC LINE GROUND.
7. EACH TIME THE POWER SET CONTROL IS ADJUSTED, THE TRANSMITTER MUST BE DE–KEYED AND AGAIN KEYED SO THAT THE POWER CONTROL BOARD COMES OUT OF THE "SHUTBACK" CONDITION.



CAUTION

DUE TO THE VOLTAGE REQUIREMENTS OF NPN TRANSISTORS, ALL "RF GROUND" PLATING IS AT A–, AND IS HOT WITH RESPECT TO CHASSIS GROUND IN POSITIVE–GROUND VEHICLES. BECAUSE OF THIS, CAUTION SHOULD BE USED TO PREVENT CONNECTION OF "GROUND" PLATING ON THE POWER AMPLIFIER 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.

TABLE I
MINIMUM PA METER READINGS

TEST SET SELECTOR SWITCH POSITION	ADAPTER CABLE REFERENCE SWITCH AND TEST SET METER–REV SWITCH POSITION	RADIO SET MODEL	MINIMUM METER READING, uA	CIRCUIT METERED
1	A OR B OFF	ALL	15 (NOTE 1)	TOTAL DC CURRENT TO 3RD AND 4TH LOW–LEVEL AMPLIFIER STAGES.
2	A OR B OFF	T34	10	PREDRIVER DC CURRENT
		T44	20	
		T54	15	
		T74	25	
3	A OR B OFF	T34	NOT USED	DRIVER DC CURRENT
		T44	NOT USED	
		T54	15	
		T74	25	
5	A OR B OFF	ALL	WHEN XMTR IS KEYED, READING SHOULD DECREASE, BUT BE AT LEAST 5 uA.	VOLTAGE DIFFERENCE BETWEEN A+ AND VOLTAGE AT CONTROLLED STAGE.

NOTES:
1. OPEN METERING RESISTOR WILL CAUSE METER TO PIN AT MAXIMUM.

EEPS-15950-O

Power Amplifier Troubleshooting Chart
Motorola No. EEPS-15950-O
11/8/76-UP

CAUTION

The power amplifier stages must be installed in a radio set for testing to provide the necessary power, ground, control, heat sinking, and signal connections.

b. Performance Tests

The only performance test needed for the power amplifier section of the radio is measurement of the rf power output at the radio set antenna connector. Before performing the following test, be sure the exciter is operating properly.

(1) Connect an rf wattmeter to the radio set antenna connector, using an 8-inch or shorter length of coaxial cable. Be sure the wattmeter is rated for UHF use and that it is terminated in a resistive 50-ohm dummy load.

(2) Key the transmitter and observe the power output reading on the wattmeter.

(3) If necessary, adjust the POWER SET control on the power control board until rated transmitter power output is obtained. If rated power output cannot be obtained, remove the shield from the power control board and set the Drive Limit control fully counterclockwise. Replace the power control board shield, key the transmitter, and again adjust the POWER SET control for rated transmitter power output.

(4) If it was necessary to change the Drive Limit control setting to obtain rated transmitter output power, refer to the ADJUSTMENTS section of this instruction manual for the Drive Limit control adjustment procedure.

If the performance test indicates that the power amplifier section of the radio set is not functioning properly, go to the following troubleshooting section.

c. Troubleshooting

If a transmitter malfunction has been isolated to the power amplifier circuits, the cause of the malfunction can be found by using the following procedures. Visual checks and operating voltage checks should be made before more extensive troubleshooting is begun.

(1) Visual Checks

Visually check for obvious physical defects, such as broken leads, broken or cracked microstrip boards, and broken or disconnected components. These defects should be corrected immediately. Then recheck the power amplifier performance. If the power amplifier fails the performance test, make voltage checks next.

If the visual inspection reveals overheated components, do not replace the overheated parts until the cause of the overheating has been found and corrected. Otherwise, the new part may be damaged.

(2) 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 cracked microstrips, intermittent leads, etc., may not be obvious to a visual inspection.

NOTE

Cracked microstrips can often be found by sliding the tip of a modeling knife blade or some other sharp object along the surface of the ceramic substrate. Usually, a noticeable "bump" will be felt as the sharp object passes over the crack in the microstrip.

(3) Isolating Defective Components

If the visual and voltage checks do not reveal the cause of subnormal power amplifier performance, refer to the power amplifier troubleshooting chart, the interstage testing procedure, and the driver and final amplifier testing procedure. These sections provide systematic troubleshooting methods to help you isolate the defective power amplifier stage and component.

d. Interstage Testing Procedure

During the troubleshooting procedure it is sometimes desirable to determine the power output of an individual transmitter stage with a given input level. The following procedure can be used to supplement a procedure using the meter readings given on the power amplifier troubleshooting chart.

If this procedure shows that a PA stage is malfunctioning and must be repaired, refer to the Power Amplifier Repair Procedures part of this section of the instruction manual.

CAUTION

Due to the voltage requirements of NPN Transistors, all "rf ground" plating is at A-, and is hot with respect to chassis ground in positive-ground vehicles. Therefore, caution should be used to prevent connection of "ground" plating on the power amplifier 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.

CAUTION

DO NOT "SHORT-CUT" THE FOLLOWING PROCEDURE. This procedure is designed to avoid situations in which excessive drive might be applied to the predriver or driver stages. Excessive drive could destroy the predriver or driver stages. It is possible to safely begin stage gain measurements at a lower power level stage than the predriver if test set metering indicates that one of these lower power level stages is not operating properly. UNDER NO CIRCUMSTANCES, however, should attempts be made to "short-cut" the following procedure by checking the driver or final PA stage without first checking the output of the predriver stage.

(1) Be sure the transmitter is not keyed. Turn the Drive Limit control fully counterclockwise (minimum drive limit).

(2) Check all PA transistors except for those in the controlled stage for proper collector operating voltages (+13.6 volts). The controlled stage collector voltage cannot be checked until later in this procedure.

(3) Turn the POWER SET control fully counterclockwise (minimum power output).

(4) Connect a UHF-rated wattmeter to the radio set antenna connector with an 8-inch or shorter length of coaxial cable. The wattmeter must be terminated in a 50-ohm resistive dummy load.

(5) Disconnect the transmitter output coax cable connector from the antenna switching network, using the special tool provided in the alignment tool kit.

(6) Disconnect the rf connector from the output jack on the low-level amplifier. Connect the low-level amplifier output to the antenna switching network, using an adapter cable from the PK700A Cable Kit.

(7) Key the transmitter and check the low-level amplifier output. The wattmeter reading should be at least 0.8 watts.

(8) If the low-level amplifier power output is low, connect a Motorola test set to the exciter and check meter position 5. With the REF switch on the TEK-37 test set adapter cable set to B, the meter 5 reading should be at least 15 uA. If the meter 5 reading is low, the exciter is defective. If the meter 5 reading is 15 uA or greater, the low-level amplifier is bad. Refer to the low-level amplifier part of this section of the instruction manual for detailed low-level amplifier troubleshooting and repair procedures.

(9) Disconnect the predriver output from the driver stage input (75- and 100-watt models) or the final amplifier input (25- and 45-watt models).

(10) Using the proper cable from the PK700A Cable Kit, connect the predriver output to the antenna switching network. The shield of the adapter cable should be soldered to the microstrip ground plating as close as possible to the point where the cable center conductor is soldered. Use a 50-watt soldering iron and silver solder (1.4% silver, 36.1% lead, 62.5% tin) as recommended in the Power Amplifier Repair Procedures part of this section of the manual. NEVER operate a PA stage without a proper 50-ohm termination.

NOTE

If the proper adapter cable is not available, the output of the predriver stage can be connected to an rf wattmeter with a short (less than 8") coaxial cable. Be sure the wattmeter is rated for use at UHF and is terminated in a 50-ohm resistive dummy load that is rated for UHF. Home-made dummy loads or radiating antennas are not adequate for these tests.

If the predriver output is connected directly to an rf wattmeter, the accuracy of the measurement will be affected. Remember that because the antenna switching network is not connected between the stage output and the wattmeter, the wattmeter readings will be about 15% greater than those listed in the PA stage power output table in this procedure.

(11) Defeat the "No Power" Protect circuit on the power control board as follows:

CAUTION

It is assumed that at this point in the procedure the interstage coupling to

CAUTION (CONT'D)

the transmitter final amplifier section has been disconnected to measure the power output of one of the earlier PA stages. In that case the following procedure is safe. IN NO CASE SHOULD THIS PROCEDURE BE USED WHEN DRIVE IS APPLIED TO THE TRANSMITTER FINAL AMPLIFIER STAGES.

(a) Disconnect the radio from the power/control cable.

(b) Remove the shield from over the power control board.

(c) Refer to the power control board schematic diagram and circuit board detail. Locate capacitor C611.

(d) Short the leads of C611 together, using a short piece of jumper wire soldered to the plating side of the circuit board. Be careful to avoid shorting any other plating.

(e) Reconnect the power/control cable and proceed with the troubleshooting procedure.

(12) Key the transmitter. Slowly increase the predriver power output by turning the POWER SET control clockwise while watching the rf wattmeter. Set the predriver power output to the level specified in the PA stage power output table in this procedure. If the proper predriver power output setting can be obtained, go directly to step (3) of the Driver and Final Amplifier Testing Procedure.

(13) If the proper predriver power output setting cannot be obtained, disconnect the controlled stage output from the predriver input. Disconnect the test cable from the predriver output and connect it to the controlled stage output.

(14) Key the transmitter and check the controlled stage output power reading on the rf wattmeter. If the controlled stage output power is at least the value given in the PA stage power output table, the predriver stage is defective.

(15) If the controlled stage power output is low, check the controlled stage transistor collector voltage with the POWER SET control set fully clockwise. If the drive level from the power control board is ok, the controlled stage transistor collector voltage will be within one volt of the dc supply voltage.

(16) If the controlled stage transistor voltage is normal, but the stage power output is low, the controlled stage is defective. It is assumed that the low-level amplifier tests earlier in this procedure have shown that the low-level amplifier is operating properly.

(17) After all malfunctions have been found and corrected and proper predriver power output can be obtained, disconnect the test coaxial cable and make sure all rf interstage connections are restored.

(18) Re-enable the "No Power" Protect circuit on the power control board by removing the jumper that was connected across C611 earlier in this procedure. Be sure none of the power control board plating is shorted. Reinstall the power control board shield.

(19) Reconnect the transmitter output coax to the antenna switching network. Make sure a properly-terminated rf wattmeter is connected to the radio set antenna connector. The coaxial cable between the radio set and the wattmeter should be 8" or less in length.

(20) Key the transmitter. If adjusting the POWER SET control allows rated power to be obtained, do a complete POWER SET and Drive Limit control adjustment procedure. Refer to the ADJUSTMENTS section of this instruction manual. If rated power cannot be obtained, go on to the driver and final amplifier testing procedure.

e. Driver and Final Amplifier Testing Procedures

It is assumed that before you begin the following procedures you have determined that the predriver, controlled stage, low-level amplifier, and exciter are operating properly.

The driver and final amplifier stages may have one, two, or four transistors. These differing configurations require slightly different troubleshooting techniques. The procedure is therefore broken up according to the number of transistors used in the stage.

All driver and final amplifier stages:

(1) Connect an rf wattmeter to the radio set antenna connector, using an 8-inch or shorter length of coaxial cable. Be sure the wattmeter is terminated in a 50-ohm resistive load.

PA STAGE POWER OUTPUT TABLE
(Minimum Values)

MODEL	POWER OUTPUT, WATTS (NOTE 1)				
	LOW-LEVEL AMPLIFIER	CONTROLLED STAGE	PRE-DRIVER	DRIVER	FINAL AMPLIFIER
406-420 MHz:					
T44	0.8 (Note 2)	4	16	NOT USED	45
T74		4	16	35	100
450-470 MHz:					
T34	0.8 (Note 2)	2	9	NOT USED	25
T44		4	16	NOT USED	45
T54		2	9	25	75
T74		4	16	35	100
470-512 MHz:					
T34	0.8 (Note 2)	1.6	7	NOT USED	19
T44		3	12	NOT USED	39
T54		1.6	7	20	59
T74		3	12	27	78

Note 1: These power levels take into account a 20% loss in the Antenna Switching Network.

Note 2: Exciter meter 5 reading must be at least 15 uA.

(2) Disconnect the predriver output connection from the following stage. Connect the predriver output to the input of the antenna switching network, using an adapter cable from a PK700A Cable Kit.

(3) Connect a Motorola test set to the radio for Power Control Board metering.

(4) Key the transmitter. Adjust the POWER SET control on the power control board until exactly the predriver output level listed in the PA stage power output table is obtained. Observe the test set meter 5 reading. Write down the reading for reference later in this procedure. Turn the POWER SET control fully counterclockwise.

(5) Disconnect the adapter cable from the predriver output and reconnect the predriver output to the driver or PA input.

Single-transistor stages:

(1) 25-watt power amplifier - Connect the final amplifier output coaxial cable to the antenna switching network input.

75-watt PA driver - Disconnect the driver stage output from the final amplifier input. Connect the driver output to the antenna switching network input, using an adapter cable from a PK700A cable kit.

(2) Key the transmitter and adjust the POWER SET control for the same meter 5 reading recorded in step (4). If the stage power output is significantly less than the value given in the PA stage power output table, the stage is defective.

Two-transistor stages:

(1) 45-watt power amplifier - Connect the final amplifier output cable to the antenna switching network input.

100-watt PA driver - Disconnect the driver output from the final amplifier input. Connect the driver input to the antenna switching network input, using an adapter cable from a PK700A cable kit.

(2) Key the transmitter, adjust the POWER SET control for the same meter 5 reading recorded previously in step (4), and observe the wattmeter. Compare the wattmeter reading with the value given in the PA stage power output table. If the stage power output is less than 25% of the value given in the PA stage power output table, it is likely that both transistors are bad. If the stage output is greater than 25% of the value in the PA stage gain table, but still below rated power, it is probable that only one of the transistor is defective. The following procedure is a quick way to determine which transistor is bad: (Refer to Figure 17).

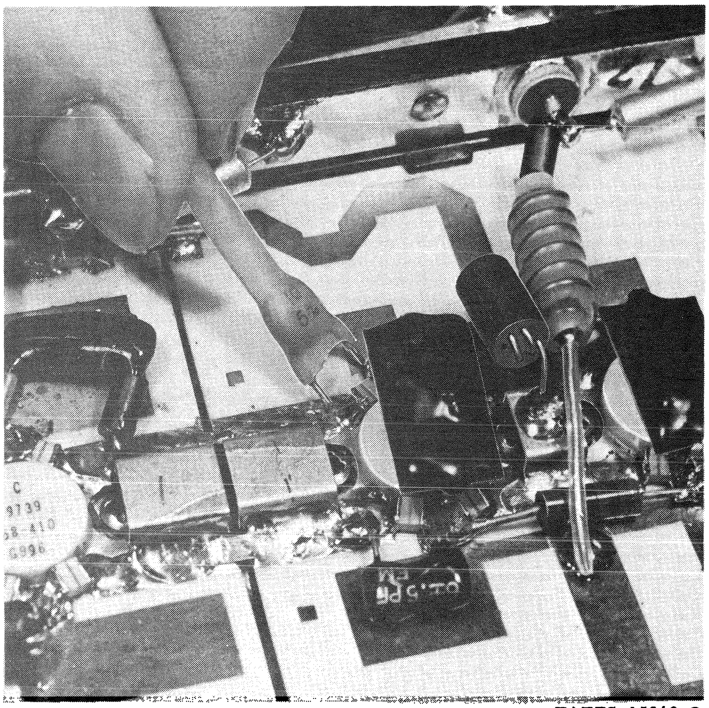


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Figure 17.
Capacitor Bridging Method of Testing PA Transistors

-- Trim the leads of a 10 pF NP0 disc ceramic capacitor to within 1/4-inch of the capacitor body. As shown in Figure 10, a length of shrinkable tubing over the capacitor body will make handling easier.

-- One at a time, bridge each transistor base-emitter junction with the 10 pF capacitor while the transmitter is keyed. If the transistor is good, the power output of the stage will drop significantly (greater than 20%). If the transistor is bad, the stage power output will drop only slightly.

Four-transistor stages:

(1) 75- and 100-watt final amplifiers - Be sure the final amplifier output coaxial cable is connected to the antenna switching network input.

(2) Key the transmitter, adjust the POWER SET control for the same meter 5 reading recorded previously in step (4), and observe the wattmeter. Compare the wattmeter reading with the value given in the PA stage power output table. If the wattmeter reading is significantly below the value in the table, it is probable that one or more of the transistors is bad.

(3) To isolate the defective pair of transistors, alternately disconnect the chokes from each pair, key the transmitter, and observe the wattmeter. Disconnecting each choke should produce the same decrease in transmitter power output. The defective pair is the one that causes the least power output change when it is disabled.

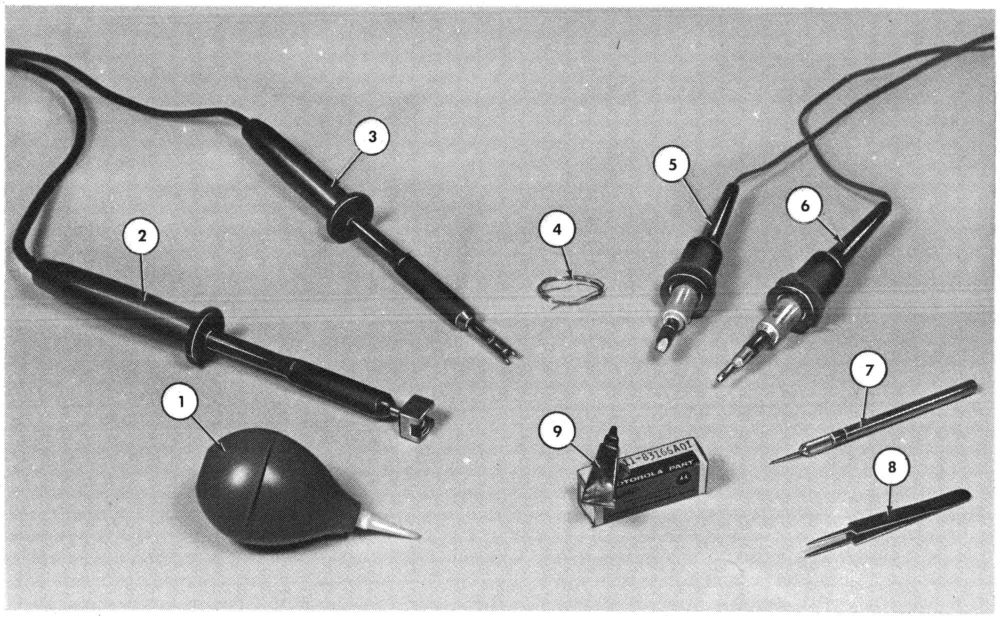
(4) After the pair that contains the defective transistor is identified, use the capacitor bridging method to determine which transistor of the pair is bad. The capacitor bridging technique is explained in the two-transistor stage testing section of this procedure.

f. Power Amplifier Repair Procedures

(1) Recommended Tools for PA Servicing

Because of the unique power amplifier construction it is recommended that the tools shown in Figure 18 be used during the repair procedures in this section. Except for the silver solder (item 4) and the Wakefield thermal compound (item 9), which are supplied with replacement transistors, use of these tools is not mandatory. You will find, however, that these tools will make quality power amplifier repairs easier to perform.

The soldering iron tips shown in Figure 19 are designed to make transistor removal and chip capacitor removal and replacement easier.



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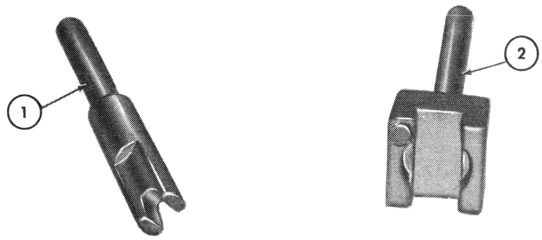
ITEM NUMBER	DESCRIPTION	MOTOROLA PART NUMBER
1	Solder remover	ST-726
2	60-watt soldering iron	ST-1144
	Special tip for PA transistor removal	ST-1161
3	60-watt soldering iron	ST-1144
	Special tip for chip capacitor soldering	ST-1160
4	Silver solder; alloy content 1.4% silver, 36.1% lead, 62.5% tin	10-10041A61
5	50-watt soldering iron	ST-646
	1/4" chisel tip	ST-1174
6	50-watt soldering iron with 1/8" chisel tip	ST-648
7	Modeling knife	ST-1172
	5 extra modeling knife blades	ST-1173
8	Tweezers	ST-492
9	Wakefield thermal compound	11-83166A01

Figure 18.
Recommended Tools for Power Amplifier Repairs



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ITEM NUMBER	MOTOROLA PART NO.	APPLICATION
1	ST-1160	Chip capacitor removal and replacement
2	ST-1161	PA transistor removal

Figure 19.
Special Soldering Iron Tips for PA Servicing

(2) Visual Inspection

After the malfunctioning stage has been identified, perform a thorough physical inspection before beginning repairs.

Check the ceramic substrate for hairline cracks. Hairline cracks can often be found by running a sharp instrument along the ceramic beside the microstrip conductors. Check in BOTH directions. A crack will usually "catch" the instrument, even when the crack is too small to be seen. Broken microstrip conductors can also be found through ohmmeter continuity checks.

Look for "leached" chip capacitors. Figure 20 shows examples of typical leaching of chip capacitor end metallization. Leaching is most often evidenced by failure of the chip capacitor end metallization to take solder. In severe cases the stacked plates inside the capacitor may be visible.

If no defects are found, proceed with repairs to the defective stage.

(3) Power Amplifier Transistor Removal

(a) As shown in Figure 21, unsolder all component connections at or near the points where the rf power transistor leads are soldered to the microstrip.

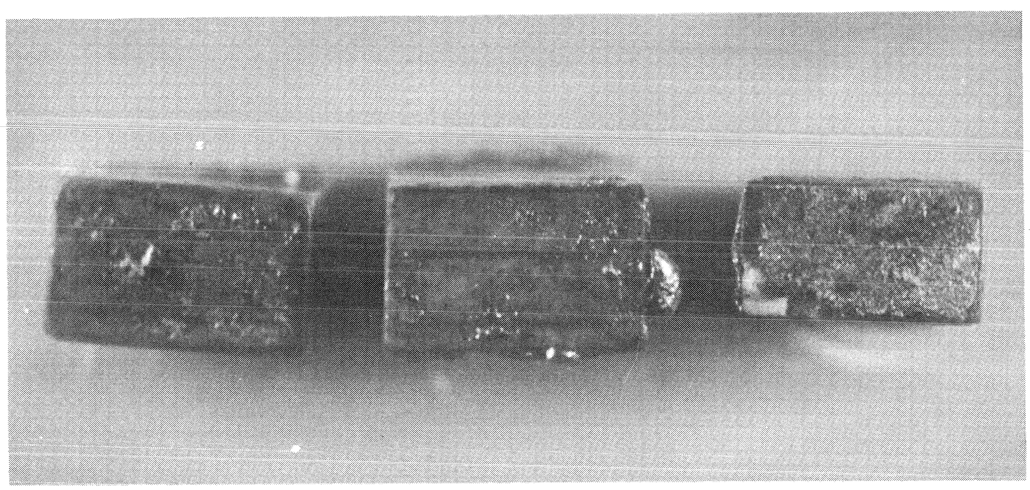

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Figure 20.
Examples of Leached Chip Capacitors

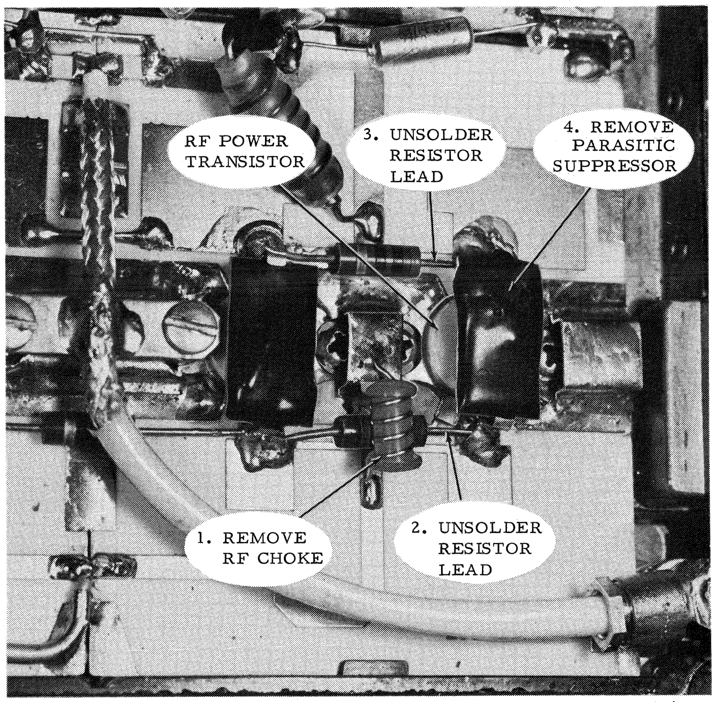

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Figure 21.
Component Removal Procedure

(b) Chip capacitors are connected between rf power transistor leads. Remove all four chip capacitors, using two soldering irons, as shown in Figure 22, or the special soldering iron tip (Motorola Part No. ST-1160), as shown in Figure 23.

CAUTION

Chip capacitors must not be re-used. Excessive heat applied during capacitor removal can cause leaching of the metallic contact area.

(c) Remove the two ground straps that cover the transistor mounting screws. See Figure 18.

(d) Remove excess solder from the transistor lead area with a vacuum-bulb solder remover.

(e) Carefully lift each of the four rf power transistor emitter leads. Use a modeling knife blade or long-nosed pliers to lift each emitter lead while applying heat, as shown in Figure 19. Be sure the solder has melted before you try to lift the lead, but avoid prolonged or excessive heating.

(f) Remove the transistor mounting screws. The mounting screw nuts on the back of the PA shelf are captive, and will therefore not fall out.

(g) Alternately lift the base and the collector leads. Use a modeling knife blade or long-nosed pliers to lift a lead while applying heat, as shown in Figure 26. Be sure the solder has melted before you try to lift a lead, but avoid prolonged or excessive heating. All six power transistor leads can be desoldered simultaneously using a Motorola ST-1161 soldering iron tip on a 90-watt iron. See Figure 27. Grasp a transistor mounting lug with long-nosed pliers as shown, and as soon as the solder melts, remove the soldering iron and lift the transistor out.

NOTE

The ST-1161 soldering iron tip should not be used to replace transistors.

(4) Power Amplifier Transistor Replacement

(a) Lightly pre-tin the underside of each transistor lead. See Figure 28.

CAUTION

When pre-tinning the transistor leads do not allow thick build-ups of solder to occur. Such a build-up could cause the transistor to separate from its

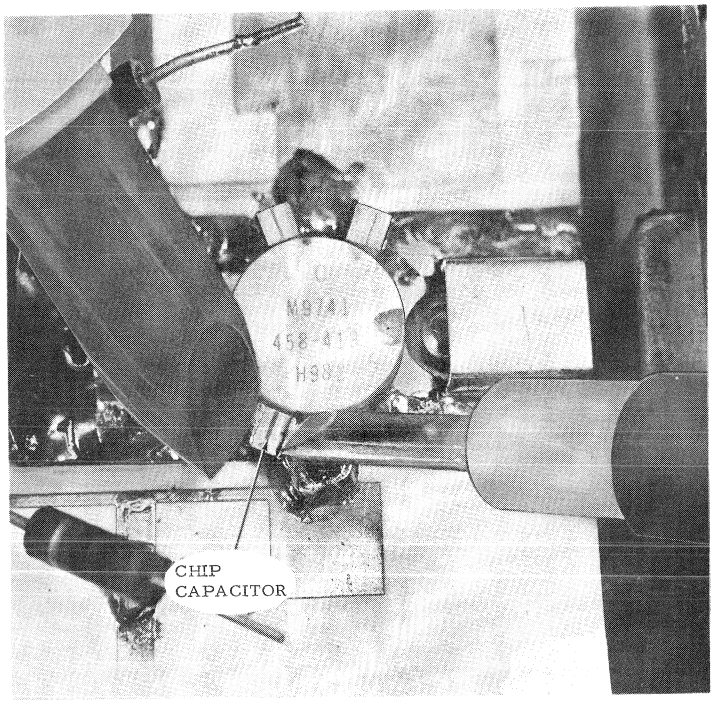

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Figure 22.
Chip Capacitor Removal Using Two Soldering Irons

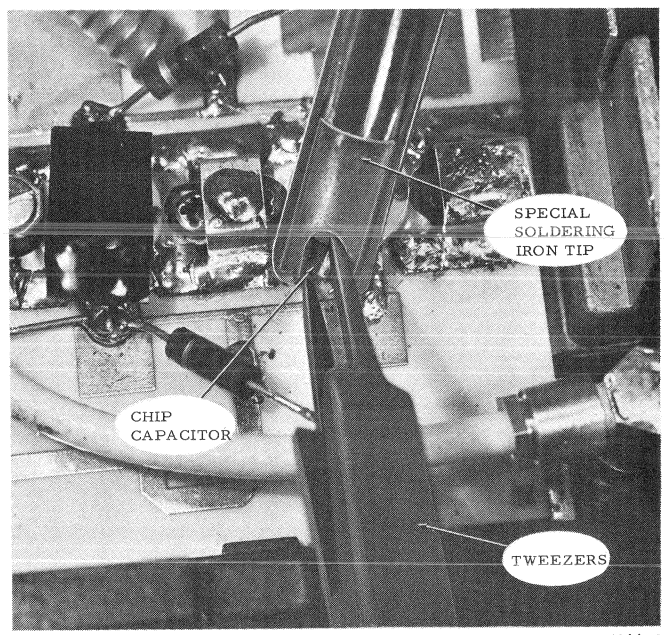

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Figure 23.
Chip Capacitor Removal Using ST-1160 Soldering Iron Tip

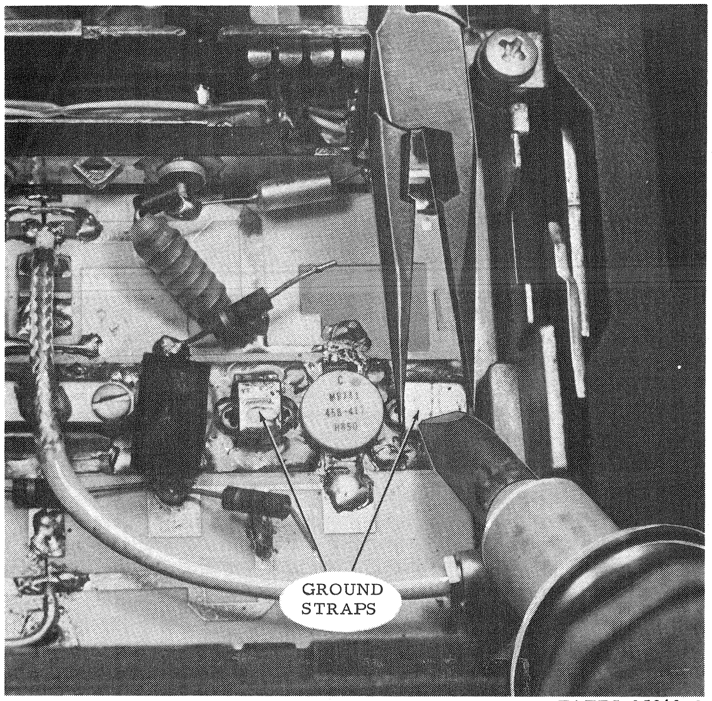

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Figure 24.
Ground Strap Removal

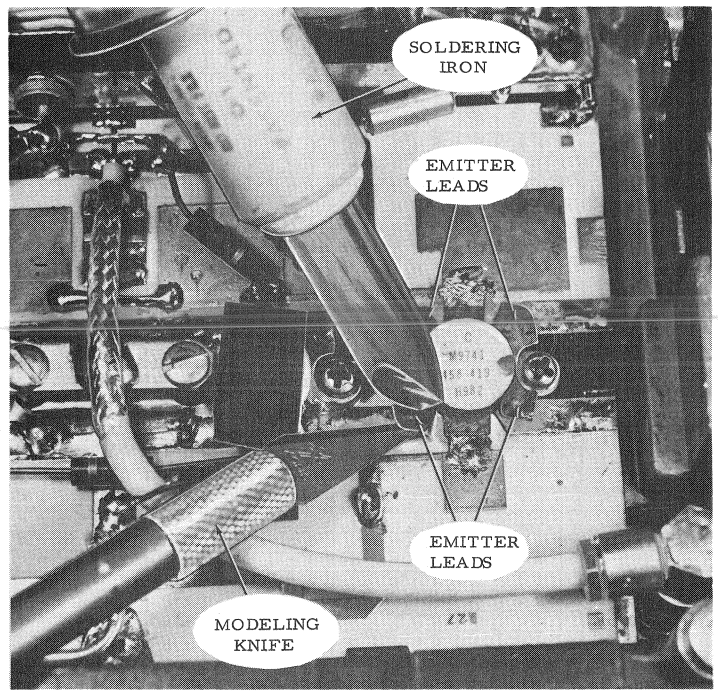

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Figure 25.
Disconnecting Power Transistor Emitter Leads

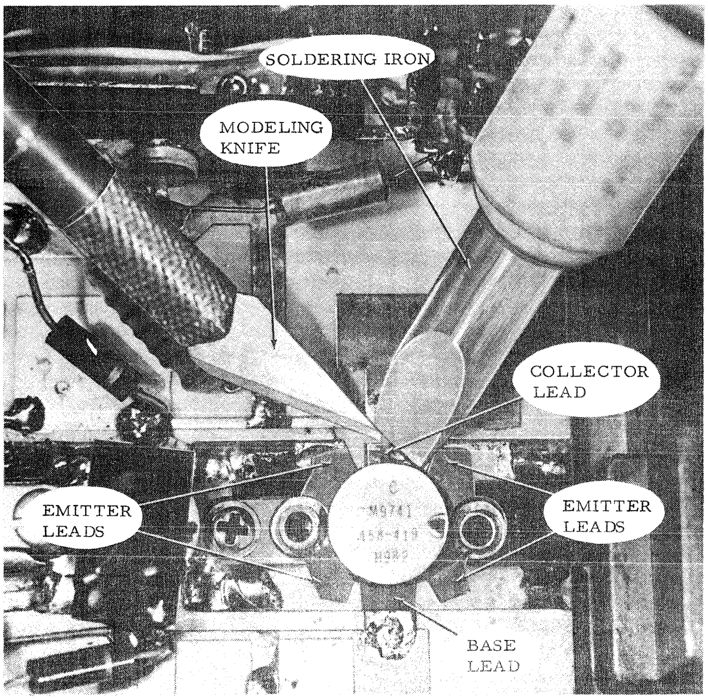

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Figure 26.
Disconnecting the Power Transistor Base and Collector Leads

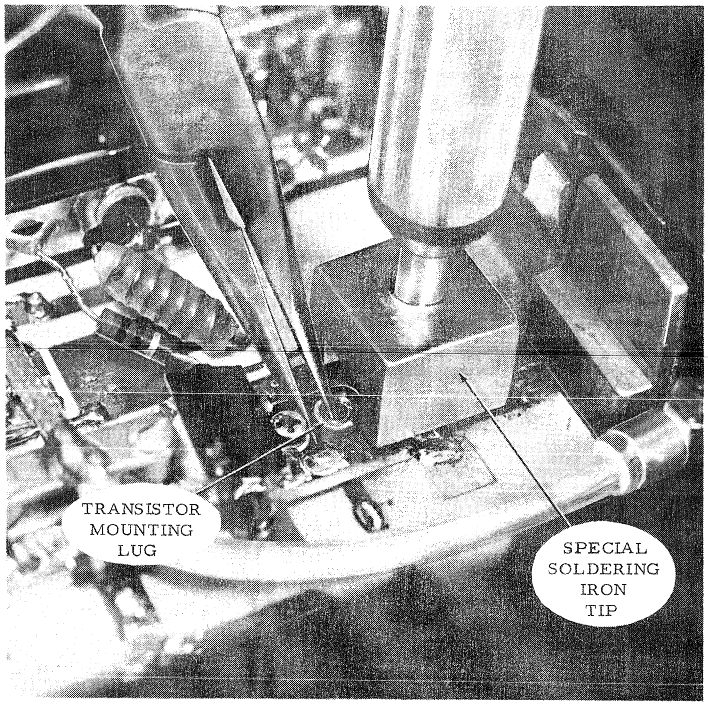

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Figure 27.
Power Transistor Removal, Using ST-1161 Soldering Iron Tip

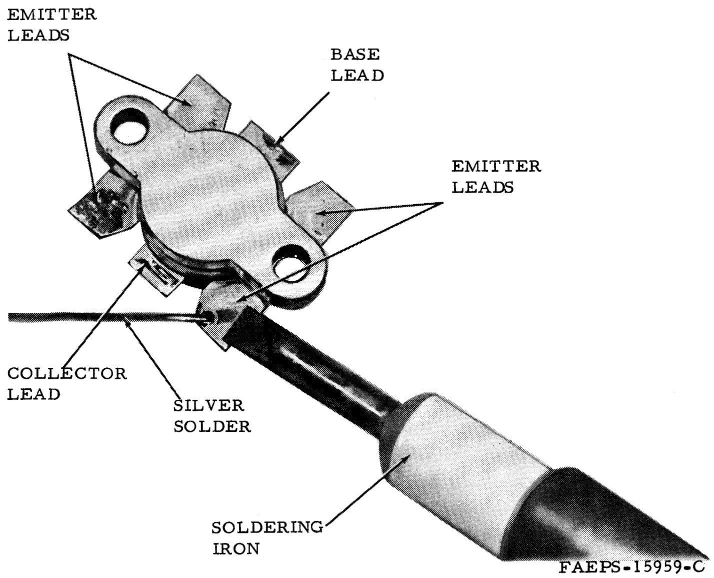

Figure 28.
Pre-Tinning Power Transistor Leads

CAUTION (CONT'D.)

mounting base when the mounting screws are tightened. Avoid getting solder or flux on the transistor mounting base.

(b) Thoroughly clean the transistor mounting surface, using alcohol or another solvent that leaves no residue. Apply a light coat of Wakefield Thermal Compound (Motorola Part No. 11-83166A01) to the mounting surface (bottom side of the transistor). See Figure 29.

CAUTION

Thick coatings of thermal compound or foreign material on the transistor mounting surface will cause poor thermal contact and may result in early transistor failure.

(c) Mount the transistor. Be sure the collector lead, marked "C" on the transistor cap, faces the proper direction. Refer to Figure 30.

(d) Carefully tighten the transistor mounting screws. Figure 31 shows proper transistor positioning before the leads are soldered to the microstrip.

CAUTION

To avoid damage to the transistor or the microstrip, the transistor mounting screws MUST be tightened before the transistor leads are soldered to the microstrip conductors.

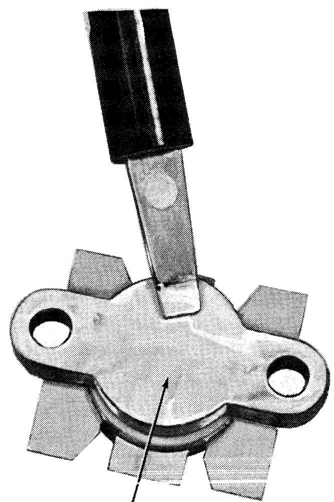

Figure 29.
Application of Wakefield Thermal Compound to Transistor Mounting Surface

(e) Solder each transistor lead, one at a time, to the microstrip. Use the silver solder (Motorola Part No. 10-10041A61) supplied with the replacement transistors. The use of a generous amount of the solder will insure a good contact over the entire area of the transistor tab and microstrip interface, and will assist in the reflow soldering of the chip capacitors. Use care that the solder does not bridge the leads or short either the base or

POWER AMPLIFIER MICROSTRIP
CROSS-REFERENCE TABLE
("A" SUFFIX MODELS)

LOCATION	RADIO MODEL	FREQ. RANGE (MHz)	MICROSTRIP PART No.	KIT NUMBER				
				PREDRIVER	DRIVER	FINAL (L. H.)	FINAL (R. H.)	HARDWARE KIT
A	T34	450-512	1-80769B98	TTN6012A	TLN5078A			TLE8082A
	T44	406-420	1-80712D36	TLN5658A	TLN5659A			TLE8091A
		450-512	1-80769B98	TTN6012A	TLN5082A			TLE8092A
	T54	450-470	1-80769B98	TTN6012A	TLN5080A	TLE8202A	TLE8202A	TLE8102A
		470-512	1-80769B98	TTN6012A	TLN5080A	TLE8203A	TLE8203A	TLE8102A
	T74	406-420	1-80712D36	TLN5658A	TLN5660A	TLN5661A	TLN5661A	TLE8111A
		450-470	1-80769B98	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8112A
		470-512	1-80769B98	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8113A
B	T34	450-512	1-80769B99	TTN6012A	TLN5078A			TLE8082A
	T44	406-420	1-80712D37	TLN5658A	TLN5659A			TLE8091A
		450-512	1-80769B99	TTN6012A	TLN5082A			TLE8092A
	T54	450-470	1-80769B99	TTN6012A	TLN5080A	TLE8202A	TLE8202A	TLE8102A
		470-512	1-80769B99	TTN6012A	TLN5080A	TLE8203A	TLE8203A	TLE8102A
	T74	406-420	1-80712D37	TLN5658A	TLN5660A	TLN5661A	TLN5661A	TLE8111A
		450-470	1-80769B99	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8112A
		470-512	1-80769B99	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8113A
C	T34	450-512	1-80739B15	TTN6012A	TLN5078A			TLE8082A
	T44	406-420	1-80754B03	TLN5658A	TLN5659A			TLE8091A
		450-512	1-80739B11	TTN6012A	TLN5082A			TLE8092A
	T54	450-470	1-80739B15	TTN6012A	TLN5080A	TLE8202A	TLE8202A	TLE8102A
		470-512	1-80739B15	TTN6012A	TLN5080A	TLE8203A	TLE8203A	TLE8102A
	T74	406-420	1-80754B03	TLN5658A	TLN5660A	TLN5661A	TLN5661A	TLE8111A
		450-470	1-80739B11	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8112A
		470-512	1-80739B11	TTN6012A	TLN5084A	TLN5088A	TLN5088A	TLE8113A
D	T34	450-512	1-80739B35	TTN6012A	TLN5078A			
	T44	406-420	1-80754B04	TLN5658A	TLN5659A			
		450-512	1-80739B12	TTN6012A	TLN5082A			
	T54	450-470	1-80739B16	TTN6012A	TLN5080A	TLE8202A	TLE8202A	
		470-512	1-80739B16	TTN6012A	TLN5080A	TLE8203A	TLE8203A	
	T74	406-420	1-80754B04	TLN5658A	TLN5660A	TLN5661A	TLN5661A	
		450-470	1-80739B13	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
		470-512	1-80739B13	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
E	T54	450-470	1-80739B22	TTN6012A	TLN5080A	TLE8202A	TLE8202A	
		470-512	1-80739B30	TTN6012A	TLN5080A	TLE8203A	TLE8203A	
	T74	406-420	1-80754B06	TLN5658A	TLN5660A	TLN5661A	TLE5661A	
		450-470	1-80739B30	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
		470-512	1-80739B30	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
F	T54	450-470	1-80739B28	TTN6012A	TLN5080A	TLE8202A	TLE8202A	
		470-512	1-80739B28	TTN6012A	TLN5080A	TLE8203A	TLE8203A	
	T74	406-420	1-80754B05	TLN5658A	TLN5660A	TLN5661A	TLN5661A	
		450-470	1-80739B28	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
		470-512	1-80739B28	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
G	T54	450-470	1-80739B21	TTN6012A	TLN5080A	TLE8202A	TLE8202A	
		470-512	1-80739B29	TTN6012A	TLN5080A	TLE8203A	TLE8203A	
	T74	406-420	1-80754B08	TLN5658A	TLN5660A	TLN5661A	TLN5661A	
		450-470	1-80739B29	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
		470-512	1-80739B29	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
H	T54	450-470	1-80739B27	TTN6012A	TLN5080A	TLE8202A	TLE8202A	
		470-512	1-80739B27	TTN6012A	TLN5080A	TLE8203A	TLE8203A	
	T74	406-420	1-80754B07	TLN5658A	TLN5660A	TLN5661A	TLN5661A	
		450-470	1-80739B27	TTN6012A	TLN5084A	TLN5088A	TLN5088A	
		470-512	1-80739B27	TTN6012A	TLN5084A	TLN5088A	TLN5088A	

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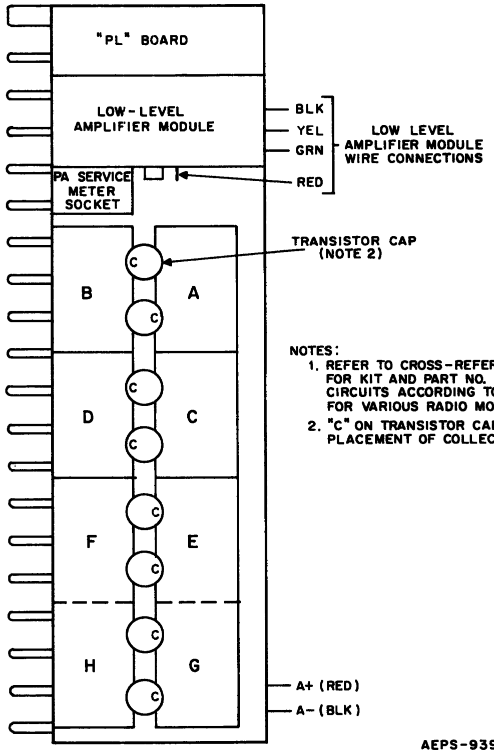

NOTES:
1. REFER TO CROSS-REFERENCE TABLE FOR KIT AND PART NO. OF MICROSTRIP CIRCUITS ACCORDING TO LOCATION FOR VARIOUS RADIO MODELS.
2. "C" ON TRANSISTOR CAPS INDICATES PLACEMENT OF COLLECTOR LEAD.

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Figure 30.
Microstrip Location and Power Transistor Placement Detail

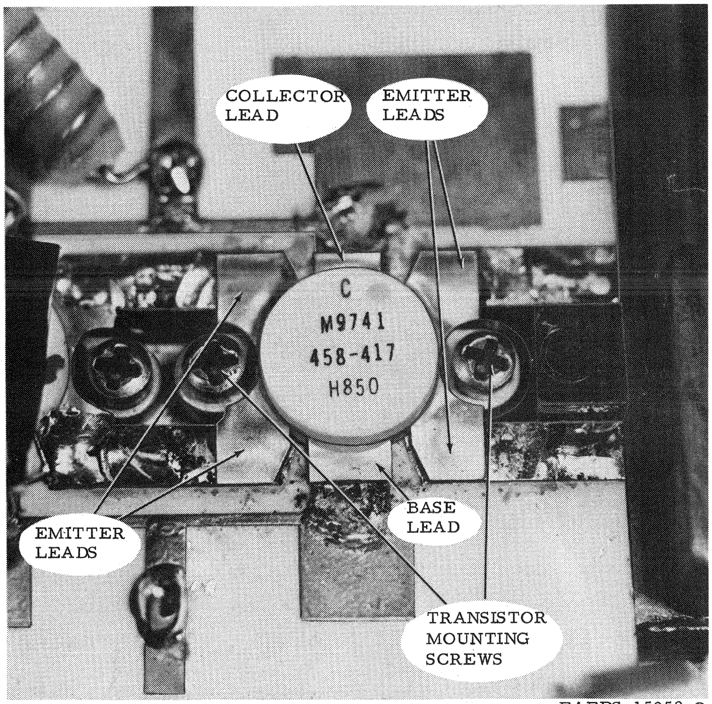

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Figure 31.
Power Transistor Placement

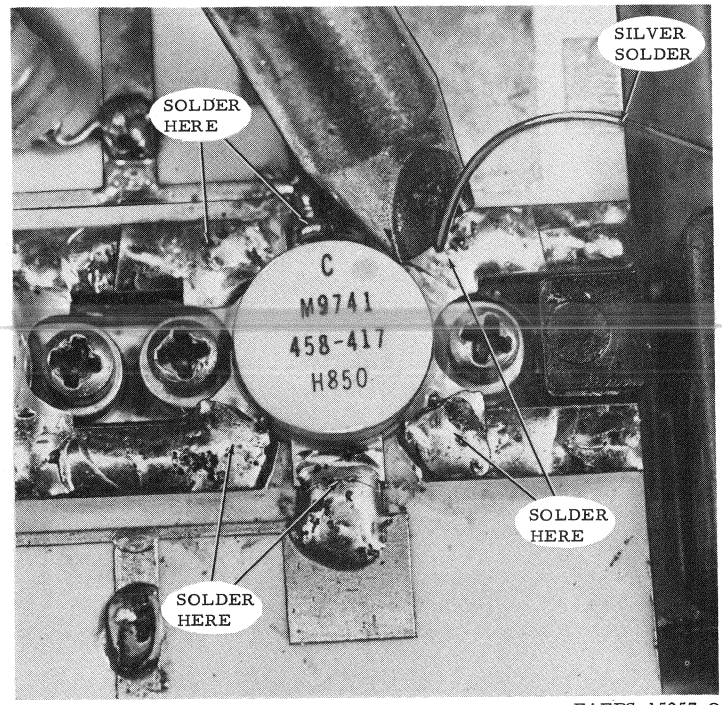

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Figure 32.
Soldering Power Transistor Leads to the Microstrip

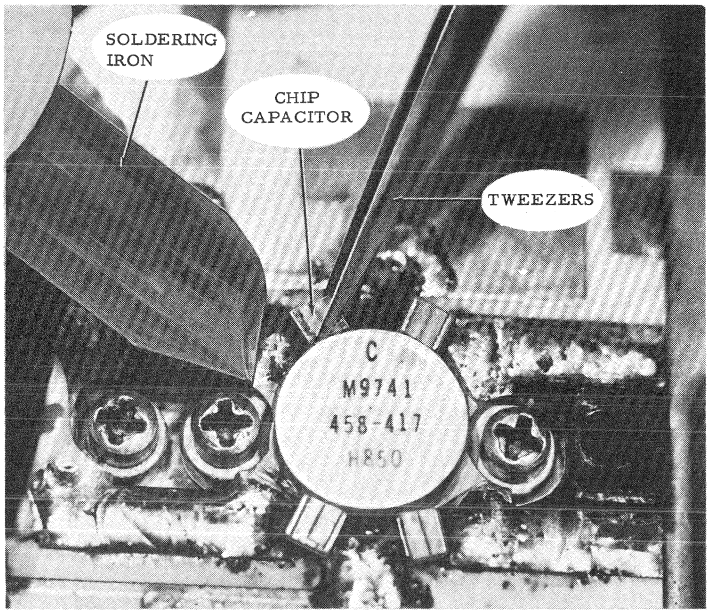

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Figure 33.
Chip Capacitor Installation, Using a 50-Watt Soldering Iron with a Chisel Tip

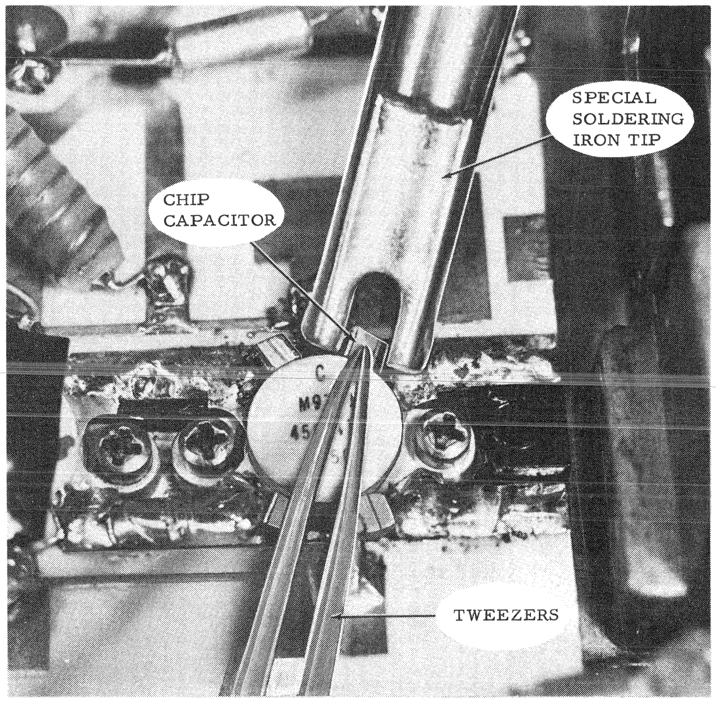

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Figure 34.
Chip Capacitor Installation, Using a 60-Watt Soldering Iron with ST-1160 Tip

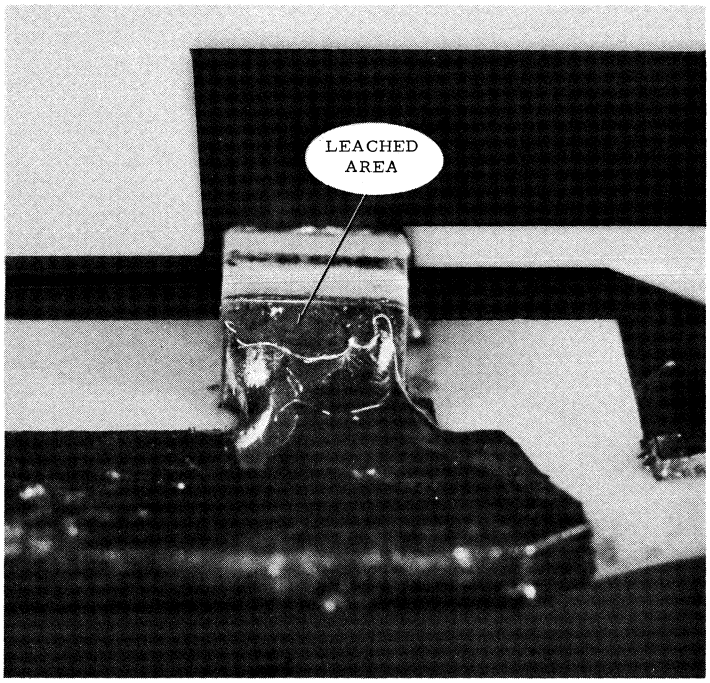

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Figure 35.
Appearance of Leached Chip Capacitor on Microstrip

collector leads to the microstrip ground. See Figure 32.

(f) Install the chip capacitors supplied with the power transistor. Use a low-wattage soldering iron (50-watts or less) with a chisel tip (Figure 33) or a 60-watt iron with a ST-1160 tip (Figure 34). A reflow-type technique MUST be used and the soldering iron tip MUST NOT be allowed to touch the chip capacitor end termination. Make sure the chip capacitor is placed as close to the transistor cap as possible, as shown in Figures 33 and 34.

CAUTION

Proper soldering technique and chip capacitor placement are essential to acceptable transmitter operation. Use extreme care when replacing chip capacitors.

(g) Check the chip capacitor solder connections. The solder should cover the entire capacitor end termination. If the solder adheres to only the lower portion of the end termination, as illustrated in Figure 35, assume that the capacitor end termination metallization is leached. The capacitor must be replaced if the radio transmitter is to function properly. Remember that the leaching is probably the result of allowing the soldering iron to touch the chip capacitor end termination.

g. Microstrip Removal

(1) Remove all transistors as described in the previous instructions.

(2) Remove all external component connections to the microstrip, including interface connections with other stages.

(3) Remove all remaining ground straps (if any).

(4) Lift the microstrip substrate out of the plastic holder.

h. Microstrip Replacement

Figure 30 provides location information for the eight microstrip boards. On the figure, each board is keyed with a letter identification. The letter is cross-referenced on the table to determine the kit number and microstrip board part number used for the various models of the radio.

NOTE

Microstrips cannot be ordered as complete kits. Each part must be ordered by its individual part number. When ordering a new microstrip be sure to order new chip capacitors, including those that are associated with the rf

NOTE (CONT'D.)

power transistors. Used chip capacitors must not be reused.

(1) Place the new microstrip substrate into the plastic holder. Refer to Figure 30 for location of the microstrip in the transmitter power amplifier assembly.

(2) Carefully clean all solder build-up off the transistor leads. Only a very thin layer of solder should remain. Check for solder-bridge shorts between transistor leads.

(3) Using silver solder (Motorola Part No. 10-10041A61), install the transistors and their associated chip capacitors as described in the power transistor replacement procedure. BE SURE YOU TIGHTEN THE TRANSISTOR MOUNTING SCREWS BEFORE YOU SOLDER THE TRANSISTOR LEADS TO THE MICRO-STRIP CONDUCTORS.

(4) Reconnect all external components to their proper locations on the microstrip.

13. 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, temperature, or load variation, and device variations. In order for the circuitry to operate properly and provide protection it is necessary to set the power output controls (Drive Limit and Power Set) in accordance with the radio set tune-up procedure.

a. Introduction

This paragraph provides maintenance shop procedures for the power control circuitry. It is assumed that preliminary tests have already localized the trouble to the power control board. These bench test type procedures include measurements with a Motorola portable test set, a simple set of performance tests, and complete troubleshooting procedures.

NOTE

The power control board must be installed in a radio set for testing to provide the necessary power, ground, and control connections. For bench testing of a board that has been removed from the radio set and replaced by a spare, another radio set, complete with control head and cable, is required as a test fixture for troubleshooting.

b. Performance Tests

(1) POWER SET Control Test

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.

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 power set procedure in the alignment section of this manual.

(a) Key the transmitter.

(b) Adjust the POWER SET control until the rated power output is reached.

(c) Unkey the transmitter.

(2) Automatic Power Leveling Test

If a power supply is used, set the power output to the rated output with the power supply voltage at +13.6 volts.

(a) Key the transmitter.

(b) Vary the supply voltage from +13.6 volts to +16 volts. The transmitter power output change should be between +10% and -5%.

(c) Return the supply to +13.6 volts and unkey the transmitter.

(3) Drive Limit Control Test

This control allows the drive power to the power amplifier from the controlled stage to be limited to a level sufficient to provide rated performance. Its purpose is to set a limit on the drive power that can be called for by the automatic power leveling circuitry. This prevents earlier PA stages from being damaged by overdrive when later stages fail. Depending on the position of the Drive Limit control, the maximum collector voltage of the controlled stage can be limited to between 6.5 volts and 12.5 volts. The proper procedure for setting the Drive Limit control is given in the alignment section of this manual under the Power Amplifier Power-Setting Section.

CAUTION

For proper operation of the power leveling circuitry, the Drive Limit control must not be set for any lower power output than that given in the Drive Limit column in Table 1 of the Power Setting section of the power control board alignment procedure in the ADJUSTMENTS section of this manual.

In radios with high gain driver and power amplifier stages, the power leveling power set circuitry may operate the controlled stage at a collector voltage less than 6.5 volts. In such radios, little or no effect will be seen from the Drive Limit control. If it is not possible to lower the radio power output by the Drive Limit control to the level called for in the alignment procedure, set the Drive Limit control to its maximum clockwise position (maximum drive limit).

In some radios the rf drive reserve is not sufficient to require use of the Drive Limit control. In these radios the radio power output level called for in the power control board alignment procedure cannot be obtained. If such a situation is found, set the Drive Limit control. fully counterclockwise (minimum drive limit).

(4) "No-Power" Protect Circuit Test

The "no-power" protect circuit prevents the transmitter power amplifier from being operated without being connected to the antenna switching network. If the forward power detector in the antenna switching network do not sense more than approximately 7 watts, the "no-power" protect circuit will shut-off the drive to the power amplifier stages. This protect circuit can be made to operate to check its performance by turning the power output of the radio down below 7 watts using the POWER SET control. Once the "no-power" protect circuit operates, the transmitter must be re-keyed to return drive power after the original "no-power" condition is corrected.

c. Troubleshooting

The power control board troubleshooting chart outlines a logical procedure for finding major functional failures. However, because of the complexity of the circuit operation, it is impossible to provide a troubleshooting chart that will be usable for some of the more subtle problems that may appear in the power control board performance tests. Efficient location of these "subtle" problems depends on a thorough knowledge of the power control board theory of operation. In any case, it is a good idea to review the power control board theory of operation before beginning troubleshooting.

Once you are familiar with the circuit operation, a defective stage or component can be found by making voltage measurements and comparing them with those shown on the schematic diagram. Observe the voltage changes that occur when the POWER SET and Drive Limit controls are varied.

The transmitter power amplifier stages can be disabled to permit easier power control board troubleshooting. To disable the PA stages, remove the fuse in the red lead that connects to the vehicle battery. If the PA stages are disabled, the "No Power" protect circuits will go into operation. To disable the "No Power" protect circuits, use the following procedure:

(1) Disconnect the power/control cable connector from the radio.

(2) Remove the shield from the power control board.

(3) Connect a jumper across C611 on the power control board.

(4) Reconnect the power/control cable connector to the radio and perform whatever troubleshooting is required.

CAUTION

Before the power amplifier stages are re-enabled, be sure you re-enable the "No Power" protect circuit. DO NOT OPERATE THE POWER AMPLIFIER STAGES WITH THE "NO POWER" PROTECT CIRCUITS DISABLED.

POWER CONTROL BOARD TROUBLESHOOTING CHART

POWER CONTROL BOARD METER READINGS

SELECTOR SWITCH POSITION	REFERENCE AND METER SWITCH POSITIONS	CIRCUIT METERED	READING
1	A–REV	forward power	see calibration label
2	A–OFF	reflected power	Maximum Readings (with normal reflected power) 9-12 uA (T34) 10-13 uA (T44) 11-14 uA (T54) 12-15 uA (T74)
3	B–OFF	control voltage	Range 5-25 uA
5	B–REV	PA current	Note 1 24/18 uA (T34) 37/32 uA (T44) 29/26 uA (T54) 43/34 uA (T74)

NOTE: 1. THE FIRST READING IS PA CURRENT FOR RADIOS IN THE 406-420 AND 450-470 MHz BANDS AND IS A MAXIMUM; THE SECOND IS FOR RADIOS IN THE 470-512 MHz BAND AND IS TYPICAL, MAXIMUM LIMIT DOES NOT APPLY IN THIS BAND.

TROUBLESHOOTING PREREQUISITES

1. CONNECT THE RADIO ANTENNA CONNECTOR TO AN RF WATTMETER THAT IS TERMINATED IN A 50-OHM RESISTIVE DUMMY LOAD. BE SURE THE WATTMETER AND DUMMY LOAD ARE RATED FOR UHF USE.
2. CONNECT THE RADIO TO A 13.5 VOLT DC POWER SOURCE THAT IS ABLE TO SUPPLY AT LEAST THE MAXIMUM TRANSMIT CURRENT SPECIFIED FOR YOUR RADIO MODEL.
3. THE POWER CONTROL BOARD MUST BE INSTALLED IN A COMPLETE RADIO FOR TESTING. TO PROVIDE THE NECESSARY POWER, GROUND, AND CONTROL CONNECTIONS. BE SURE THE CIRCUIT BOARD MOUNTING SCREWS ARE SECURE AND THAT ALL CONNECTIONS TO THE CIRCUIT BOARD ARE PROPERLY MADE.
4. USING A TEK37 ADAPTER CABLE, CONNECT A MOTOROLA PORTABLE TEST SET TO THE RADIO AS FOLLOWS:
   A. CONNECT THE 20-PIN CONNECTOR OF THE ADAPTER CABLE TO THE RECEPTACLE ON THE FRONT OF THE TEST SET.
   B. CONNECT THE ADAPTER CABLE RED "CONTROL" PLUG TO THE RECEPTACLE ON THE CONTROL (INTERCONNECT) BOARD.
   C. CONNECT THE ADAPTER CABLE WHITE "METERING" PLUG AS NEEDED IN THE TROUBLESHOOTING PROCEDURE.
5. SET THE TEST SET SWITCHES AS FOLLOWS:
   A. SET THE TEST SET FUNCTION SWITCH TO THE XMTR POSITION.
   B. SET THE TEST SET METER SWITCH TO THE OFF POSITION.
   C. SET THE TEST SET METER SELECTOR SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
   D. SET THE ADAPTER CABLE REF SWITCH AS REQUIRED BY THE TROUBLESHOOTING PROCEDURE.
   E. SET THE ADAPTER CABLE 1V–100 mV SWITCH TO THE 100 mV POSITION. IF THE ADAPTER CABLE HAS NO SUCH SWITCH THE UNIT OPERATES AT 100 mV AT ALL TIMES.

Power Control Board
Troubleshooting Chart
Motorola No. EEPS-15951-O
8/27/76-UP

The following table lists some power control board malfunctions and their possible causes:

Power Control Board Troubleshooting Hints

Symptom	Possible Cause - Check the following:
Power Set malfunctioning	a. Power detector diodes CR1001 and/or CR1002
	b. IC601 bias circuitry
	c. POWER SET pot
Drive Limit malfunctioning	a. CR603
	b. Drive Limit pot
"No Power" protect malfunctioning	a. CR604
	b. C611

14. ANTENNA SWITCHING NETWORK

NOTE

Field servicing of the antenna switching network, other than replacing power sensing diodes, reed switch, and current limiter, is not recommended. If other components of the antenna switching network are defective, it must be replaced as a unit.

a. Performance Tests

(1) Transmitter Leg Insertion Loss Measurement

The transmitter leg insertion loss should be about 0.8 to 0.9 dB (15-20% power loss). Use the following procedure:

(a) Connect a thru-line wattmeter, a 50-ohm dummy load, and adapter cables (from PK700A Cable Kit) as shown in Figure 36.

NOTE

For accurate wattmeter readings, make sure low VSWR cable connections are made at all points. This means that all connectors must be properly installed and that a minimum number of adapters are used.

(b) Key the transmitter and write down the wattmeter reading.

(c) Exchange the positions of the UHF thru connector and the rf wattmeter, placing the wattmeter at the input to the antenna network.

(d) Key the transmitter and take a second wattmeter reading.

(e) If the difference between the two wattmeter readings is greater than 20% of the second wattmeter reading, replace the antenna switching network. Refer to the antenna switching network removal and reinstallation procedure in this manual section.

(2) Receiver Leg Insertion Loss Measurement

The antenna switching network receiver leg insertion loss should be about 1.2 to 1.3 dB (a voltage loss of 10-15%). Use the following procedure to measure the receiver leg insertion loss:

(a) Connect a rf signal generator to the radio antenna connector through a 6 dB rf pad.

(b) Make a 20 dB quieting sensitivity measurement. Refer to the receiver rf and i-f troubleshooting chart for the test procedure. Write down the measured 20 dB quieting sensitivity.

(c) Connect the rf signal generator to the rf input of the receiver rf and i-f board (J104).

(d) Make a second 20 dB quieting sensitivity check. Write down this second 20 dB quieting sensitivity figure.

(e) If the difference between the two 20 dB quieting sensitivity figures is greater than 15% of the second 20 dB quieting sensitivity figure, replace the antenna switching network. Refer to the antenna switching network removal and reinstallation procedure in this manual section.

(3) Isolation Measurement

The antenna switching network provides approximately 20 dB of isolation between the transmitter rf output connector and the receiver output cable with the transmitter unkeyed and the radio antenna connector terminated in a 50-ohm load. When the transmitter is keyed, switching action in the receiver leg of the network provides 40 to 50 dB of additional isolation. Perform the following procedure to ensure that proper switching action takes place.

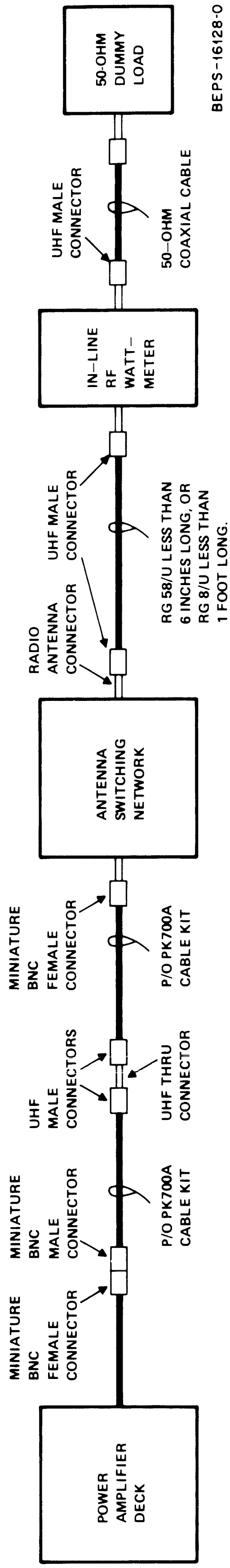

Figure 36.
Transmitter Leg Insertion Loss Test Set-Up

NOTE

Lack of switching action in the receiver leg of the network can allow sufficient transmitter power into the receiver to damage the receiver mixer transistor.

(a) Disconnect the red power lead from the power source or remove the red lead fuse to prevent transmitter PA operation.

(b) Disconnect the transmitter output coaxial cable from the antenna switching network.

(c) Connect an rf signal generator to the antenna connector and an rf voltmeter to the receiver output cable of the network. (If a voltmeter is not available, leave the cable connected to the receiver rf deck and use 20 dB quieting as a measuring reference.)

(d) Set the signal generator to the receiver frequency and at maximum output level. With the transmitter unkeyed, the presence of the injected signal from the signal generator should be noted on the rf voltmeter with only slight attenuation (1.2 to 1.3 dB).

(e) Make sure the transmitter is disconnected from the network. Key the transmitter and check the rf voltmeter reading.

(f) The rf voltmeter reading should drop at least 60 dB (a voltage reduction of 1000 times). If receiver 20 dB quieting is used as a reference, signal generator level should have to be 1000 times greater than normal 20 dB quieting or approximately 500 microvolts.

(g) If the isolation is less than 60 dB, replace the antenna switching network. See the removal and reinstallation procedure in this manual section.

(h) Disconnect the test equipment. Reconnect the transmitter output cable to the antenna switching network. Reconnect the red lead to the power source or replace the red lead fuse.

b. <u>Antenna Switching Network Removal and Reinstallation Procedure</u>

(1) Remove the radio front panel.

(2) Remove the power control board.

(3) Remove the five wires from the push-pins on the antenna network board.

(4) Disconnect the transmitter output coaxial cable from the antenna switching network.

(5) Disconnect the antenna switching network coaxial cable from the rf input jack on the receiver rf and i-f board.

(6) Remove the right-angle bracket that attaches the antenna switching network assembly to the front surface of the radio chassis.

(7) Remove the screw that attaches the antenna switching network assembly to the radio chassis. This screw is located on the "control-board" end of the assembly.

(8) Carefully slide the antenna switching network assembly out of the radio chassis.

(9) To reinstall the antenna switching network assembly, reverse the procedure given in steps (1) through (8).

c. Troubleshooting of Power Sensing Diodes

(1) Check of CR1001 and CR1002

Step 1. Remove the power control board from the radio.

Step 2. With the positive ohmmeter probe at J1001-E and the negative probe at J1001-F, the ohmmeter should read about 250 ohms. When the positions of the probes are reversed, the ohmmeter should read nearly infinity. This checks CR1001.

Step 3. With the positive ohmmeter probe at J1001-D and the negative probe at J1001-E, the ohmmeter should read about 250 ohms. When the positions of the probes are reversed, the ohmmeter should read nearly infinity. This checks CR1002.

(2) Replacement of Diodes

Step 1. Remove the antenna switching network assembly from the radio.

Step 2. Remove the cover from the antenna switching network assembly.

Step 3. Replace the bad diode with Motorola Part Number 48-83654H01.

Step 4. Reassemble the antenna switching network and reinstall it in the radio

d. Troubleshooting of Reed Switch

(1) Tests to Assure Antenna Switch Network Is Faulty

Step 1. Disable the transmitter by (1) removing the red lead fuse (A+ line), (2) removing the exciter filter input(s) at J301 or J401 or both, or (3) removing the channel element.

Step 2. Measure the dc resistance between the radio antenna connector J1002 and groun. It should be a dc short circuit. If not, remove the antenna switch network and look for an open connection on the output lead (harmonic filter) between the connector and the circulators.

Step 3. Disconnect P104 from the rf deck and check the dc resistance from the center conductor to ground. It should be a dc short and should become an open circuit when the radio is keyed.

Step 4A. If an open is found in both conditions of Step 5, either the connector on the relay is open, the relay lead to the circulator is broken, or the relay is defective. If the relay is defective, replace it and realign the antenna switch network per the test procedure which follows in paragraph 14d. (4).

Step 4B. If a short is found in both doncitions of Step 5 either the cable is shorted, the relay is not being switched by current limiter Q1001, or the relay coil (typically 150 ohms) is open. Remove the radio front panel (hand 6) and check the dc voltages on Q1001 and replace if faulty. If the relay is defective, replace it and realign the antenna switch network per the test procedure which follows in paragraph 14d. (4).

Step 5. Remove the antenna switch network following the procedure in paragraph 14b. above and remove the cover by removing the six Phillips head screws.

Step 6. Check the dc resistance across R1005 (see Figure 37); it should be 50 ohms ±10%. Energize the relay (white wire to A- yellow wire to A+) the resistance should drop to a short circuit. If it does not, check for a poor connections to the resistor. If the connection is good the relay should be replaced.

NOTE

In the event of a faulty circulator, 50-ohm resistor, or harmonic filter, the entire antenna switch network should be replaced.

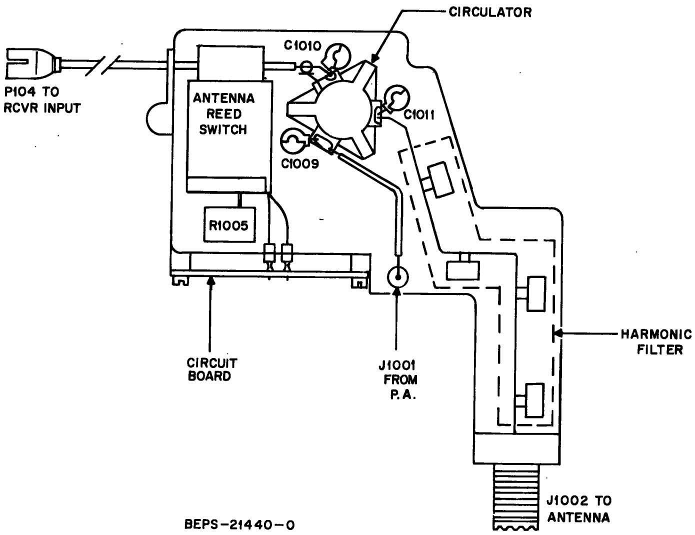

Figure 37.
Antenna Switch Network,
Component Location

(2) Removal of Reed Switch

Step 1. Remove antenna switching network as described in paragraph 14b. above.

Step 2. Remove antenna switch network cover by removing six Phillips head screws.

Step 3. Remove the two Phillips head mounting screws on the relay.

Step 4. Unsolder the three wires going to the feed-through capacitors and the 50 ohm resistor, taking care not to damage the 50 ohm resistor (see Figure 37).

Step 5. Unsolder the solid coax shield and center conductor going to the circulator.

Step 6. Clip the phono connector off the white coax cable.

Step 7. Remove reed switch assembly.

(3) Installation of New Reed Switch Assembly 1V80747B76

Step 1. Insert the white coax cable through the antenna switch network housing and set the new reed switch network in place.

Step 2. Insert and tighten the two Phillips head mounting screws.

Step 3. Solder the connecting wires to the feed-through capacitors and the 50 ohm load. Also solder the shielded coax cable to the circulator in place (see Figure 37).

Step 4. Resolder a new 28C84282D01 male phono connector to the white coax cable. The old phono connector may be cleaned for this purpose.

(4) Antenna Switch Network Retuning

Step 1. Connect an RF signal generator to the coax receiver port through a 6 dB pad.

Step 2. Connect a g00d 50 ohm load to the transmitter port. A minature BNC female connector is needed. Cable No. 6 in PK700A is suggested.

Step 3. Connect a 50 ohm RF voltmeter to the antenna port. The voltmeter should be capable of reading at least 40 dB below the generator level.

Step 4. Set the rf generator frequency, halfway between the receive and transmit frequencies, if different. Set generator output to maximum.

Step 5. Adjust variable capacitor C1009 (see Figure 37) on the transmitter leg of the circulator for minimum indication on the rf voltmeter.

Step 6. Move signal generator to the transmitter port, the 50 ohm load to the receive port. Apply +13.8 volts dc at P1004-2 and ground at P1004-1 to energize the reed switch. Adjust variable capacitor C1011 on the antenna leg of the circulator for minimum indication on the rf voltmeter.

Step 7. De-energize the reed switch by removing 13.8 volts. Move the signal generator to the antenna port, the 50 ohm load to the receiver port and the rf voltmeter to the transmitter port. Adjust variable capacitor C1010A on the receiver leg of the circulator for minimum indication on the rf voltmeter.

Step 8. Repeat steps 1 through 7 until no further improvement is obtained.

Step 9. Check the antenna switching network for satisfactory operation as outlined on paragraph 14a. above. If the antenna switching network is still unsatisfactory the entire ASN must be replaced. Failure of the 50 ohm resistor or the magnetic circulator are not field repairable, and would require replacing the entire antenna switching network.

Step 10. Reinstall antenna switching network in radio and check receiver sensitivity and transmitter power.

15. "PRIVATE-LINE" ENCODER

a. Recommended Test Equipment

(1) Motorola SLN6221A "Private-Line" Tone Generator -- used for testing "Vibrasender" resonant reeds.

(2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.

(3) General purpose oscilloscope -- variable for signal tracing and locating sources of distortion.

(4) Motorola Solid-State DC Multimeter -- used for dc voltage measurements.

(5) Motorola S1343 Series Digital Frequency Meter or S1344 Series Digital Frequency and Deviation Meter -- used for measuring PL tone frequency.

b. Performance Test

Meausre frequency deviation of the transmitter in which the PL encoder is installed. With the transmitter keyed and PL-tone modulation (only), deviation should read ±0.5 to ±1.0 kHz.

c. Troubleshooting

(1) If no deviation is measured, the trouble may lie in the tone oscillator or tone output circuit. The trouble may be isolated by the following steps.

(a) Check 9.6-volt input to encoder.

(b) Check ac signal voltage at collector of Q701.

(c) If signal is present, check Q704.

(d) If no signal is present by component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the SLN6221A "Private-Line" Tone Generator.

(e) If the tone generator does not produce an output signal, the reed may be defective. Check it by substituting another "Vibrasender" reed in this place, or by using it in another encoder circuit.

(f) If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.

(2) If low deviation is measured, check ac signal voltages and compare them with those given on the schematic diagram in the diagram section of the manual to find the source of trouble.

(3) If deviation is normal, but your calls are not being received, check the frequency of the PL encoder tone. If the tone is off-frequency, replace the "Vibrasender" resonant reed.

(4) If squelch-tail noise bursts are heard by all listening receivers, check dc voltages of Q703 and Q706 in keyed and unkeyed conditions.

(5) If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q705 and Q707 stages.

(6) If too much tone deviation is measured, check feedback amplifier Q708.

16. "DIGITAL PRIVATE-LINE" ENCODER

a. Recommended Test Equipment

(1) Motorola Model SLN6413A "Digital Private-Line" Test Set -- used to encode and decode a "Digital Private-Line" code for test purposes.

(2) Motorola Solid-State AC Voltmeter -- used for tone level measurement.

(3) General purpose oscilloscope -- used to observe waveforms.

(4) Motorola Solid-State DC Multimeter or Digital Voltmeter -- used for dc voltage measurements.

b. Performance Tests

A properly functioning encoder should be able to modulate the transmitter rf carrier at least ±0.5 kHz with no other modulating signal applied to the transmitter. A Digital PL code should be transmitted during the time the PTT switch is closed. Immediately after the PTT switch is opened, the encoder should keep the transmitter keyed for about 180 milliseconds more and modulate the transmitter with a turn-off code. A Motorola Model SLN6413A "Digital Private-Line" Test Set can be used to determine if the encoder is producing the proper Digital PL code.

c. Troubleshooting

Before you begin troubleshooting, inspect the encoder board and transmitter exciter board for visible defects. If any defects are found, correct them and check the encoder performance again. If the encoder performance is still unsatisfactory, use the following troubleshooting chart to help you isolate the defective circuit and component.

DIGITAL "PRIVATE-LINE" ENCODER BOARD TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSES	ACTION
No delayed keyed A+ to exciter board.	1. No keyed A+ to encoder board (pin 2).	Check K901 (1st PTT relay) operation on control board.
	2. Malfunction in delayed keyed A+ generation circuitry.	Check delayed turn-off switch, delay generator and keying switch operation on encoder board.
Delayed keyed A+ remains high less than 160 msec or longer than 220 msec after unkeying.	Malfunction in delayed keyed A+ circuits.	Check C710. Then check delay generator circuit.
Delayed xmit code enable (pin 7) remains low when radio keyed.	1. A- not present at Q706 collector.	Check for keyed A+ at pin 2. Then check operation of keying switch Q706.
	2. Code enable switch Q705 is inoperative.	Check for +9.6 V at Q705 emitter. Then check Q705 and C708.
Delayed xmit code enable (pin 7) goes high less than 20 msec or longer than 40 msec after keying.	C708 is bad.	Replace C708.
No output on xmit code out (pin 10), keyed or unkeyed.	1. No input to encoder board pin 6 from decoder board.	On decoder board, check U801-5 for code signal. Check for 6.0 V dc at U801-24. If 6.0 V dc is present, check 50 kHz clock for proper operation (U801-4). If clock is ok, replace U801.
	2. Faulty inverter (Q702).	Check inverter operation.
	3. Active filter malfunction	Check Q703, Q704 operation.
Code (not turn-off code) is on encoder board pin 10 when the radio is unkeyed.	1. Encoder board pin 7 (delayed xmit enable) remains high.	Check encoder board pin 7.
	2. U801 code generator on decoder board is not switching.	Ground U801-9. If code is still present at U801-5, check 50 kHz clock output (U801-4). If clock is ok, replace U801.
Turn-off code (not code) is on encoder board pin 10 when the radio is keyed.	1. Encoder board pin 7 (delayed xmit enable) stays low.	Check encoder board pin 7.
	2. U801 code generator on decoder board is not switching.	Apply +9.6 V at J805 on decoder board. If turn-off code is still present at U801-5, replace U801.
Excessive "code sound" heard at the speaker of a radio listening to this transmitter.	1. Code deviation is greater than ±1 kHz.	Check the IDC setting (UHF), or replace channel element (LB & HB). Check for proper waveform amplitude at encoder board pin 10 (Xmit code out).
	2. Low pass active filter is not switching from 140 Hz to 85 Hz.	Replace Q709.
Squelch tails are heard at the speaker of a radio listening to this transmitter.	1. No turn-off code is being transmitted.	Check the delayed keyed A+ duration (170-250 mS). Then check U801-5 on decoder board for presence of the turn-off code.
	2. Low pass active filter is always switched low (85 Hz).	Replace Q709.
No other DPL radios in the system are enabled by this transmitter; code is being transmitted.	Wrong code is being transmitted.	Feed U801-5 from decoder board into a Motorola Model SLN6413A DPL Test Set. Check for proper decode. If proper decode is not obtained, check for an intermittent or bad code plug (TRN6005A) or resistor network (Z801) on the decoder board. Check U801-15 thru U801-23 for a proper octal code.

1. EXCERPTS FROM FCC REGULATIONS

a. Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working directly under their immediate supervision.

b. The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

(1) When the transmitter is initially installed.

(2) When any change is made in the transmitter which may increase the power input.

(3) At intervals not to exceed one year.

c. Frequency and deviation of a transmitter must be checked:

(1) When it is initially installed.

(2) When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.

(3) At intervals not to exceed one year.

2. GENERAL

The radio set adjustments are broken down into a series of major alignments, adjustments, or checks. For complete alignment and adjustment of the radio set, the following sequence of adjustments should be used. For a particular touch-up or check, only the particular step-by-step procedure is required.

--Receiver Alignment Procedure

--Offset Oscillator Frequency Adjustment

--Standard Exciter Alignment Procedure or Wide-Spaced Exciter Alignment Procedure

--Power Amplifier Power Setting Procedure

--Transmitter Carrier Frequency Setting Procedure.

--IDC Adjustment Procedure

3. ADJUSTMENT LOCATIONS AND ALIGNMENT TOOLS (Refer to following Adjustment Location Detail)

a. Alignment Equipment

(1) Motorola S-1056B Portable Test Set and TEK-37 Cable, or Motorola TEK-5 Meter Panel and TEK-40 "Micor" Adapter.

(2) RF Signal Generator (Refer to the Table of Recommended Test Equipment in the Servicing Information Section of the manual.)

(3) Frequency Meter & Deviation Monitor (See Table of Recommended Test Equipment.)

(4) RF Wattmeter and 50-ohm Termination (See Table of Recommended Test Equipment.)

b. Unique Alignment Tools and Connectors

(1) White Tuning Tool, Motorola Part Number 66C84389G01.

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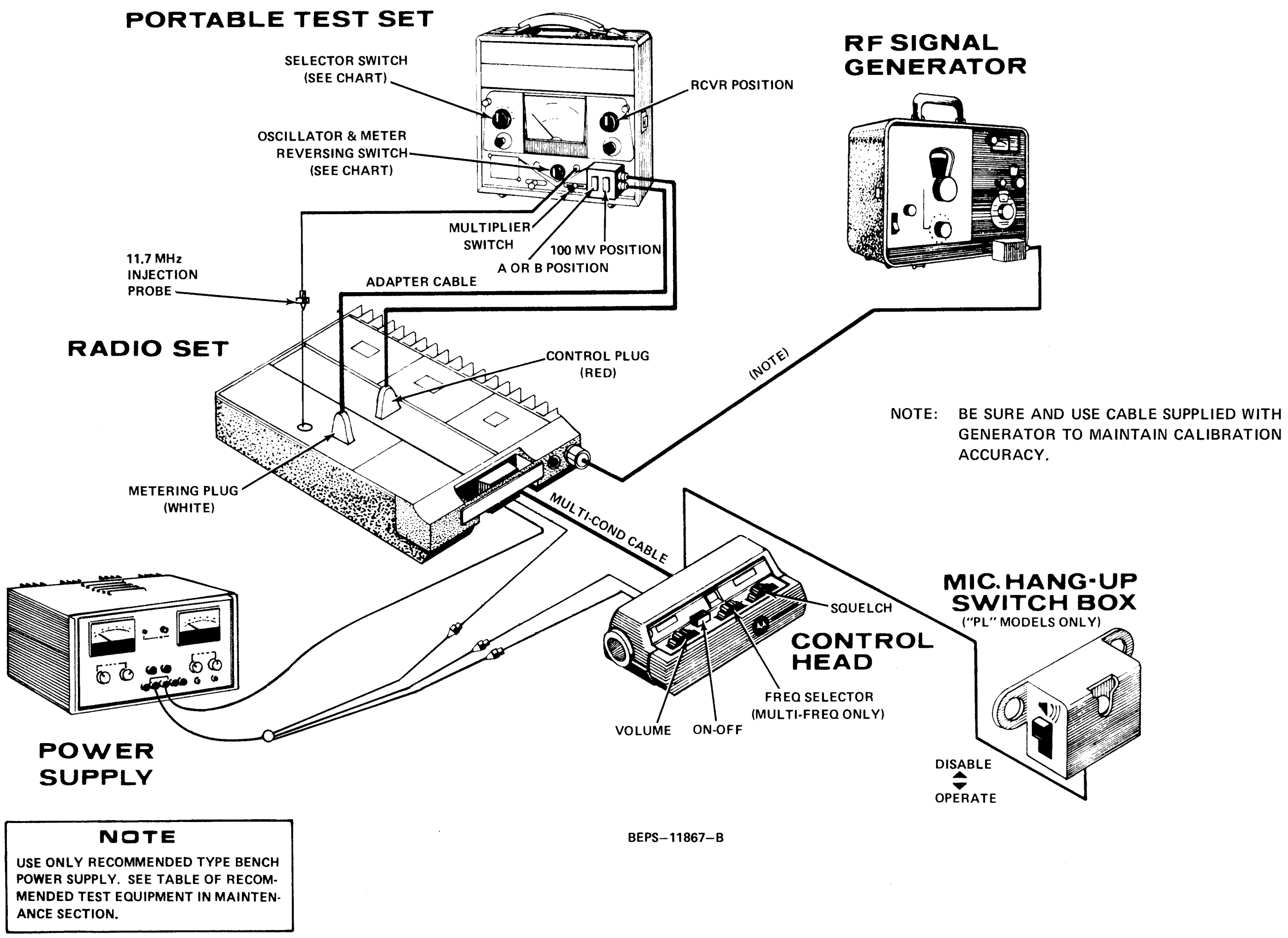


Receiver Alignment Test Set-Up

(2) Black Tuning Tool, Motorola Part Number 66D84387C01.

(3) Antenna Adapter, Motorola Part Number 58A82896G01. (See diagram on page 6-10.)

(4) UHF Thru Connector, Motorola Part Number 58A109152. (See diagram on page 6-10.)

(5) Connector Removal Tool, Motorola Part Number 66-84390C01.

(6) TRN6332A Shorting Plug ("Digital Private-Line" models only).

4. 20 dB QUIETING SENSITIVITY CHECK

Refer to Servicing Information section of the manual for this procedure (see Receiver RF and IF Board).

5. RECEIVER ALIGNMENT PROCEDURE

a. Alignment Set-Up and Equipment

(1) When using Motorola S-1056B Portable Test Set and TEK-37 cable or equivalent, set controls as follows unless otherwise specified: Oscillator Switch to Off; Function Switch to Receiver; TEK-37 Reference Switch to A or B; and TEK-37 Sensitivity Switch to 100 mV.

(2) When using Motorola TEK-5 Meter Panel with TEK-40 MICOR Adapter or equivalent, set TEK-40 selector switch to position "B".

(3) Use Tuning Tool (Part No. 66D84387C01) for all adjustments (see alignment tool illustration).

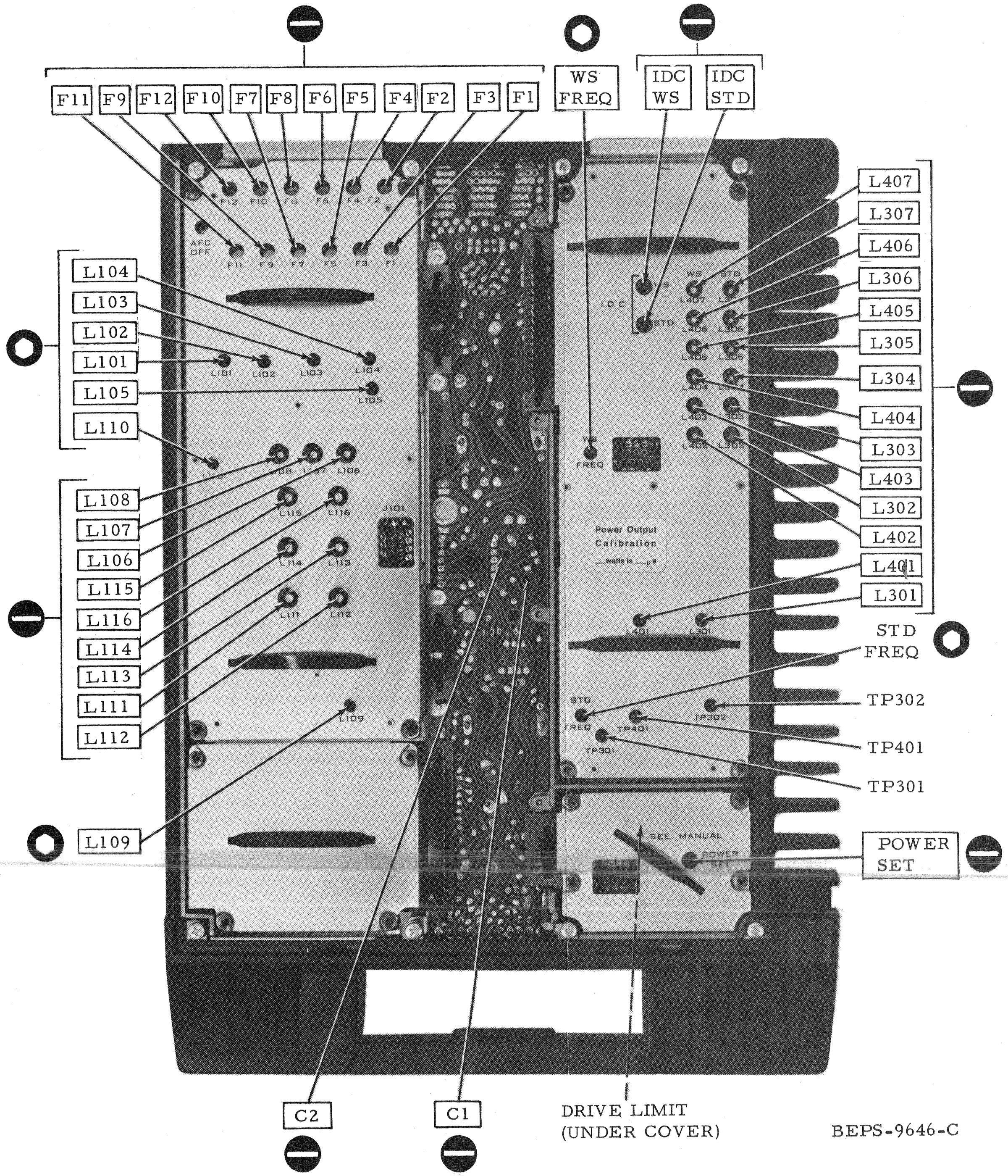
b. Tune-Up Frequency Selection for Multi-Frequency Radios

(1) Maximum frequency separation up to .5 MHz - Set the frequency selector switch to the frequency closest to the center of the range covered. For two-frequency radios select the higher frequency.

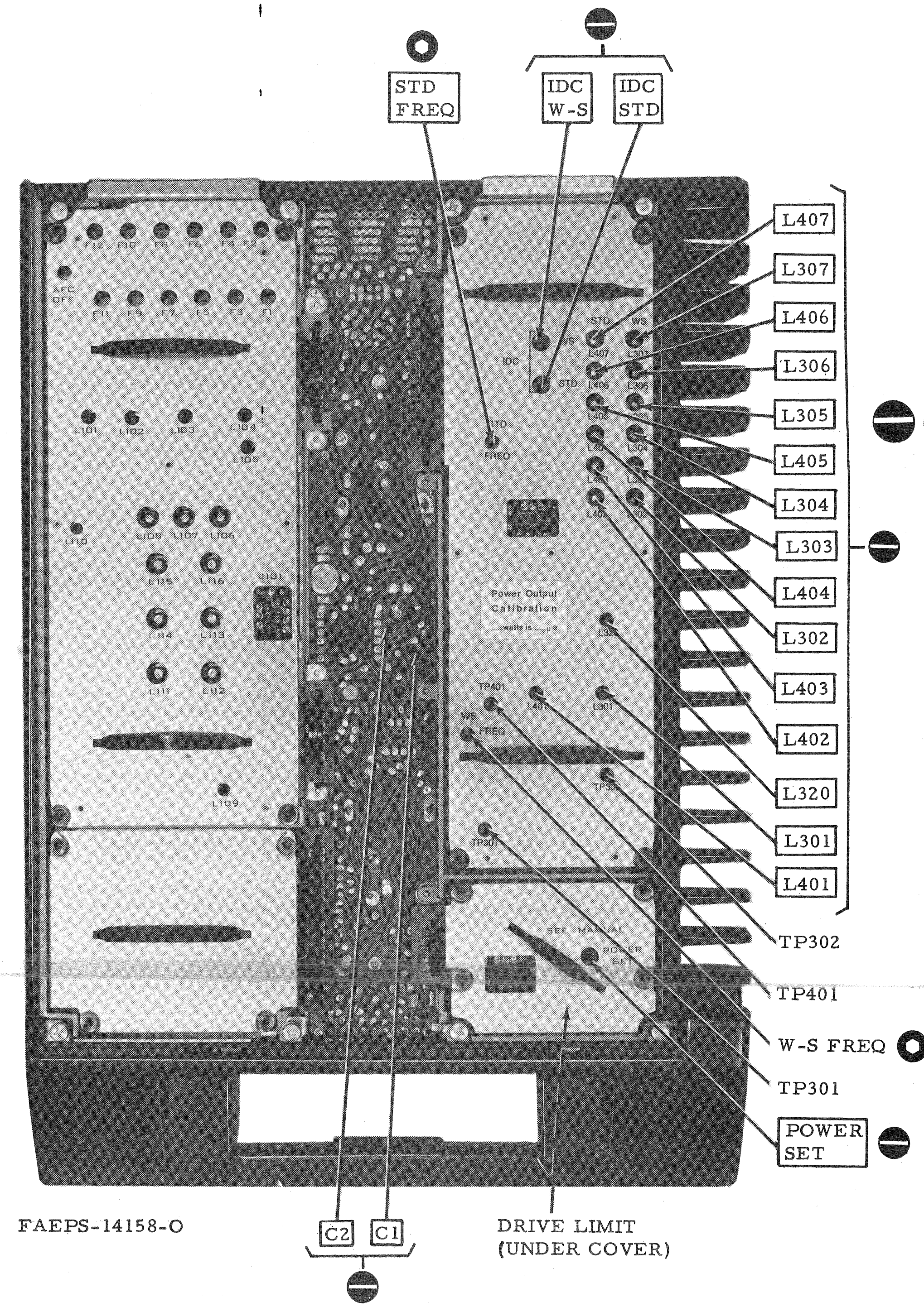
(2) Maximum frequency separation between .5 MHz and 1.0 MHz - Remove one channel element and insert a tune-up element whose frequency is midway between the two most widely separated frequencies. Set the frequency selector switch to select this element.

c. Alignment

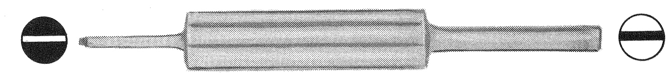
Refer to Receiver Alignment Test Set-Up and align the receiver using the following procedure.



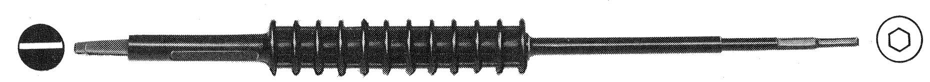
450-512 MHz Radio Adjustment Locations



406-420 MHz Radio Adjustment Locations



MOTOROLA PART NO. 66C84389G01



MOTOROLA PART NO. 66D84387C01

FAEPS-14109-A

STEP	ADJUSTMENT	METER POSITION	STAGE AND PROCEDURE
1	L101, L102, L103, L104, L105	-	Multiplier Coils - Adjust the cores of L101 through L105 to the end of the coil form away from the circuit board.
2	L106, L107, L108	-	Injection Filter - Adjust the tuning screws for L106 through L108 until the top of each tuning screw extends approximately one-eighth inch below the receiver shield.
3	L101, L102	1	Channel Element Output - Alternately tune L101 and L102 CCW two turns at a time until a peak indication on meter 1 is obtained.
4	L103, L104	2	First Doubler - Tune L103 CCW for a peak reading on meter 2. Tune L104 CCW for a dip on meter 2.
5	L105, L104	3	Second Doubler - Tune L105 CCW for a peak on meter 3. Tune L104 for a peak on meter 3. Repeak both coils until no further improvement can be obtained.
6	L101, L103	3	Detune L101 until meter 3 drops to 10 uA. Tune L103 for peak reading on meter 3, keeping this peak below 12 uA by further detuning of L101 if necessary.
7	L101, L102	1	Alternately tune L101 and L102 for peak reading on meter 1 until no further improvement can be obtained.
8	L106, L107, L108	3	Injection Filter - Tune L106 for a dip on meter 3. Tune L107 for a peak reading on meter 3. Tune L108 for a dip on meter 3. Do not repeat.
9	L109	4, 5	Discriminator - Insert 11.7 MHz injection probe of the test set into L110 hole on receiver shield. Be careful not to contact the circuit board. Set METER REV switch to position A or B for this step and be sure that the test set is equipped with an 11.7 MHz crystal in the corresponding A or B socket. Insert the injection probe far enough to obtain a saturated reading on meter 5. It should be possible to obtain readings on either side of zero (center) on meter 4 by tuning L109. Tune L109 for an EXACT zero (center) reading on meter 4. This adjustment is critical.
10	L110, L111, L112, L113, L114, L115, L116	4, 5	RF Preselector and Mixer-Unsquelch the receiver by turning the SQUELCH control on the control head fully counterclockwise. Disable the PL decoder by switching the PL monitor switch to the off position. Connect an rf signal generator to the antenna connector of the radio and set the rf output of the generator to maximum. NOTE If the receiver frequency has been changed by more than 1 MHz, preset tuning screws L111 through L116 so that the screw end is in the space between the board and its shield, and approximately one-eighth inch from the shield.

STEP	ADJUSTMENT	METER POSITION	STAGE AND PROCEDURE
10 Cont'd			If the radio is equipped with the optional preamplifier, disconnect and bypass the preamplifier. Set the generator to the carrier frequency by observing meters 4 and 5. NOTE If no indication is seen, unscrew the shell of the antenna cable connector, and pull the plug partially out of the jack so that the cable shield no longer makes contact with the radio chassis. Set the generator to the carrier frequency as indicated by meter positions 4 and 5, then reconnect the cable shield to the radio. Adjust L111 through L116 clockwise one turn at a time, watching meter 5 for an increase in indication above noise level. Tune L111 through L116 for peak reading on meter 5, reducing generator output level as necessary to keep meter 5 out of saturation. Tune L110 for peak on meter 5. Repeat the adjustment of L111 through L116. Turn L111 through L116 in or out as necessary until all screws are level. Repeat the adjustment of L111 through L116.
11	L106, L107, L108	11 (rcvr audio)	Tune L106, L107 and L108 for best noise quieting (Minimum meter indication). Maximum meter 11 sensitivity may be obtained by placing the multiplier switch on the test set in the .2 V AC position.
12	L111, L112, L113, L114, L115, L116	11 (rcvr audio)	Tune L111 through L116 for best noise quieting. Repeat until no further improvement in quieting level can be obtained.
13	C1, C2, L111	5, 11	Preamplifier - If the radio is equipped with the optional preamplifier, reconnect the preamplifier. Tune C1 and C2 for maximum meter 5 reading. Then tune C1, C2, and L111 for best noise quieting on meter 11.
14			Perform 20 dB quieting sensitivity measurement as check of alignment. Refer to the Servicing Information Section of the manual for this procedure (see receiver RF and IF board).

6. OFFSET OSCILLATOR FREQUENCY ADJUSTMENT (450-512 MHz)

NOTE

Adjustment of the offset oscillator to set the transmitter frequency may result in the radio failing to operate. Transmitter frequency adjustment should be accomplished only by warping the channel element.

a. Alignment Set-Up and Equipment

(1) A frequency counter and/or frequency meter capable of measuring 11.7 MHz, 14.7 MHz, and 16.7 MHz to within ±10 Hz is required. Connect a coax cable with one inch tinned wire leads on one end to the frequency measuring equipment. An alligator clip on the wire lead connected to the shield will be required.

(2) Unplug the exciter input cable (at J300) from the receiver rf deck (located on the Main Control Board side of the RF deck).

(3) On PL models, remove the "Vibrasender" reed from the PL encoder. On DPL models connect a TRN6332A Shorting Plug between J701 and J702 on the DPL encoder board.

(4) Use tuning tool (Part No. 66D84387C01) to adjust the slug in the oscillator warp coil (see alignment tool illustration).

b. Frequency Selection

(1) On multi-frequency standard and/or duplex model transmitters, set the frequency selector to any channel.

(2) On multi-frequency wide-space model transmitters, set the frequency selector to any channel in the high frequency group to adjust the 16.7 MHz or 14.7 MHz offset oscillator and to any channel in the low frequency group to adjust the 11.7 MHz offset oscillator.

c. Alignment

(1) Key the transmitter with the pushbutton on the portable test set (or meter panel) rather than with the microphone.

(2) On standard and/or duplex model transmitters, touch the center conductor of the coax cable from the frequency measuring equipment to TP302 and clip the cable shield to chassis or ground (NOT TO THE EXCITER SHIELD). Adjust the standard frequency warp coil until the oscillator frequency reads 16.7 MHz (450-470 MHz band) or 14.7 MHz (470-512 MHz band) or 11.7 MHz (optional). Unkey the transmitter.

(3) On widespace model transmitters, touch the center conductor of the coax cable from the frequency measuring equipment to TP302 for the 16.7 MHz or 14.7 MHz adjustment and to TP401 for the 11.7 MHz adjustment. The cable shield in either case should be clipped to the chassis or ground, not the exciter shield. Adjust the standard frequency warp coil for the 16.7 MHz or 14.7 MHz oscillators and the W-S frequency warp coil for the 11.7 MHz oscillator. Unkey the transmitter.

(4) Reconnect exciter input cable to the receiver rf deck.

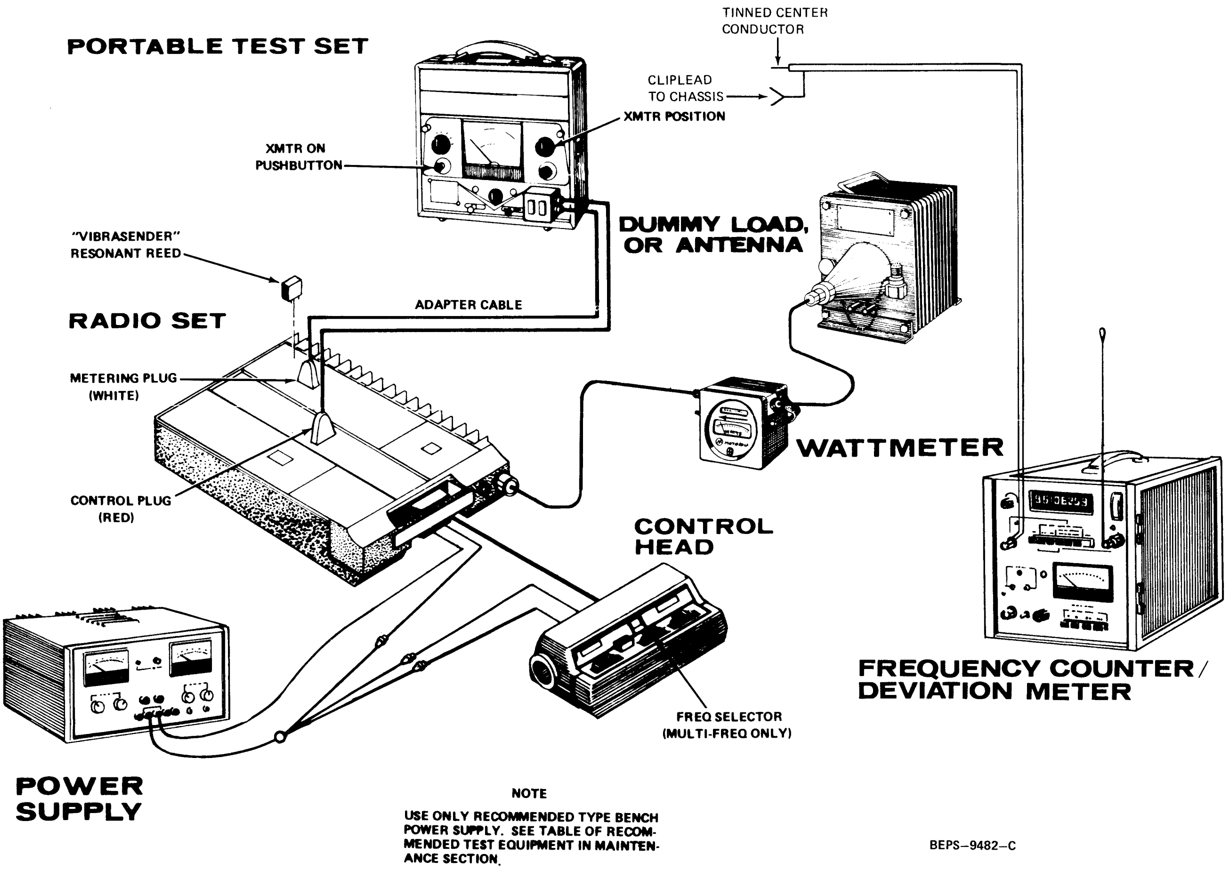
7. OFFSET OSCILLATOR FREQUENCY ADJUSTMENT (406-420 MHz)

NOTE

Adjustment of the offset oscillator to set the transmitter frequency may result in the radio failing to operate. Transmitter frequency adjustments should be accomplished only by warping the channel element.

a. Alignment Set-Up and Equipment

(1) A frequency counter and/or frequency meter capable of measuring 8.7 MHz through



Offset Oscillator Frequency Measurement Test Set-Up

20.7 MHz to within ±10 Hz is required. Connect a coax cable with one inch tinned wire leads on one end to the frequency measuring equipment. An alligator clip on the wire lead connected to the shield will be required.

(2) Unplug the exciter input cable from the receiver rf deck (locatedon the Main Control Board side of the rf deck).

(3) On PL models, remove the "Vibrasender" reed from the PL encoder. On DPL models, connect a TRN6332A Shorting Plug between J701 and J702 on the DPL encoder Board.

(4) Use tuning tool (Part No. 66D84387C01) to adjust the slug in the oscillator warp coil (L300 and L400) counterclockwise until the core is flush with the top of the board.

(5) The wide-space offset oscillator circuit is designed to accept KXN6108AA crystals in the frequency range of 8.7 MHz to 25.7 MHz. However, it is necessary to remove R321, R355, or R356, and change the tap position of the L300 warp coil, depending on the crystal frequency that is required. The following table is listed here for reference in those cases where the radio is to be retuned using a different offset oscillator frequency.

KXN6108AA Frequency (MHz)	L300 Tap Position	R321	R355	R356
8.700-10.999	1	IN	IN	IN
11.000-13.999	2	IN	OUT	IN
14.000-17.499	3	OUT	OUT	IN
17.500-20.700	4	OUT	OUT	OUT
20.701-21.999	1	IN	IN	IN
22.000-25.700	2	IN	OUT	IN

b. Frequency Selection

(1) On multi-frequency standard model transmitters, set the frequency selector to any channel to adjust the 11.7 MHz offset oscillator.

(2) On multi-frequency wide-space model transmitters, set the frequency selector to any channel in the wide-space (lower) frequency group to adjust the wide-space offset oscillator and to any channel in the standard (higher) frequency group to adjust the 11.7 MHz offset oscillator.

c. Alignment

(1) Key the transmitter with the pushbutton on the portable test set (or meter panel) rather than with the microphone to prevent unwanted modulation of the carrier.

(2) On standard model transmitters, touch the center conductor of the coax cable from the frequency measuring equipment to TP401 and clip the cable shield to chassis or ground, not to the exciter shield. Adjust the standard frequency warp coil clockwise until the oscillator frequency reads 11.7 MHz. Unkey the transmitter.

(3) On wide-space model transmitters, touch the center conductor of the coax cable from the frequency measuring equipment to TP302 for the wide-space adjustment and to TP401 for the 11.7 MHz adjustment. The cable shield in both cases should be clipped to the chassis or ground, not to the exciter shield. Adjust the wide-space warp coil clockwise for the frequency stamped on the crystal and the standard frequency warp coil for the 11.7 MHz oscillator. Unkey the transmitter.

(4) Reconnect the exciter input cable to the receiver rf deck.

8. STANDARD EXCITER ALIGNMENT PROCEDURE

(See Test Set-Up Diagram on page 6-9)

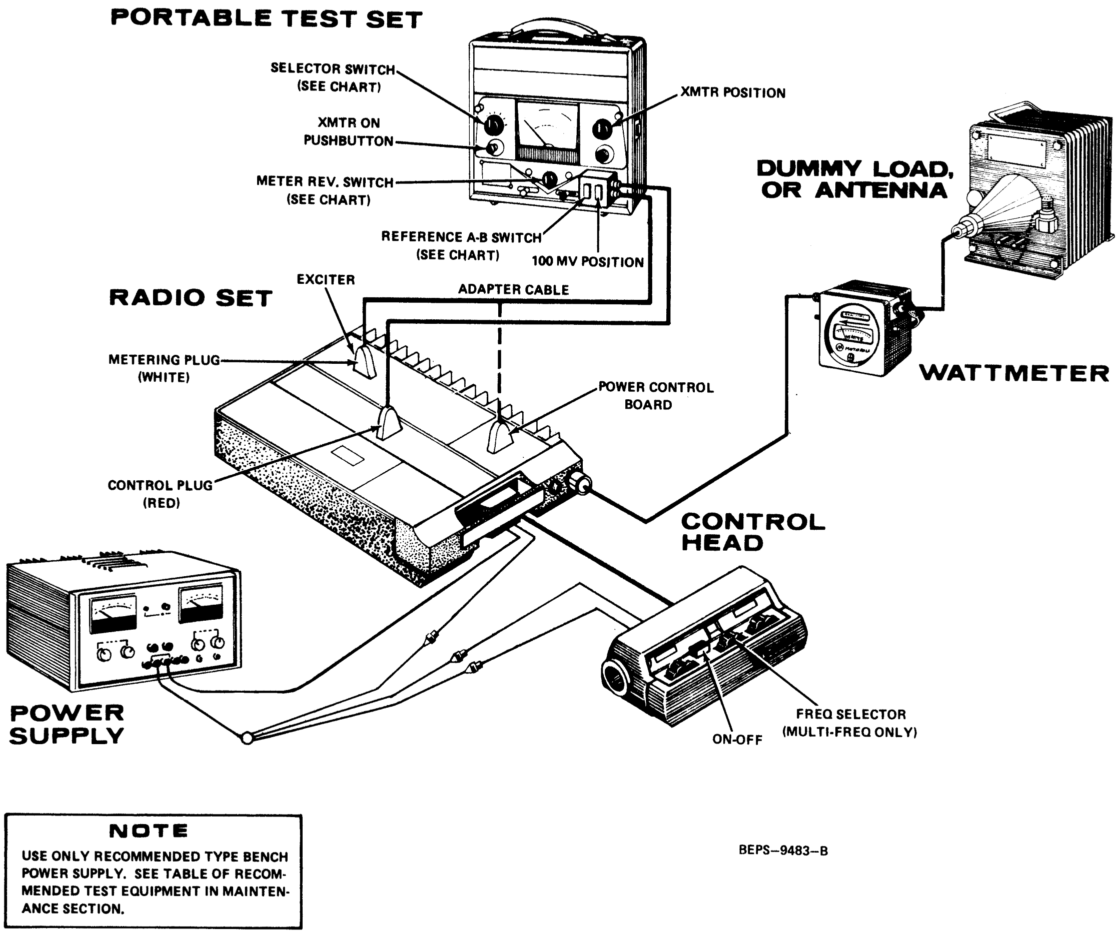
a. Alignment Set-Up and Equipment

(1) When using Motorola S1056B Portable Test Set and TEK-37 cable, set controls as follows unless otherwise specified: Function Switch to Transmitter; Sensitivity Switch to 100 mV.

(2) When using Motorola TEK-5 Meter Panel with TEK-40 MICOR Adapter, set TEK-40 Selector switch to Position B.

(3) Use tuning tool 66C84389G01 for L301 through L307 and L401 through L407, and tuning tool 66D84387C01 for power set adjustment. Use a probe to short TP301 to ground, or place a clip lead between pins 3 and 4 of the time-out timer receptacle on the main control board.

(4) Major realignment of the exciter also requires the use of cable adapters to feed the exciter filters from an r-f generator (see diagram on page 6-10). This adapter consists of a phono-to-UHF adapter (Motorola Part No. 58A82896G01) and a UHF double-female through-connector or equivalent adapters to connect to a male phono connector.



Exciter Alignment Test Set-Up

b. Tune-Up Frequency Selection for Multi-Frequency Radios (Without Wide Space Transmitter)

(1) For maximum frequency separation up to .5 MHz -- Set the frequency selector switch to the frequency closest to the center of the range covered. For two-frequency radios select the higher frequency.

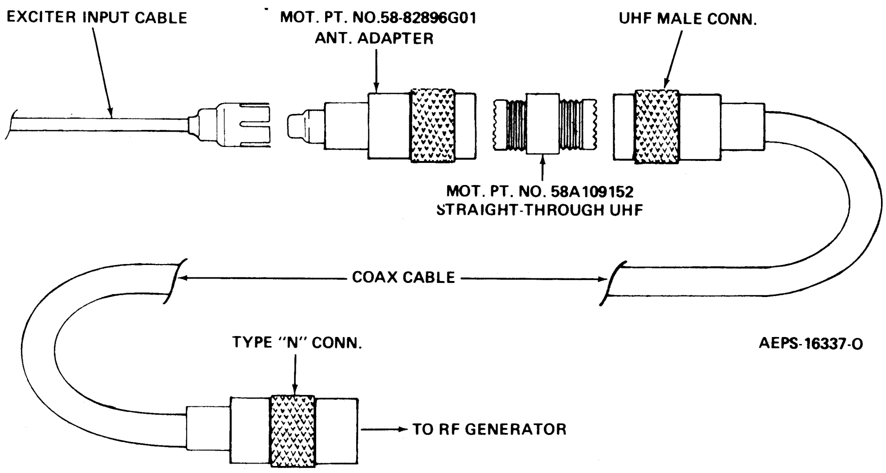
(2) For maximum frequency separation between .5 MHz and 1.0 MHz. -- Remove one channel element and insert a tune-up element whose frequency is midway between the two most widely separated frequencies. Set the frequency selector switch to select this element.

c. Alignment

(1) Follow the step-by-step procedure below for complete alignment. For Touch-Up Alignment, Steps 2, 3, 4, 5, and 6 can be omitted.

(2) References enclosed in brackets [ ] pertain to the 406-420 MHz models, while those without brackets apply to 450-512 MHz.

(3) The following procedure must be strictly adhered to when a complete alignment is needed. Although rated power may be obtained by rough peak tuning at one temperature, proper performance of the exciter cannot be expected over the specified temperature range if the procedure is not strictly adhered to.



Adapters Required for Exciter Alignment

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set				Power Output - Turn the Power Set Control fully CCW (minimum power).
2	L301 through L307 [L401 through L407]				Pre-Alignment - Adjust the tuning screws in the exciter output filter, L402 to L407, fully CCW until each screw is fully extended. NOTE: There is a stop on each screw which will prevent it from being completely removed from the filter cover. Adjust the slug in L401 so that its end is flush with the circuit board.
3	TP301	Exciter	4	Off Ref. A	Disable Offset Oscillator - Short TP301 to ground by either connecting it to ground with a clip lead, or jumper pin 3 to pin 4 on the time-out timer receptacle on the control board. (M4 should read zero when the radio is keyed and TP301 is shorted to ground.)
4	L401	Exciter	2 [3]	Off Ref. A	Offset Mixer Output - Remove the exciter input cable from the receiver rf deck (main control-board side) and connect it to the signal generator using a 58A82896G01 adapter. Set the signal generator to the transmitter frequency, and its output level to 50-70 millivolts. Key transmitter. Adjust the slug in L301 [L401] for a peak reading on meter 2 [3] by turning the slug clockwise so it moves away from the circuit board. In some cases, the reading will initially decrease. Tune until a peak reading is obtained. Adjust generator output to obtain a final meter 2 [3] reading in the center of the meter scale.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
5	L302 through L307 [L402 through L407]	Exciter	2 [3]	Off Ref. A	Exciter Filter - With transmitter keyed, adjust L302 [L402] for minimum meter 2 [3] reading. Adjust L303 [L403] for peak meter 2 [3] reading. Adjust L304 [L404] for a minimum meter reading. Adjust L305 [L405] for a peak meter reading. Adjust L306 [L406] for a minimum meter reading. Adjust L307 [407] for a peak meter 2 [3] reading. Unkey transmitter. Adjust L302 through L307 [L402 through L407] CW (in) one-half turn each.
6	TP301	Exciter	4	Off Ref. A	Offset Oscillator - Remove exciter input cable from signal generator and reconnect to receiver rf deck. Remove short from TP301 on the jumper added in step 3, which will enable the offset oscillator. Key the transmitter. A meter 4 reading of +30 to 40 uA should be obtained. (When TEK-5 Meter Panel is used, reading is +15 to 20 uA).
7	L302 through L306 [L402 through L406]	Exciter	2 [3]	Off Ref. A	Exciter Filter - Adjust L302 [L402] CCW to first M2 [M3] minimum. Adjust L303 [L403] CCW to first M2 [M3] maximum. Adjust L304 [L404] CCW to first M2 [M3] minimum. Adjust L305 [L405] CCW to first M2 [M3] maximum. Adjust L306 [L406] CCW to first M2 [M3] minimum. Unkey the transmitter.
8	L302, L307 [L402, L407]	Exciter	5	Off Ref. B	Exciter Filter - Key the transmitter. Adjust L307 [L407] then L302 [L402] for a maximum meter reading on meter 5.
9	L301 [L401]	Exciter	5	Off Ref. B	Offset Mixer Output - Touch up L301 [L401] for maximum meter 5. The tuning tool detunes L301 [L401] while tuning. Therefore, it is necessary to remove the tool and check for the meter peak. Repeat as necessary until the maximum meter 5 indication is reached after the tuning tool is removed. Unkey transmitter.
10					Proceed to power set procedure.

9. WIDE-SPACE EXCITER ALIGNMENT PROCEDURE (450-512 MHz)

a. Alignment Set-Up and Equipment

Use the same equipment, set-up, and tuning tools as for the standard exciter alignment procedure.

b. Tune-Up Frequency Selection for Multi-Frequency Radios

(1) Wide-Space Frequency Channel Group

Use same procedure as for standard exciter except pick proper channel from wide-space frequency group of frequencies.

(2) Standard Frequency Channel Group

Use same procedure as for standard exciter except pick proper channel from standard frequency group of frequencies.

c. Alignment

(1) Follow the step-by-step procedure below for complete alignment. For touch-up alignment or frequency changes of less than 1.0 MHz, steps 2, 3, 4, 5 and 6, may be omitted.

(2) The following procedure must be strictly followed when complete alignment is needed. Although rated power may be obtained by peak tuning at one temperature, proper performance of the exciter cannot be expected over the specified temperature range if the procedure is not strictly adhered to.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set				Power Output - Turn the Power Set Control fully CCW (minimum power).
2	L301 through L307 & L401 through L407				Pre-Alignment - Adjust the slugs in L301 and L401 so that their ends are flush with the circuit board. Adjust the tuning screws in the exciter output filters, L302 to L307 and L402 to L407, fully CCW until each screw is fully extended. NOTE: There is a stop on each screw which will prevent it from being completely removed from the filter cover.
3	TP301	Exciter	4	Off Ref. A	Disable Standard Offset Oscillator: Short TP301 to ground by either shorting the point to the shield or connecting pins 3 & 4 of the Time-Out Timer together with a clip lead. (See Fig. 3) (M4 should read zero when radio is keyed with TP301 shorted to ground.)
4	L301	Exciter	2	Off Ref. A	Standard Offset Mixer Output: Remove the exciter input cable from the receiver RF deck (located on the Control Board side of the RF deck) and connect it to the signal generator using an antenna adapter (#58A82896G01) and a UHF Thru-Connector. Set the signal generator to the proper transmitter frequency in the high frequency group. Set the generator output level to 50-70 millivolts. Key transmitter. Adjust the slug in L301 for a peak reading on meter 2 by turning the slug clockwise so it moves away from the circuit board. In some cases, the reading on meter 2 will initially decrease. Tune until a peak reading is obtained. Adjust the generator output to obtain a final meter 2 indication at the center of the meter scale.
5	L302 to L307	Exciter	2	Off Ref. A	Standard Exciter Filter: With transmitter keyed, adjust L302 for minimum meter 2 reading. Adjust L303 for peak meter reading. Adjust L304 for a minimum meter reading. Adjust L305 for a peak meter reading . Adjust L306 for a minimum meter reading. Adjust L307 for a peak meter reading. Unkey the transmitter. Adjust L302 through L307 CW (in) one-half turn each.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
6	Frequency Selector TP301	Exciter	4	Rev. Ref. A	Disable W-S Offset Oscillator: Switch Frequency Selector to proper channel in low frequency group. Maintain short on TP301 to ground to disable W-S offset oscillator. (Meter 4 should read zero when radio is keyed on channel in low frequency group with TP301 shorted to ground.)
7	L401	Exciter	3	Off. Ref. A	W-S Offset Mixer Output: Set the signal generator to the proper transmitter frequency in the low frequency group. Set the generator output level to 50-70 millivolts. Key transmitter. Adjust the slug in L401 for a peak reading on meter 3 by turning the slug clockwise so it moves away from the circuit board. In some cases, the reading on meter 3 will initially decrease. Tune until a peak reading is obtained. Adjust the signal generator for a center-scale reading on meter 2.
8	L402 through L407	Exciter	3	Off Ref. A	W-S Exciter Filter - With transmitter keyed, adjust L402 for minimum meter 3 reading. Adjust L403 for peak meter reading. Adjust L404 for a minimum meter reading. Adjust L405 for a peak meter reading. Adjust L406 for a minimum meter reading. Adjust L407 for a peak meter reading. Unkey transmitter. Adjust L404 through L407 CW (in) one-half tune each.
9	TP301	Exciter	4	Rev. Ref. A	W-S Offset Oscillator: Remove exciter input cable from signal generator and reconnect to receiver rf deck. Remove short from TP301 which will enable the W-S Offset Oscillator. Key the transmitter on proper channel in low frequency group. A meter 4 reading of +30 to 40 uA should be obtained. (When TEK-5 Meter Panel is used, reading is +15 to 20 uA).
10	L402 through L406	Exciter	3	Off Ref. A	Wide-Space Exciter Filter: Adjust L402 CCW to first Meter 3 Minimum. Adjust L403 CCW to first Meter 3 maximum. Adjust L404 CCW to first Meter 3 minimum. Adjust L405 CCW to first maximum. Adjust L406 CCW to first Meter 3 minimum. Unkey transmitter.
11	L402 L407	Exciter	5	Off Ref. B	Wide-Space Exciter Filter: Key transmitter. Adjust L407, then L402 for maximum meter 5 reading.
12	L401	Exciter	5	Off Ref. B	Wide-Space Mixer Output: Touch up L401 for maximum reading on meter 5. The tuning tool detunes L401 while tuning. Therefore, it is necessary to remove the tool and check for the meter peak. Repeat as necessary until the maximum meter 5 indication is reached after the tuning tool is removed. Unkey transmitter.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
13	Frequency Selector	Exciter	4	Off Ref. A	Standard Offset Oscillator: Select proper channel in high frequency group. Key the transmitter. A meter 4 reading of +30 to 40 uA should be obtained (when TEK-5 Meter Panel is used, reading is +15 to 20 uA). Unkey transmitter.
14	L302 through L306	Exciter	2	Off Ref. A	Standard Exciter Filter: Key transmitter. Adjust L302 CCW to first meter 2 minimum. Adjust L303 CCW to first meter 2 maximum. Adjust L304 CCW to first meter 2 minimum. Adjust L305 CCW to first meter 2 minimum. Adjust L306 CCW to first meter 2 minimum. Unkey transmitter.
15	L302	Exciter	5	Off Ref. B	Standard Exciter Filter: Key transmitter. Adjust L307, then L302 for a maximum on meter 5.
16	L301	Exciter	5	Off Ref. B	Standard Offset Mixer Output: Touch up L301 for maximum reading on meter 5. The tuning tool detunes L301 while tuning. Therefore, it is necessary to remove the tool and check for the meter peak. Repeat as necessary until the maximum meter5 indication is reached after the tuning tool is removed. Unkey transmitter.
17					Proceed to power set procedure.

10. WIDE-SPACE EXCITER ALIGNMENT PROCEDURE (406-420 MHz)

a. Alignment Set-Up and Equipment

Use the same equipment, set-up, and tuning tools as for the standard exciter alignment procedure.

b. Tune-Up Frequency Selection for Multi-Frequency Radios

(1) Wide-Space Frequency Channel Group

Use same procedure as for standard exciter except pick proper channel from wide-space frequency group of frequencies.

(2) Standard Frequency Channel Group

Use same procedure as for standard exciter except pick proper channel from standard frequency group of frequencies.

c. Alignment

Follow the step-by-step procedure below for complete alignment. For touch-up alignment, Steps 2, 3, 4, 5 and 6 may be omitted.

(1) Omit steps 2, 3, 4, 5 and 6 for touch-up Alignment (i. e., changing frequency by less than 1.0 MHz).

(2) Following procedure must be strictly followed when complete alignment is needed. Although rated power may be attained by rough peak tuning at one temperature, proper exciter performance cannot be expected over the specified temperature range if the following procedure is not strictly adhered to.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set				Power Output: Turn the Power Set Control fully CCW (minimum power).
2	L301 through L307 & L320, & L401 through L407				Pre-Alignment: Adjust the slugs in L301, L320 and L401 so that their ends are flush with the circuit board. Adjust the tuning screws in the exciter output filters, L302 to L307 and L402 to L407, fully CCW until each screw is fully extended. NOTE: There is a stop on each screw which will prevent it from being completely removed from the filter cover.
3	TP301	Exciter	4	Off Ref. A	Disable Wide-Space Offset Oscillator: Short TP301 to ground by either shorting the point to the shield or connecting pins 3 & 4 of the time-out timer receptacle (located on the main control board) together with a clip lead. (See Fig. 3) (Meter 4 should read zero when radio is keyed with TP301 shorted to ground.)
4	L301, L320	Exciter	2	Off Ref. A	Wide-Space Offset Mixer Output: Remove the exciter input cable from the receiver rf deck (located on the main control board side of the rf deck) and connect it to the signal generator using an antenna adapter (#58A82896G01) and a UHF Thru Connector. Set the signal generator to the proper transmitter frequency in the wide-space frequency group. Set the generator output level to 50-70 millivolts. Key transmitter. Adjust the slugs in L301 and in L320 for a peak meter 2 reading by turning the slug clockwise so it moves away from the circuit board. In some cases, the meter 2 reading will initially decrease. Tune until a peak reading is obtained. Adjust generator output for a center-scale reading on meter 2.
5	L302 through L307	Exciter	2	Off Ref. A	Wide-Space Exciter Filter: With transmitter keyed, adjust L302 for minimum meter 2 reading. Adjust L303 for peak meter reading. Adjust L304 for a minimum meter reading Adjust L305 for a peak meter reading. Adjust L306 for a minimum meter reading. Adjust L307 for a peak meter reading. Unkey the transmitter. Adjust L302 through L307 CW (in) one-half turn ea.
6	Frequency Selector TP301	Exciter	4	Off Ref. A	Disable Standard Offset Oscillator: Switch frequency selector to proper channel in standard frequency group. Maintain short from TP301 to shield to disable standard offset oscillator. (Meter 4 should read zero when radio is keyed with TP301 shorted to ground).

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
7	L401	Exciter	3, 2	Off Ref. A	Standard Offset Mixer Output: Set the signal generator to the proper transmitter frequency in the standard frequency group. Set the generator output level to 50-70 mV. Key transmitter. Adjust the slug in L401 for a peak reading on meter 3 by turning the slug clockwise so it moves away from the circuit board. In some cases, the reading on meter 3 will initially decrease. Tune until a peak reading is obtained. Adjust generator output for a center-scale reading on meter 2.
8	L402 through L407	Exciter	3	Off Ref. A	Standard Exciter Filter: With transmitter keyed, adjust L402 for minimum meter 3 reading Adjust L403 for peak meter reading. Adjust L404 for a minimum meter reading. Adjust L405 for a peak meter reading. Adjust L406 for a minimum meter reading. Adjust L407 for a peak meter reading. Unkey the transmitter. Adjust L402 through L407 CW (in) one-half turn each.
9	TP301				Standard Offset Oscillator: Remove exciter input cable from signal generator and reconnect to receiver rf deck. Remove short from TP301, which will enable standard offset oscillator.
10	Frequency Selector	Exciter	4	Off Ref. A	Key the transmitter on proper channel in standard frequency group. A meter 4 reading of +30 to 40 uA should be obtained. (When TEK-5 Meter Panel is used, reading is +15 to 20 uA.)
11	L402 through L406	Exciter	3	Off Ref. A	Standard Exciter Filter - Adjust L402 CCW to first meter 3 minimum. Adjust L403 CCW to first meter 3 maximum. Adjust L404 CCW to first meter 3 minimum. Adjust L405 CCW to first meter 3 maximum. Adjust L406 CCW to first meter 3 minimum. Unkey transmitter.
12	L402, L407	Exciter	5	Off Ref. B	Standard Exciter Filter: Key transmitter. Adjust L407, then L402 for maximum meter 5 reading.
13	L401	Exciter	5	Off Ref. B	Standard Mixer Output: Touch up L401 for maximum reading on meter 5. The tuning tool detunes L401 while tuning. Therefore, it is necessary to remove the tool and check for the meter peak. Repeat as necessary until the maximum meter 5 indication is reached after the tuning tool is removed. Unkey transmitter.
14	Frequency Selector	Exciter	4	Off Ref. A	Wide-Space Offset Oscillator: Select proper channel in wide-space frequency group. Key the transmitter. A meter 4 reading of +30 to 40 uA should be obtained (when TEK-5 Meter Panel is used, reading is +15 to 20 uA). Unkey transmitter.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
15	L302 through L306	Exciter	2	Off Ref. A	Wide-Space Exciter Filter: Key transmitter. Adjust L302 CCW to first meter 2 minimum. Adjust L303 CCW to first meter 2 maximum. Adjust L304 CCW to first meter 2 minimum. Adjust L305 CCW to first meter 2 minimum. Adjust L306 CCW to first meter 2 minimum.
16	L302, L307	Exciter	5	Off Ref. B	Wide-Space Exciter Filter: Adjust L307, then L302 for a maximum on meter 5.
17	L301, L320	Exciter	5	Off Ref. B	Wide-Space Offset Mixer Output: Touch up L301 and L320 for maximum reading on meter 5. The tuning tool detunes L301 while tuning. Therefore, it is necessary to remove the tool and check for the meter peak. Repeat as necessary until the maximum meter 5 indication is reached after the tuning tool is removed. Unkey the transmitter.
18					Proceed to power set procedure.

11. PA POWER SETTING PROCEDURE

a. Equipment Set-Up

(1) Using a TEK-37 cable, connect a Motorola S-1056B Portable Test Set to the radio. Set Function Switch to TRANSMITTER.

(2) Connect wattmeter to the front panel connector of radio.

(3) Remove the shield over the power control board.

(4) Use tuning tool 66D84387C01 (see tuning tool illustration).

b. Frequency Selection for Multi-Frequency Radios

The transmitter power amplifier is broadband. Any channel may be used for initial PA power setting. See step-by-step procedure for final PA power setting.

c. Power Output Specifications

TABLE I

406-420 MHz

Model	Power Output	Drive Limit	Power Set
T44	45	55	45
T74	100	125	100

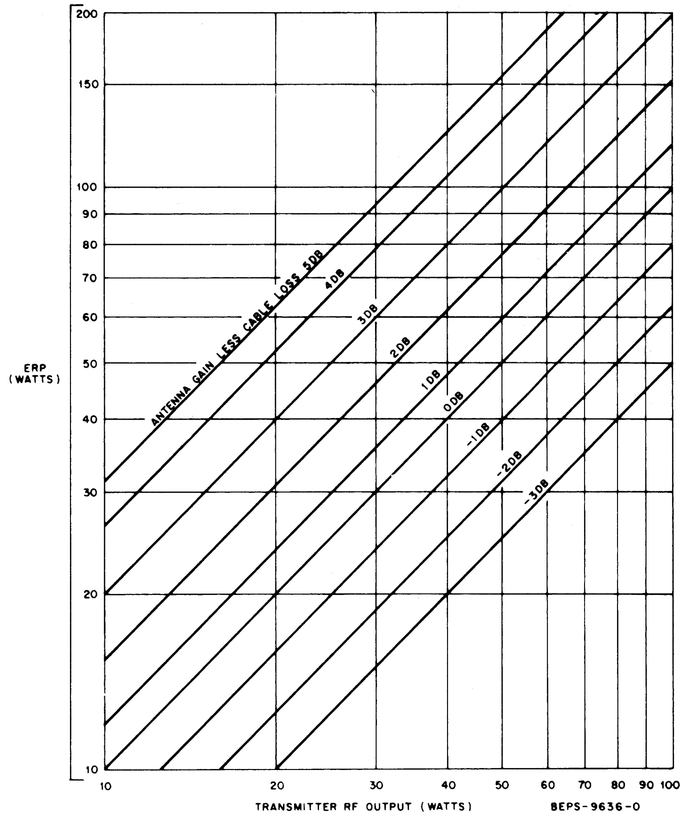
450-470 MHz

Model	Power Output	Drive Limit	Power Set	DC Input
T34	25	31	25	80
T44	45	55	45	120
T54	75	88	75	180
T74	100	125	100	270

470-512 MHz

Model	Power Output	Drive Limit	Power Set	ERP*
T34	19	24	19	50
T44	39	48	39	100
T54	59	70	59	150
T74	78	94	78	200

*The ERP applies only when using a standard 5 dB gain antenna connected to the radio through 10 feet of coaxial cable (Motorola part no. 30C82921H01). In all other cases, refer to the GRAPH OF EFFECTIVE RADIATED POWER. Antenna gain for non-standard types is obtained from individual specification sheet or Motorola Standard Parts catalog. Cable loss of the specified 30C82921H01 Teflon cable is nominally 0.095 dB/foot.



Graph of Effective Radiated Power

d. Power Setting Procedure

Follow the step-by-step procedure below.

PA POWER SETTING PROCEDURE

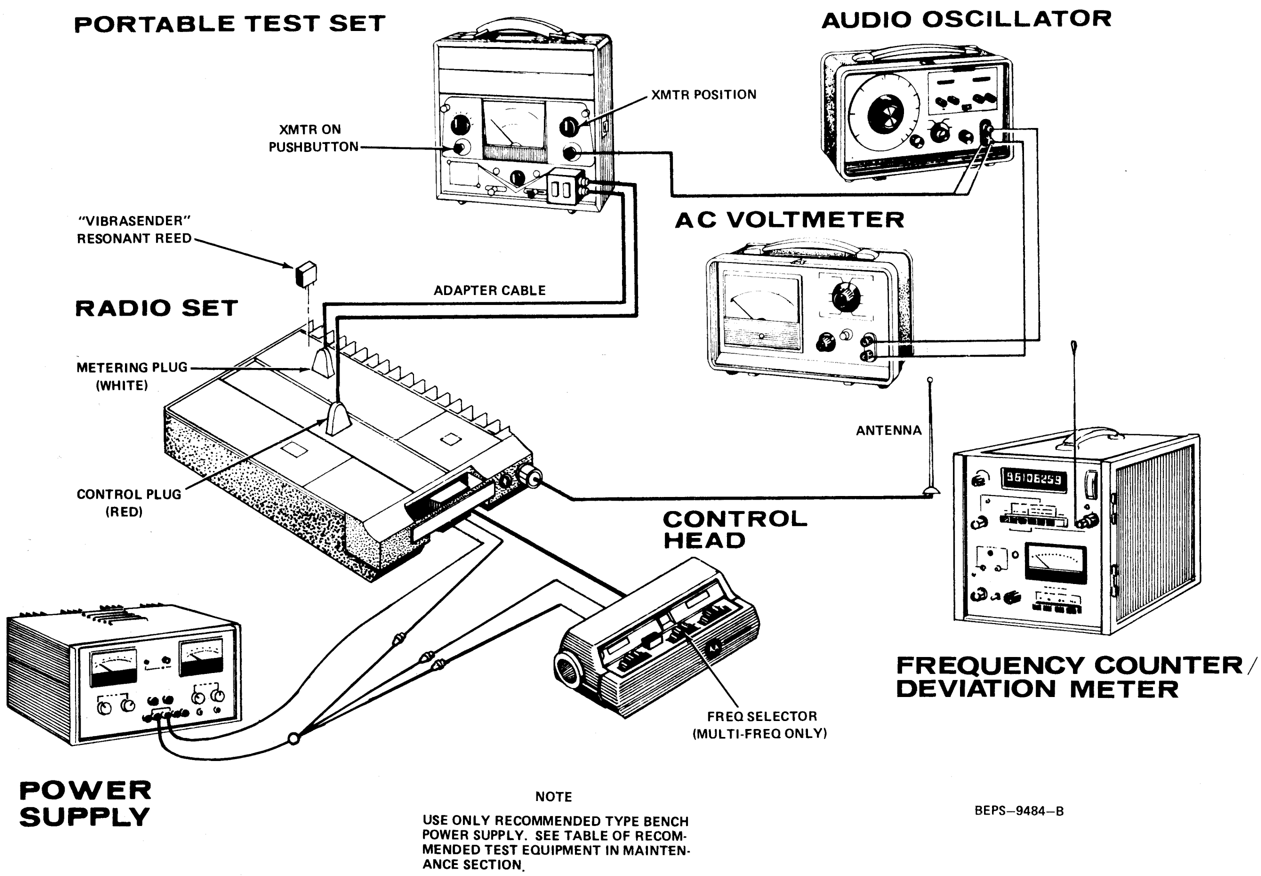
NOTE

If transmitter is to be brought back up to rated power after turning down the Power Set control for alignment or troubleshooting procedures, proceed directly to Step 4.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
1	Power Set and Drive Limit	Power Control Board	Watt-meter		Pre-Setting of Controls: Adjust the Drive Limit control fully clockwise (maximum drive limit). Adjust the Power Set control 1/4 turn from fully counterclockwise (just up from minimum power output).

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
2	Power Set	Power Control Board	Watt-meter		Power Set: Key Transmitter. Adjust the Power Set control clockwise until the power output under Drive Limit in Table 1 of paragraph 11. c. is obtained. If power output limits before that value is obtained, adjust power set control to maximum clockwise.
3	Drive Limit	Power Control Board	Watt-meter		Drive Limit: NOTE: For proper operation of the power leveling circuitry, the drive limit control must not be set for any lower power output than that given in Table 1 of paragraph 11. c. in the power-setting section of the alignment procedure. In radios where the drive limit power output level is not obtainable, the drive limit protection circuitry is not necessary and the drive limit control can be set to minimum. Key transmitter. If the proper level was not attainable in Step 2, adjust the Drive Limit control counterclockwise to the proper value indicated in Table 1 of paragraph 11. c. under Drive Limit. On multi-frequency radios, check power output on all channels. If necessary readjust Drive Limit control so the lowest power channel is set per paragraph 11. c. Drive Limit. If Drive control has no effect, set it fully clockwise (maximum drive limit). If the Drive Limit control cannot obtain a high enough reading, set it fully counter-clockwise (minimum drive limit). Unkey transmitter. Replace power control board shield.
4	Power Set	Power Control Board	Watt-meter		Power Set: Key transmitter. Adjust the Power Set control CCW and set power output per Table 1 of paragraph 11. c. under Power Set. On multi-frequency radios, check power output on all channels. If necessary, readjust Power Set control so the lowest power channel is set per Table 1 of paragraph 11. c. under Power Set. Unkey transmitter. This completes the power setting procedure for 406-420 MHz and 470-512 MHz radios. For radios in the 450-470 MHz band, proceed to Step 5.
5		Power Control Board	5	B-REV.	PA Current: Key transmitter, and check current indication. For radios in the 406-470 MHz ranges, the following maximum current indications are applicable: T34-24 uA; T44-37 uA; T54-29 uA; and T74-43 uA. For radios in the 470-512 MHz range, the following maximum current indications are applicable: T34-20 uA; T44-35 uA; T54-28 uA; and T74-36 uA.
6	Final Stage DC Power Input				DC power input to final stage can be determined by performing Steps 7, 8, and 9.

Step	Adjust	Metering Plug Location	Test Set Selector Switch Position	Meter Rev. Switch & Ref. A-B Switch	Stage and Procedure
7	DC Current to Final PA	Power Control	5	Meter Rev.	Final PA Stage Collector, I_c: The collector current in amperes is the meter 5 reading (0 to 50) times 0.25 on T34 and T44 Series Radio Sets. On T54 and T74 Series Radio Sets, the collector current in amperes is the meter 5 reading (0 to 50) times 0.5.
8	DC Voltage to Final PA Stage				Final PA Collector Voltage, V_c: The PA collector voltage is the voltage measured between the two large feed-thru capacitors located at the center front of the radio on the transmitter side.
9	Final Stage DC Power Input				Final Stage DC Power Input: Calculate the final input power, $P_{in} = V_c \times I_c$. A list of the maximum dc inputs as specified by the FCC for the various radio set models is given in Table 1 of paragraph 11.c. under DC input.



Frequency and Deviation Measurement Test Set-Up

12. TRANSMITTER CARRIER FREQUENCY SETTING PROCEDURE

NOTE

This Procedure should be used only after offset oscillator frequency has been adjusted or checked as described in paragraph 7 of this procedure.

Adjustment of the offset oscillator to set the transmitter frequency may result in the radio failing to operate. Transmitter frequency adjustment should be accomplished only by warping the channel element.

a. Equipment Set-Up

(1) Using a TEK-37 cable, connect a Motorola S-1056B Portable Test Set to the radio. Set function switch to TRANSMITTER.

(2) Couple the transmitter output signal into a frequency counter or frequency meter.

(3) On PL models, remove the "Vibrasender" reed from the PL encoder. On the DPL models connect a TRN6332A Shorting Plug between J701 and J702 on the DPL encoder board.

(4) Use tuning tool 66D84387C01 (see tuning tool illustration).

b. Frequency Selection for Multi-Frequency Radios

(1) On a standard transmitter, the carrier freuquency of each channel must be set.

(2) On a wide-space transmitter, the same channel element may be used for a pair of transmitter frequencies, one in the high frequency group and one in the low frequency group. Either frequency may be used to set the carrier frequency.

c. Frequency Setting Procedure

(1) Using the pushbutton on the portable test set, key the transmitter. No modulation should be applied to the transmitter during this procedure.

(2) Adjust the channel element warp capacitor for the selected channel to the exact carrier frequency.

(3) Repeat for each channel element.

(4) On PL models, replace the "Vibrasender" reed in the PL encoder. On DPL models, remove the TRN6332A Shorting Plug from the DPL encoder.

13. IDC ADJUSTMENT PROCEDURE

(Refer to Set-Up Diagram on Page 6-20)

a. Equipment Set-Up

(1) Using a TEK-37 cable, connect a Motorola S-1056B Portable Test Set to the radio. Set function switch to TRANSMITTER.

(2) Connect an audio oscillator to the Portable Test Set. Set audio oscillator to 1000 Hz and 1 volt rms output.

(3) On "Private-Line" models, check to see that "Vibasender" reed is in PL encoder. On DPL models, be sure the TRN6332A Shorting Plug has been removed from the DPL encoder board.

(4) Use tuning tool 66D84387C01 (see tuning tool illustration).

b. Frequency Selection for Multi-Frequency Radios

(1) On a standard transmitter, any frequency may be used.

(2) On a wide-space transmitter, follow instructions in paragraph 13. c. ADJUSTMENT.

c. ADJUSTMENT

NOTE

To obtain accurate measurement of transmitter deviation in radios equipped with "Digital Private-Line" binary-coded squelch, the frequency response of the deviation measuring equipment must be <1 Hz. If a deviation meter with this low frequency response characteristic is not available, the transmitter deviation can be checked by making the transmitter send continuous turn-off code during the measurement. Since the turn-off code waveform is sinusoidal, standard test equipment will then provide an accurate deviation measurement. To make the transmitter send continuous turn-off code, short together the base and emitter plating of PTT inverter Q705 and key the transmitter. If the transmitter is made to send continuous turn-off code set the total transmitter deviation to ±4.8 kHz.

(1) On a standard transmitter, key the transmitter and adjust the STD IDC control for ±5 kHz deviation. Reduce audio oscillator output to 0.25 volt. Essentially full deviation should still be indicated.

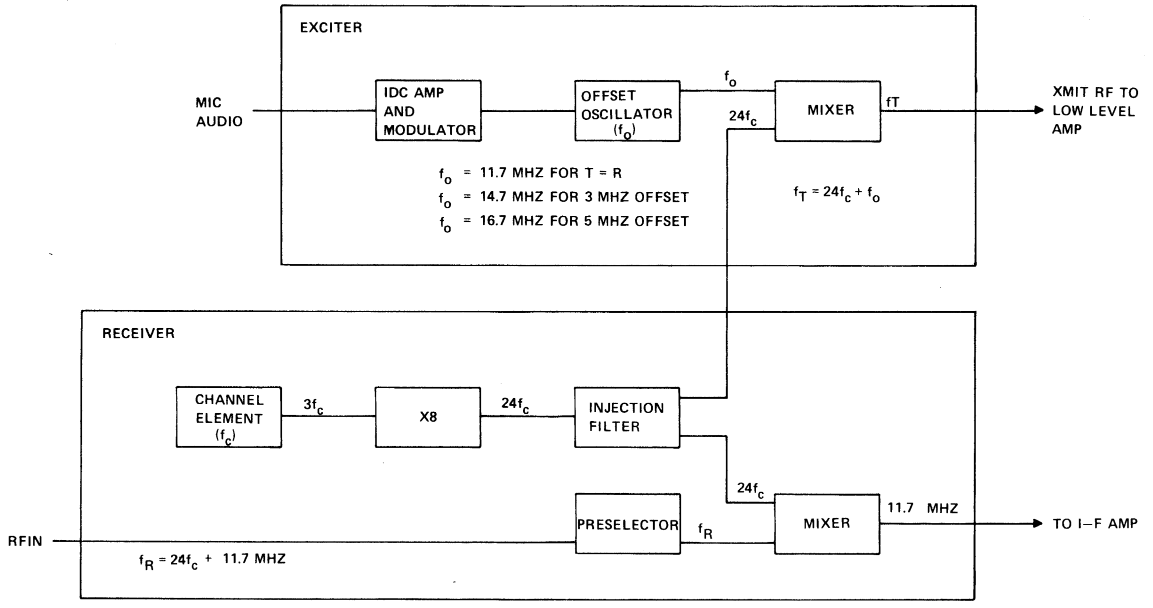
(2) On a wide-space transmitter, select any frequency in the high frequency group. Key the transmitter and adjust the STD IDC for ±5 kHz deviation. Unkey transmitter. Select any frequency in the low frequency group. Key the radio and adjust the W-S IDC for ±5 kHz deviation. Reduce audio oscillator output to 0.25 volt. Essentially full deviation should still be indicated on all frequencies in both high and low group.

Radio Set
Block Diagram
Motorola No. EEPS-9005-C
4/27/77-UP

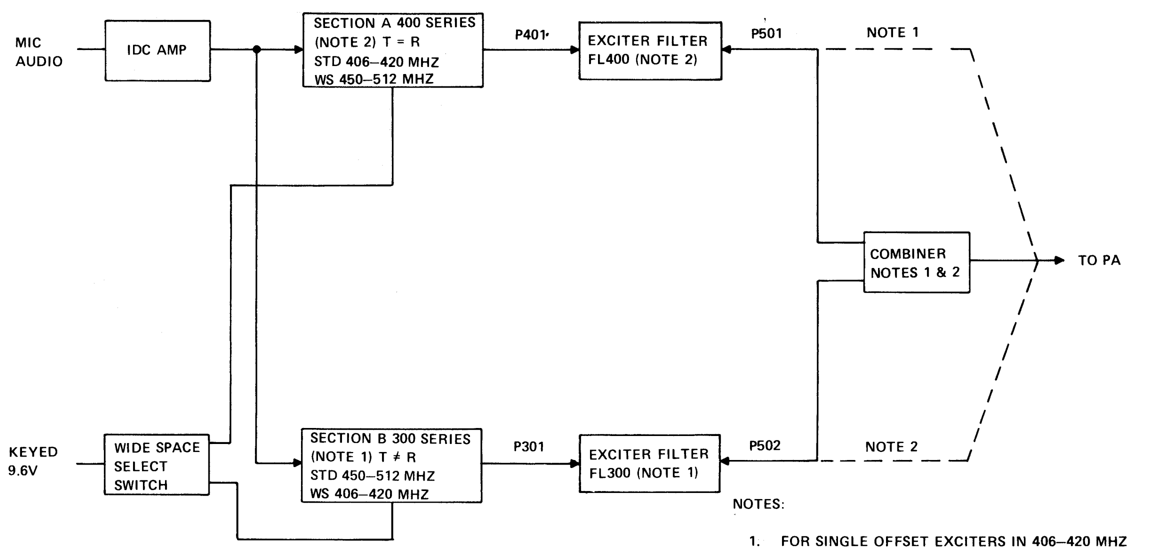
UHF Micor Mobile Radio
Functional Interconnection Diagram
Motorola No. EEPS-21175-B
10/3/78-UP

EXCITER DATA

INJECTION SYSTEM



EXCITER BLOCK DIAGRAM



NOTES:

1. FOR SINGLE OFFSET EXCITERS IN 406–420 MHZ RANGE COMBINER AND 300 SERIES COMPONENTS ARE OMITTED AND P501 CONNECTS TO PA.
2. FOR SINGLE OFFSET EXCITERS IN 450–512 RANGE COMBINER AND 400 SERIES COMPONENTS ARE OMITTED AND P501 CONNECTS TO PA. (SEE NOTE BELOW.)

DEPS-21620-A

WIDESPACE MODELS (DUAL OFFSET)

- SECTION A (400 Reference Series) T = R

  Standard in 406-420 MHz Models Wide Space in 450-512 MHz Models. Always selected by absence of ground on wide space select input.

- SECTION B (300 Reference Series) T ≠ R

  Wide Space in 406-420 MHz Models Standard in 450-512 MHz Models. Always selected by presence of ground on wide space select input.

SUMMARY

	406-420 MHz	450-512 MHz
Standard Channel	Section A 400 Series	Section B 300 Series
Wide Space Channel	Section B 300 Series	Section A 400 Series
W-S Channel Select	Ground On W-S Select	Open On W-S Select
Std Channel Select	Open On W-S Select	Ground On W-S Select

SINGLE OFFSET MODELS

- Components always located in the standard channel location.
  Section A (400 Series) 406-240 MHz
  Section B (300 Series) 450-512 MHz (See Note)
- Wide space select switch omitted and standard channel 9.6 volts strapped to keyed 9.6 volts.
  JU402 in 406-420 MHz range
  JU302 in 450-512 MHz range

NOTE

For T = R single offset models in the 450-512 MHz range components are located in Section A (400 series). For T ≠ R single offset models in this range, components are in Section B (300 series) as shown above.

MODELS AVAILABLE

	Single Offset Models			Dual Offset Models (Wide Space Applications)		
T/R Spacing (MHz) (Ft - Fr)	0 (T = R)	3	5	0 and Var	0 and 3	0 and 5
406-420 MHz	TLE8041A	-	-	TLE8051A	-	-
450-470 MHz	TLE8443A*	-	TLE8423A	-	-	TLE8433A
470-512 MHz	TLE8444A*	TLE8424A	-	-	TLE8434A	-

* See Note above.

REFERENCE NOTES

UHF MICOR MOBILE RADIO

FUNCTION

This diagram provides a central location for many of the important considerations required to understand the operation of the UHF MICOR mobile radio.

POWER CONSIDERATIONS

- Radio will plug into either positive or negative ground cable kits. A positive ground converter must be used inside the radio for use in positive ground systems.
- Continuous 9.6 volts is always available.
  Keyed 9.6 volts is available in transmit mode (PTT low).
  Switched 9.6 volts is available in receive mode (PTT high).
- Delayed keyed A+ is generated on the tone "Private-Line" or "Digital Private-Line" encoder board. Delayed keyed A+ is the same as keyed A+ in non-PL radios -- jumper JU304 (JU404) is installed on the exciter board.

VOLTAGE SOURCES

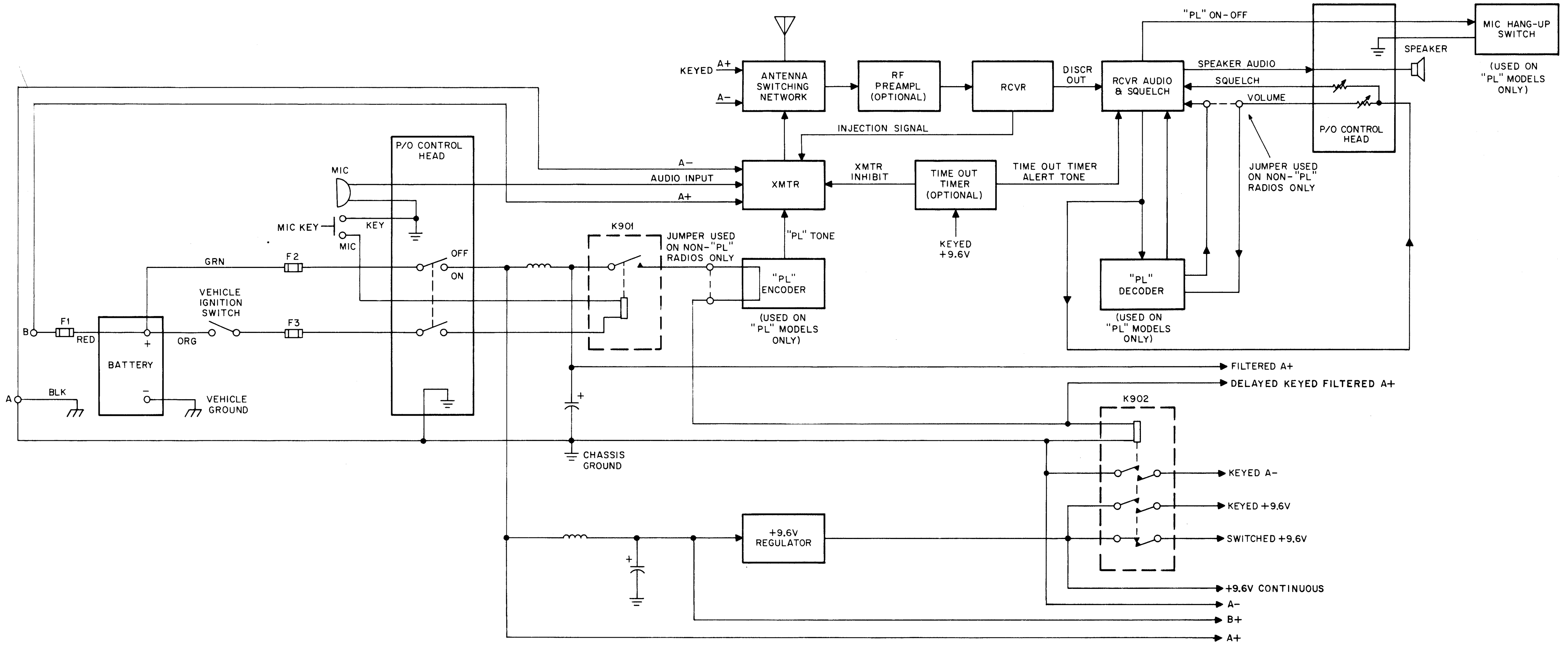
SYSTEM	NEGATIVE GROUND	POSITIVE GROUND
A+	Battery Hot	Chassis
A-	Chassis	Battery Hot
B+	Battery Hot (filtered)	Converter
B-	Chassis	Chassis

- 9.6 volt supplies are always derived from the B+ line.

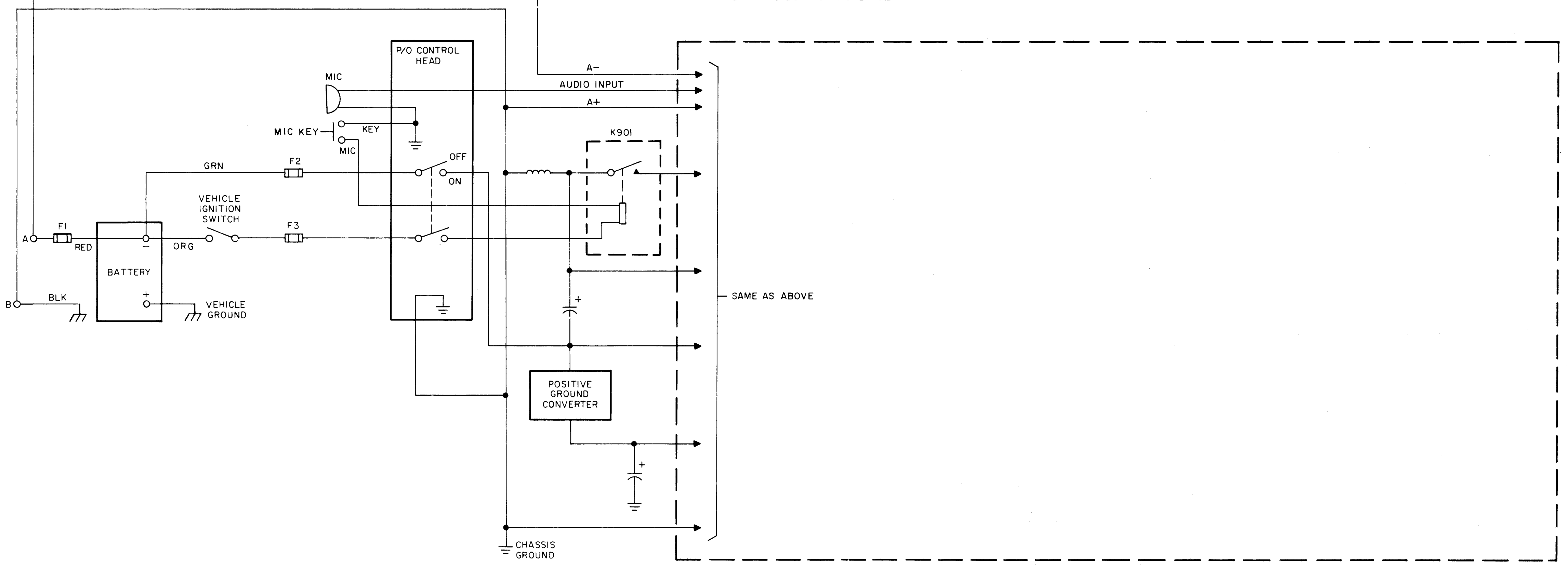
METERING

- Four metering connectors are provided on the top of the radio to facilitate monitoring performance. These are:
  J101 on the receiver rf and i-f board
  J402 on the exciter board.
  J601 on the power control board.
  J910 on the control (interface) board.
- A fifth metering connector is provided on the power amplifier for servicing.
- The meter connectors are seven pin sockets with five pins (1-5) allocated to metering functions and two pins (6 and 7) allocated as meter references. When using a VOM, be sure to return the meter to one of these references, not to chassis. Refer to paragraph 2b. in the Troubleshooting and Repair section of this manual for information on correct reference to use for each reading.

NEGATIVE GROUND



POSITIVE GROUND



DEPS-9673-0

Positive and Negative Ground Kit
Power Distribution Diagram
Motorola No. DEPS-9673-O
8/27/76-UP

PARTS LIST
AUDIO POWER AMPLIFIER

TLN4290B Audio Power Amplifier PL-1062-B

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female

AUDIO & SQUELCH BOARD

TLN4289A and TLN4289B Audio & Squelch Board PL-2021-B

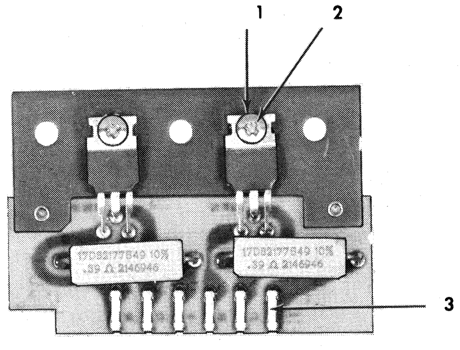
CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	55B84300B02	HANDLE (short)
2	3S136905	LOCKSCREW, tapping: #4 x 5/16" (4 req'd)
3	42C84284B01	RETAINER, screw (4 req'd)
4	55B84300B01	HANDLE (long)
5	29C84028H02	PIN (short)
6	29C84028H01	PIN (long)
NON-CODED ITEM		
	1V80707B17	SHIELD ASSEMBLY (Audio & Squelch board) includes: 26B84256B01 SHIELD 46B84090C01 STUD, 4 req'd. 2510101A53 NUT, Spring; 4 req'd.

AUDIO PA

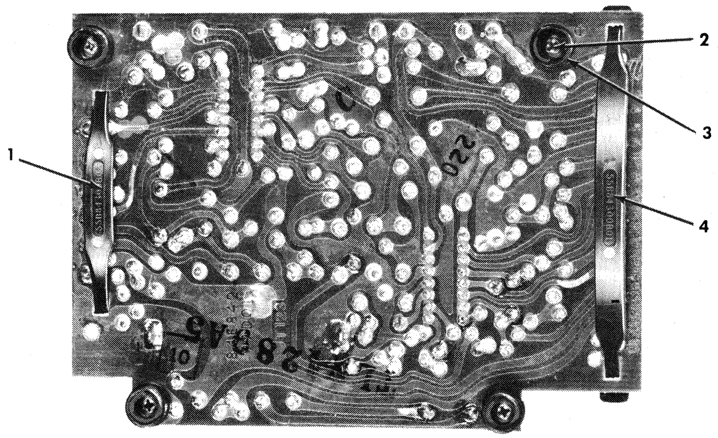
TLN4290B Audio Power Amplifier PL-1061-D

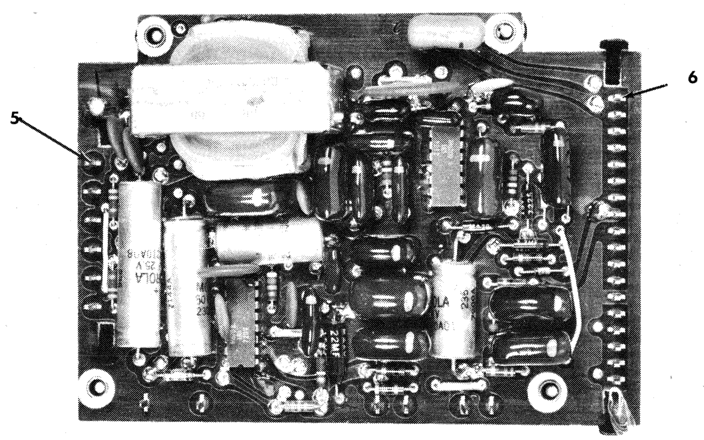
		CONNECTOR, receptacle:
J202		c/o; 9B83011H01 PIN, female; 6 req'd.
		TRANSISTOR: (SEE NOTE)
Q201	48R869807 or	PNP; type M9807
	48R869677	PNP; type M9677
Q202	48R869806 or	NPN; type M9806
	48R869676	NPN; type M9676
		RESISTOR, fixed: ±10%; 3 W:
R251	17D82177B49	0.39
R252	17D82177B49	0.39
MECHANICAL PARTS		
	14-84268B03	INSULATOR, mounting
	2-9627	NUT, 4-40 x 3/16", 2 req'd.
	3-488236	SCREW, machine; 4-40 x 3/8" 2 req'd.
	4-7683	LOCKWASHER, #4 internal, 2 req'd.
	4-84180C01	WASHER, shoulder, 2 req'd.

TRN6540A Audio & Squelch Board
TLN4290B Audio Power Amplifier Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-16616-C
(Sheet 1 of 2)
4/27/77-UP



AEPS-6502-O





AEPS-10170-O

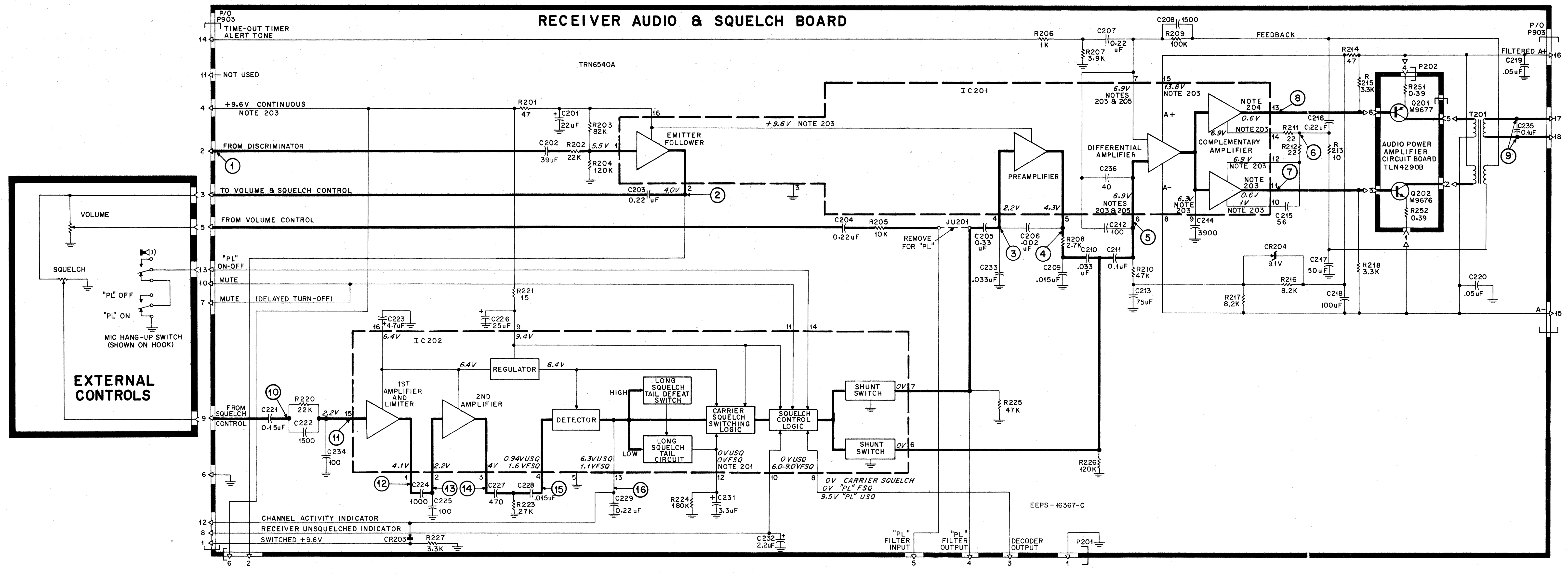
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

AUDIO & SQUELCH

TRN6540A Audio & Squelch Board PL-3163-B

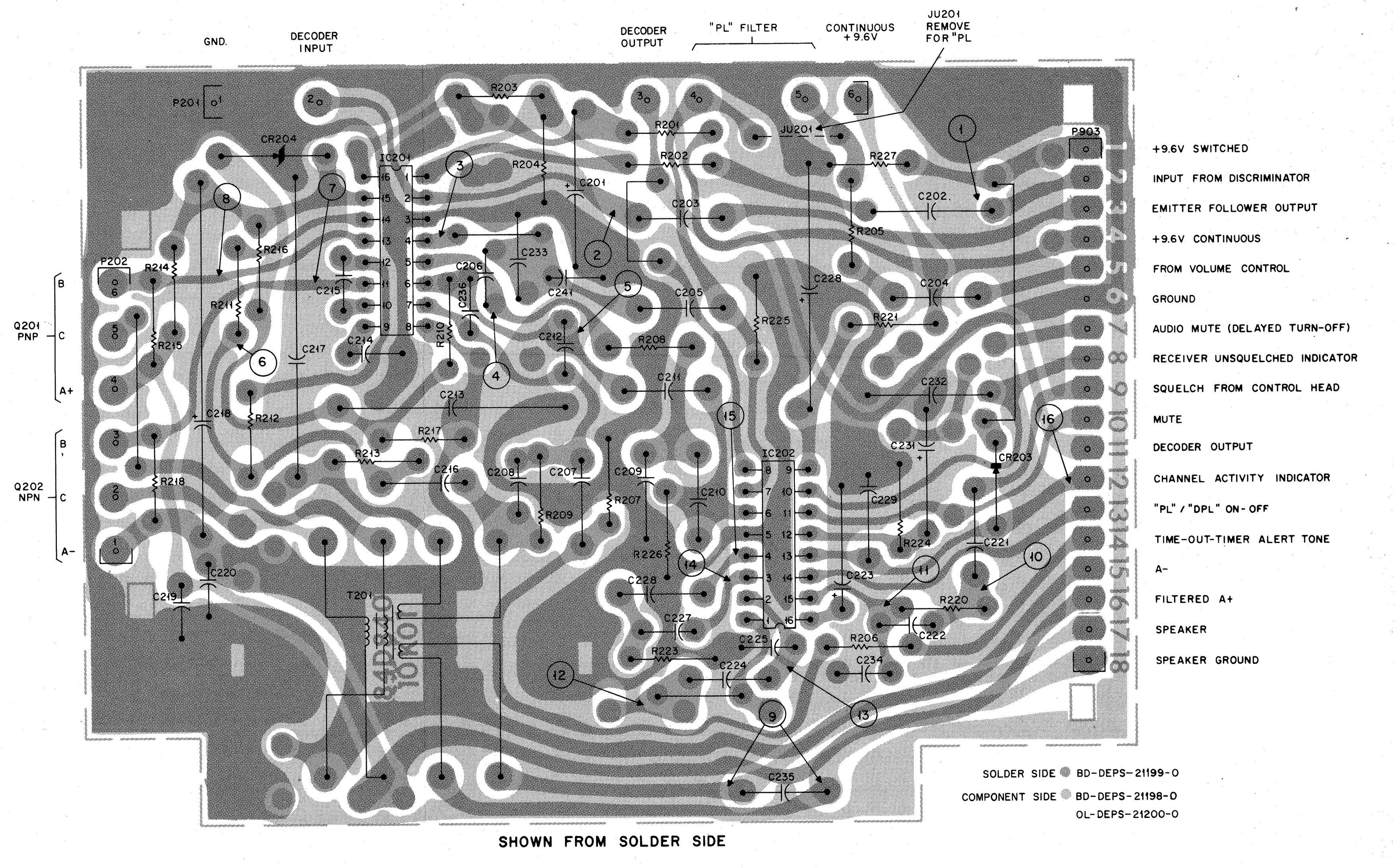
		CAPACITOR, fixed: uF: ±10%; 100 V: unless otherwise stated
C201	23D84762H10	22 ±20%; 15 V
C202	23D82783B36	39 ±10%; 10 V
C203	8D83813H11	0.22; 75 V
C204	8D83813H11	0.22; 75 V
C205	8D83813H29	0.33; 50 V
C206	21D82187B27	.002
C207	8D83813H11	0.22; 75 V
C208	21C82187B31	.0015; 100 V
C209	8D83813H32	.015
C210	8D83813H09	.033
C211	8D83813H06	0.1
C212	21D84426B06	100 pF ±5%; 500 V
C213	23D84081B03	75 ±10%; 15 V; NP
C214	21D82187B43	.0039; 200 V
C215	21D83406D46	56 pF ±5%; N150
C216	8D82905G32	0.22; 50 V
C217	23D84081B01	50 +100-10%; 25 V; NP
C218	23D83210A08	100 +150-10%; 25 V
C219	21C82372C04	.05 +80-20%; 25 V
C220	21C82372C04	.05 +80-20%; 25 V
C221	8D83813H07	0.15; 75 V
C222	21D84426B63	1500 pF ±5%
C223	23D84762H07	4.7 ±20%; 10 V
C224	21D84493B05	1000 pF; N2200
C225	21D84426B06	100 pF ±5%; 500 V
C226	23D83210A01	25 +150-10%; 25 V
C227	21D84426B11	470 pF ±5%; 500 V
C228	8D83813H32	.015
C229	8D83813H11	0.22; 75 V
C230		NOT USED
C231	23D84762H17	3.3 ±20%; 15 V
C232	23D84762H04	2.2 ±20%, 25 V
C233	8D83813H09	.033
C234	21D82610C58	100 pF ±10%; 100 V; N750
C235	08-82905G30	0.1 uF; 50 V
C236	21-82610C01	40 pF ±10%; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR201, 202		NOT USED
CR203	48C83654H01	silicon
CR204	48D82256C38	silicon; Zener type 9.1 V ±0.45 V
		INTEGRATED CIRCUIT: (SEE NOTE)
IC201	51R84267A08	type M6708
IC202	51R84267A09	type M6709
		RESISTOR, fixed: ±5%; 1/4 W: unless otherwise stated
R201	6S129233	47 ±10%
R202	6S127802	1K ±10%
R203	6S124A95	82K
R204	6S131446	120K
R205	6S129668	10K
R206	6S127802	1K ±10%
R207	6S129819	3.9K
R208	6S129707	2.7K
R209	6S129226	100K ±10%
R210	6S131527	47K
R211	6S124A09	22
R212	6S124A09	22
R213	6S129755	10 ±10%
R214	6S129233	47 ±10%
R215	6S129981	3.3K
R216	6S129983	8.2K
R217	6S129983	8.2K
R218	6S129981	3.3K
R220	6S129667	22K
R221	6S131377	15 ±10%
R222		NOT USED
R223	6S129886	27K
R224	6S129229	180K ±10%
R225	6S128902	47K ±10%
R226	6S128987	120K ±10%
R227	6S129231	3.3K ±10%
		TRANSFORMER, AF:
T201	25D84083B02	audio output

NOTE: Replacement parts must be ordered by Motorola part number only for optimum performance.



D-Star Mod.

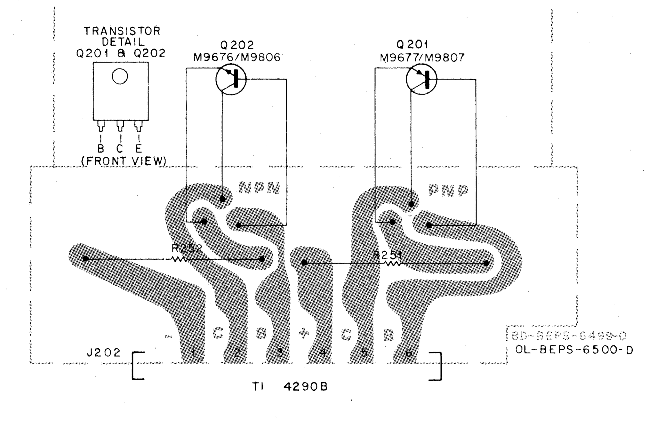
AUDIO AND SQUELCH BOARD

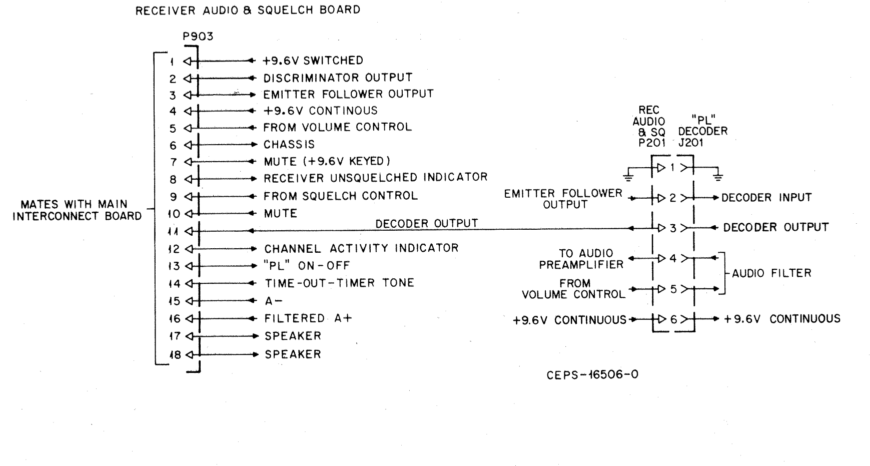


SHOWN FROM SOLDER SIDE

AUDIO POWER AMPLIFIER

SHOWN FROM SOLDER SIDE





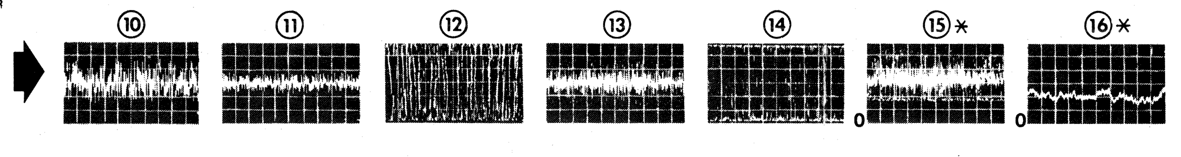
ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.

*4. WAVEFORMS (15) AND (16) ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6534-O

SQUELCH CIRCUIT WAVEFORMS

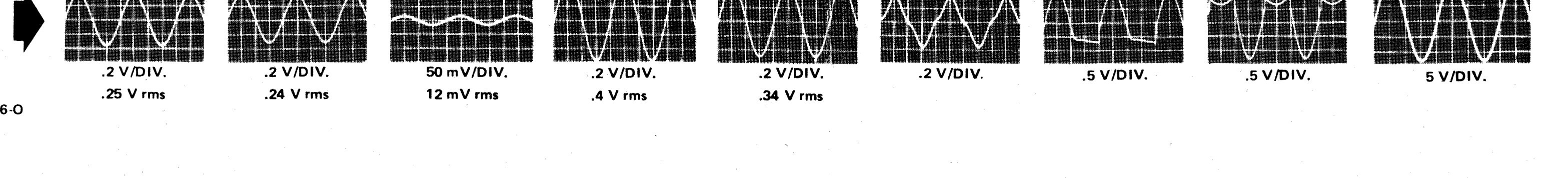


ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = .25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.3 kHz DEVIATION
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8-OHM LOAD.

EPS-7656-O

AUDIO CIRCUIT WAVEFORMS



DC VOLTAGE TABLE FOR IC'S

IC201				IC202			
PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE	PIN	VOLTAGE
1	5.5 V	9	6.3 V NOTE 203	1	4.1 V	9	9.4 V
2	4.0 V	10	1.0 V NOTE 203	2	2.2 V	10	0 V USQ 6.0–9.0 V FSQ
3	0 V	11	0.6 V NOTE 203	3	4.0 V	11	– –
4	2.2 V	12	6.9 V NOTE 203	4	0.94 V USQ 1.6 V FSQ	12	0 V USQ 0 V FSQ NOTE 201
5	4.3 V	13	0.6 V NOTE 204	5	0 V	13	6.3 V USQ 1.1 V FSQ
6	6.9 V NOTES 203 & 205	14	6.9 V NOTE 203	6	0 V	14	– –
7	6.9 V NOTES 203 & 205	15	13.8 V NOTE 203	7	0 V	15	2.2 V
8	A–	16	9.6 V NOTE 203	8	0 V CARRIER SQ. 9.5 V "PL" USQ 0 V "PL" FSQ	16	6.4 V

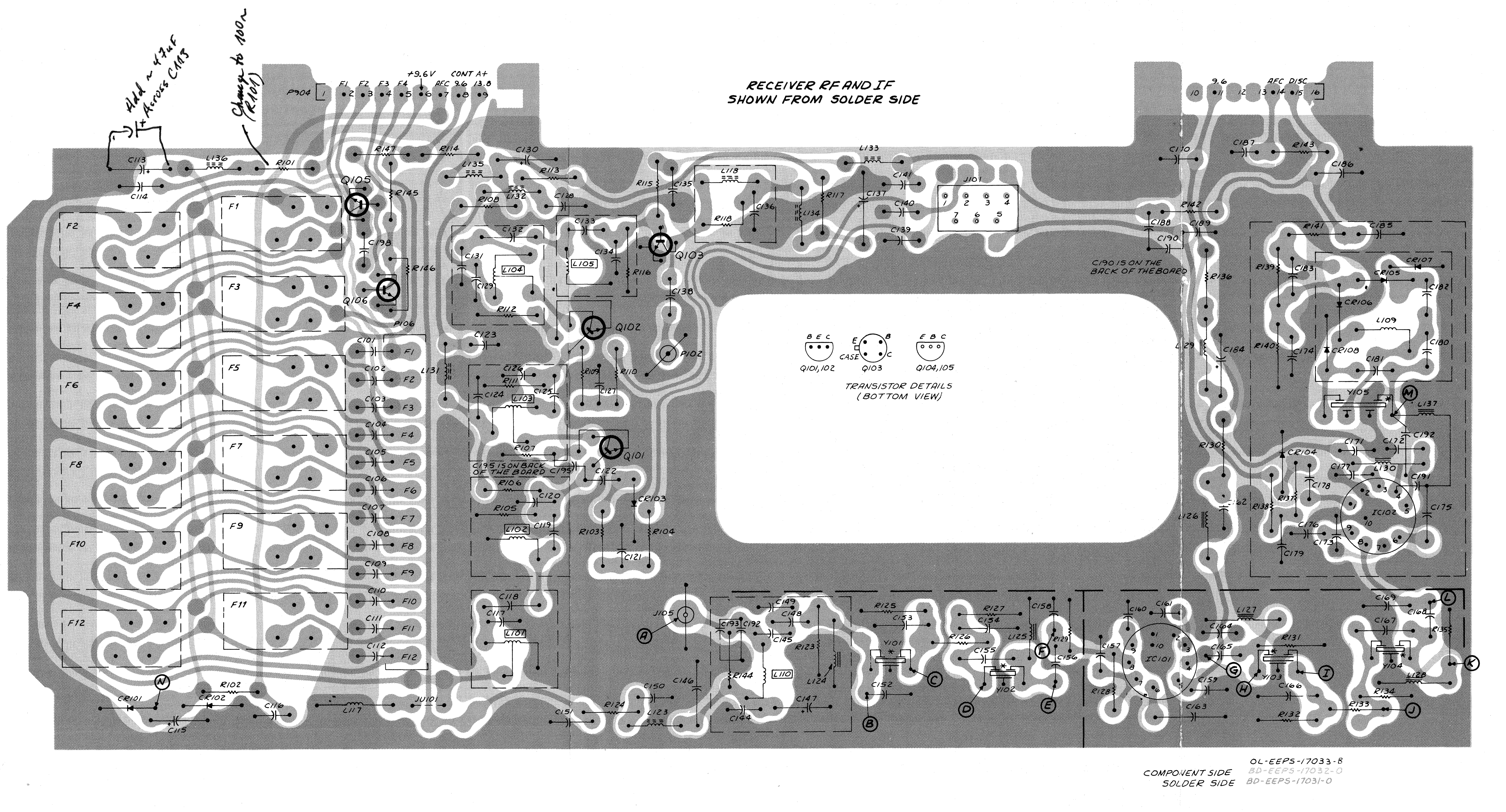
EPS–16507–O

RECEIVER AUDIO & SQUELCH BOARD

201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS:
USQ = RECEIVER UNSQUELCHED
FSQ = RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A-.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT IC201-6 AND -7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ±10% MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.

EPS-6229-C

TRN6540A Audio & Squelch Board
TLN4290B Audio Power Amplifier Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-16616-C
(Sheet 2 of 2)
4/47/77-UP



TLE8030B Series
Receiver RF & IF Board
Circuit Board Detail
Motorola No. PEPS-17027-C
(Sheet 1 of 2)
9/29/78-UP

RF DECK

TLE8021A (406-420 MHz)
TLE8023A (450-470 MHz)
TLE8024A (470-494 MHz)
TLE8025A (494-512 MHz)

LEGEND:
L = 406-420 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz

PL-1878-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C142	21-840846	15 pF ±5%; 500 V; NP0
C143	21-83880G01	.001 uF ±10%; 100 V
C196	21-82355B26	10 pF ±0.25 pF; 500 V; NP0
		CONNECTOR, receptacle:
J102, 103, 104	9-84135B02	female; coaxial; miniature type
		COIL, RF:
L106L	24-84769E12	(coded RED, RED); 6-5/8 turns, tapped
L106M, H	24-84769E14	(coded YEL, YEL); 6-1/8 turns, tapped
L106HH	1-80752B34	(coded VIOLET-VIOLET); 5-7/8 turns; tapped
L107L	24-84769E15	(coded GRN, GRN); 6-5/8 turns
L107M, H, HH	24-84769E16	(coded BLU, BLU); 6-1/8 turns
L108L	24-84769E12	(coded RED, RED); 6-5/8 turns, tapped
L108M, H, HH	24-84734E01	(coded YEL, YEL); 6-1/8 turns, tapped
L111L	24-84731E09	4-1/2 turns
L111M	24-84731E01	4 turns, tapped
L111H	24-84731E04	3-3/4 turns, tapped
L111HH	24-84731E07	3-9/16 turns, tapped
L112L-112L	24-84731E10	4-1/2 turns
L112M-115M	24-84731E02	4 turns
L112H thru 115H	24-84731E05	3-3/4 turns
L112HH thru 115HH	24-84731E08	3-9/16 turns
L116L	24-84731E09	4-1/2 turns
L116M	24-84734E03	4 turns, tapped
L116H	24-84734E06	3-3/4 turns, tapped
L116HH	24-84734E07	3-9/16 turns, tapped
L122L	24-83884G06	YEL; 4-1/2 turns
L122M, H, HH	24-83884G03	BRN; 1-1/2 turns
L138	24-82723H04	choke; 0.29 uH
		RESISTOR, fixed:
R119 L	6-10401C45	680 ±10%; 1/4 W
R119M, H, HH		560 ±10%; 1/4 W
		CONNECTOR, plug:
P105	28-84282D01	male; coaxial; miniature type
		TRANSISTOR: (SEE NOTE)
Q104L, M, H, HH	48-869839	field-effect; N-channel M9839
		NON-REFERENCED ITEMS
	1-80745B84	MIXER BOARD: includes reference parts C142, C143, C196, L122, Q104, R119
	3-138841	SCREW, tuning: used with L106, L107, L108
	2-84773E01	NUT, tensioning: "star" type; used with L106, L107, L108
	3-139002	SCREW, tuning: used with L111 thru 116
	2-84773E03	NUT, tensioning: "star" type; used with L111 thru 116

RECEIVER RF & IF BOARD

TLE8031A/B(406-420 MHz)
TLE8032A/B(450-494 MHz)
TLE8033A/B(494-512 MHz)

LEGEND:
L = 406-420 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz
* = For B Suffix boards only

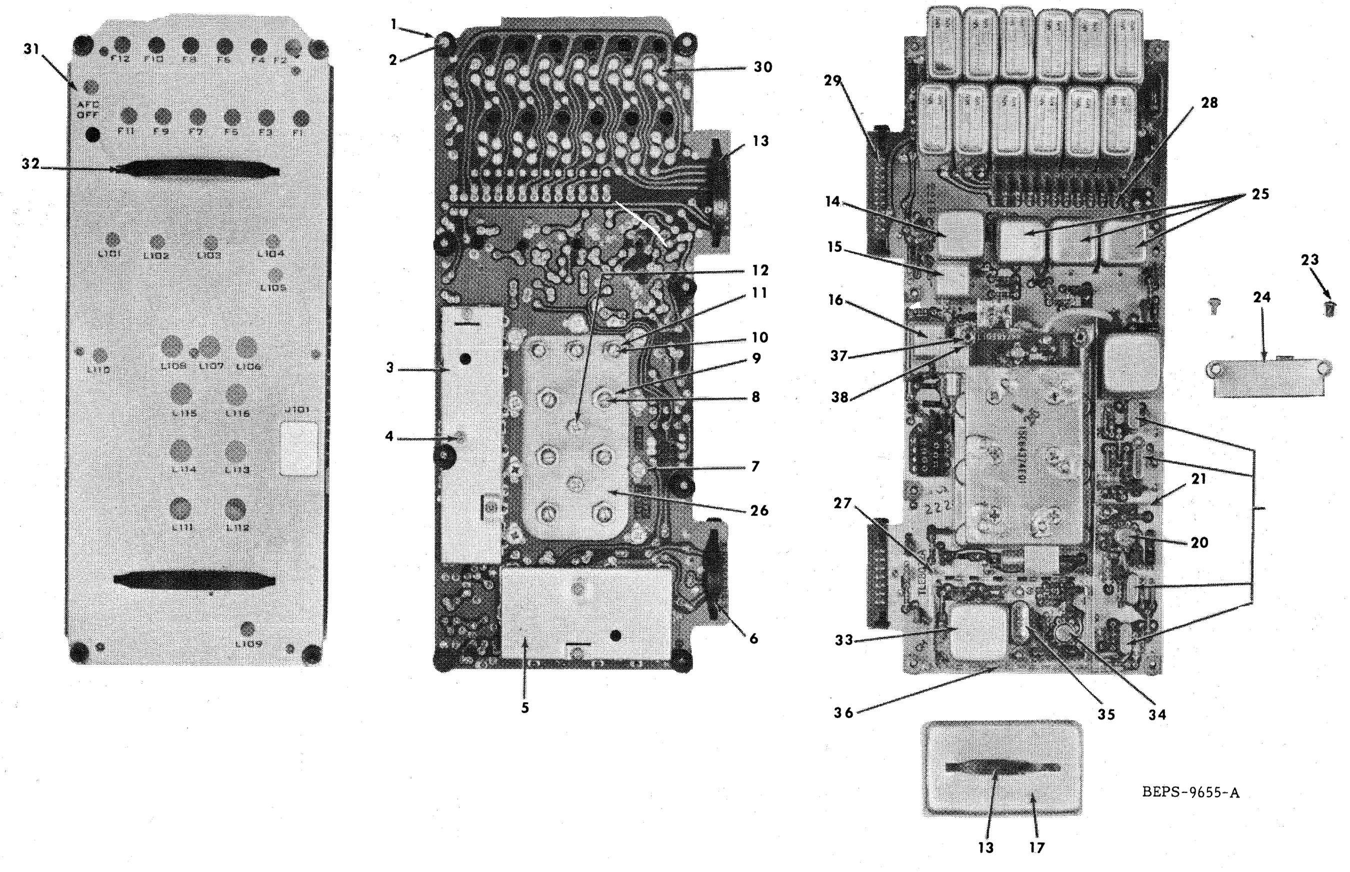
PL-1879-H

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; ±5%; 500 V; unless otherwise stated
C101 thru 112	21-82428B59	.01 uF +80-20%; 200 V
C113	23-84762H03	10 uF ±10%; 20 V
C114	21-82428B59	.01 uF +80-20%; 200 V
C115	8-83813H11	0.22 uF ±10%; 75 V
*C115	23-84762H03	10 uF ±10%; 20 V
C116	21-82187B39	470 +10%
C117L	21-840895	27; N330
C117M, H	21-82133G44	18; N330
C117HH	21-83406D01	13; N330
C118L	21-82450B46	0.62; coded BLU-RED-GRAY-GOLD
C118M, H, HH	21-82450B29	0.51; coded GRN-BRN-GRAY-GOLD
C119L	21-83406D06	39; N220
C119M, MO, H, HH	21-84493B44	33; 250 V; N150
C120	21-82610C44	100; 100 V; N220
C121	21-82428B59	.01 uF +80-20%; 200 V
C122	21-857336	2 ±0.25 pF; NP0
C123	21-82187B08	220 ±10%
C124	21-82187B11	.0015 uF ±10%; 100 V
C125L	21-82133G73	12; N150
C125M, H, HH	21-838912	8 +0.25 pF; N150
C126L	21-84493B44	33; N150
C126M, MO, H, HH	21-82610C14	30; 200 V; N150
C127	21-82428B59	.01 uF +80-20%; 200 V
C128	21-831125	100 ±10%; 300 V; N750
C129	21-82187B08	220 ±10%
C130	23-84762H04	2.2 uF +20%; 25 V
C131L	21-83406D51	3 ±0.25 pF; NP0
C131M, H	21-857336	2.0 ±.25 pF; NP0
C131HH	21-868487	1.5 ±0.25 pF; NP0
C132	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C133L	21-82133G18	6 ±0.25 pF; N470
C133M, H, HH	21-849320	4 +0.25 pF; N470
C134L	21-84493B43	8 ±0.25 pF; N470
C134M, H, HH	21-82204B33	5 ±0.25 pF; N470
C135	21-82428B59	.01 uF +80-20%; 200 V
C136L	21-82610C07	51; 200 V; N150
C136M, H, HH	21-847056	10; 250 V; N150
C137	23-84762H04	2.2 uF ±20%; 25 V
C138	21-82355B30	2.7 ±0.1 pF; NP0 (450-512 MHz)
	or 21-82355B39	4.7 ±0.1 pF; NPO (406-420 MHz)
C139, 140	21-82428B59	.01 uF +80-20%; 200 V
C141	21-82187B17	820 ±10%
C144	21-82610C03	47; 200 V; N220
C145	21-82133G01	10; NP0
C146	8-82905G04	.068 uF +10%; 50 V
C147	23-84762H04	2.2 uF +20%; 25 V
C148, 149	21-82133G01	10; NP0
C150, 151	21-82428B59	.01 uF +80-20%; 200 V
C152	21-82133G33	6.8 +0.5 pF; NP0
C153	21-82450B04	0.3 +10%; coded ORG-BLK-GRAY-SILVER
C154	21-82450B35	0.2 +10%; coded RED-BLK-GRAY-SILVER
C155	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C156	21-82610C43	62; 100 V; NP0
C157	21-82428B59	.01 uF +80-20%; 200 V
C158	21-82133G29	18; NP0
C159, 160, 161	21-82428B57	.0033 uF +10%; 200 V
C162	21-82428B59	.01 uF +80-20%; 200 V
C163	8-83813H05	.068 uF +10%; 100 V
C164	21-82610C84	39; 450 V; NP0
C165	21-82355B09	33; NP0
C166	21-82450B33	0.56; coded GRN-BLU-GRAY-GOLD
C167	21-82450B07	0.39; coded ORG-WHT-GRAY-GOLD
C168	21-82355B09	33; NP0
C169	21-82610C45	40; 100 V; NP0
C170	21-82428B57	.0033 uF +10%; 200 V
C171, 172	21-82428B59	.01 uF +80-20%; 200 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C173	21-82428B57	.0033 uF +10%; 200 V
C174	23-84762H04	2.2 uF +20%; 25 V
C175	8-83813H06	0.1 uF +10%; 100 V
C176, 177	21-82428B57	.0033 uF +10%; 200 V
C178	21-82187B08	220 +10%
C179	21-82428B57	.0033 uF ±10%; 200 V
C180, 181	21-83798B01	100; 200 V; NP0
C182	21-82428B59	.01 uF +80-20%; 200 V
C183, 184	21-82187B07	470 +10%
C185, 186, 187	21-82187B39	470 +10%
C188	21-82428B59	.01 uF +80-20%; 200 V
C189	21-82428B57	.0033 uF +10%; 200 V
C190	21-84493B24	40; N150
C191	21-82610C07	51; N150
C192	21-861443	.01 uF +100-20%; 75 V
C193, 194	21-840848	6 +.5 pF; NP0
C195	21-82355B26	10 ±0.25 pF; NP0
C197	21-82355B26	10 ±0.25 pF; NP0
*C198	21-82428B59	0.01 uF +80-20%; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR101, 102	48-82392B13	silicon
CR103, 104	48-82139G01	germanium
CR105 thru 108	48-84616A01	silicon; hot carrier type
		INTEGRATED CIRCUIT:
IC101	51-84267A38	type M6738
IC102	51-84269A07	type M6707
		CONNECTOR, receptacle:
J101	9-84207B01	metering; 7-contact
J105	9-84231B02	female; coaxial; miniature type
		COIL, RF:
L101	24-84972A15	BRN; 8-1/2 turns, tapped at 2-1/8 turns; includes tuning core
L102	24-84972A16	RED; 8-1/2 turns; includes tuning core
L103	24-84972A17	ORG; 6-1/2 turns, tapped at 1-7/8 turns; includes tuning core
L104	24-83857G07	YEL; 3-1/2 turns, tapped at 1-5/8 turns; includes tuning core
L105	24-83855G05	GRN; 3-1/2 turns; includes tuning core
L109	24-83879G04	YEL; 20 turns; includes tuning core
L110	24-84253B06	BLU; 16 -2/3 turns; includes tuning core
L117L		NOT USED
L117M, H	24-82542E01	.31 uH; choke
L117HH	24-82543E11	.245 uH; choke
L118	24-82723H02	choke; .039 uH
*L118	24-82723H03	3 turns
L120, 121		NOT USED
L123	24-82723H07	choke; 10 uH; coded VIO
L124	24-82549D25	choke; 10 uH; shielded; coded (SILVER) -BRN-BLK-BLK-GOLD
L125	24-84250D02	choke; 6.8 uH; shielded; coded WHT-BLU-GOLD-GRAY-GOLD
L126	24-82723H07	choke; 10 uH; coded VIO
L127, 128	24-84250D02	choke; 6.8 uH; shielded; coded WHT-BLU-GOLD-GRAY-GOLD
L129, 130	24-82723H07	choke; 10 uH; coded VIO
L131 thru 136	24-83961B01	3 turns over ferrite bead; coded BRN
L137	24-84250D03	choke; 2.2 uH (shld.) coded WHT-RED-GOLD-RED-GOLD
		CONNECTOR, plug:
P102	28-84227B01	male; coaxial; miniature type
		TRANSISTOR: (SEE NOTE I)
Q101	48-869658	NPN; type M9658 (450-512 MHz)
	or 48-869570	NPN; type M9570 (406-420 MHz)
Q102	48-869658	NPN; type M9658
Q103	48-869756	NPN; type M9756
*Q104, 105	48-869642	NPN; type M9642
		CONNECTOR, plug:
P106		(for reference only)
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R101	6-129755	10
R102	6-127807	33k
R103	6-129230	12k
R104	6-129231	3.3k
R105	6-129269	1.8k
R106	6-127806	27k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R107	6-10401A13	33 +5%
R108	6-129862	150
R109	6-128685	22k
R110	6-129231	3.3k
R111	6-129269	1.8k
R112	6-124A09	22 +5%
R113	6-129862	150
R114	6-129755	10
R115L	6-10401C87	39k
R115M, H, HH	6-127807	33k
R116L	6-10401C57	2.2k
R116M, H, HH	6-127803	1.5k
R117	6-129224	82
R118L	6-10401C59	2.7k
R118M, H, HH	6-127803	1.5k
R120, 121		NOT USED
R123	6-129667	22k ±5%
R124	6-129233	47
R125	6-129667	22k ±5%
R126	6-131289	910 ±5%
R127	6-129667	22k ±5%
R128	6-129237	6.8k ±5%
R129	6-129982	5.6k +5%
R130	6-131377	15
R131	6-129236	15k +5%
R132	6-129667	22k +5%
R133	6-131289	910 +5%
R134	6-129667	22k +5%
R135	6-129668	10k +5%
R136	6-129755	10
R137	6-124C86	36k
R138	6-127803	1.5k
R139	6-10401A76	13k ±5%
R140	6S124A76	13k ±5%
R141	6-127802	1k
R142	6-129226	100k
R143	6-128902	47k
R144	6-10401C81	22k
*R145	6-124C89	47k
R146	6-124C69	6.8k
R147	6-124C89	47k
		CRYSTAL UNIT, quartz 11.7 MHz
Y101	48-84755E01	i-f filter
*Y102	48-84755E01	i-f filter
	or 48-84755E02	i-f filter
*Y103, 104	48-84755E01	i-f filter
	or 48-84755E03	i-f filter
Y105	48-84754E01	discriminator
		*When replacing Y102, Y103 or Y104, order Part No. 48-84755E01 only.
		NON-REFERENCED ITEMS
	3-138804	SCREW, machine: 4-40 x 5/16" includes lockwasher; 5 used
	3-138891	SCREW, tapping: 6-32 x 7/16" includes lockwasher; 9 used
	3-139506	SCREW, tapping: 4-40 x 5/16" includes lockwasher; 8 used
	4-49854	WASHER, spacer: 2 used
	5-84500B03	EYELET, special; 8 used
	14-84560B01	INSULATOR, dual: 0.55" long x 0.22" wide; 4 used
	14-84583B01	INSULATOR, dual: 0.74" long x 0.37" wide
	26-83838F01	SHIELD, coil
	26-84250B01	SHIELD, coil: 0.750" inside dimension
	26-84250B03	SHIELD, coil: 0.625" outside dimension
	26-84250B08	SHIELD, coil: 1" outside dimension
	26-84250B12	SHIELD, coil: 0.750" inside dimension; 1.25" high
	26-84250B13	SHIELD, coil: 1" outside diam.; 1.30" high
	26-84253B01	SHIELD, can: 1.56" wide x 2.625" long
	26-84614G01	SHIELD, coil: 0.625" outside dimension
	26-84639E01	SHIELD, barrier
	26-84641E01	SHIELD, bottom
	26-84642E01	SHIELD, bottom

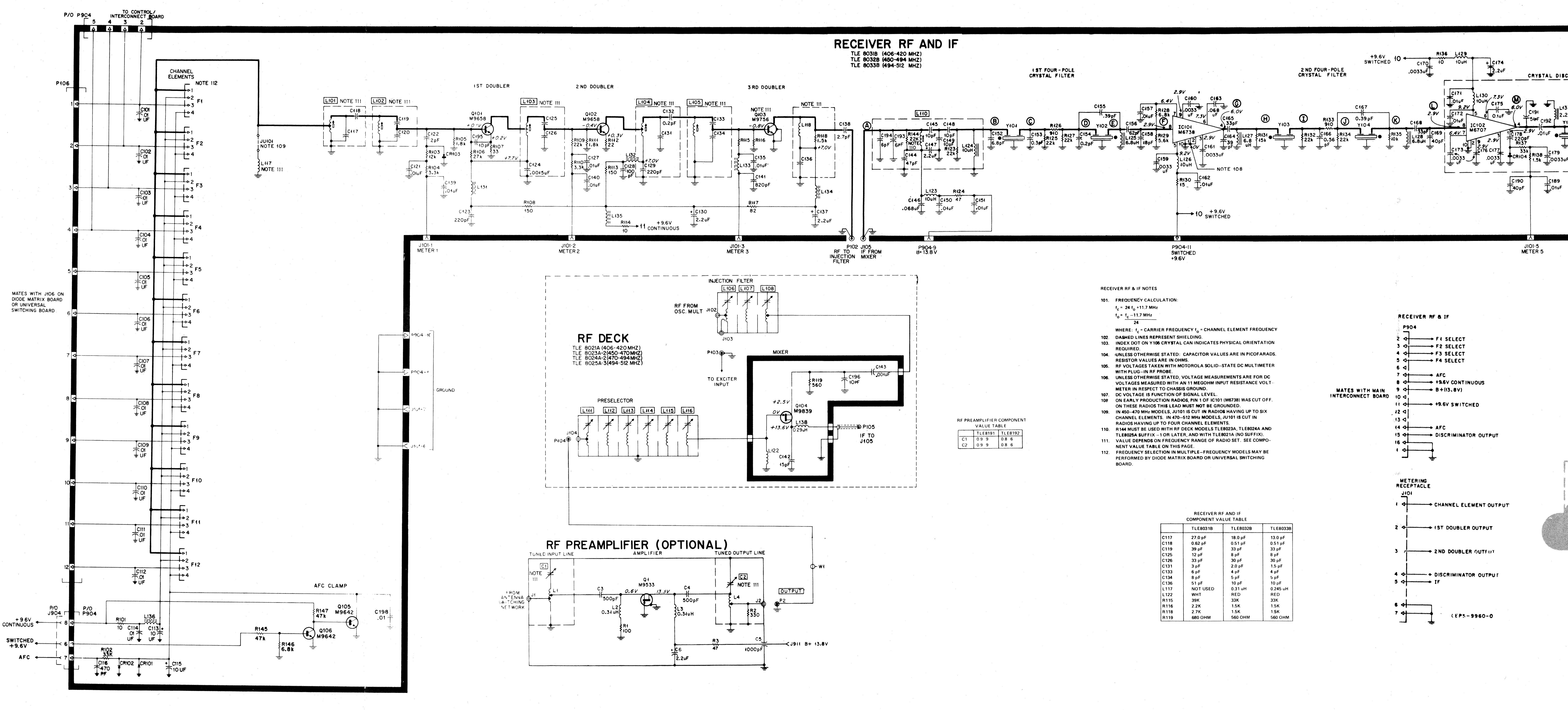
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	26-84861E01	SHIELD, barrier
	28-84227B01	CONNECTOR, phono
	42-84284B01	RETAINER; 8 used
	55-84300B02	HANDLE (long) 2 used
	55-84300B03	HANDLE (short)



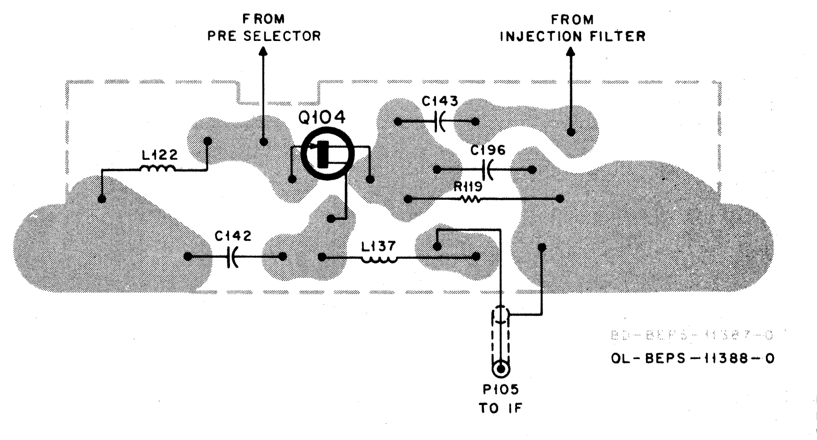
RECEIVER RF & IF

TRE1200A Series Receiver RF and IF — PL-1924-C

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B01	RETAINER, screw (8 req'd)
2	3-138162	LOCKSCREW, tapping: No. 4-40 x 3/8" Phillips roundhead (8 req'd)
3	26-84641E01	SHIELD, bottom (IF)
4	3-138804	LOCKSCREW, machine: No. 4-40 x 5/16" Phillips hexhead (5 req'd)
5	26-84642E01	SHIELD, bottom (discriminator)
6	55-84300B03	HANDLE
7	3-138891	LOCKSCREW, tapping: No. 6-32 x 7/16" Phillips hexhead (9 req'd)
8	3-138812	SCREW, tuning: No. 10-32 x 7/8" slothead (6 req'd)
9	2-84773E03	NUT, tension (6 req'd)
10	3-138841	SCREW, tuning: No. 8-32 x 5/8" slothead, silver plated (3 req'd)
11	2-84773E02	NUT, tension (3 req'd)
12	3-136138	LOCKSCREW, tapping: No. 6-32 x 3/8" Phillips hexhead (2 req'd)
13	55-84300B02	HANDLE (2 req'd)
14	26-84250B01	CAN, square (staked)
15	26-84250B03	CAN, square (staked)
16	26-84614G01	CAN, square (slotted, staked)
17	26-84253B01	SHIELD (discriminator)
18	26-84861E01	SHIELD, barrier
19	14-84540B01	INSULATOR, crystal (4 req'd)
20	4-49854	WASHER, spacer
21	26-84639E01	SHIELD, barrier
22	26-84250B13	CAN, square (4 lug staked)
23	3-400138	SCREW, machine: No. 4-40 x 3/16" slotted binderhead (2 req'd)
24	15-84446E01	COVER, mixer
25	26-84250B12	CAN, square (staked) (3 req'd)
26	64-84445E01	COVER, RF deck
27	29-10134A29	RECEPTACLE, female (13 req'd)
28	29-84028H02	TERMINAL, male (12 req'd)
29	29-84028H01	TERMINAL, male (16 req'd)
30	29-855943	TERMINAL, pin (plated) (48 req'd)
31	1-80734B44	SHIELD, receiver rf & i-f board
32	55-84300B01	HANDLE (2 req'd)
		A. NON-REFERENCED PARTS FOUND UNDER CODE NO. 17 SHIELD:
33	26-84250B08	CAN, square (slotted, staked)
34	4-49854	WASHER, spacer
35	14-84583B01	INSULATOR, crystal
36	26-84254B01	SPRING, retainer
		B. NON-REFERENCED PARTS FOUND UNDER CODE NO. 24 COVER:
37	43-84855E01	SPACER, threaded (2 req'd)
38	4-9761	LOCKWASHER, #4 internal star (2 req'd)



LATER VERSION
1V80755B09 (406-420 MHz)
1V80745B84 (450-512 MHz)
MIXER



RECEIVER RF & IF BOARD

TLE8030B Series Receiver RF and IF
Schematic Diagram
Motorola No. PEPS-17027-C
(Sheet 2 of 2)
9/28/78-UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

CONTROL BOARD

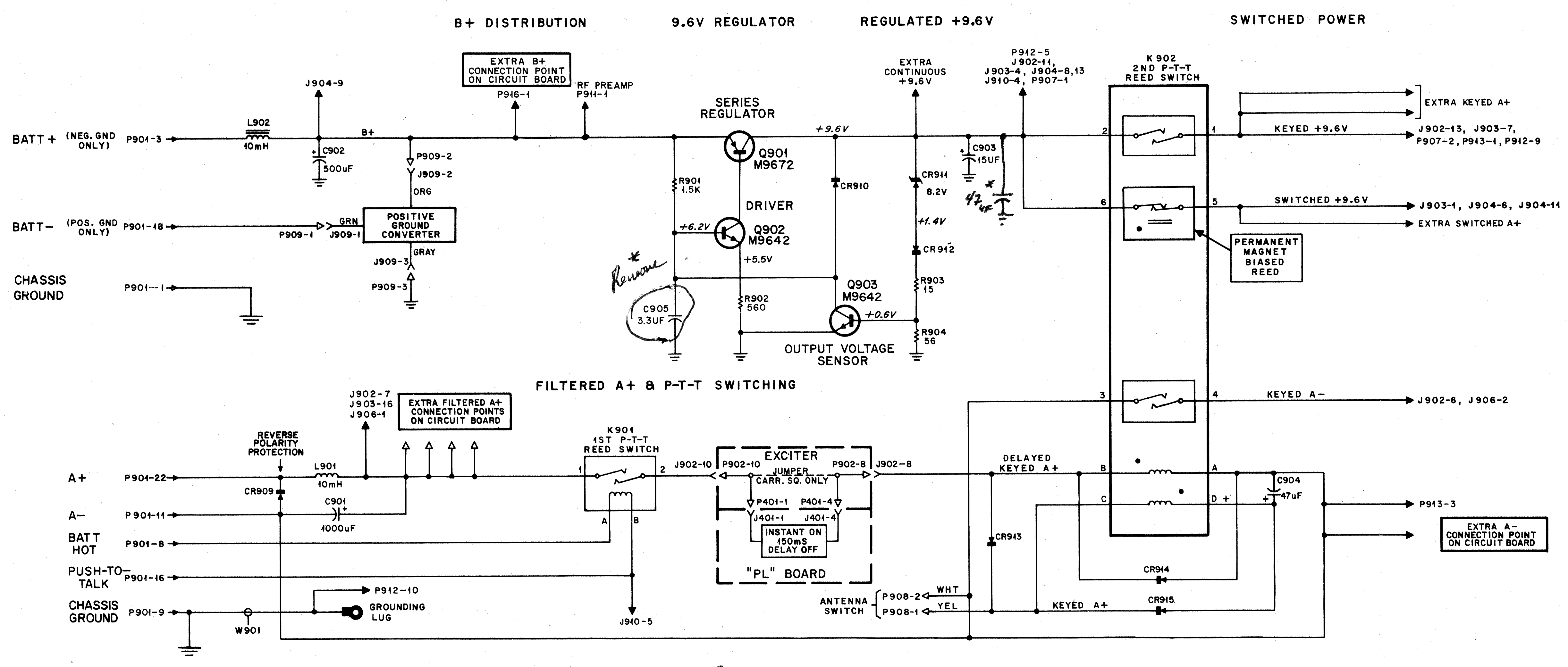
TLN4930C Control Board — PL-3202-A

		CAPACITOR, fixed:
C901	23-82394A16	1000 uF +150-10%; 25 V
C902	23-83210A23	500 uF +150-10%; 25 V
C903	23-82601A31	15 uF +33-10%; 25 V
C904	23-82783B31	47 uF ±20%; 20 V
C905	23-83214C17	3.3 uF ±20%; 15 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR901 thru 908	48-82392B03	silicon
CR909	48-82525G13	silicon
CR910	48-82392B03	silicon
CR911	48-83461E32	silicon; Zener type; 8.2 V ±3%
CR912 thru 915	48-82392B03	silicon
		CONNECTOR, receptacle:
J910	9-84207B01	female; 7-contact
		SWITCH, magnetic reed: 13.4 V;
K901	80-84157B01	1 form "A"; coil res 820 ohms ±10%
K902	80-84157B02	2 form "A"; 1 form "B" (biased with permanent magnet) 2 coil; 1st coil res 285 ohms ±10%; 2nd coil res 285 ohms ±10%
		CONNECTOR, plug:
P901	28-84085B01	male; 37-contact
		TRANSISTOR: (SEE NOTE)
Q901	48-869672	PNP; type M9672
Q902, 903	48-869642	NPN; type M9642
		RESISTOR, fixed: 1/4 W;
R901	6-127803	1.5k ±10%
R902	6-129620	560 ±10%
R903	6-124A05	15 ±5%
R904	6-124A19	56 ±5%

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

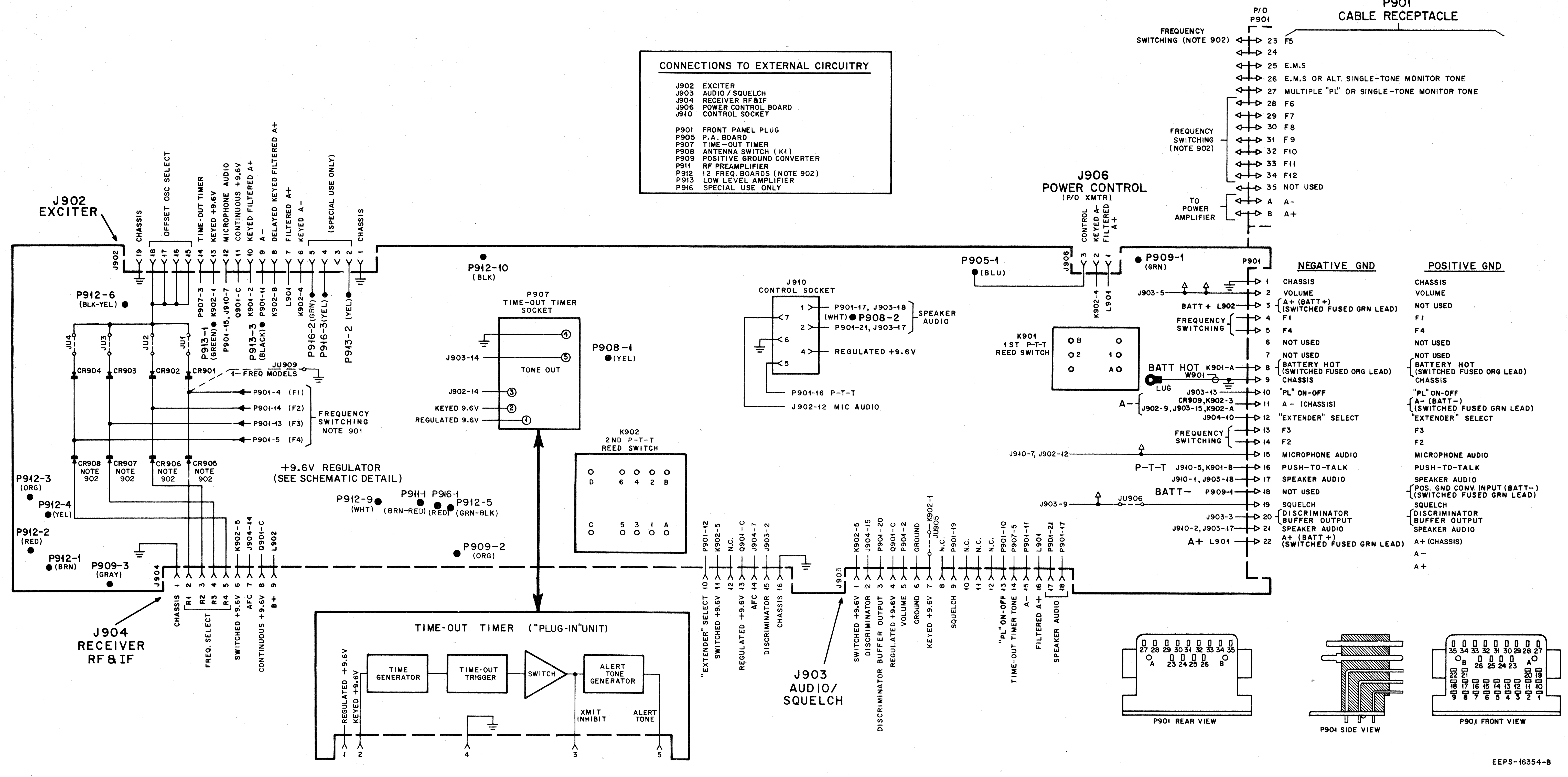
TLN4930C Control (Interconnect) Board
Circuit Board Detail
Motorola No. PEPS-16353-B
(Sheet 1 of 2)
4/27/77-UP

SCHEMATIC DETAIL



7-7-12 9x
*C905 causes Rx Data transcient when Tx Keys - corrupts header
*Add at least 47uF to +9.6V cont.

POINT-TO-POINT CONNECTIONS DETAIL



NOTES:

901. FREQUENCY SWITCHING MAY BE PERFORMED BY DIODE MATRIX BOARD OR UNIVERSAL SWITCHING BOARD.
902. THESE DIODES ARE REMOVED IN RADIO SETS THAT USE A UNIVERSAL SWITCHING BOARD.

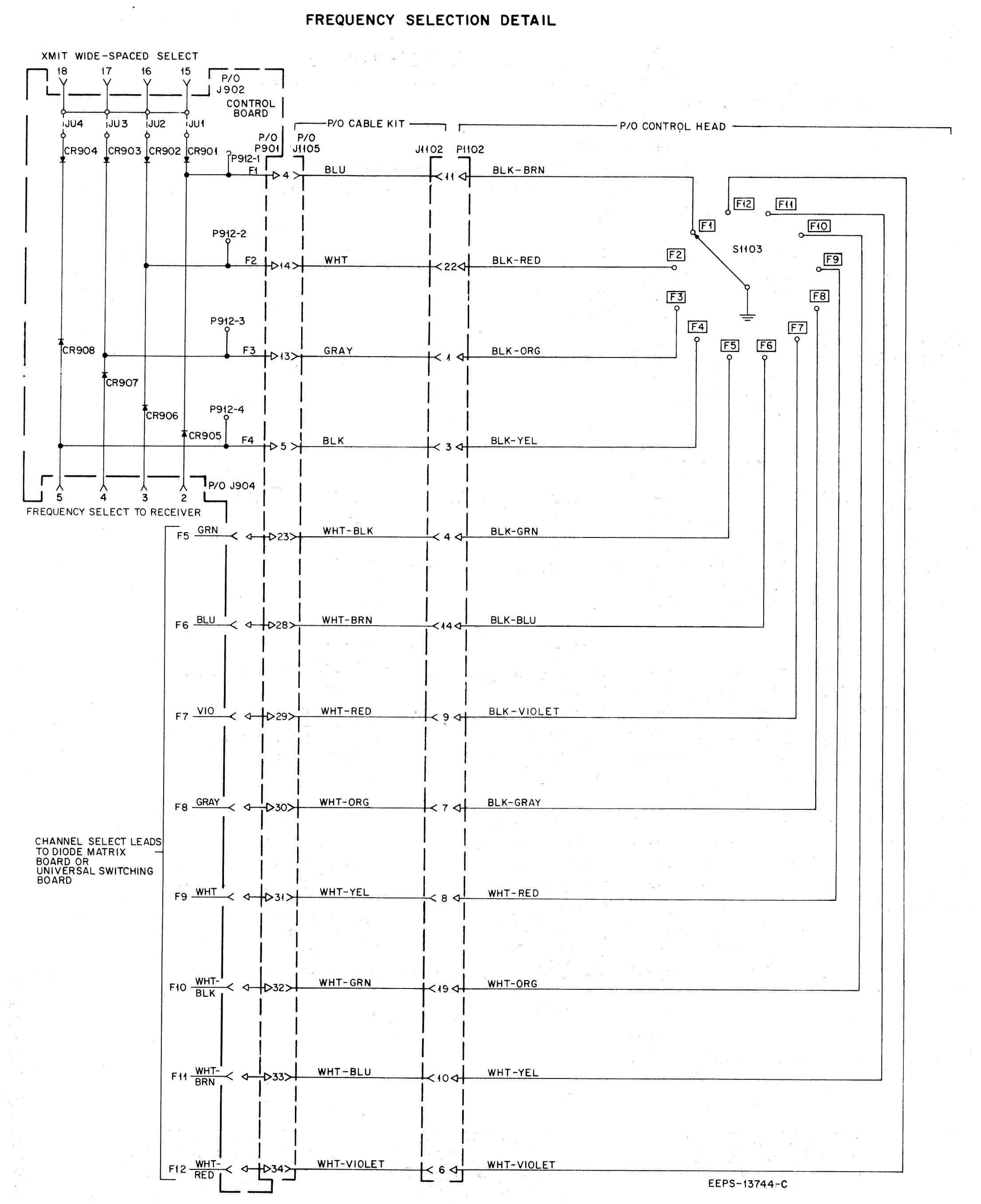
EPS-16517-O

CONTROL (INTERCONNECT) BOARD

CONTROL (INTERCONNECT) BOARD/UNIVERSAL SWITCHING BOARD AND DIODE MATRIX BOARD

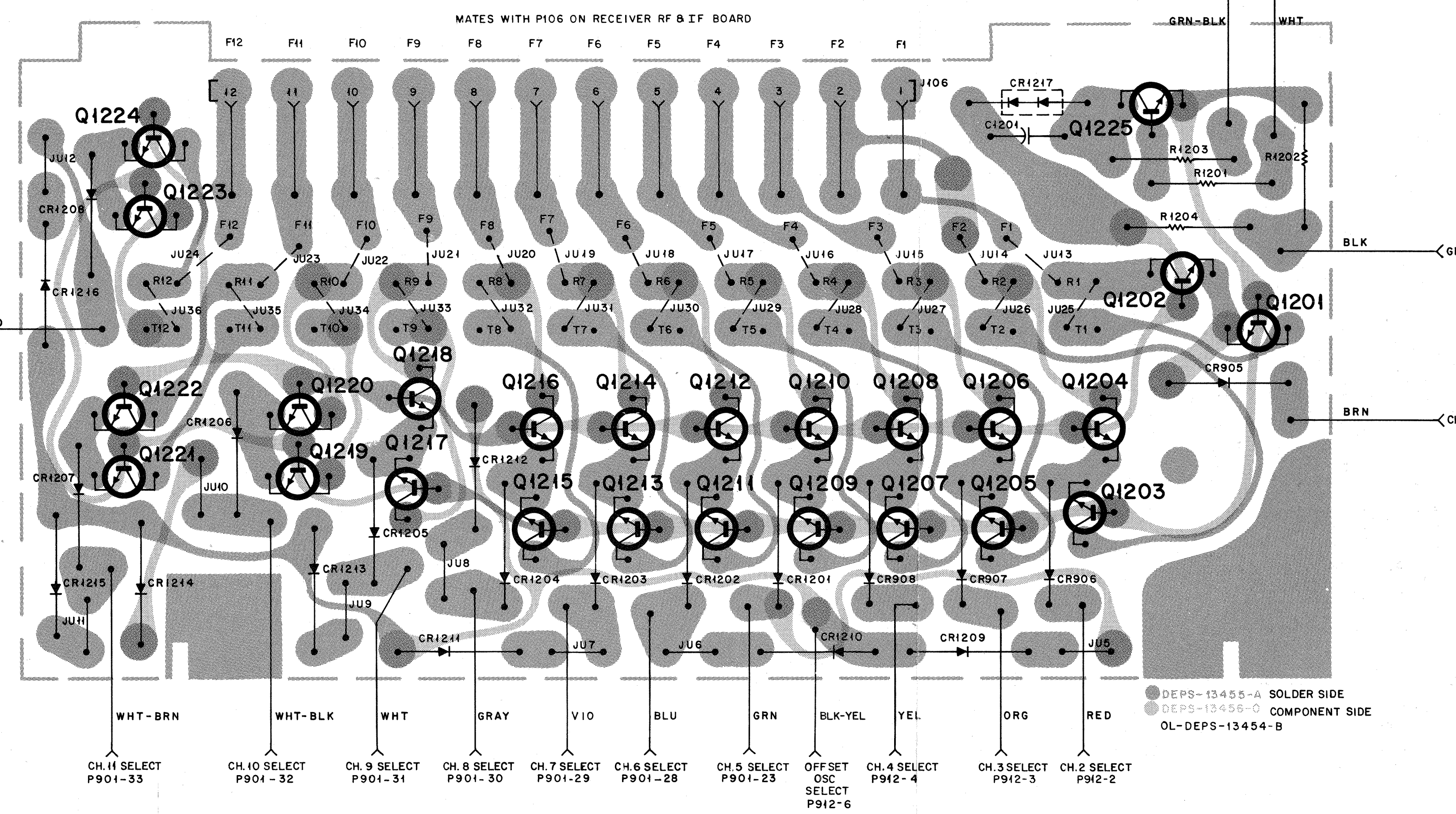
TLN4930C Control (Interconnect) Board
Schematic Diagram
Motorola No. PEPS-16353-B
(Sheet 2 of 2)
4/27/77-UP

FREQUENCY SELECTION DETAIL

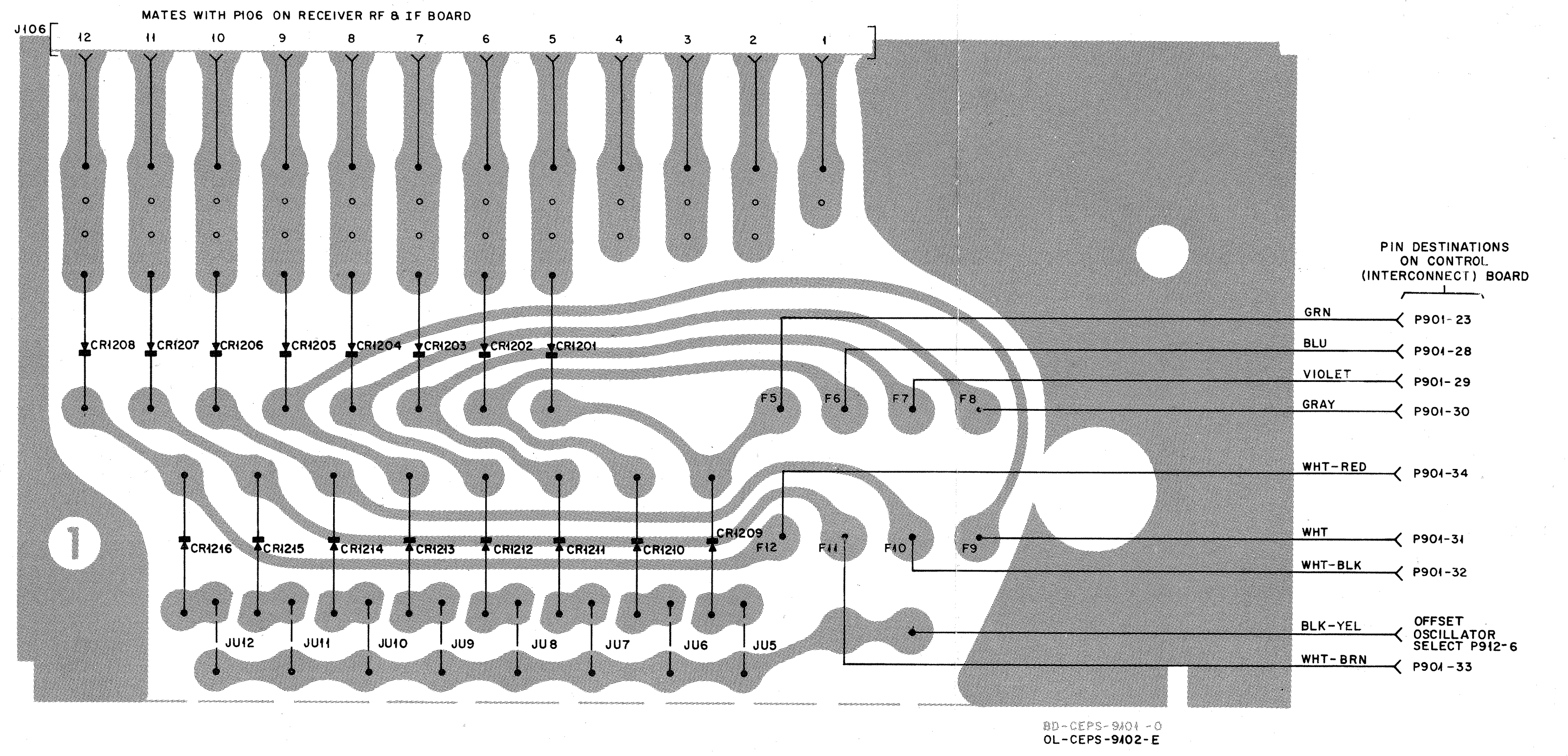


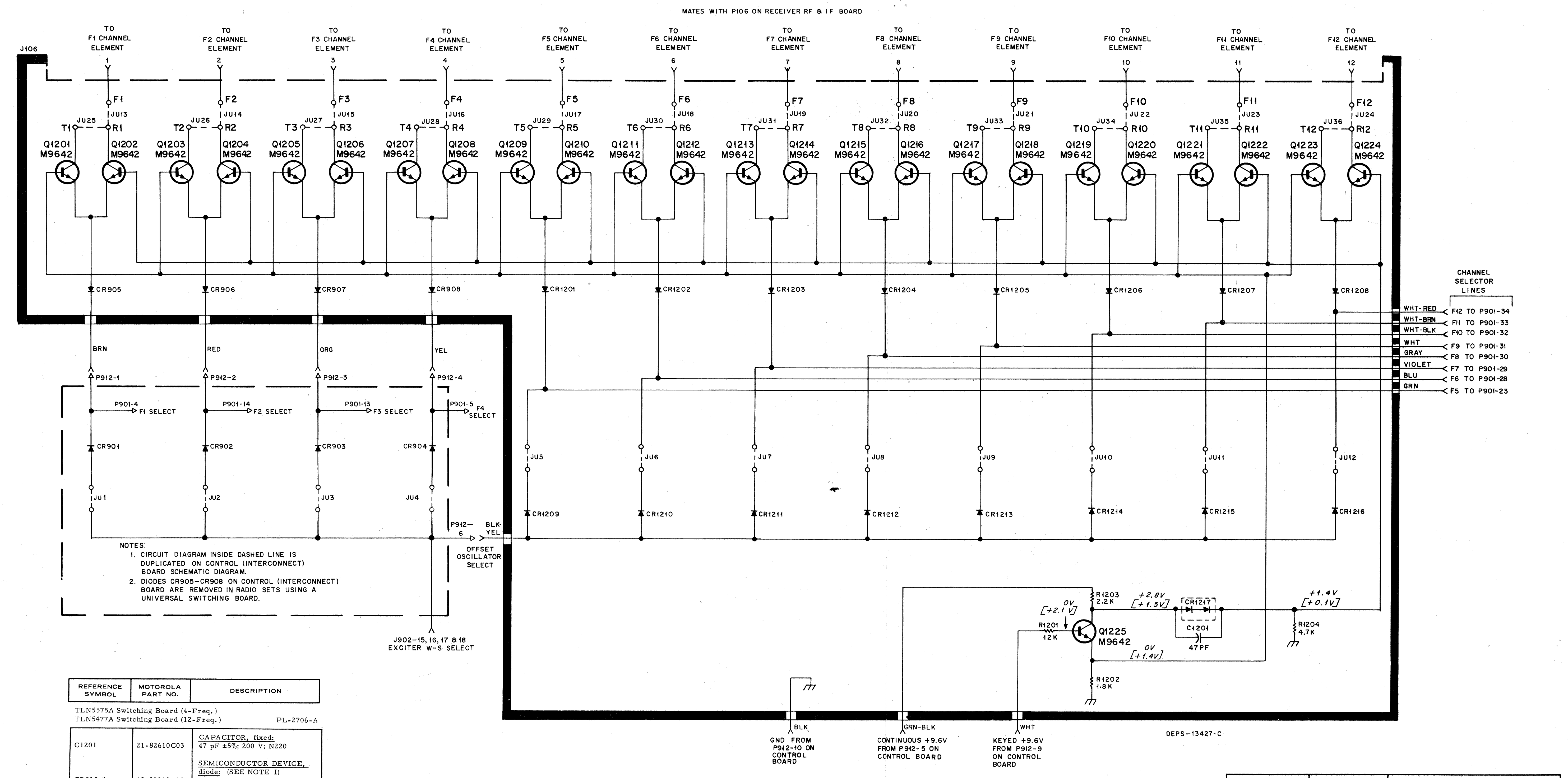
UNIVERSAL SWITCHING BOARD

VIEWED FROM SOLDER SIDE

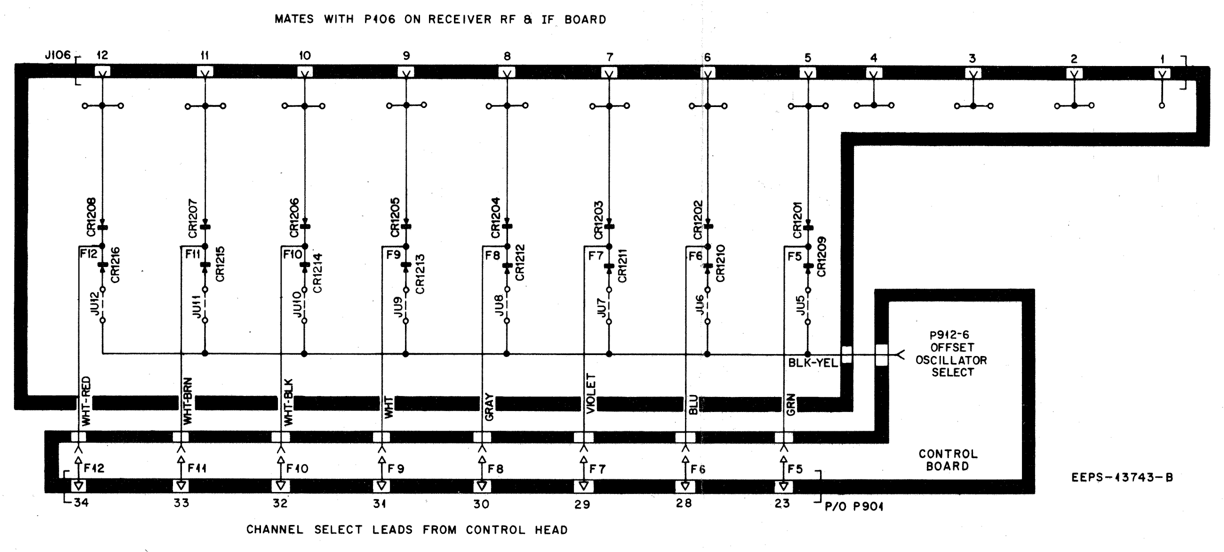


DIODE MATRIX BOARD





REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN5575A Switching Board (4-Freq.) TLN5477A Switching Board (12-Freq.)		PL-2706-A
		CAPACITOR, fixed:
C1201	21-82610C03	47 pF ±5%; 200 V; N220
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR905 thru 908	48-82392B03	silicon
CR1201 thru 1216	48-82392B03	silicon (12-freq. only)
CR1217	48-83329G04	silicon; dual-junction
		TRANSISTOR: NPN; (SEE NOTE I)
Q1201 thru 1208	48-869642	type M9642
Q1209 thru 1224	48-869642	type M9642 (12-freq. only)
Q1225	48-869642	type M9642
		RESISTOR, fixed: 1/4 W:
R1201	6-10401C75	12k ±10%
R1202	6-10401A55	1.8k ±5%
R1203	6-10401A57	2.2k ±5%
R1204	6-10401C65	4.7k ±10%
NON-REFERENCED ITEMS		
	1-80753B77	CABLE ASSEMBLY
	2-7019	NUT, hex: 4-40 x 1/4"
	3-129951	SCREW, machine: 4-40 x 3/8"
	3-139506	SCREW, tapping: 4-40 x 5/16" 2 used
	4-7683	LOCKWASHER: #4 internal
	38-84344F01	BUTTON, plug
	42-10217A02	STRAP, cable harness: 3 used
	42-10217A15	STRAP, cable harness: 1 used
	42-84284B01	RETAINER: 2 used
	42-84816B01	CLIP, cable: 2 used



DIODE MATRIX BOARD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN4934A Diode Matrix Board		PL-1882-C
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR1201 thru 1216	48-82392B03	silicon
		CONNECTOR, receptacle:
J106		consists of: 9B83011H01; PIN, female; 12 req'd
NON-REFERENCED ITEMS		
	1-80736B17	CABLE ASSY (freq. select)
	2-7019	NUT, hex: 4-40 x 1/4"
	3-129951	SCREW, machine: 4-40 x 3/8"
	3-138162	SCREW, tapping: 4-40 x 3/8"; 2 used
	4-7683	LOCKWASHER, #4 split
	5-84500B01	EYELET, special; 2 used
	42-84284B01	RETAINER: 2 used
	42-84816B01	CLIP, cable: 2 used

TLN5575A (4-Freq.) & TLN5477A (12-Freq.)
Universal Switching Board and
TLN4934A Diode Matrix Board Schematic
Diagrams and Circuit Board Details
Motorola No. PEPS-13470-E
4/27/77-UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

EXCITER(406-420 MHz)

Standard
TLE[illegible]1A/*TLE8421A
Wide-Spaced
TL[illegible]1A/*TLE8431A

*Used on Model Series TLE8400 Only. PL-2690-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; ±5%; 200 V; unless otherwise stated
C300	8-82905G09	0.21 uF ±10%; 50 V
*C300, *C301	23-84538G06	470 ±20%; 20 V
C304, 305	21-82610C03	47; N220
C306		NOT USED
C307	21-82610C03	47; N220
*C308	21-82428B59	.01 uF +80-20%
C311	21-82372C01	0.1 uF +80-20%; 25 V
C312	23-83214C15	4.7 uF ±20%; 25 V
*C312, *C313	23-83214C02	15 uF ±20%; 25 V
C313	8-82905G11	0.22 uF ±10%; 50 V
C314	21-82610C03	47; N220
C317	21-82187B20	.001 uF ±10%; 100 V
C319	21-82428B59	.01 uF +80-20%
C320	21-859944	300; 500 V
C321	21-83798B01	100; NPO
C322	21-82428B59	.01 uF +80-20%
C323	21-82187B20	.001 uF ±10%; 100 V
C324	21-82428B59	.01 uF +80-20%
C325		NOT USED
C326	21-82428B59	.01 uF +80-20%
C328	21-82428B59	.01 uF +80-20%
C329	21-82428B59	.01 uF +80-20%
C330	21-82187B20	.001 uF ±10%; 100 V
C335	21-82187B20	.001 uF ±10%; 100 V
C336	21-84494B35	19; 500 V; NP0
C337, 338	21-82610C03	47; N220
C339	21-82358G77	1 ±0.1 pF; 50 V; NP0
C340	21-82450B18	2 ±10%; 500 V
*C340	21-82450B13	1.5 ±5%, 500 V
C341	21-82610C03	47; N220
C342	21-82358G77	1 ±0.1 pF; 50 V; NP0
*C342	21-82450B48	0.75 ±5%; 500 V
C343	21-84493B35	19; 500 V; NP0
C344	21-82204B30	5 ±0.25 pF; NP0
C345	21-84493B34	17; 500 V; NP0
C346	21-82610C03	47; N220
C347	21-84355B39	4.7 pF ±0.25 pF; 500 V
C348 thru 352	21-82610C03	47; N220
C353		NOT USED
C355	21-82610C03	47 pF ±5%; 200 V; N220
*C355	21-82355B39	4.7 ±0.25 pF
C356	21-861428	6 ±10%; 75 V; N150
C360	21-84493B35	19; 500 V
C400	8-82905G09	0.12 uF ±10%; 50 V
C401	23-83214C15	4.7 uF ±20%; 25 V
*C401	23-83214C02	15 uF ±20%; 25 V
C402	21-82610C03	47; N220
C403	21-859944	300; 500 V
C404	21-82610C44	100; 100 V; N220
C405, 406	21-82428B59	.01 uF +80-20%
C407	21-82610C03	47; N220
C408	21-82187B20	.001 uF ±10%; 100 V
C409	21-83596E10	220 ±20%; 500 V
C410, 411, 412	21-82428B59	.01 uF +80-20%
C413		NOT USED
C414	21-82187B20	.001 uF ±10%; 100 V
C415, 416, 417		NOT USED
C418, 419	21-82610C03	47; N220
C420	21-82358G77	1 ±0.1 pF; 50 V; NP0
C421	21-864518	1 ±10%; 500 V
*C421 or	21-82450B08	1.2 ±5%; 500 V (TLE8421A)
*C421	21-82450B13	1.5 ±5%; 500 V (TLE8431A)
C422	21-82610C03	47; N220
C423	21-82355B30	2.7 ±0.1 pF; 500 V; NP0
C424	21-84493B35	19; 500 V; NP0
C425	21-82204B30	5 ±0.25 pF; NP0
C426	21-82610C03	47; N220
C427	21-84355B39	4.7 pF ±0.25 pF; 500 V
C428	21-84493B34	17; 500 V; NP0
C429, 430, 431	21-82610C03	47; N220
C432	21-84493B35	19; 500 V; NP0
C433, 434, 435	21-82610C03	47; N220
C436	21-84493B35	19; 500 V; NP0
C437	8-82905G18	.068 uF ±10%; 100 V
C438	23-83214C06	10 uF ±20%; 15 V
C439	21-82428B56	.0047 uF ±10%
C440, 441	21-82610C03	47; N220
C443	21-82187B20	.001 uF ±10%; 100 V
C444	21-82372C01	0.1 uF +80-20%; 25 V
*C444	23-84538B04	15 uF ±20%; 20 V
C445	8-82905G11	0.22 uF ±10%; 50 V (standard)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
*C445	8-82905G18	.068 uF ±10%; 100 V
C446	21-82187B20	.001 uF ±10%; 100 V
C447	21-82610C03	47; N220
C448	21-82372C01	0.1 uF +80-20%; 25 V
C449	21-82187B20	.001 uF ±10%; 100 V
C450	21-82428B59	.01 +80-20%
C451	21-82187B20	.001 uF ±10%; 100 V
C452, 453	21-82610C03	47; N220
*C454	21-861428	6 ±10%; N150 (TLE8431A)
*C455	23-84538G04	15 ±20%; 20 V
*C456	21-82610C03	47 ±5%; N220
*C458	21-82372C02	0.2 uF +80-20%; 25 V
C459	21-82877B19	15; NP0
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR301	48-82190H50	silicon, varactor
CR302	48-83654H01	silicon
CR303	48-82139G01	germanium
CR304	48-84616A01	silicon; hot-carrier type
CR305, 306, 307	48-83654H01	silicon
CR400	48-83654H01	silicon
CR401	48-82190H35	silicon
CR402	48-83654H01	silicon
CR403	48-82139G01	germanium
CR404	48-84616A01	silicon, hot-carrier type
		INTEGRATED CIRCUIT: (SEE NOTE I)
IC401	51-84312B01	hybrid
*IC401	1-80714B64	thick film; type 14B64
		CONNECTOR, receptacle:
J400	9-84231B02	female; coaxial; miniature type
J402	9-84207B01	female; 7-contact
		COIL, RF:
L300	24-83879G14	BLK; 16 turns; includes tuning cord
L301	24-84783E02	GRN; 5-1/2 turns; tapped; includes tuning core
L308, 309	24-82835G20	choke; 9.3 uH; coded WHT-ORG-GOLD
L314	24-800484	choke; 0.31 uH; 16 turns
L315, 316	24-83884G03	choke; BRN; 1-1/2 turns
L317	24-82723H04	choke; 0.29 uH; 22 turns (green wire)
L318	24-83884G01	choke; RED; 3-1/2 turns
L319	24-83884G01	choke; RED; 3-1/2 turns
L320	24-84783E01	RED; 4-1/2 turns; includes tuning core
L400	24-83879G10	RED; includes tuning core
L401	24-84783E02	GRN; 5-1/2 turns; tapped; includes tuning core
L408, 409	24-82835G20	choke; 9.3 uH; coded WHT-ORG-GOLD
L414	24-800484	choke; 0.31 uH; 16 turns
L415	24-82723H04	choke; BRN; 1-1/2 turns (wide-spaced only)
L416	24-83884G03	choke; BRN; 1-1/2 turns
L417	24-82723H03	choke; 0.29 uH; 22 turns (green wire)
L418	24-83884G01	choke; RED; 3-1/2 turns
L419	24-83884G01	choke; RED; 3-1/2 turns
L420	24-84813E01	choke; 1 turn
		CONNECTOR, plug:
P301	28-82365D03	male; coaxial; miniature type
P401		(for reference only)
P902		(for reference only)
		TRANSISTOR: (SEE NOTE I)
Q301	48-869571	PNP; type M9571
Q302	48-869494	NPN; type M9494
Q303	48-869652	field-effect; N-channel; type M9652
Q304	48-869494	NPN; type M9494
Q305	48-869687	dual-gate "MOSFET", type M9687
Q306, 307	48-869756	NPN; type M9756
Q308, 309	48-869328	PNP; type M9328
Q310	48-869643	PNP; type M9643

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q400	48-869570	NPN; type M9570
Q401	48-869494	NPN; type M9494
Q402	48-869652	field-effect; N-channel; type M9652
Q403	48-869494	NPN; type M9494
Q404	48-869687	dual-gate "MOSFET", type M9687
		RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated
R303	6-124C49	1k
R305	6-124C73	10k
R307	6-124A75	12k ±5%
R309	6-124A93	68k ±5%
R310	6-124A77	15k ±5%
R311	6-124A61	3.3k ±5%
R312	6-124A75	680 ±5%
R313	18-83083G24	variable: 25k ±30%
R318	6-124C81	22k
R319	6-124C77	15k
R320	6-124C81	22k
R321	6-124A83	27k ±5%
R322	6-124C49	1k
R323, 324	6-124A73	10k ±5%
R325	6-124C25	100
R326	6-124B57	3.3 ±5%
R327	6-124A43	680 ±5%
R328	6-124C49	1k
R329, 330	6-124C63	3.9k
R331	6-124A11	27 ±5%
R332	6-124C35	270
R333	6-124A83	27k ±5%
R334	6-124C29	150
R336	6-124C17	47; 1/8 W
*R336	6-124C47	47
R337, 338	6-124A73	10k ±5%
R339	6-124A69	6.8k ±5%
R341	6-124A63	3.9k ±5%
R342	6-124A49	1k ±5%
R343	6-124A35	100 ±5%
R344	6-124A63	3.9k ±5%
R345	6-124C51	1.2k
R346	6-124A25	100 ±5%
R348	6-129229	180k
*R348	6-124002	100k
R350	6-124C47	820
R351	6-124C73	10k
R352	6-124C47	820
R353	6-124C85	33k
R354	6-124C79	18k
R355	6-124A39	390 ±5%
R356	6-124A35	270 ±5%
R357	6-124A27	120 ±5%
R401	18-83083G24	variable: 25k ±30%
R402	6-124C81	22k
R403	6-124C77	15k
R404	6-124E15	39 ±5%
R405	6-124A69	6.8k ±5%
R406, 407	6-124A73	10k ±5%
R408	6-129753	100k
*R408	6-124C25	100
R409	6-124B57	3.3k ±5%
R410	6-124A49	1.2k ±5%
R411	6-124C49	1k
R412, 413	6-124C63	3.9k
R415	6-124C11	270
R416	6-124A83	27k ±5%
R417	6-124C29	150
R418	6-124A29	150 ±5%
R419	6-124C17	47 (wide-spaced)
	or6-124C07	18 (standard)
R420, 421	6-124A73	10k ±5%
R422	6-124A69	6.8k ±5%
R424	6-124A63	3.9k ±5%
R425	6-124A49	1k ±5%
R426	6-124A25	100 ±5%
R427	6-124A63	3.9k ±5%
R428	6-124C51	1.2k
R429	6-124A25	100 ±5%
R430	6-129229	180k ±5%
*R430	6-124002	150k
R431, 432	6-124C73	10k
R433	6-124C49	1k
*R434	6-124A95	82k ±5%
R436	6-124C49	1k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R438	6-124C37	330
R439	6-124C11	270
R440	6-124A61	3.3k
R441	6-124C95	82k
R442	6-124A71	8.2k ±5%
R444	6-124C77	15k
R445	6-124A93	68k ±5%
R446	6-124A77	15k ±5%
R447	6-124A61	3.3k ±5%
R448	6-124A45	680 ±5%
R449	6-124A95	82k ±5%
R450	6-83175C15	14k ±1%
R451	6-83175C32	23.2k ±1%
R452	6-124A87	39k ±5%
R453	6-124C81	22k
*R454	6-124A75	12k ±5%
*R456	6-124A71	8.2k ±5%
		THERMISTOR:
RT401	6-867628	194k ±10% @25°C; 3/4 W
		SOCKET, crystal:
XY301	9-84268F01	2-contact
		CRYSTAL UNIT, quartz:
Y401	48-84730E01	11.7 MHz
	NON-REFERENCED ITEMS	
	26-84808E01	SHIELD (Mixer)
	26-84809E01	SHIELD (1st & 2nd ampl.)
	42-84284B01	RETAINER: 7 req'd (for board shield)
	14-84583B02	INSULATOR
	55-84300B01	HANDLE (3.52" long)
	55-84300B03	HANDLE (1.83" long)
	55-84973E01	HANDLE (1.40" long)
	76-84069B01	FERRITE BEAD: 6 used
	3-139506	SCREW, tapping: 4-40 x 5/16"; 7 used
	5-84500B03	EYELET, special: 7 used
	1-80736B85	COAX CABLE & CONNECTOR ASSY. includes:
	30-83794C01	CABLE, coaxial: 4" used
	37-61348	SLEEVE, neoprene
	5-136977	EYELET
	28-82365D03	CONNECTOR, plug: male, coaxial

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

EXCITER (450-512 MHz)

Standard
TLE8423A (450-470 MHz)
TLE8424A (470-512 MHz)
TLE8443A (450-470 MHz)

Wide-Spaced
TLE8053A/8433A (450-470 MHz)
TLE8054A/8434A (470-512 MHz)

LEGEND:
M = 450-470 MHz ($F_T=F_R$ +5 MHz)
MO = 450-470 MHz ($F_T=F_R$)(SEE NOTE II
H = 470-494 MHz ($F_T=F_R$+3 MHz)
HH = 494-512 MHz ($F_T = F_R$ +3 MHz)
*USE ON MODEL SERIES TLE8400 ONLY

PL-1880-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; ±5%; 200 V; unless otherwise stated
C300	8-82905G09	0.12 uF ±10%; 50 V
C301	8-82905G18	.068 uF ±10%; 100 V
C302	23-83214C06	10 uF ±20%; 15 V
C303	21-82428B56	.0047 uF ±10%; 200 V
C304, 305	21-82610C03	47; N220
C306		NOT USED
C307	21-82610C03	47; N220
C308	21-82187B20	.001 uF ±10%; 100 V
C309	21-82428B56	.0047 uF ±10%; 200 V
C310	21-82372C01	0.1 +80-20%; 25 V
C311	21-82428B59	.01 uF +80-20%; 200 V
C312	8-82905G09	.12 uF ±10%; 50 V
*C312	23-83214C02	15 uF ±20%; 25 V
C313	8-82905G11	0.22 uF ±10%; 50 V
*C313	8-82905G18	0.068 uF ±10%; 100 V
C314	21-82610C03	47; N220
C315	21-82372C01	0.1 +80-20%; 25 V
C316, 317	21-82187B20	.001 uF ±10%; 100 V
C318, 319	21-82428B59	.01 uF +80-20%; 200 V
C320	21-859944	300; 500 V
C321	21-82610C44	100; 100 V; N220
C322	21-82428B59	.01 uF +80-20%; 200 V
C323	21-82187B20	.001 uF ±10%; 100 V
C324	21-82428B59	.01 uF +80-20%; 200 V
C325		factory selected
C326	21-82428B59	.01 uF +80-20%; 200 V
C327	21-82187B20	.001 uF ±10%; 100 V
C328	21-82428B59	.01 uF +80-20%; 200 V
C329	21-82428B59	.01 uF +80-20%; 200 V
C330	21-82187B20	.001 uF ±10%; 100 V
C331	21-82610C03	47; N220
C332M	21-82610C04	36; N220
C332H, HH	21-82610C45	40; 100 V; NP0
C332MO	21-82610C62	51; 100 V; N150
C333M	21-82355B25	75; 500 V; N1500
C333H, HH	21-82610C71	90; NP0
C333MO	21-82610C69	110; N150
C334M	21-84493B14	68; NP0
C334H, HH	21-82610C64	80; N80
C334MO	21-82610C44	100; 100 V; N220
C335	21-82187B20	.001 uF ±10%; 100 V
C336	21-84493B35	19; 500 V; NP0
C337, 338	21-82610C03	47; N220
C339M, 339MO	21-82358G82	1.5 ±0.1 pF; 50 V; NP0
C339H, HH	21-82358G77	1 ±0.1 pF; 50 V; NP0
C340	21-82204B31	8 ±0.25 pF; 500 V; N330
C341	21-82610C03	47; N220
C342	21-82355B30	2.7 ±0.1 pF; 500 V; NP0
C343	21-84493B35	19; 500 V; NP0
C344	21-82204B30	5 ±0.25 pF; NP0
C345	21-84493B34	17; 500 V; NP0
C346	21-82610C03	47; N220
C347M, 347MO	21D82355B39	4.7 pF ±.25 pF; 500 V
C347H, HH	21-82610C94	3.0 pF ±0.1 pF; 500 V
C348 thru 352	21-82610C03	47; N220
C353		NOT USED
C354, 355	21-82610C03	47; N220
*C356	21-82187B20	0.001 uF ±10%; 100 V
*C357	23-84538G09	6.8 uF ±20%; 20 V
*C358	21-82610C03	47; N220
*C401	23-83214C02	15 uF ±20%; 25 V
*C360	21-84493B35	19; 500 V
C401	8-82905G09	.12 uF ±10%; 50 V
C402	21-82610C03	47; N220
C403	21-859944	300; 500 V
C404	21-82610C44	100; 100 V; N220
C405, 406	21-82428B59	.01 uF +80-20%; 200 V
C407	21-82610C03	47; N220
C408	21-82187B20	.001 uF ±10%; 100 V
C409	21-83596E10	220 ±20%; 500 V
C410, 411, 412	21-82428B59	.01 uF +80-20%; 200 V
C413		factory selected
C414	21-82187B20	.001 uF ±10%; 100 V
C415	21-82610C62	51; 100 V; N150
C416	21-82610C69	110; N150
C417	21-82610C44	100; 100 V; N220
C418, 419	21-82610C03	47; N220

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C420M	21-82358G82	1.5 ±0.1 pF; 50 V; NP0
C420H, 420HH	21-82358G77	1 ±0.1 pF; 50 V; NP0
C421	21-82204B31	8 ±0.25 pF; 500 V; N330
C422	21-82610C03	47; N220
C423	21-82355B30	2.7 ±0.1 pF; 500 V; NP0
C424	21-84493B35	19; 500 V; NP0
C425	21-82204B30	5 ±0.25 pF; NP0
C426	21-82610C03	47; N220
C427M	21-82355B39	4.7 ±.25 pF; 500 V
C427H, HH	21-82610C94	3.0 ±0.1 pF; 500 V
C428	21-84493B34	17; 500 V; NP0
C429, 430, 431	21-82610C03	47; N220
C432	21-84493B35	19; 500 V; NP0
C433, 434, 435	21-82610C03	47; N220
C436	21-84493B35	19; 500 V; NP0
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR300	48-83654H01	silicon
CR301	48-82190H24	silicon
CR302	48-83654H01	silicon
CR303, 304	48-84616A01	silicon
CR401	48-82190H24	silicon
CR402	48-83654H01	silicon
CR403, 404	48-84616A01	silicon
CR405, 406, 407	48-83654H01	silicon
		INTEGRATED CIRCUIT: (SEE NOTE I)
IC301	51-84312B01	hybrid
		CONNECTOR, receptacle:
J300	9-84231B02	female; coaxial; miniature type
J402	9-84207B01	female; 7-contact
		COIL, RF:
L300M	24-83879G12	BLU; includes tuning core
L300H, HH	24-83879G11	WHT; includes tuning core
L300MO	24-83879G10	RED; includes tuning core
L301	24-84783E01	RED; 4-1/2 turns; includes tuning core
L308, 309	24-82835G20	choke; 9.3 uH; coded WHT-ORG-GOLD
L310M	24-82835G33	choke; 1.1 uH; coded BRN-BRN-GOLD
L310H, HH	24-82835G30	choke; 1.3 uH; coded BRN-ORG-GOLD
L310MO	24-82835G12	choke; 1.7 uH; coded BRN-VIO-GOLD
L311M	24-82835G34	choke; 4.6 uH; coded YEL-BLU-GOLD
L311H, HH	24-82835G31	choke; 5.2 uH; coded GRN-RED-GOLD
L311MO	24-82835G29	choke; 6.7 uH; coded BLU-VIO-GOLD
L312M	24-82835G35	choke; 2.3 uH; coded RED-ORG-GOLD
L312H, HH	24-82835G08	choke; 2.6 uH; coded RED-BLU-GOLD
L312MO	24-82835G11	choke; 3.5 uH; coded ORG-GRN-GOLD
L313M	24-82835G36	choke; 0.57 uH; coded GRN-VIO-SILVER
L313H, HH	24-82835G32	choke; 0.64 uH; coded BLU-YEL-SILVER
L313MO	24-82835G13	choke; 0.82 uH; coded GRAY-RED-SILVER
L314	24-800484	choke; 0.31 uH; 16 turns
L315, 316	24-83884G03	choke; BRN; 1-1/2 turns
L317	24-82723H04	choke; 0.29 uH; 22 turns (green wire)
L318, 319	24-83884G07	choke; GRN; 2-1/2 turns
L400	24-83879G10	RED; includes tuning core
L401	24-84783E01	RED; 4-1/2 turns; includes tuning core
L408, 409	24-82835G20	choke; 9.3 uH; coded WHT-ORG-GOLD
L410	24-82835G12	choke; 1.7 uH; coded BRN-VIO-GOLD
L411	24-82835G29	choke; 6.7 uH; coded BLU-VIO-GOLD
L412	24-82835G11	choke; 3.5 uH; coded ORG-GRN-GOLD

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L413	24-82835G13	choke; 0.82 uH; coded GRAY-RED-SILVER
L414	24-800484	choke; 0.31 uH; 16 turns
L415, 416	24-83884G03	choke; BRN; 1-1/2 turns
L417	24-82723H04	choke; 0.29 uH; 22 turns (green wire)
L418, 419	24-83884G07	choke; GRN; 2-1/2 turns
L420	24-84813E01	choke; 1 turn
		CONNECTOR, plug:
P301	28-82365D03	male; coaxial; miniature type
P401		(for reference only)
P403	28-82365D03	male; coaxial; miniature type
P902		(for reference only)
		TRANSISTOR: (SEE NOTE I)
Q301	48-869570	N-P-N; type M9570
Q302	48-869494	N-P-N; type M9494
Q303	48-869652	field-effect; N-channel; type M9652
Q304	48-869494	N-P-N; type M9494
Q305	48-869687	dual-gate "MOSFET"; type M9687
Q306, 307	48-869756	N-P-N; type M9756
Q401	48-869494	N-P-N; type M9494
Q402	48-869652	field-effect; N-channel; type M9652
Q403	48-869494	N-P-N; type M9494
Q404	48-869687	dual-gate "MOSFET"; type M9687
Q405, 406	48-869756	N-P-N; type M9756
Q407	48-869643	P-N-P; type M9643
Q408, 409	48-869328	P-N-P; type M9328
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R300	6-129775	330
R301	6-129752	270
R302	6-129231	3.3k
R303	6-127802	1k
R304	6-129145	82k
R305	6-129225	10k
R306	6-129983	8.2k ±5%
R307	6-129230	12k ±5%
R308	6-127805	15k
R309	6-129299	68k ±5%
R310	6-129236	15k ±5%
R311	6-129981	3.3k ±5%
R312	6-129984	680 ±5%
R313	18-83083G24	variable: 25k ±30%
R314	6S124A95	82k ±5%
R315	6-83175C15	14k ±1%
R316	6-83175C32	23.2k ±1%
R317	6S129983	8.2k
R318	6-128685	22k
R319	6-127805	15k
R320	6-128685	22k
R321M	6-129236	15k ±5%
R321H, HH	6-129668	10k ±5%
R321MO	6-129982	5.6k ±5%
R322	6-127802	1k
R323, 324	6-129668	10k ±5%
R325	6-129753	100
R326	6-124B57	3.3 ±5%
R327	6-129708	1.2k ±5%
R328	6-127802	1k
R329, 330	6-129232	3.9k
R331	6-124E15	39 ±5%
R332	6-129752	270
R333	6-129145	82k
R334	6-129862	150
R335	6-131276	150 ±5%
R336, M, MO, H, HH	6-185B58	18; 1/8 W (standard)
	or 6-185B63	47; 1/8 W (wide-spaced)
R337, 338	6-129668	10k ±5%
R339	6-129237	6.8k ±5%
R340	6-131641	22
R341	6-129819	3.9k ±5%
R342	6-129805	1k ±5%
R343	6-131524	100 ±5%
R344	6-129819	3.9k ±5%
R345	6-185B80	1.2k; 1/8 W
R346	6-131524	100 ±5%
R347		NOT USED
R348	6-129229	180k
R349	6S129777	39k ±5%
*R350	6-124A71	82k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R401	18-83083G24	variable: 25k ±30%
R402	6-128685	22k
R403	6-127805	15k
R404	6-124E15	39 ±5%
R405	6-129237	6.8k ±5%
R406, 407	6-129668	10k ±5%
R408	6-129753	100
R409	6-124B57	3.3 ±5%
R410	6-129708	1.2k ±5%
R411	6-127802	1k
R412, 413	6-129232	3.9k
R414		NOT USED
R415	6-129752	270
R416,	6-129145	82k
R417	6-129862	150
R418	6-131276	150 ±5%
R419	6-129233	47
R420, 421	6-129668	10k ±5%
R422	6-129237	6.8k ±5%
R423	6-131641	22
R424	6-129819	3.9k ±5%
R425	6-129805	1k ±5%
R426	6-131524	100 ±5%
R427	6-129819	3.9k ±5%
R428	6-185B80	1.2k; 1/8 W
R429	6-131524	100 ±5%
R430	6-129229	180k ±5%
R431, 432	6-129225	10k
R433	6-127802	1k
R434, 435	6-129432	820
R436	6-127802	1k
R437	6-129862	150 (standard)
		THERMISTOR:
RT301	6-867628	194k ±10% @ 25° C; 3/4 W
		CRYSTAL UNIT, quartz;
Y301M	48-84730E03	16.7 MHz
Y301H, HH	48-84730E02	14.7 MHz
Y301MO	48-84730E01	11.7 MHz
Y401	48-84730E01	11.7 MHz
	NON-REFERENCED ITEMS	
	26-84808E01	SHIELD (mixer)
	26-84809E01	SHIELD (1st & 2nd ampl.)
	42-84284B01	RETAINER: 7 req'd (for board shield)

REVISIONS

PEPS-21305-C

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE8421A TLE8431A	C321	FROM 21-82610E44 TO 21-88798B01	PARTS LIST
	C415	DELETED 21-82610C62 51 pF	
	C416	DELETED 21-82610C69 110 pF	
	C417	DELETED 21-82610C44 100 pF	
	IC301	CHANGED TO IC401	
	J300	CHANGED TO J400	
	R404	ADDED 6-124E15, 39	
	R405	ADDED 6-124A69, 6.8k	
	R442	FROM 6-124C81, 22k TO 6-124A71, 8.2k	IC401-5
	R456	ADDED 6-124A71, 8.2k	Q400 EMITTER CIRCUIT

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

EXCITER OUTPUT FILTER

TFE6211A (406-420 MHz) Coded L
TFE6213A (450-470 MHz) Coded M
TFE6214A (470-494 MHz) Coded H
TFE6215A (494-512 MHz) Coded HH

PL-1881-C

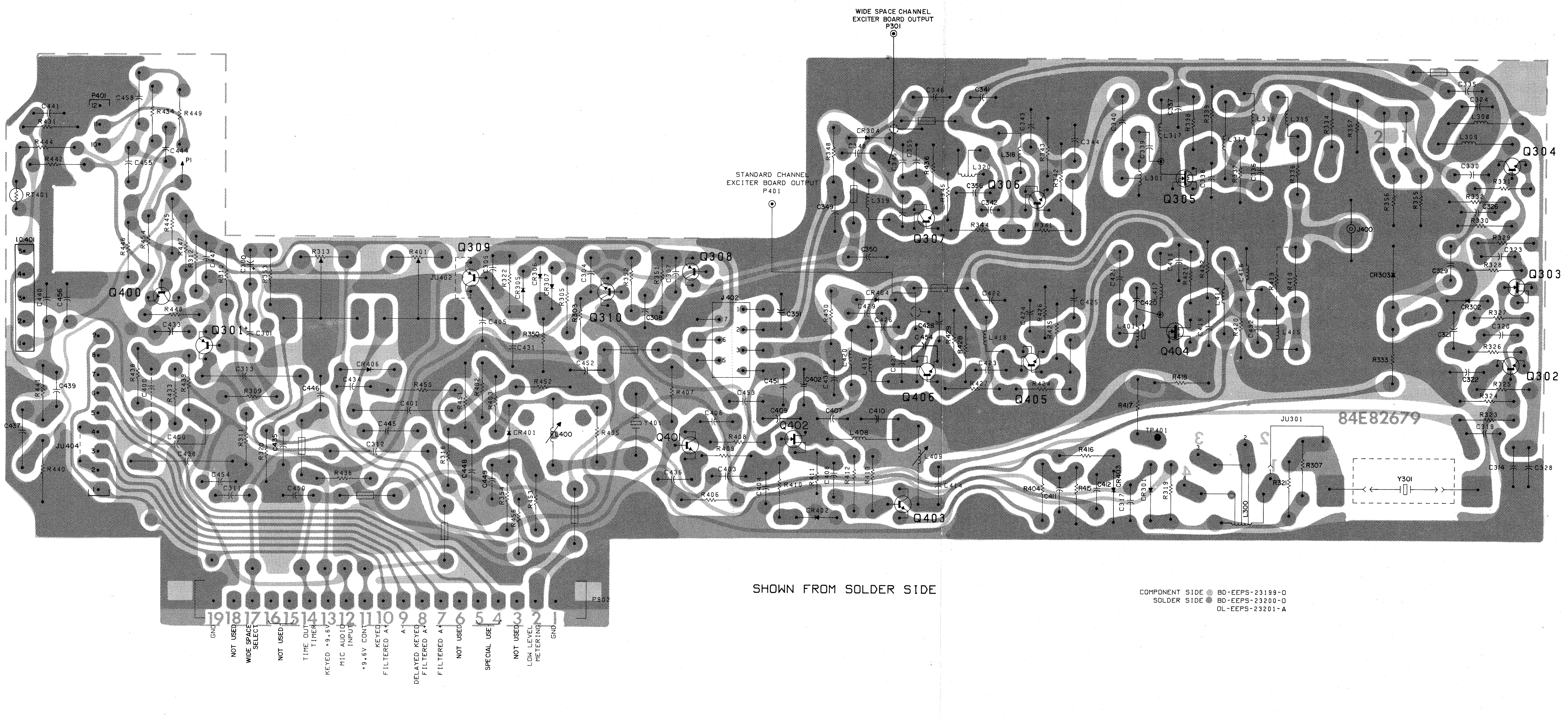
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle:
J301, 302, 403 404	9-84135B02	female; coaxial; miniature type
		COIL, RF: 5-3/4 turns:
L302L	1-80734B67	GRAY-GRAY; tapped
L302M	1-80734B69	BLU; tapped
L302H	1-80734B70	GRN; tapped
L302HH	1-80734B71	BLK; tapped
L303L	24-84769E19	WHT-WHT
L303M	24-84769E05	GRN
L303H	24-84769E07	VIO
L303HH	24-84769E09	WHT
L304L	24-84769E19	WHT-WHT
L304M	24-84769E05	GRN
L304H	24-84769E07	VIO
L304HH	24-84769E09	WHT
L305L	24-84769E19	WHT-WHT
L305M	24-84769E05	GRN
L305H	24-84769E07	VIO
L305HH	24-84769E09	WHT
L306L	24-84769E19	WHT-WHT
L306M	24-84769E05	GRN
L306H	24-84769E07	VIO
L306HH	24-84769E09	WHT
L307L	1-80734B67	GRAY-GRAY; tapped
L307M	1-80734B69	BLU; tapped
L307H	1-80734B70	GRN; tapped
L307HH	1-80734B71	BLK; tapped
L402L	1-80734B67	GRAY-GRAY; tapped
L402M	1-80734B69	FLU; tapped
L402H	1-80734B70	GRN; tapped
L402HH	1-80734B71	BLK; tapped
L403L	24-84769E19	WHT-WHT
L403M	24-84769E05	GRN
L403H	24-84769E07	VIO
L403HH	24-84769E09	WHT
L404L	24-84769E19	WHT-WHT
L404M	24-84769E05	GRN
L404H	24-84769E07	VIO
L404HH	24-84769E09	WHT
L405L	24-84769E19	WHT-WHT
L405M	24-84769E05	GRN
L405H	24-84769E07	VIO
L405HH	24-84769E09	WHT
L406L	24-84669E19	WHT-WHT
L406M	24-84769E05	GRN
L406H	24-84769E07	VIO
L406HH	24-84769E09	WHT
L407L	1-80734B67	GRAY-GRAY; tapped
L407M	1-80734B69	BLU; tapped
L407H	1-80734B70	GRN; tapped
L407HH	1-80734B71	BLK; tapped
	NON-REFERENCED ITEMS	
	3-84835E01	TUNING SCREW: #6-32 (early models)
	2-84773E01	NUT, tensioning: #6 (early models)
	3-138841	TUNING SCREW: #8-32 (later models)
	2-84773E02	NUT, tensioning: #8 (later models)

NOTES:

I. FOR OPTIMUM PERFORMANCE, DIODES, TRANSISTORS, AND INTEGRATED CIRCUITS MUST BE ORDERED BY MOTOROLA PART NUMBERS.
II. WHEN REPLACING CAPACITOR C1 OR C2 FOR THE 450-512 MHz RANGE, ORDER THE TWO ITEMS (CAPACITOR AND SPECIAL TUNING "PISTON") SHOWN IN THE PARTS LIST. REMOVE THE STANDARD TUNING PISTON FROM THE CAPACITOR AND REPLACE IT WITH THE SPECIAL PISTON.
III. "MO" REFERENCE DESIGNATIONS APPLY ONLY TO CERTAIN COMPONENTS IN THE EXCITER.

EPS-14170-O

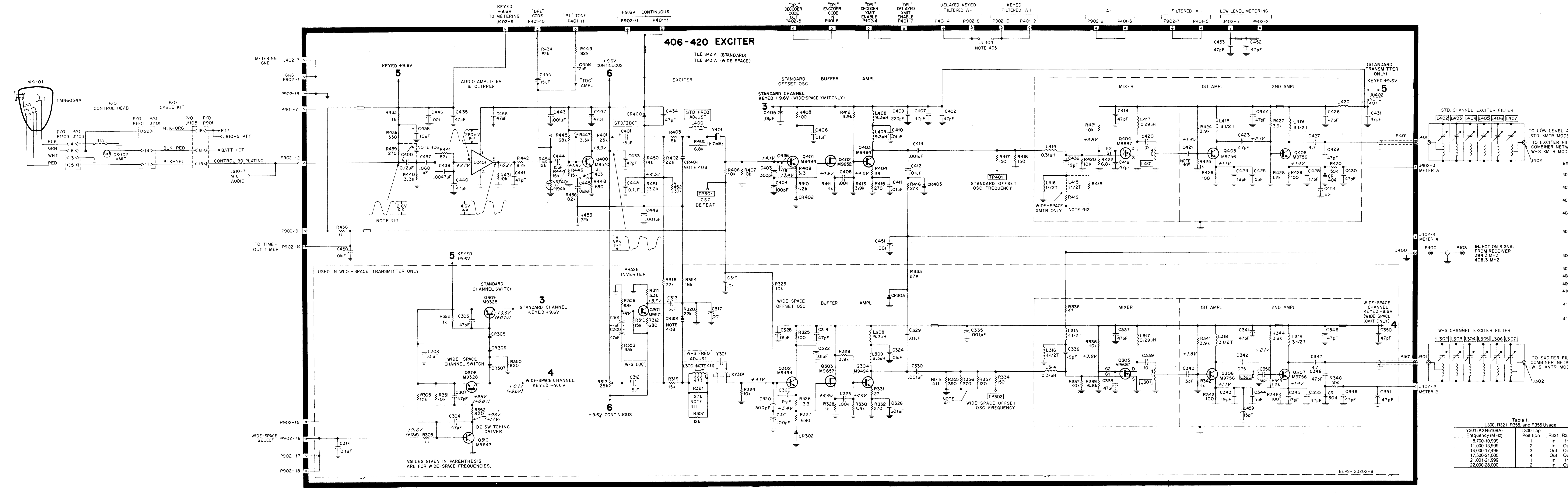
EXCITER BOARD PARTS LIST



SHOWN FROM SOLDER SIDE

COMPONENT SIDE BD-EEPS-23199-O
SOLDER SIDE BD-EEPS-23200-O
OL-EEPS-23201-A

TLE8421A & TLE8431A Exciter Board
"Digital Private-Line" Compatible
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-23211-B
(Sheet 1 of 2)
9/28/78-UP



EXCITER NOTES:

401. SYMBOL -▭- INDICATES A FERRITE BEAD, MOTOROLA PART NO. 76C84069B01.

402. WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER.

403. UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.

404. VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.3 TO 9.9 VOLTS REGULATED.

405. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
RESISTOR VALUES ARE IN OHMS.
JU404 REMOVED IN "PRIVATE-LINE" RADIOS.

406. CONNECT C400 AS SHOWN IN DASHED LINES FOR REDUCED AUDIO SENSITIVITY.

407. JU402 USED ONLY FOR STANDARD TRANSMITTER.

408. REPLACE BOTH CR301 AND CR401 IF EITHER DIODE FAILS.

409. 1.2 pF ON TLE8421A, 1.5 pF ON TLE8431A.

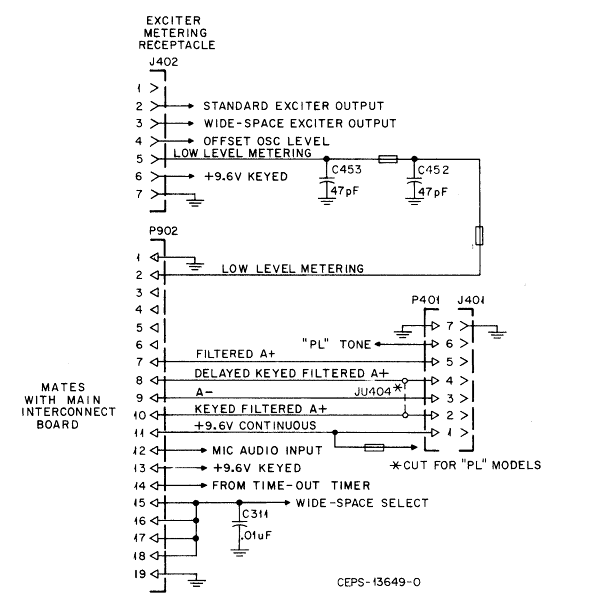
410. AUDIO WAVEFORMS SHOWN WITH 2.8 V p-p (1 V RMS) INPUT SIGNAL AT 1 kHz.

411. Refer to Table 1 for tap settings for L300 and usage of R321, R355, and R356.

412. Alternate position for R419 used in standard xmtrs only.

Table 1.
L300, R321, R355, and R356 Usage

Y301 (KXN6108A) Frequency (MHz)	L300 Tap Position	R321	R355	R356
8,700-10,999	1	In	In	In
11,000-13,999	2	In	Out	In
14,000-17,499	3	Out	Out	In
17,500-21,000	4	Out	Out	Out
21,001-21,999	1	In	In	Out
22,000-28,000	2	In	Out	Out

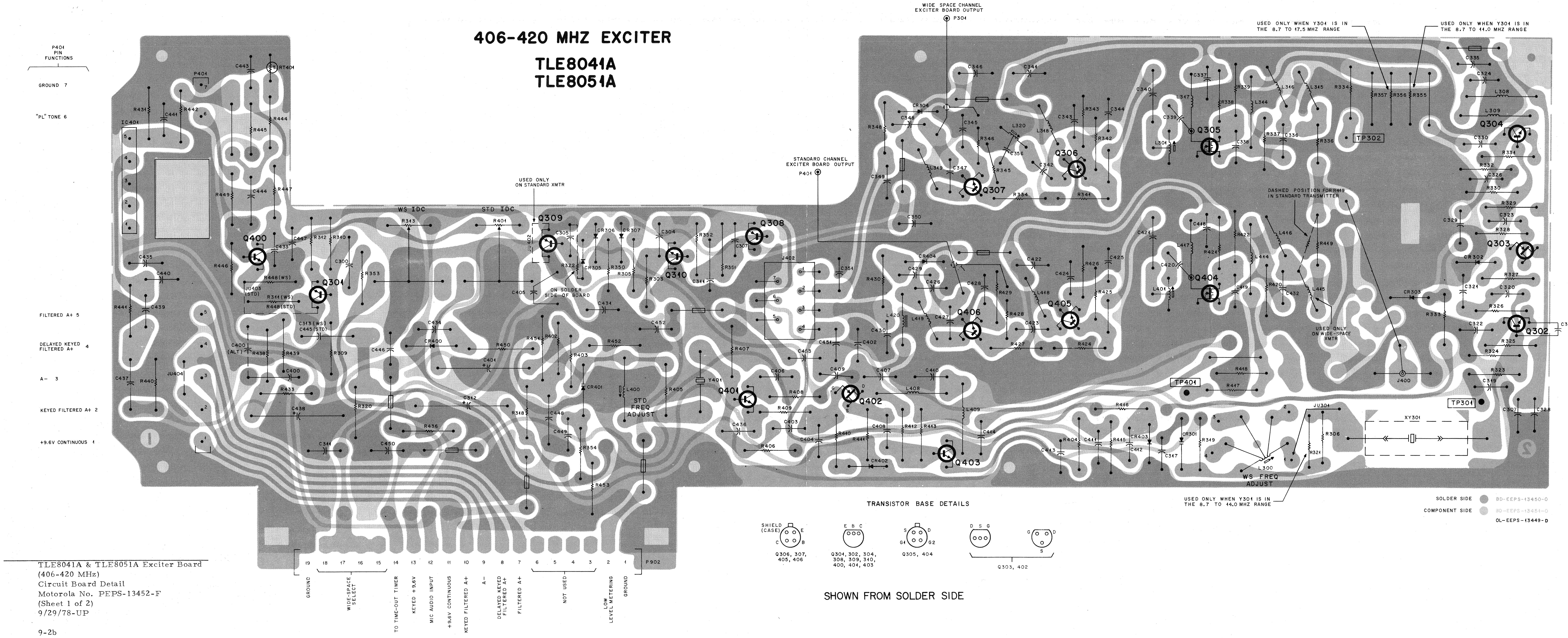


PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLE8421A & TLE8431A Exciter Board (406-420 MHz)
"Digital Private-Line" Compatible
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-23211-B
(Sheet 2 of 2)
9/29/78-UP

406-420 MHZ EXCITER

TLE8041A
TLE8051A



SHOWN FROM SOLDER SIDE

TLE8041A & TLE8051A Exciter Board
(406-420 MHz)
Circuit Board Detail
Motorola No. PEPS-13452-F
(Sheet 1 of 2)
9/29/78-UP

RADIO SET HARDWARE KITS

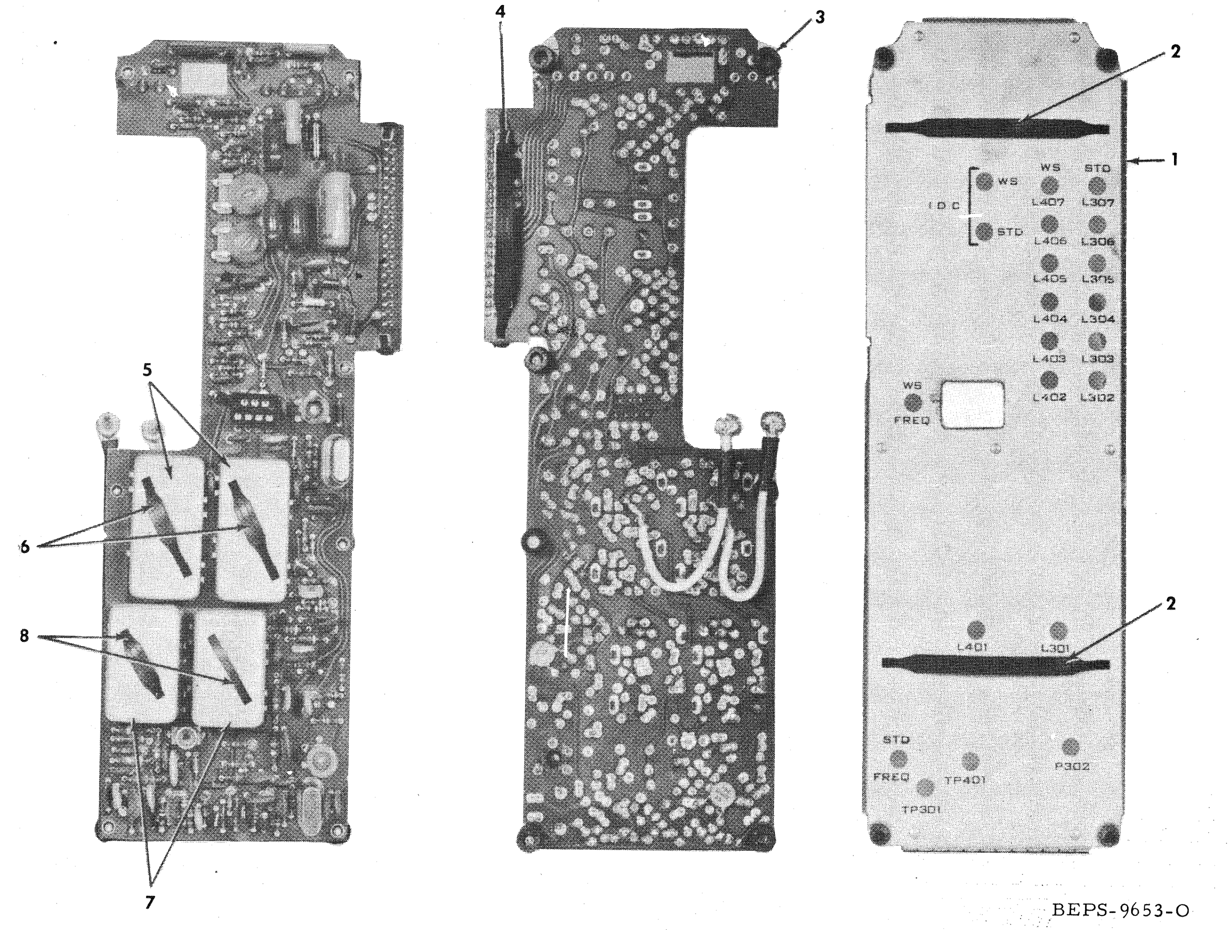
TLN4931A, B (Standard) Carrier Squelch
TLN4932A, B (Wide-Spaced) Carrier Squelch
TLN5096A, B (Standard) "Private-Line"
TLN5097A, B (Wide-Spaced) "Private-Line" PL-4196-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	1V80734B46	SHIELD, exciter (Models TLN4931A, TLN4932A, TLN5096A, TLN5097A)
	or 1V80770B70	SHIELD, exciter (Models TLN4931B, TLN4932B, TLN5096B, TLN5097B)
2	42-84300B01	HANDLE, exciter shield; 2 req'd.

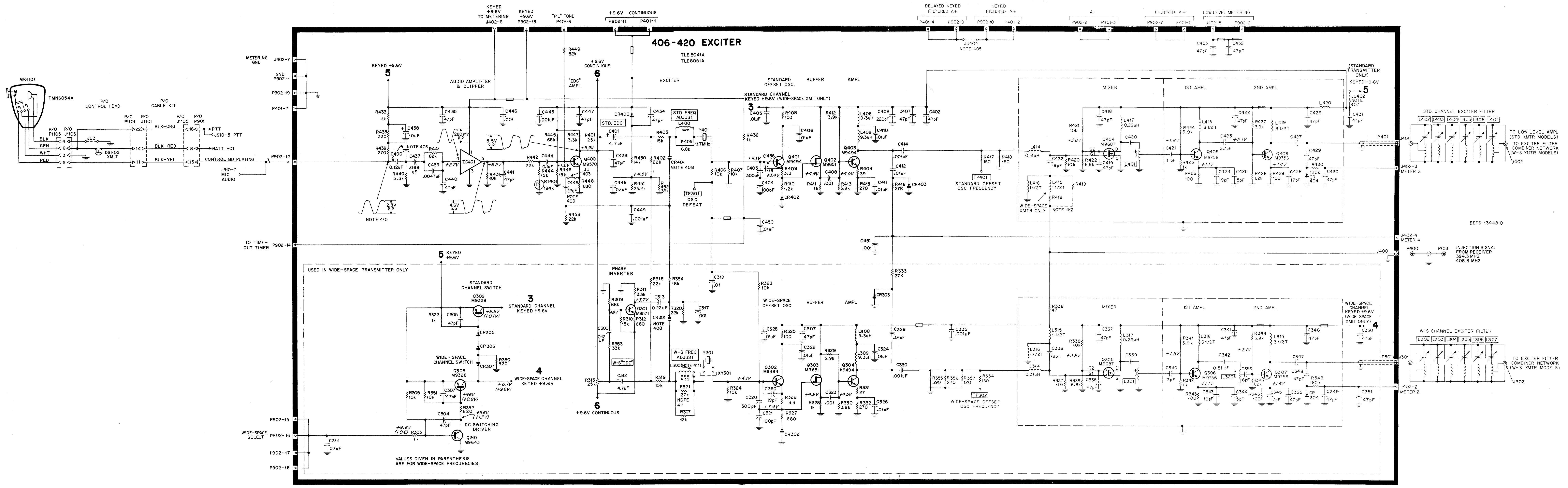
EXCITER

TLE8420A Series Exciter (Standard)
TLE8430A Series Exciter (Wide-Spaced)
TLE8040A Series Exciter (Standard)
TLE8050A Series Exciter (Wide-Spaced) PL-1921-A

CODE	MOTOROLA PART NO.	DESCRIPTION
3	42-84284B01	RETAINER (7 required)
4	55-84300B01	HANDLE, Exciter Board
5	26-84809E01	SHIELD CAN, Amplifier
6	55-84300B03	HANDLE, Amplifier Shield Can
7	26-84808E01	SHIELD CAN, Mixer
8	55-84973E01	HANDLE, Mixer Shield Can



BEPS-9653-O



EXCITER NOTES

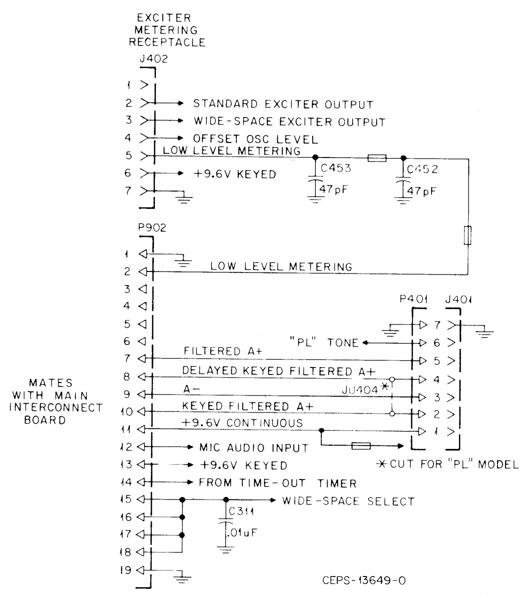
401. SYMBOL ⊏⊐ INDICATES A FERRITE BEAD, MOTOROLA PART NO. 76C84069B01.
402. WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER.
403. UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.
404. VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.3 TO 9.9 VOLTS REGULATED.
405. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
RESISTOR VALUES ARE IN OHMS.
JU404 REMOVED IN "PRIVATE-LINE" RADIOS.
406. CONNECT C400 AS SHOWN IN DASHED LINES FOR REDUCED AUDIO SENSITIVITY.
407. JU402 USED ONLY FOR STANDARD TRANSMITTER.
408. REPLACE BOTH CR301 AND CR401 IF EITHER DIODE FAILS.
409. C445 IS USED ONLY ON TLE8041A STANDARD EXCITER BOARD.
410. AUDIO WAVEFORMS SHOWN WITH 2.8 Vp-p (1 V RMS) INPUT SIGNAL AT 1 kHz.
411. REFER TO TABLE 1. FOR TAP SETTINGS FOR L300 AND USAGE. OF R321, R355 AND R356.

Table 1.
L300, R321, R355, and R356 Usage

Y301 (KXN6108A) FREQUENCY (MHz)	L300 TAP POSITION	R321	R355	R356
8.700 - 10.999	1	In	In	In
11.000 - 13.999	2	In	Out	In
14.000 - 17.499	3	Out	Out	In
17.500 - 21.000	4	Out	Out	Out
21.001 - 21.999	1	In	In	Out
22.000 - 28.000	2	In	Out	Out

412. ALTERNATE POSITION FOR R419 USED IN STANDARD XMTRS ONLY.

EPS-13453-A



REVISIONS

PEPS-13452-F

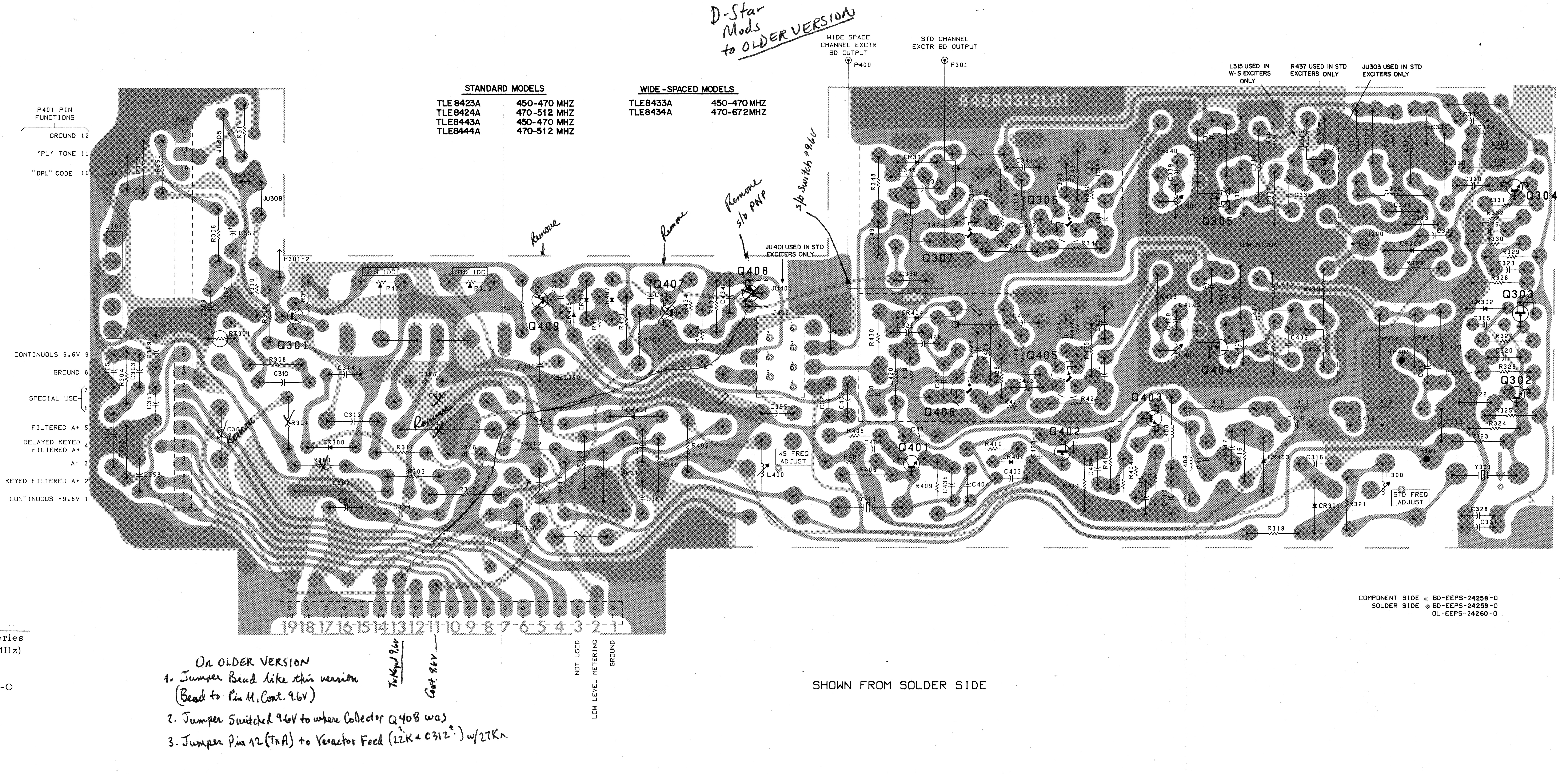
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE8051A	C360	ADDED: 21-84493B35, 19 pF ±5%; 500 V	Q302 BASE

EXCITER BOARD (406-420 MHz)

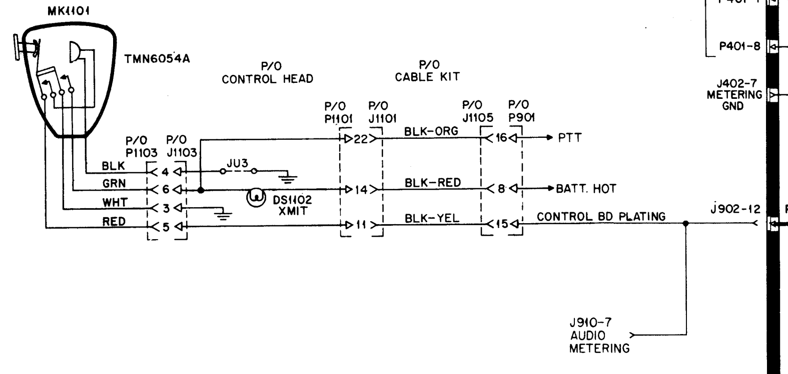
PARTS LIST SHOWN ON PAGE 9-1

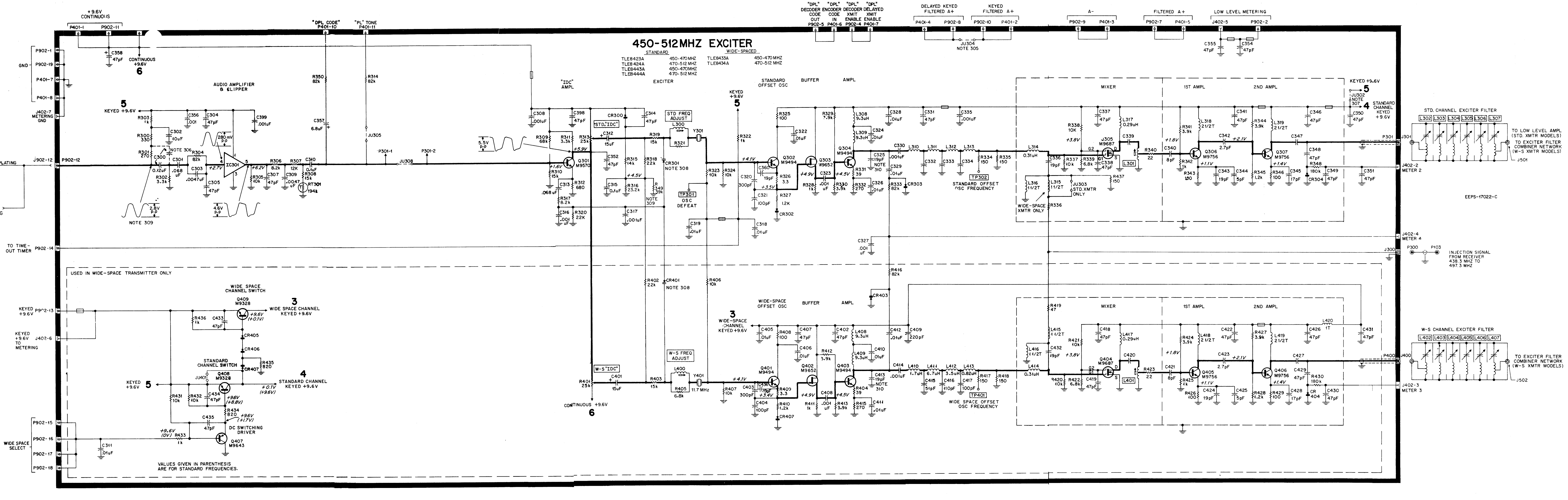
TLE8041A & TLE8051A Exciter (406-420 MHz)
Schematic Diagram
Motorola No. PEPS-13452-F
(Sheet 2 of 2)
9/29/78-UP

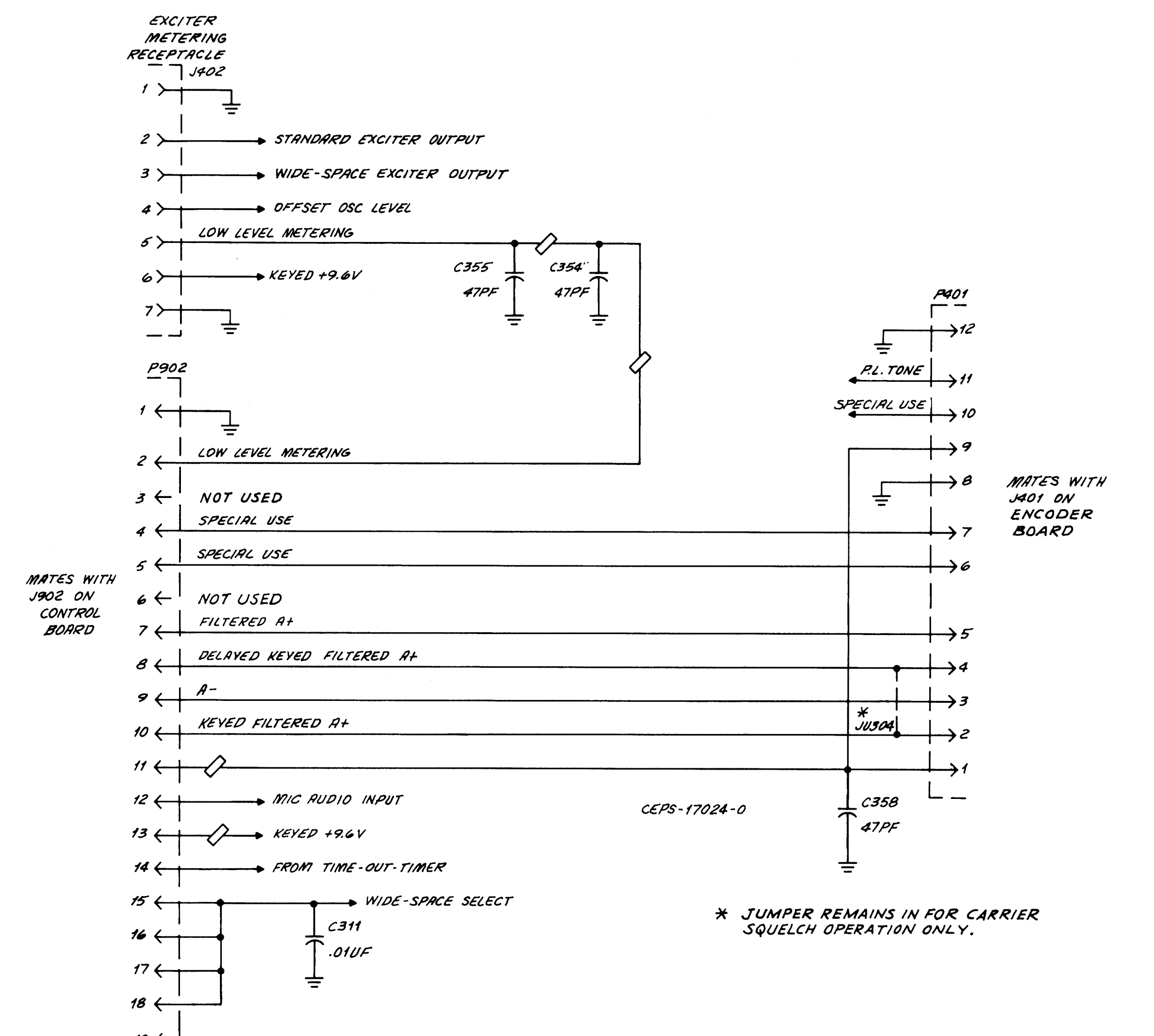
LATER VERSION



TLE8420A & TLE8430A Series
Exciter Boards (450-512 MHz)
(PL and DPL Compatible)
Circuit Board Detail
Motorola No. PEPS-24463-O
(Sheet 1 of 2)
6/21/77-UP







EXCITER NOTES:

301. SYMBOL ⊟ INDICATES A FERRITE BEAD, MOTOROLA PART NO. 76C84069B01.
302. WHERE ONLY ONE DC VOLTAGE READING IS SHOWN, USE ONLY A HIGH IMPEDANCE (11 MEGOHM) VOLTMETER.
303. UNLESS OTHERWISE STATED, VOLTAGES AND WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.
304. VOLTAGES WILL VARY SLIGHTLY IF +9.6 VOLT SOURCE IS ABOVE OR BELOW NOMINAL VALUE. NORMAL VARIATION FROM RADIO TO RADIO IS 9.3 TO 9.9 VOLTS REGULATED.
305. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
RESISTOR VALUES ARE IN OHMS.
JU304 LEFT IN FOR CARRIER SQUELCH RADIOS.
306. CONNECT C300 AS SHOWN IN DASHED LINES FOR REDUCED AUDIO SENSITIVITY.
307. JU302 USED ONLY FOR STANDARD TRANSMITTER.
308. REPLACE BOTH CR301 AND CR401 IF EITHER DIODE FAILS.
309. AUDIO WAVEFORMS SHOWN WITH 2.8 V P–P (1 V RMS) INPUT SIGNAL AT 1 kHz.
310. CAPACITORS C325 AND C413 ARE FACTORY SELECTED, AND MAY OR MAY NOT BE INSTALLED IN YOUR RADIO SET.

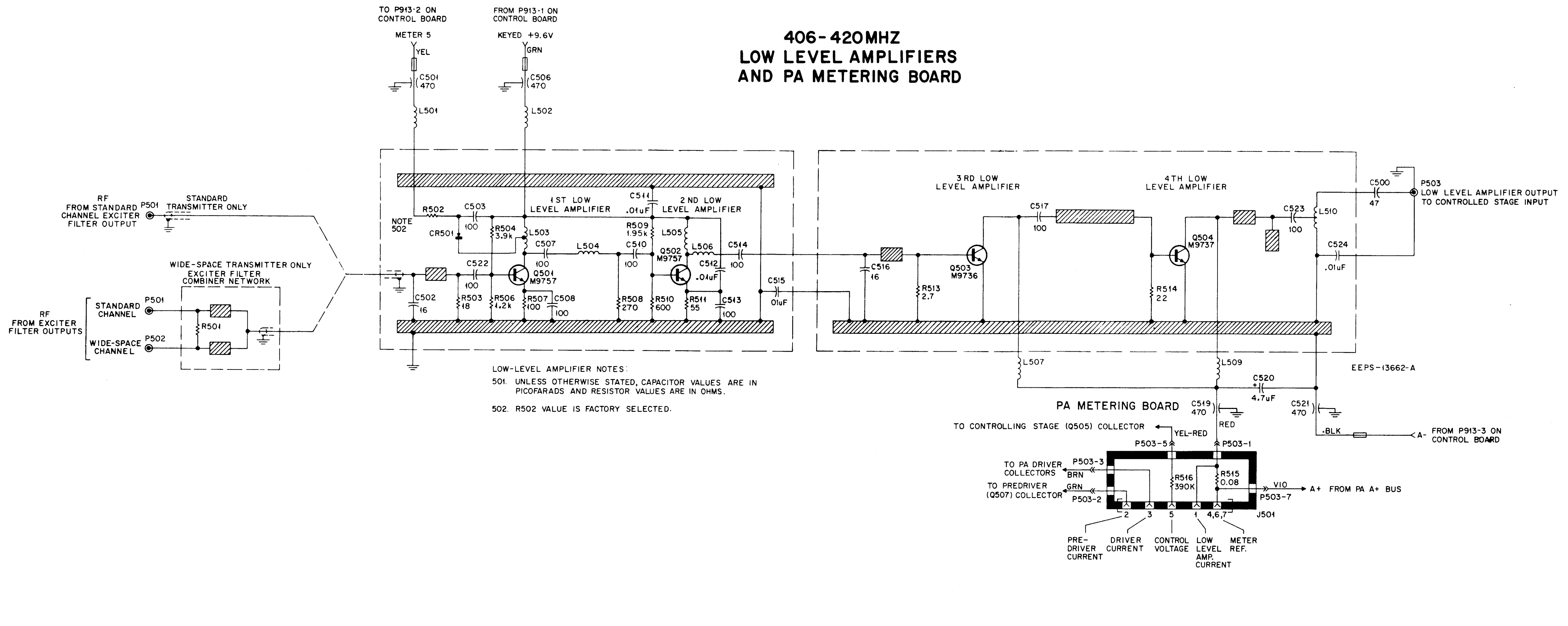
COMPONENT VALUE TABLE

	TLE8423A STANDARD EXCITER 450–470 MHz	TLE8424A STANDARD EXCITER 470–512 MHz	TLE8443A 11.7 MHz EXCITER 450–470 MHz	TLE8433A WIDE–SPACE EXCITER 450–470 MHz	TLE8434A WIDE–SPACE EXCITER 470–512 MHz	TLE8444A 11.7 MHz EXCITER 470–512 MHz
C332	36 pF	40 pF	51 pF	36 pF	40 pF	51 pF
C333	75 pF	90 pF	110 pF	75 pF	90 pF	110 pF
C334	68 pF	80 pF	100 pF	68 pF	80 pF	100 pF
C339	1.5 pF	1.0 pF	1.5 pF	1.5 pF	1.0 pF	1.0 pF
C347	4.7 pF	3.0 pF	4.7 pF	4.7 pF	3.0 pF	3.0 pF
C420	NOT USED	NOT USED	NOT USED	1.5 pF	1.0 pF	NOT USED
C427	NOT USED	NOT USED	NOT USED	4.7 pF	3.0 pF	NOT USED
L300	30 TURNS BLUE	27 TURNS WHITE	35 TURNS RED	30 TURNS BLUE	27 TURNS WHITE	35 TURNS RED
L310	1.1 uH	1.3 uH	1.7 uH	1.1 uH	1.3 uH	1.7 uH
L311	4.6 uH	5.2 uH	6.7 uH	4.6 uH	5.2 uH	6.7 uH
L312	2.3 uH	2.6 uH	3. 5 uH	2.3 uH	2.6 uH	3.5 uH
L313	.57 uH	.64 uH	0.82 uH	.57 uH	.64 uH	0.82 uH
R321	15k	10k	5.6k	15k	10k	5.6k
R336	18	18	18	47	47	18
Y301	16.7 MHz	14.7 MHz	11.7 MHz	16.7 MHz	14.7 MHz	11.7 MHz

EXCITER BOARD (450–512 MHz)

TLE8420A & TLE8430A Series
Exciters (450-512 MHz)
Schematic Diagram
Motorola No. PEPS-24463-O
(Sheet 2 of 2)
6/21/77-UP

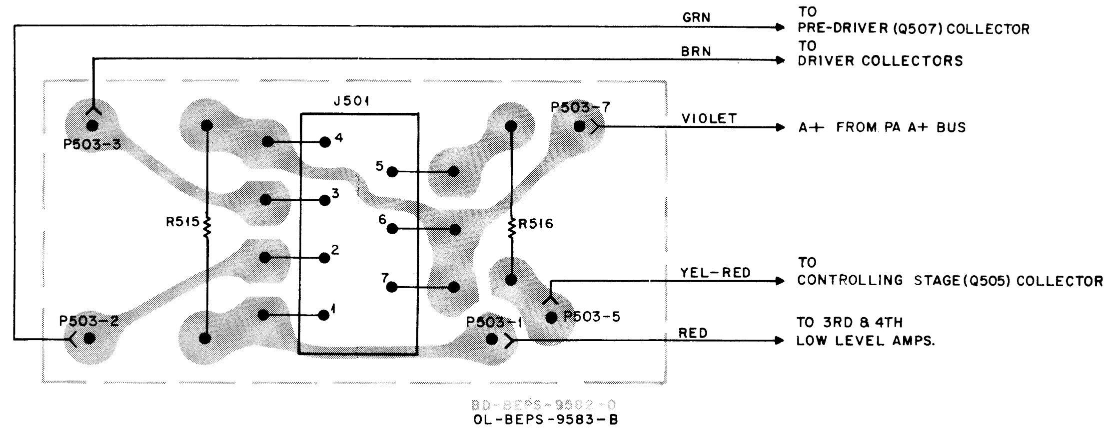
406-420MHZ LOW LEVEL AMPLIFIERS AND PA METERING BOARD



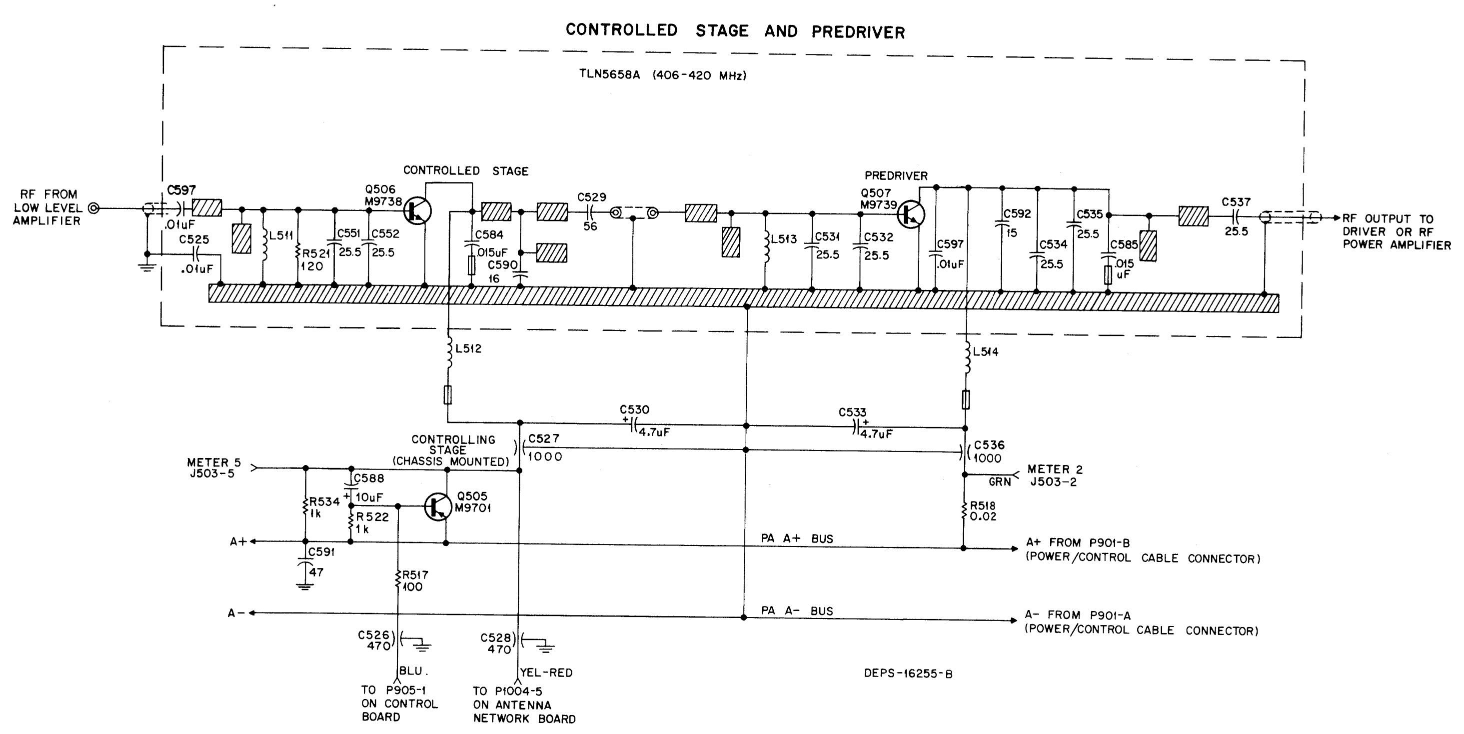
MODEL	CAPACITOR		
NUMBER	C509	C529	C591
TLE8061A TLE8071A	NOT USED	NOT USED	NOT USED
TLE8063A TLE8073A	3.3 pF	28 pF	3.3 uF
TLE8064A TLE8074A	3.3 pF	28 pF	NOT USED
TLE8065A TLE8075A	3.3 pF	28 pF	NOT USED

EPS-19705-A

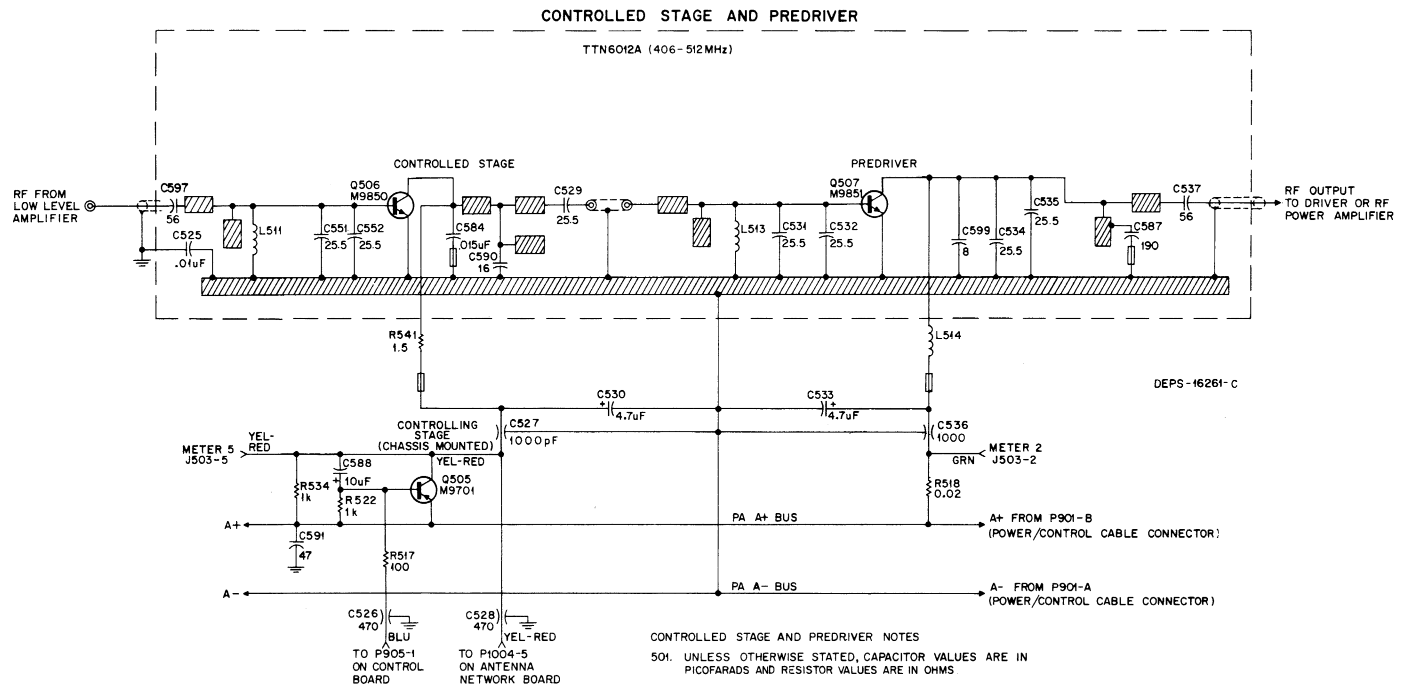
P. A. METERING BOARD



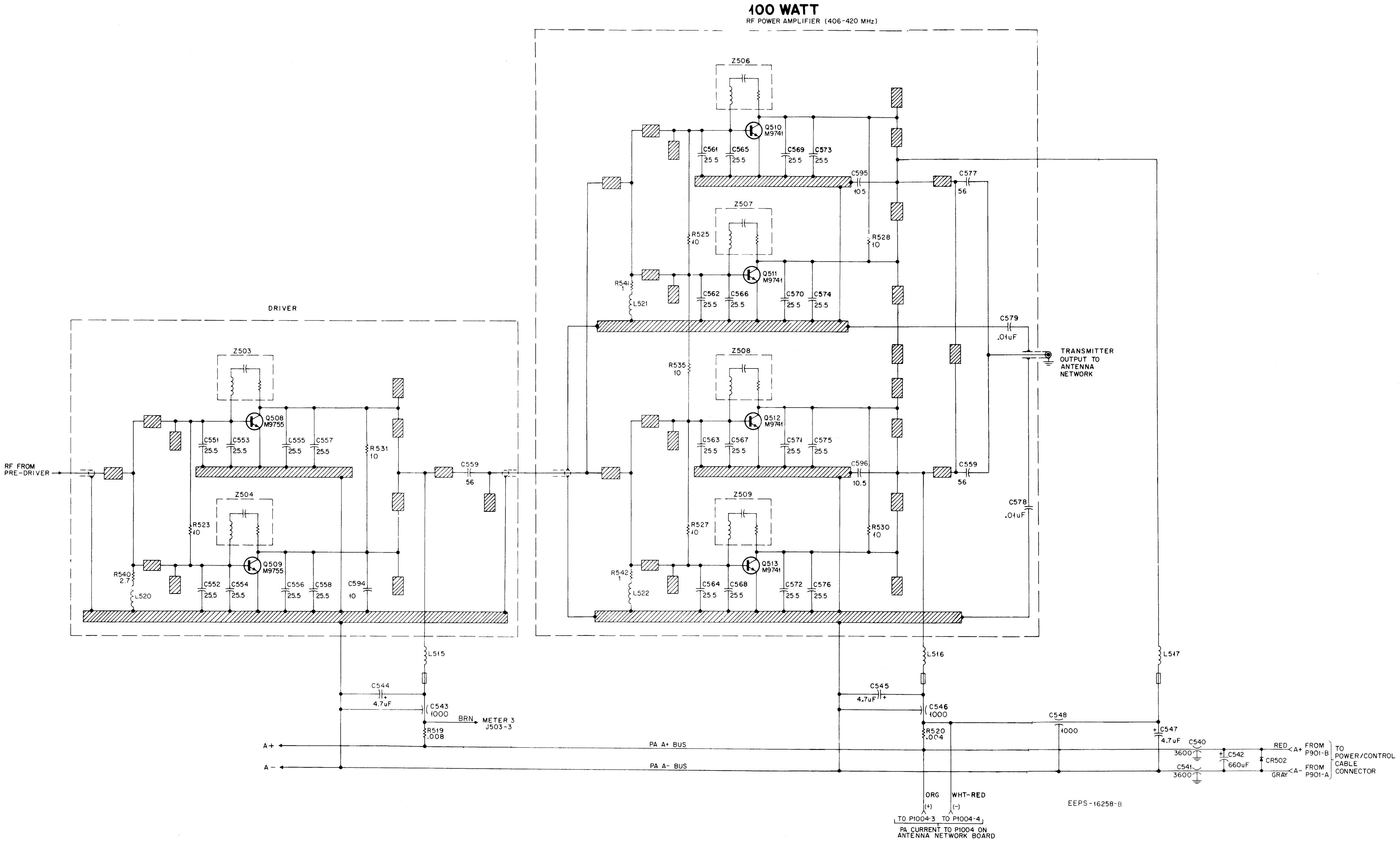
EARLIER MODEL

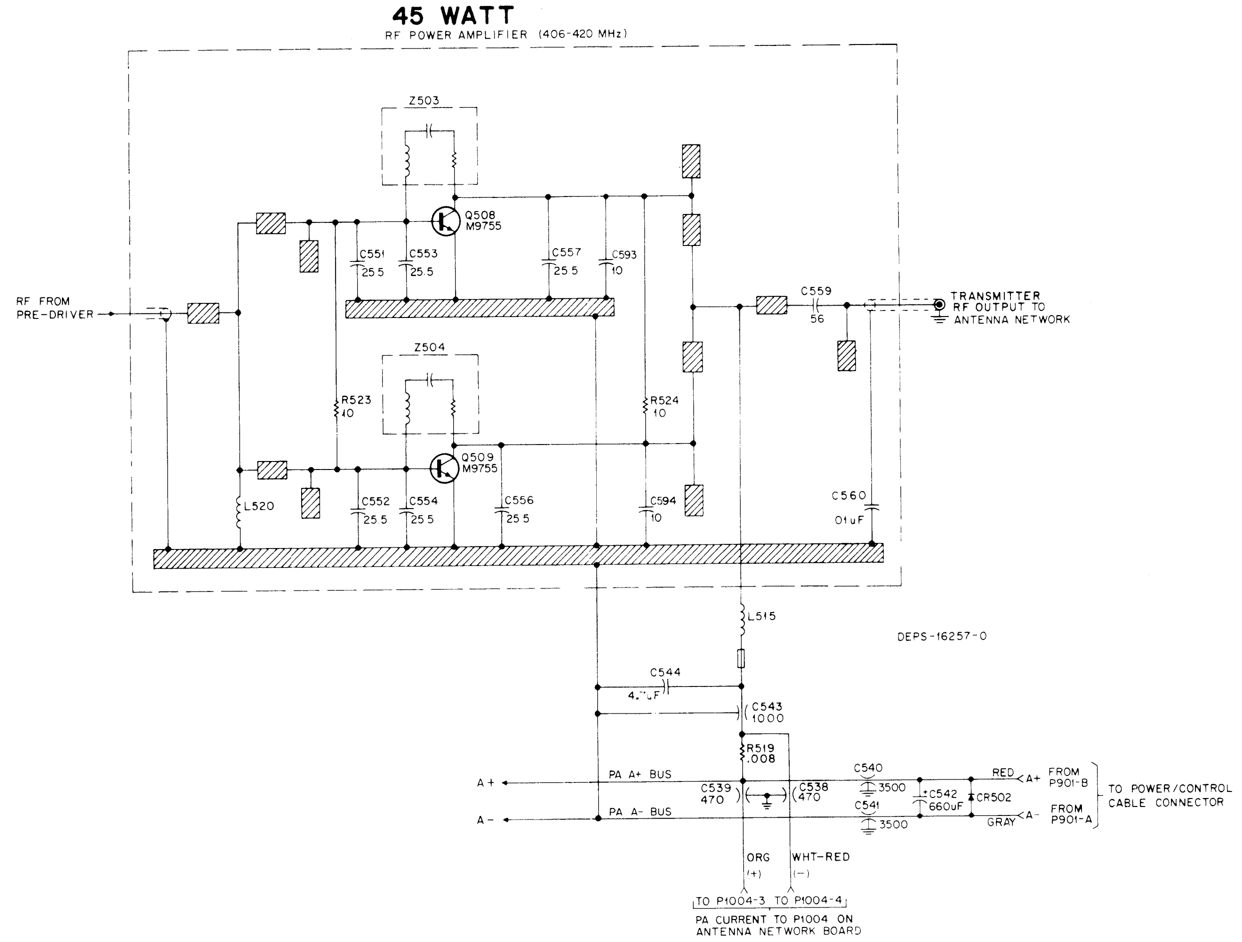


LATER MODEL



406-420 MHz Low-Level Amplifier, PA Metering, and Controlled Stage & Predriver Schematic Diagrams and Circuit Board Details
Motorola No. PEPS-16256-C
4/27/77-UP

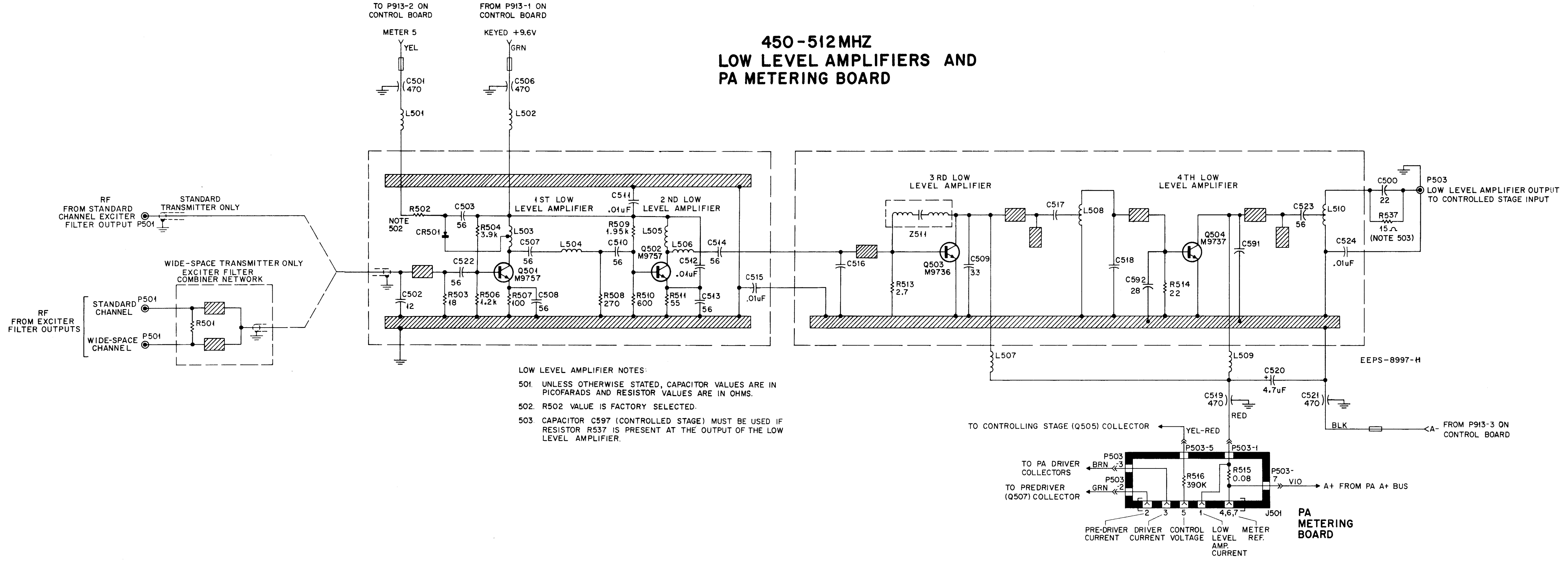




45 AND 100 WATT POWER AMPLIFIERS (406-420 MHz)/LOW LEVEL AMPLIFIER (450-512 MHz), PA METERING, AND CONTROLLED STAGE & PREDRIVER

406-420 MHz 45-Watt and 100-Watt Power Amplifiers
Schematic Diagrams
Motorola No. PEPS-16259-C
9/29/78-UP

450-512 MHZ LOW LEVEL AMPLIFIERS AND PA METERING BOARD



LOW LEVEL AMPLIFIER NOTES

501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS AND RESISTOR VALUES ARE IN OHMS.

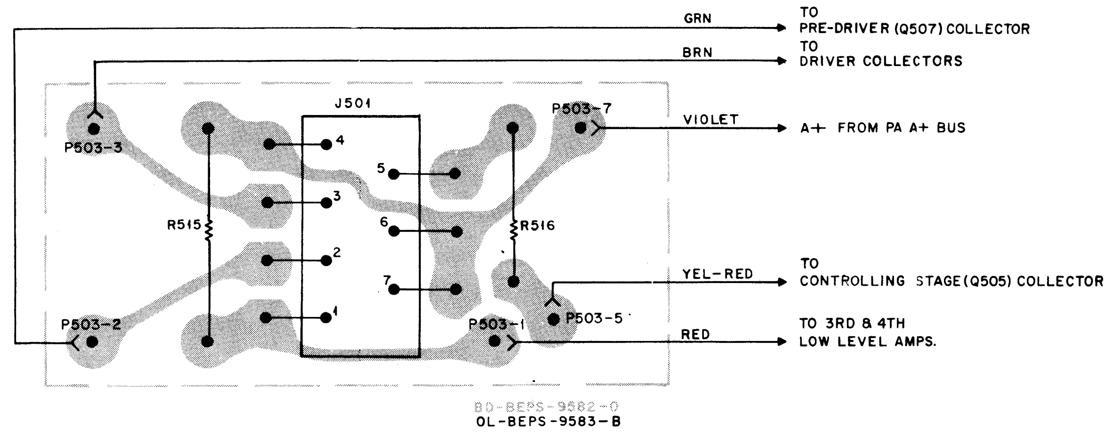
502. R502 VALUE IS FACTORY SELECTED.

503. CAPACITOR C597 (CONTROLLED STAGE) MUST BE USED IF RESISTOR R537 IS PRESENT AT THE OUTPUT OF THE LOW LEVEL AMPLIFIER.

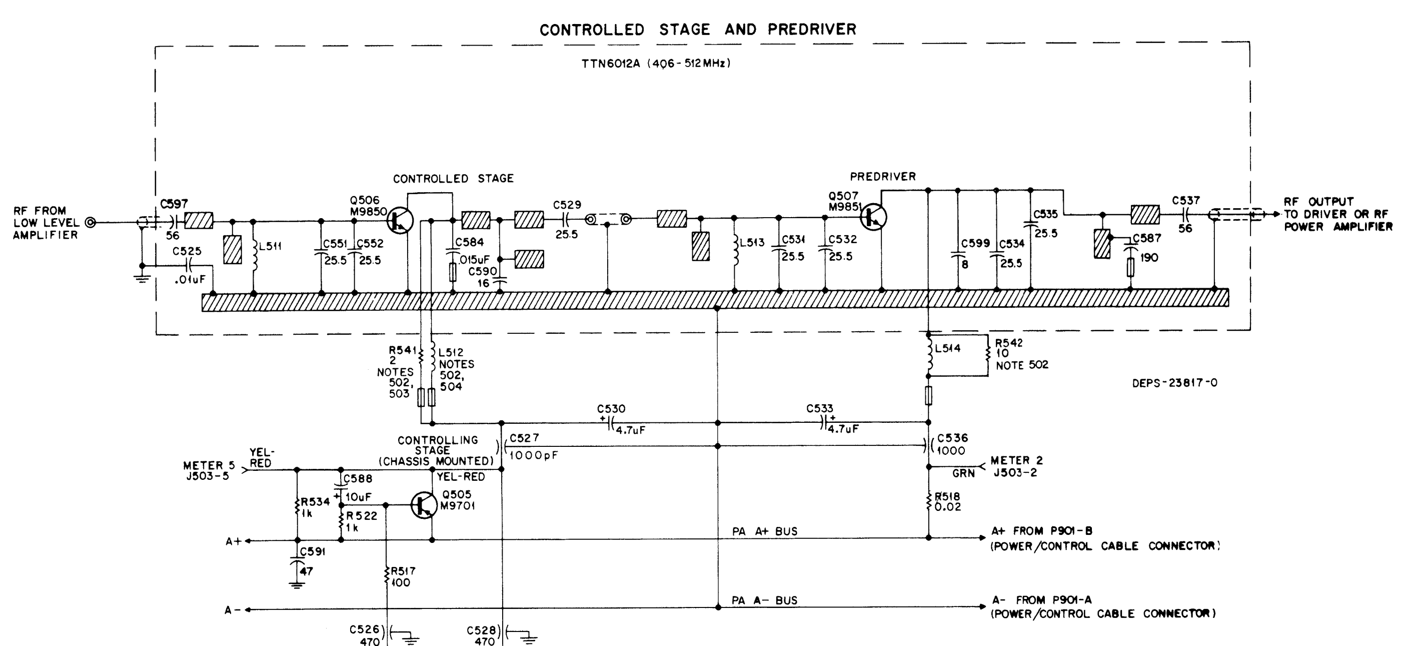
MODEL NUMBER	CAPACITOR		
	C509	C529	C591
TLE8061A TLE8071A	NOT USED	NOT USED	NOT USED
TLE8063A TLE8073A	3.3 pF	28 pF	3.3 uF
TLE8064A TLE8074A	3.3 pF	28 pF	NOT USED
TLE8065A TLE8075A	3.3 pF	28 pF	NOT USED

EPS–19705–A

P. A. METERING BOARD



LATER MODEL



CONTROLLED STAGE AND PREDRIVER NOTES:

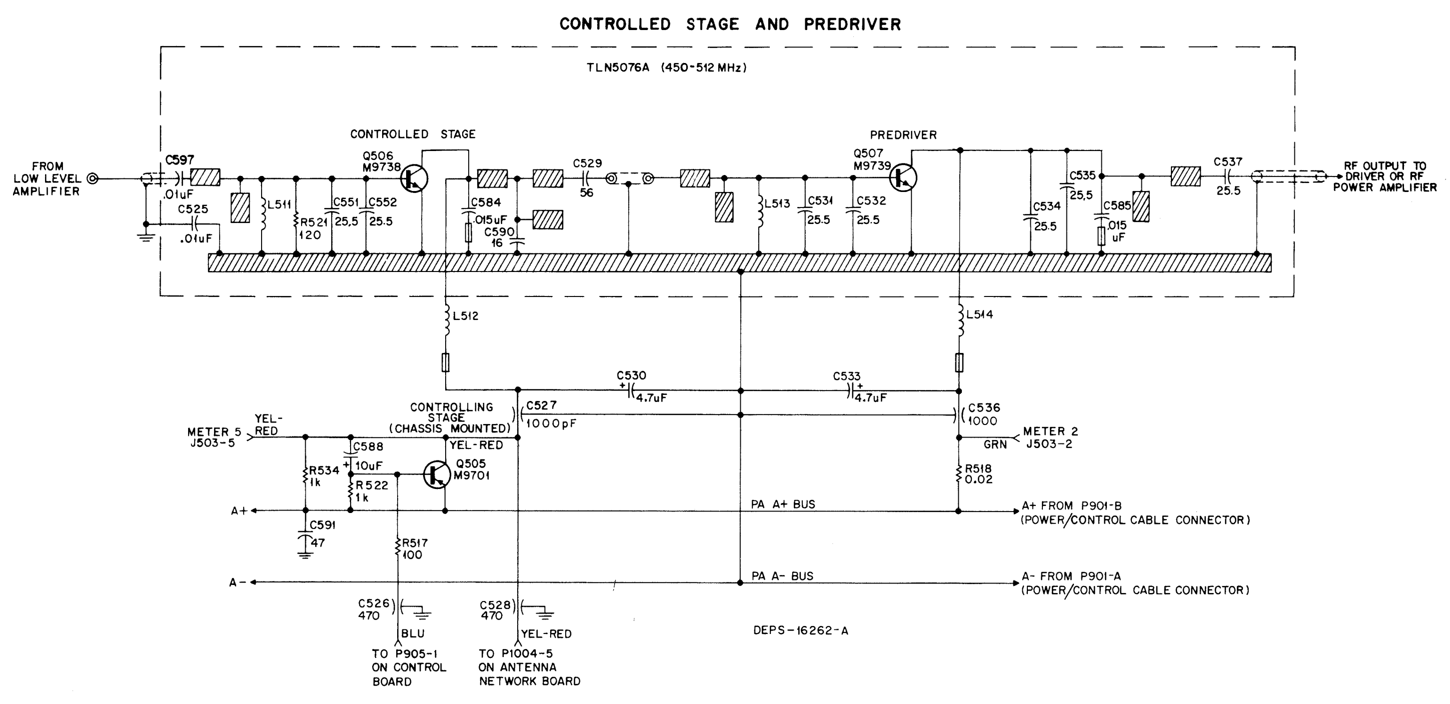
501. UNLESS OTHERWISE STATED, CAPACITOR VALUES ARE IN PICOFARADS AND RESISTOR VALUES ARE IN OHMS.

502. USED IN 450-512 MHz ONLY.

503. USED IN 25W AND 75W MODELS ONLY.

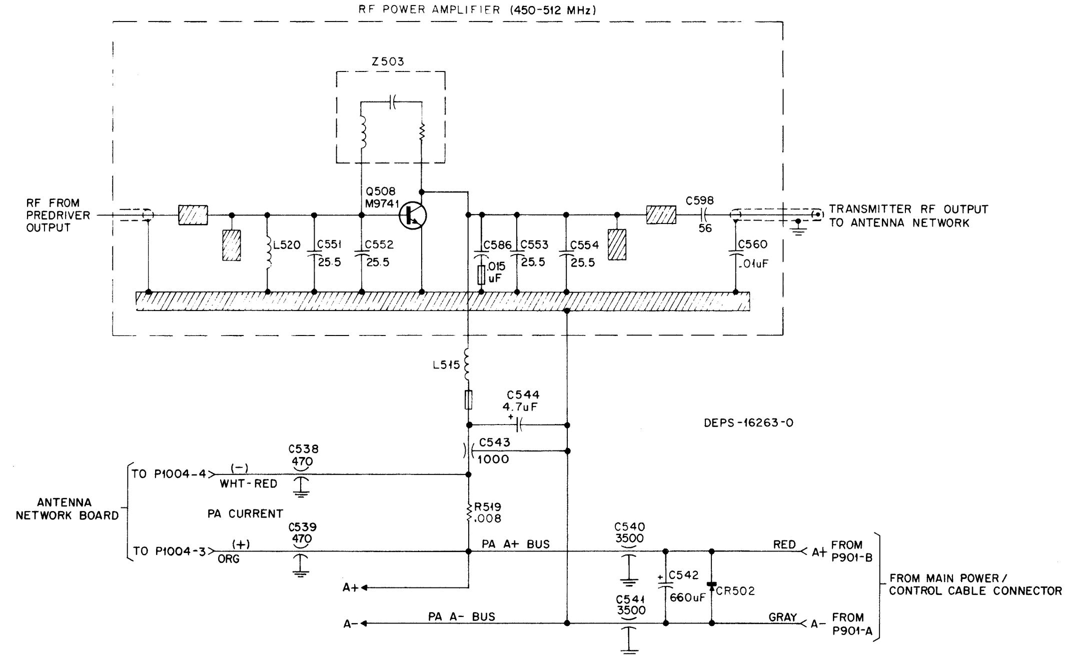
504. USED IN 45W AND 100W MODELS ONLY.

EARLIER MODEL

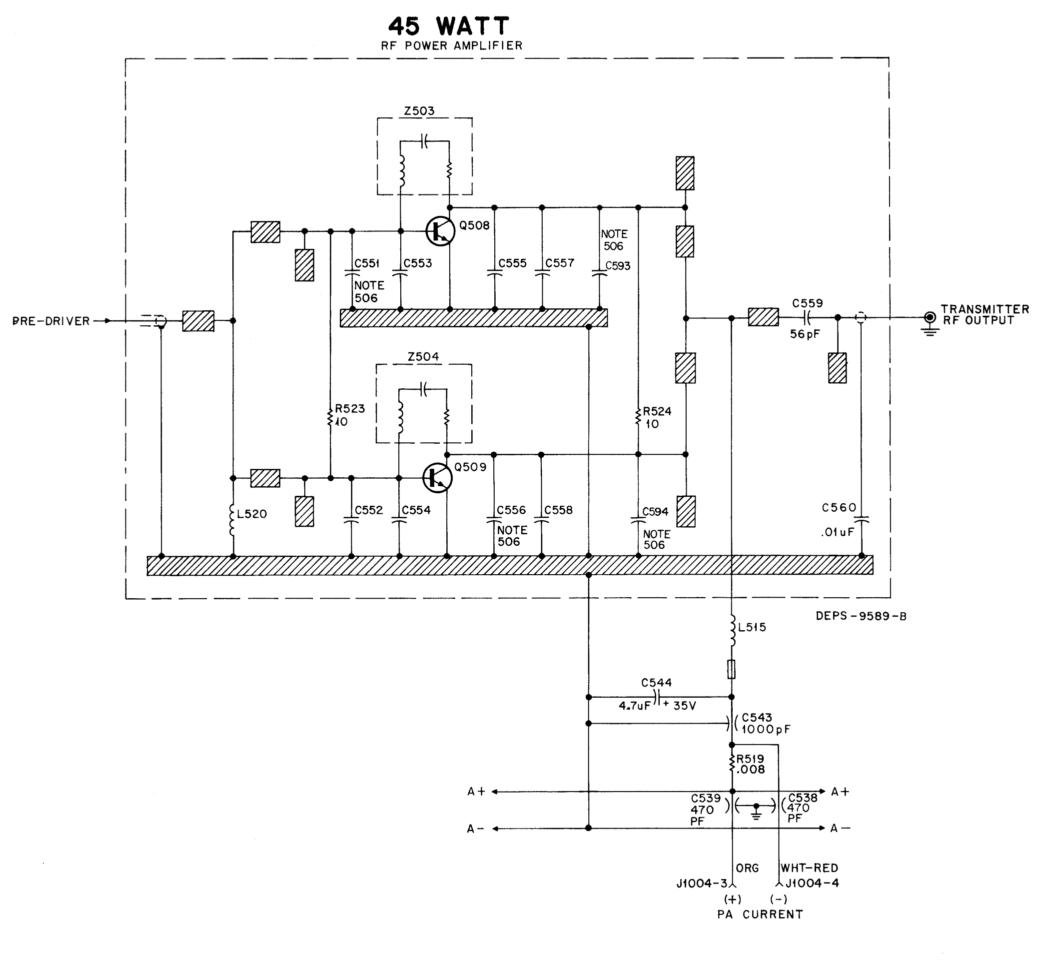


25 WATT

RF POWER AMPLIFIER (450-512 MHz)

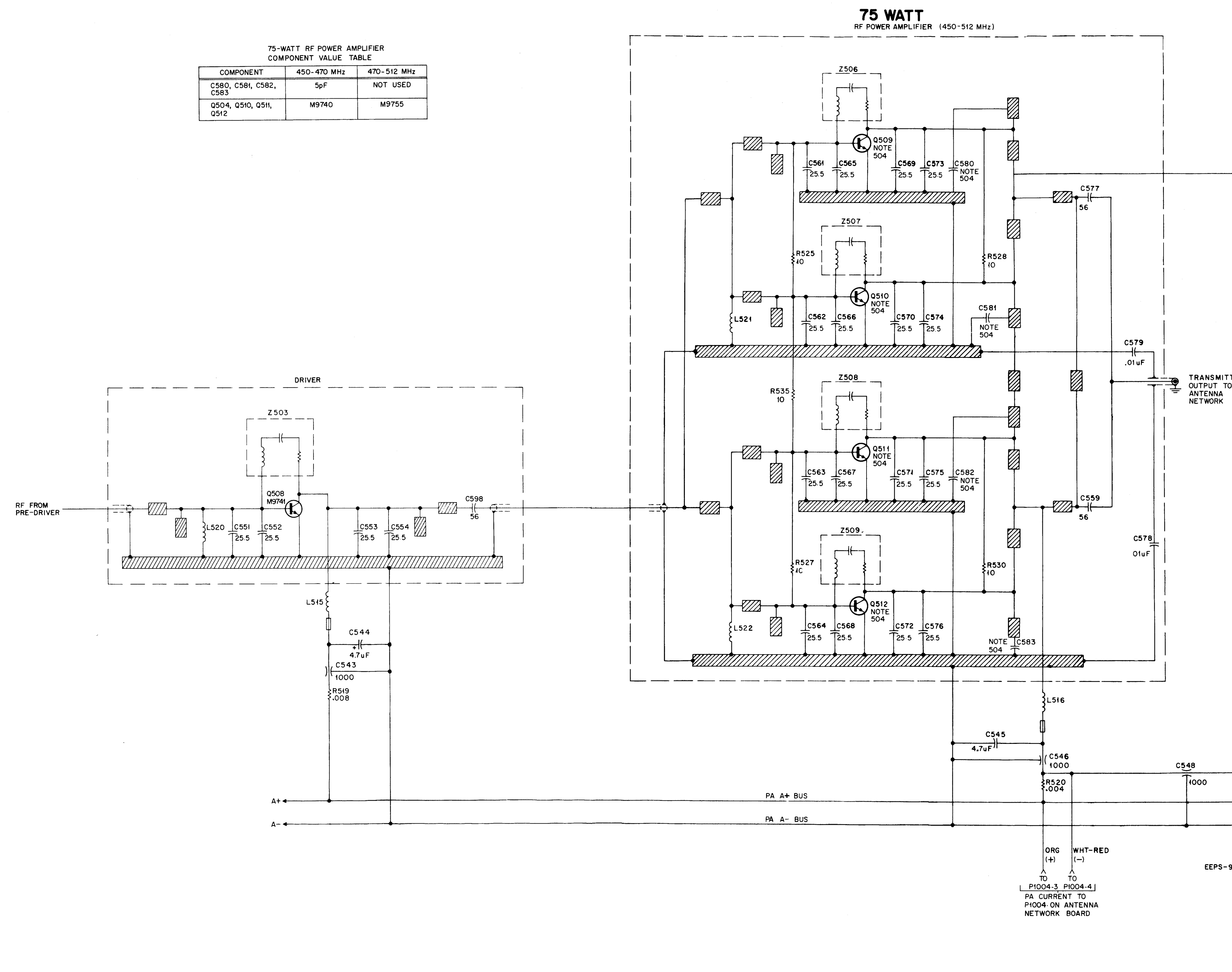


450-512 MHz Low-Level Amplifier, PA Metering Board, Controlled Stage & Predriver, and 25-Watt Power Amplifier Schematic Diagrams and Circuit Board Details
Motorola No. PEPS-16264-C
4/27/77-UP



75-WATT RF POWER AMPLIFIER
COMPONENT VALUE TABLE

COMPONENT	450-470 MHz	470-512 MHz
C580, C581, C582, C583	5pF	NOT USED
Q504, Q510, Q511, Q512	M9740	M9755

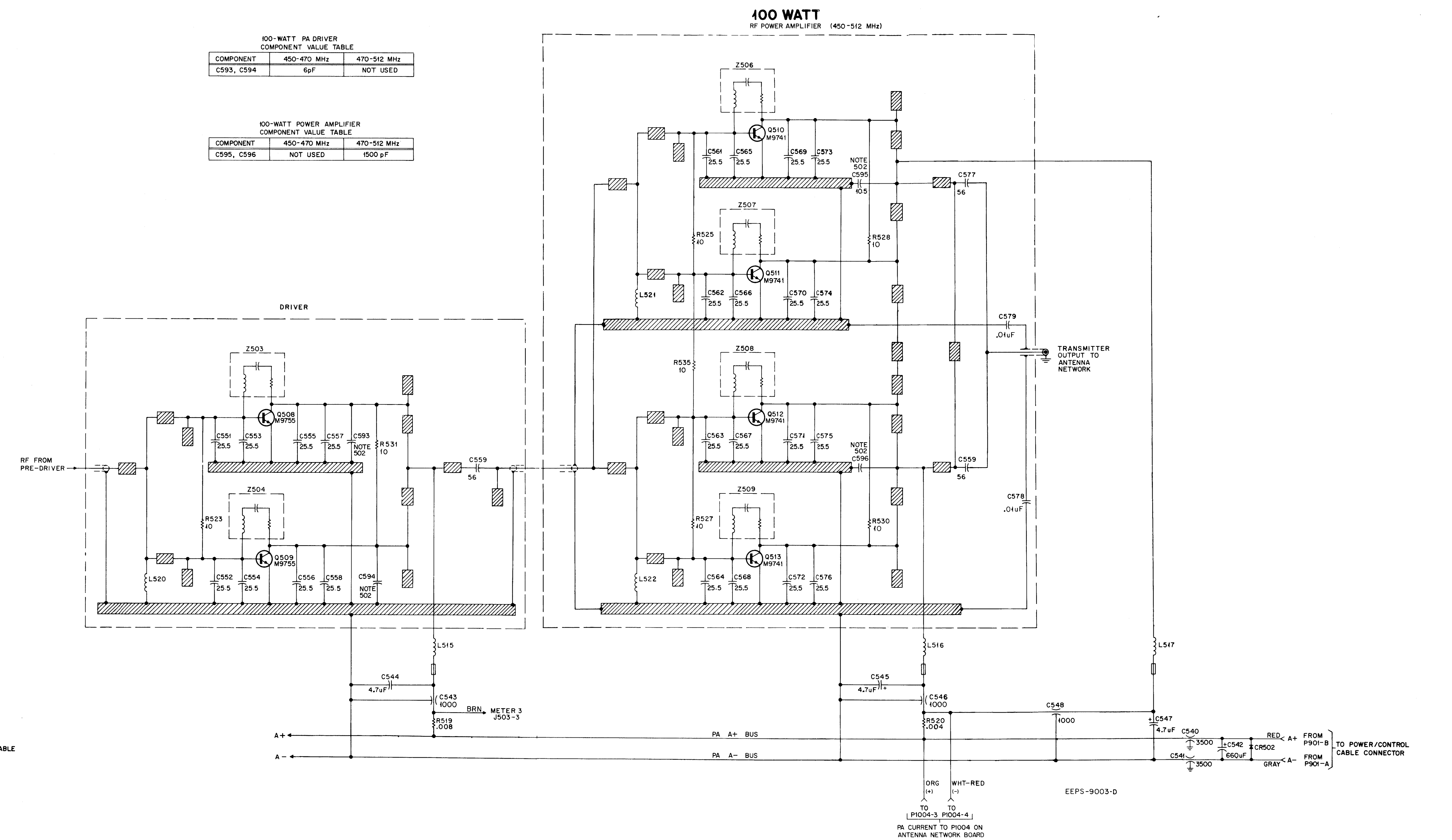


100-WATT PA DRIVER
COMPONENT VALUE TABLE

COMPONENT	450-470 MHz	470-512 MHz
C593, C594	6pF	NOT USED

100-WATT POWER AMPLIFIER
COMPONENT VALUE TABLE

COMPONENT	450-470 MHz	470-512 MHz
C595, C596	NOT USED	1500 pF



POWER AMPLIFIER 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
RESISTOR VALUES ARE IN OHMS.
504. FOR COMPONENT VALUES NOT STATED ON THE SCHEMATIC DIAGRAM, REFER TO THE ACCOMPANYING TABLE.
505. FILTER AND REVERSE VOLTAGE PROTECTION CIRCUITRY COMMON TO ALL POWER AMPLIFIERS.
506. SEE PARTS LIST FOR VALUES.

NEPS-9669-C

PARTS LIST

LOW LEVEL AMPLIFIER

Standard*
TLE8061A (406-420 MHz) L
TLE8063A (450-470 MHz) M
TLE8064A (470-494 MHz) H
TLE8065A (494-512 MHz) HH

Wide-Spaced*
TLE8071A (406-420 MHz) L
TLE8073A (450-470 MHz) M
TLE8074A (470-494 MHz) H
TLE8075A (494-512 MHz) HH

PL-1912-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C500L	21-82610C03	47 pF ±5%; 200 V; N220
C500M, H, HH	21-124554	22 pF ±5%; 500 V; NP0
C501, 506, 519, 521	21-821474	470 pF ±20%; 500 V
C502L	21-84873H22	16 pF ±5%; 50 V; NP0
C502M, H, HH	21-84873H20	12 pF ±5%; 50 V; NP0
C503L, 507L, 508L, 510L, 513L, 514L, 517L, 522L, 523L	21-05157A07	100 pF ±20%; 50 V
C503M, H, HH, 507M, H, HH, 508M, H, HH, 510M, H, HH, 513M, H, HH 514M, H, HH, 522M, H, HH, 523M, H, HH	21-84873H17	56 pF ±10%; 50 V; NP0
C509M, H, HH, 591M	21-84873H01	3.3 pF ±0.5 pF; 50 V; NP0
C511, 512, 515, 524	21-84547A05	.01 uF ±20%; 50 V; Y5F
C516L	21-84873H22	16 pF ±5%; 50 V; NP0
C516M	21-84873H18	22 pF ±5%; 50 V; NP0
C516H, 517H, 517HH	21-84736E05	16 pF ±5%; 50 V (BLK)
C517M	21-84736E10	25.5 pF ±5%; 50 V (RED)
C518M	21-84873H18	22 pF ±5%; 50 V; NP0
C518H, HH	21-84736E04	5.1 pF ±0.25 pF; 50 V
C520	23-82783B11	4.7 uF ±20%; 35 V
C592M, H, HH	21-84736E06	28 pF ±5%; 50 V (ORG)
		DIODE: (SEE NOTE)
CR501	48-84616A01	hot-carrier
		COIL, RF:
L501L, 502L, 507L, 509L	24-82723H07	choke; 10 uH
L501M, H, HH, 502M, H, HH	24-84813E01	choke; GRAY
L507M, H, HH, 509M, H, HH	24-84813E02	choke; PURPLE
		TRANSISTOR: (SEE NOTE I)
Q501, 502	48-869757	NPN; type M9757
Q503	48-869736	NPN; type M9736 (SEE NOTE II)
Q504	48-869737	NPN; type M9737 (SEE NOTE III)
		RESISTOR, fixed:
R502		factory-selected
R513	6-124B55	2.7k ±5%; 1/4 W
R514	6-124C09	22 ±10%; 1/4 W
R537M, H, HH	6-185B57	15 ±10%; 1/8 W
		SUPPRESSOR:
Z501M, H, HH	1-80739B47	parasitic

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEMS		
	1-80754B10	HYBRID AMPLIFIER (Class "A") TLE8061A, TLE8071A only
	1-80747B12	HYBRID AMPLIFIER (Class "A") TLE8063A, TLE8073A only
	1-80739B02	HYBRID AMPLIFIER (Class "A") TLE8064A, TLE8065A, TLE8074A and TLE8075A only
	1-80754B11	HYBRID AMPLIFIER (Class "C") TLE8061A, TLE8071A only
	1-80739B49	HYBRID AMPLIFIER (Class "C") TLE8063A, TLE8073A only
	1-80739B54	HYBRID AMPLIFIER (Class "C") TLE8064A, TLE8065A, TLE8074A and TLE8075A only
	1-80739B04	COMBINER NETWORK: TLE8071A, TLE8073A, TLE8074A and TLE8075A only
	42-84495E01	PLASTIC HOLDER, microstrip
	28-84227B01	CONNECTOR, male; phono type
	76-84069B09	FERRITE BEAD: TLE8061A and TLE8071A only
	76-84069B01	FERRITE BEAD: TLE8063A, TLE8064A, TLE8065A, TLE8073A, TLE8074A and TLE8075A
	30-84117G01	CABLE, coaxial (solid)

NOTES:
I. Replacement diodes and transistors must be ordered by Motorola part numbers for optimum performance.
II. Order PK791 Kit for replacement.
III. Order PK792 Kit for replacement.

PA METERING BOARD

PL-3129-O

		RESISTOR, fixed:
R515	17-82350A12	0.08 ±10%; 1 W
R516	6-128682	390k ±10%; 1/4 W
NON-REFERENCED ITEM		
	1-80734B64	PA METERING BOARD AS ASSEMBLY: includes J501, R515, R516

CONTROLLED STAGE & PREDRIVER

TLN5658A Microstrip Kit **(406-420 MHz)
TLN5076A Microstrip Kit **(450-512 MHz)
TTN6012A Microstrip Kit **(450-512 MHz) PL-1890-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR; fixed:
C525	21-84547A05	0.01 uF ±5%; 50 V
C526, 528	21-821474	470 pF ±20%; 500 V; coded YEL-VIO-BRN
C527, 536	21-861219	1000 pF +100-0%; 500 V; coded RED dot
C529	21-84736E31	56 pF ±10%; 50 V (TLN5658A and TLN5076A only)
	21-84736E10	25.5 pF ±5%; 50 V (TTN6012A only)
C530, 533, 591	23-82783B11	47 uF ±20% 35 V
C531, 532, 534 535, 551, 552	21-84736E10 or 21-84736E06	25.5 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
C537	21-84736E10	25.5 pF ±5%; 50 V (TLN5658A and TLN5076A only)
	21-84736E31	56 pF ±10%; 50 V (TTN6012A only)
C584, 585	8-82905G15	0.015 uF ±10%; 100 V
C587	21-848978	190 pF ±3%; silver mica
C588	23-83214C20	10 uF; 20 V
C590	21-84366F02	16 pF ±5%; 250 V
C592	21-859936	15 pF ±5%; 500 V
C597	21-832501	0.01 uF +80-20%; 250 V (TLN5658A & TLN5076A only)
	21-84873H26	56 pF ±10%; 50 V (TTN6012A only)
C599	21-851846	8 pF ±0.25 pF;NP0(TTN6012A)
		COIL, RF:
L511, 513	24-83977B02	choke; 2 1/2 turns through ferrite core
L512, 514	24-84346A03	choke; 6 turns; sleeved
		TRANSISTOR (NOTE 1)
Q505	48-869701	PNP; type M9701; does not include 14-83575A01 insulator, transistor mounting
Q506	48-869738	NPN; type M9738 (TLN5658A and TLN5076A only)
	48-869850	NPN; type M9850 (TTN6012A only)
Q507	48-869739	NPN; type M9739 (TLN5658A and TLN5076A only)
	48-869851	NPN; type M9851 (TTN6012A only)
		RESISTOR, fixed:
R517	17-82291B21	100 ohm ±5%; 3 W
R518	17-82620B03	0.02 ohm ±10%; 3 W
R521	6-5551	120 ohm ±10%; 1/2 W
R522, 534	6-127802	1k ±10%; 1/4 W
R541L	17-82991B40	1.5 ±5%; 5 W
R541M, H	17-82291B39	2.0 ohm ±5%; 5 W
R542L		NOT USED
R542M, H	6-869851	10 ohm ±10%; 1/2 W
		SOCKET, transistor:
XQ505	9-83662A01	female; 2-contact
NON-REFERENCED ITEMS		
		MICROSTRIPS:
	1-80754B01	input (TLN5658A only)
	1-80739B05	input (TLN5076A only)
	1-80769B98	input (TTN6012A only)
	1-80754B02	output (TLN5658A only)
	1-80739B06	output (TLN5076A only)
	1-80769B99	output (TTN6012A only)
	42-84470E01	MICROSTRIP HOLDER/ INSULATOR
	42-84473E02	GROUND STRAP: 0.358" wide
	42-84473E03	GROUND STRAP: 0.250" wide
	76-84069B01	FERRITE BEAD

PA DRIVER MICROSTRIP KITS

(For items not listed here, refer to PA COMPONENT KIT parts lists.)

75 W PA DRIVER

TLN5080A ** Microstrip kit (450-512 MHz) PL-1894-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C551 thru 554	21-84736E32 or 21-84736E06	27 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
		TRANSISTOR: (SEE NOTE I)
Q508	48-869741	NPN; type M9741
NON-REFERENCED ITEMS		
	1-80739B15	MICROSTRIP (input)
	1-80739B16	MICROSTRIP (output)

100 W PA DRIVER

TLN5660A Microstrip Kit **(406-420 MHz)
TLN5084A Microstrip Kit **(450-512 MHz) PL-1898-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C551 thru 558	21-84736E32	27 pF ±5%; 50 V; P90
		TRANSISTOR: (SEE NOTE I)
Q508, 509	48-869755	NPN; type M9755
NON-REFERENCED ITEMS		
		MICROSTRIPS
	1-80754B03	input (406-420 MHz)
	1-80754B09	output (406-420 MHz)
	1-80739B11	input (450-512 MHz)
	1-80739B13	output (450-512 MHz)

PA MICROSTRIP KITS

(For items not listed here, refer to PA COMPONENT KIT parts lists)

25 W PA

TLN5078A Microstrip Kit **(450-512 MHz) PL-1892-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C551 thru 554	21-84736E32 or 21-84736E06	27 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
C560	21-84547A05	.01 uF ±20%; 50 V
C598	21-84736E31	56 pF; ±10%; 50 V
		TRANSISTOR: (SEE NOTE I)
C508	48-869741	NPN; type M9741
NON-REFERENCED ITEMS		
	1-80739B15	MICROSTRIP (input)
	1-80739B35	MICROSTRIP (output)

45 W PA

TLN5659A Microstrip Kit **(406-420 MHz)
TLN5082A Microstrip Kit **(450-512 MHz) PL-1896-E

		CAPACITOR, fixed:
C551-554, 556, 557	21-84736E32 or 21-84736E06	27 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
C560	21-84547A05	.01 uF ±20%; 50 V
		TRANSISTOR: (SEE NOTE I)
Q508, 509	48-869755	NPN; type M9755
NON-REFERENCED ITEMS		
		MICROSTRIPS
	1-80754B03	input (406-420 MHz)
	1-80754B04	output (406-420 MHz)
	1-80739B11	input (450-512 MHz)
	1-80739B12	output (450-412 MHz)

75 W PA

TLE8202A Microstrip Kit**(450-470 MHz) PL-2009-E

		CAPACITOR, fixed:
C561 thru 576	21-84736E32 or 21-84736E06	27 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
		TRANSISTOR: (SEE NOTE I)
Q509 thru 512	48-869740	NPN; type M9740
NON-REFERENCED ITEMS		
	1-80739B27	MICROSTRIP (input; front)
	1-80739B28	MICROSTRIP (input; rear)
	1-80739B21	MICROSTRIP (output; front)
	1-80739B22	MICROSTRIP (output; rear)

75 W PA

TLE8203A Microstrip Kit **(470-512 MHz) PL-1900-E

		CAPACITOR, fixed:
C561 thru 576	21-84736E32	27 pF ±5%; 50 V; P90
		TRANSISTOR: (SEE NOTE I)
Q509 thru 512	48-869755	NPN; . type M9755
NON-REFERENCED ITEMS		
	1-80739B27	MICROSTRIP (input; front)
	1-80739B28	MICROSTRIP (input; rear)
	1-80739B29	MICROSTRIP (output; front)
	1-80739B30	MICROSTRIP (output; rear)

100 W PA

TLN5661A Microstrip kit **(406-420 MHz)
TLN5088A Microstrip kit **(450-512 MHz) PL-1902-D

		CAPACITOR, fixed:
C561 thru 576	21-84736E32 or 21-84736E06	27 pF ±1 pF; 50 V; P120 28 pF ±5%; 50 V; P90
		TRANSISTOR: (SEE NOTE I)
Q510 thru 513	48-869741	NPN; type M9741
NON-REFERENCED ITEMS		
		MICROSTRIPS (406-420 MHz)
	1-80754B05	input (front)
	1-80754B07	input (rear)
	1-80754B06	output (front)
	1-80754B08	output (rear)
		MICROSTRIPS (450-512 MHz)
	1-80739B27	input (front)
	1-80739B28	input (rear)
	1-80739B29	output (front)
	1-80739B30	output (rear)

**These kits cannot be ordered. Order the individual parts listed in the parts list.

PA COMPONENTS KITS

25 & 45 W PA

TLE8082A **(25 W)
TLE8091A **(45 W; 406-420 MHz)
TLE8092A **(45 W; 450-512 MHz)

PL-1907-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C538, 439	21-821474	470 pF ±20%; 500 V; coded YEL-VIO-BRN
C540, 541	21-84211B03	3500 pF +100-0%; 500 V @ 85° C
C542	23-83210A22	660 uF +150-10%; 25 V
C543	21-861219	1000 pF +100-0%; 500 V; coded RED dot
C544	23-82783B11	4.7 uF ±20%; 35 V
C559, 598	21-84736E31	56 pF ±10%; 50 V
C586	8-82905G15	.015 uF ±10%; 100 V
C591	21-859211	47 pF ±5%; 300 V
C593, 594	21-84494B29	10 pF ±5%; 500 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR502	48-82525G13	silicon
		COIL, RF: choke:
L515	24-84346A03	6 turns; sleeved
L520	24-83977B02	2-1/2 turns thru ferrite core
		CONNECTOR, plug: coaxial:
P501	28-84282D01	male; miniature type
P502	9-84886E01	female; right-angle; sub-miniature bayonet type
		RESISTOR, fixed:
R519	6-84605E01	meter shunt; .008 ±1%
R521	6-5551	120 ±10%; 1/2 W
R522	6-10401C49	1k ±10%; 1/4 W
R523, 524	6-5621	10 ±10%; 1/2 W
		LINE, RF transmission:
W501	1-80734B38	includes P501 and 30-859004 CABLE, RF: coaxial; type RG-188/U; 4" length required
W502	1-80734B40	includes 30-82921H01 CABLE, RF: coaxial; 7" length required
W503	30-83693F01	consists of a 1/2" length of solid rf coaxial cable, processed
		FILTER, parasitic suppressor:
Z503, 504	51-84312B59	hybrid
NON-REFERENCED ITEMS		
	42-84470E01	MICROSTRIP HOLDER/ INSULATOR
	42-84473E02	GROUND STRAP: 0.385" wide
	42-84473E03	GROUND STRAP: 0.250" wide
	76-84069B01	FERRITE BEAD
	1-80734B37	BUSS BAR
	42-84930G01	RETAINER, shield
	14-84430G01	INSULATOR, mylar

75 & 100 W PA

75 W & 100 W PA Components Kits
TLE8102A **(75 W; 450-512 MHz)
TLE8111A **(100 W; 406-420 MHz)
TLE8112A **(100 W; 450-470 MHz)
TLE8113A **(100 W; 470-512 MHz)

LEGEND:
L = 406-420 MHz
M = 450-470 MHz
H = 470-512 MHz

PL-1910-H

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C543, 546, 548	21-861219	1000 pF +100-0%; 500 V; coded RED dot
C544, 545, 547	23-82783B11	4.7 uF ±20%; 35 V
C559, 577, 598	21-84736E31	56 pF ±10%; 50 V
C578, 579	21-84547A05	0.01 uF ±20%; 50 V
C580 thru 583	21-84736E07	5.1 pF ±.25 pF; 50 V
C586	8-82905G15	0.015 uF ±10%; 100 V
C593L, 594L	21-84494B29	10 pF ±5%; 500 V
C593M, 594M	21-83107B07	6 pF ±0.5 pF; 500 V
C595L, 596L	21-82877B11	10.5 pF ±5%; 250 V
C595H, 596H	21-82187B11	1500 pF ±10%; 100 V
		COIL, rf choke:
L515, 516, 517	24-84346A03	6 turns; sleeved
L520M, 520H	24-83977B02	2-1/2 turns thru ferrite core
L520L,	24-83884G01	3-1/2 turns; coded RED
L521, 522	24-83884G01	3-1/2 turns; coded RED
		CONNECTOR, plug: coaxial:
P501	28-84282D01	male; miniature type
P502	9-84886E01	female; right-angle; sub-miniature bayonet type
		RESISTOR, fixed:
R517	17-82291B21	100-ohm ±5%; 3 W
R519	6-84605E01	meter shunt; .008 ±1%
R520	6-84606E01	meter shunt; .004 ±1%
R523, 525, 527 528, 530, 531 535, 536	6-5621	10 ±10%; 1/2 W
R540	6-125D55	2.7 ±5%; 1/2 W
R541, 542	6-125D70	1 ±5%; 1/2 W
		LINE, RF transmission:
W501	1-80748B40	includes P501 and 30-859004 CABLE, RF: coaxial; type RG-188/U 4" length required
W502	1-80734B40	includes 30-82921H01 CABLE, RF; coaxial; 7" length required
W503	30-83693F01	consists of a 1/2" length of solid rf coaxial cable, processed
		FILTER, parasitic suppressor:
Z503, 504, 506, 507, 508, 509	51-84312R59	hybrid
NON-REFERENCED ITEMS		
	42-84470E01	MICROSTRIP HOLDER/INSU-LATOR
	42-84473E02	GROUND STRAP: 0.385" wide
	42-84473E03	GROUND STRAP: 0.250" wide
	76-84069B01	FERRITE BEAD
	42-84473E01	GROUND STRAP
	1-80734B37	BUSS BAR
	42-84930G01	RETAINER, shield
	14-84430G01	INSULATOR, mylar
	7-84631E01	BRACKET, strain-relief (For W502)

ANTENNA SWITCHING NETWORK

TFE6221A Antenna Switch Network (406-420 MHz)
TFE6223A Antenna Switch Network (450-470 MHz)
TFE6224A Antenna Switch Network (470-494 MHz)
TFE6225A Antenna Switch Network (494-512 MHz)
TFE6331A Antenna Switch Network (406-420 MHz)
TFE6333A Antenna Switch Network (450-470 MHz) PL-4484-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1001, 1002, 1003	21-821474	470 pF ±20%; 500 V (feedthru type)
C1004		NOT USED
C1005	21-82785H56	5 pF ±0.5 pF; 850 V
C1006	21-82989E67	5.5 pF ±.25 pF; 500 V
C1007, 1008	21-82355B62	1 pF ±.25 pF; 500 V
C1009, 1010, 1011	19-84774E01	variable: 2.04 to 9.9 pF; 250 V
C1012 thru 1015		NOT USED
C1016, 1017	21-821474	470 pF ±20%; 500 V (feedthru type)
		DIODE: (SEE NOTE)
CR1001, 1002	48-84616A01	hot carrier
CR1003, 1004	48-82392B12	silicon
		CIRCULATOR:
E1001	-	(See Note III)
		LOW PASS FILTER:
FL1001	-	(See Note III)
		RELAY, reed:
K1001	1-80747B76	(See Note II)
		COIL, rf:
L1001, 1002	24-82723H04	0.29 uH
		CONNECTOR, plug:
P1001	28-84884E02	coaxial, male
P1002	-	(See Note III)
P1003	28-84282D01	phono, male
		TRANSISTOR: (SEE NOTE I)
Q1001	48-869640	NPN; type M9640
		RESISTOR, fixed: ±5%; 1/4 W: unless otherwise stated
R1001	6-124A03	12
R1002, 1003		NOT USED
R1004	6-124A49	1k
R1005	-	(See Note III)

NOTES:
I. For optimum performance replacement diodes and transistors must be ordered by Motorola part numbers.

II. Field service of K1001 not recommended, must be replaced as a unit.

III. Field replacement of E1001, FL1001, P1002 and R1005 not recommended. For replacement, order the entire unit. Specify kit number and frequency range required.

HARDWARE KIT

Hardware Kit

For Standard Transmitter Radio Sets
TLN5096A/B (Carrier Squelch)
TLN4931A/B ("Private-Line")

For Wide-Spaced Transmitter Radio Sets
TLN5097A/B (Carrier Squelch)
TLN4932A/B ("Private-Line") PL-1883-A

		CONNECTOR, plug: male; coaxial;
P400	28-82365D03	right angle; miniature type
P103	28-84282D01	miniature type
		LINE, RF transmission:
W101	1-80734B58	includes P400, P103 and 30-83794C01 CABLE, RF: coaxial; 11" length req'd

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

POWER CONTROL

TLN4926A Power Control Board PL-1887-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: unless otherwise stated
C601 thru 606	21-82610C04	36 pF +5%; 200 V; N220
C607	21-82372C04	.05 uF +80-20%; 25 V
C608, 609, 610	21-82610C04	36 pF +5%; 200 V; N220
C611	23-82783B10	1 uF +20%; 50 V
C612	21-82610C04	36 pF +5%; 200 V; N220
C613	23-83214C04	1 uF +20%; 15 V
C614 thru 623	21-82610C04	36 pF +5%; 200 V; N220
C624	8-82905G30	0.1 uF, ±10%; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR601	48-83654H01	silicon
CR602	48-83696E04	silicon; Zener type; 9.1 V +5%
CR603	48-84616A01	silicon; hot-carrier type
CR604	48-869777	silicon; controlled type, anode-gated; type M9777
CR605, 606, 607	48-82392B18	silicon
CR608	48-82392B03	silicon
CR609	48-82466H18	silicon
		INTEGRATED CIRCUIT: (SEE NOTE I)
IC601	51-84320A02	
		CONNECTOR, receptacle:
J601	9-84207B01	female; 7-contact
		TRANSISTOR: (SEE NOTE I)
Q601	48-869641	PNP; type M9641
Q602	48-869570	NPN; type M9570
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R601	6-129860	56
R602	6-129984	680 +5%
R603	6-127802	1k
R604	6-129230	12k
R605	6-128902	47k
R606	6-129225	10k
R607	18-83083G20	variable: 50k +30%
R608	6-127802	1k
R609	18-83083G14	variable: 1k +30%
R610	6-129232	3.9k
R611	6-124A39	390 +5%
R612	6-129984	680 +5%
R613	6-131527	47k ±5%
R614	6-129886	27k +5%
R615	6-129805	1k ±5%
R616	6-129804	2.2k ±5%
R617	6-129805	1k ±5%
R618	6-128686	8.2k
R619	6-131527	47k +5%
R620	6-128686	8.2k
R621	6-127807	33k
R622	6-128685	22k
R623	6-128682	390k
R624	6-124C81	22k ±10%; 1/4 W
R625	6-124C91	56k ±10%; 1/4 W
		THERMISTOR:
RT601	6-82462G03	194k ±20% @25°C (17.5k ±5% @80°C)
NON-REFERENCED ITEMS		
	55-84300B03	HANDLE, plastic (long)
	55-84973E01	HANDLE, plastic (short)

TLN4926A Power Control Board PL-1922-O

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	29C84028H01	TERMINAL (MALE)
2	42B84284B01	RETAINER
3	55B84300B02	HANDLE
4	IV80734B45	SHIELD, POWER CONTROL
5	55B84973E01	HANDLE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

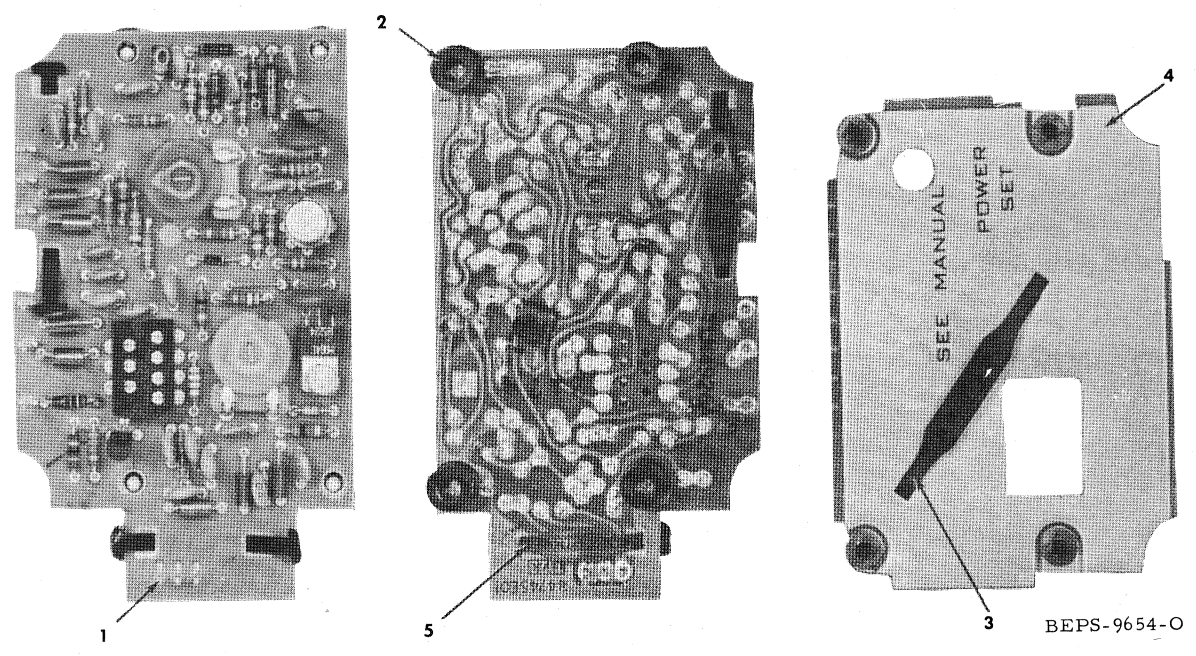
ANTENNA SWITCHING NETWORK

PL-1911-B

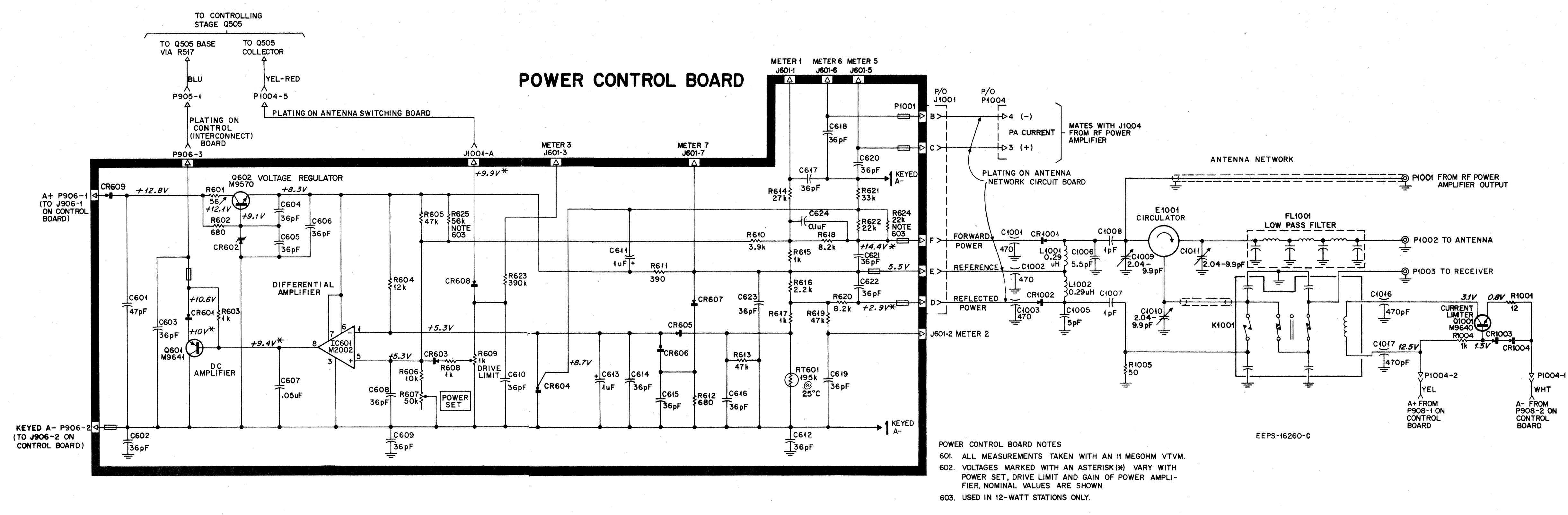
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	TFE6221A	(406-420 MHz)
	TFE6223A-1	(450-470 MHz)
	TFE6224A-1	(470-494 MHz)
	TFE6225A-1	(494-512 MHz)
		NOTE Field-replacement of component parts of this unit is not recommend. For replacement, order the entire unit. Specify kit numbers and frequency range required.

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



BEPS-9654-O

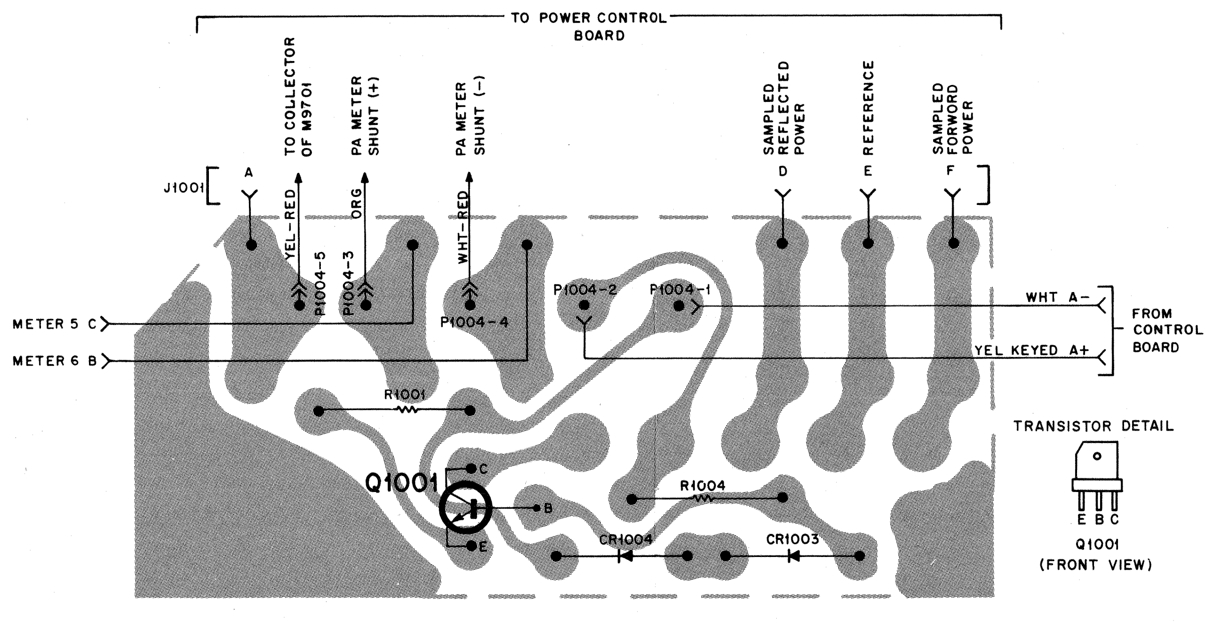


POWER CONTROL BOARD NOTES
601. ALL MEASUREMENTS TAKEN WITH AN 11 MEGOHM VTVM.
602. VOLTAGES MARKED WITH AN ASTERISK(*) VARY WITH POWER SET, DRIVE LIMIT AND GAIN OF POWER AMPLIFIER NOMINAL VALUES ARE SHOWN.
605. USED IN 12-WATT STATIONS ONLY.

EEPS-16260-C

ANTENNA NETWORK (NEW VERSION)

TFE 6221A-1, 6223A-1, 6224A-1, 6225A-1, 6331A, AND 6333A



SHOWN FROM SOLDER SIDE

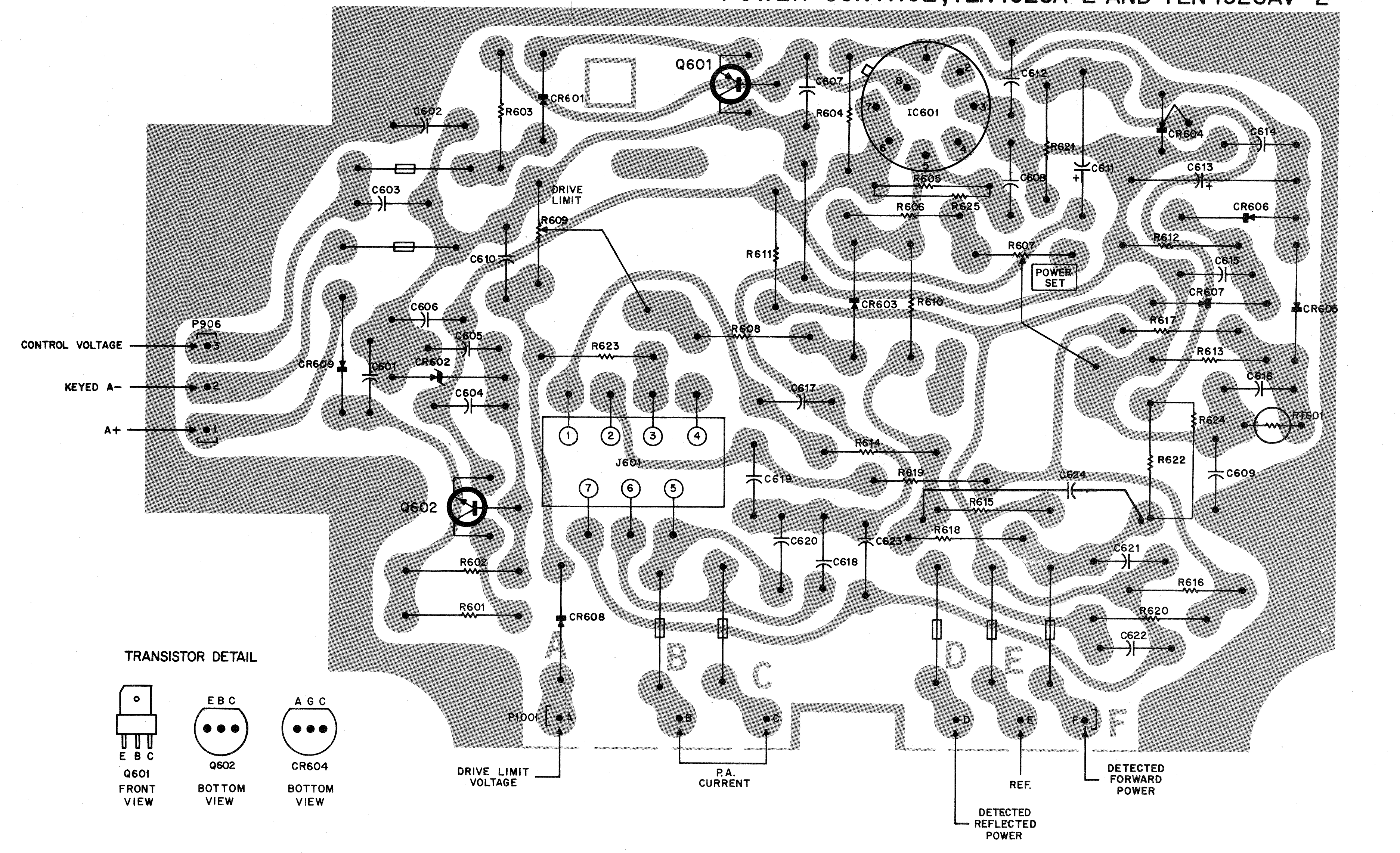
BD-CEPS-11371-O
OL-CEPS-11372-B

POWER CONTROL BOARD

601. ALL MEASUREMENTS TAKEN WITH AN 11 MEGOHM VTVM.
602. VOLTAGES MARKED WITH AN ASTERISK(*) VARY WITH POWER SET, DRIVE LIMIT, AND GAIN OF POWER AMPLIFIER NOMINAL VALUES ARE SHOWN.

EPS-9670-O

POWER CONTROL, TLN4926A-2 AND TLN4926AV-2



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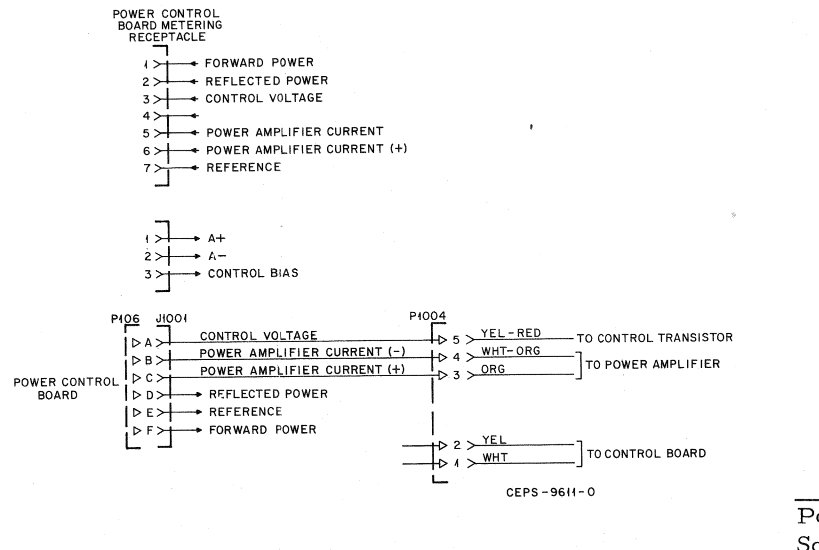
SOLDER SIDE BD-DEPS-9273-O
OL-DEPS-9275-E



POWER CONTROL BOARD AND ANTENNA NETWORK

Power Control Board and Antenna Network
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-13953-E
9/29/78-UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

"PL" ENCODER

TLN5731A & TLN5732A PL Encoder Board PL-3327-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 50 V; unless otherwise stated
C701	23-84762H09	15 ±20%; 20 V
C702	21-82187B23	820 pF; 500 V
C703	8-82905G32	0.22
C704	8-82905G32	0.22
C705	8-83813H08	.022
C706		NOT USED
C707	23-84762H08	3.9 uF ±20%; 15 V
C708	23-83214C26	15; 25 V
C709	21-82372C04	.05; +80-20%; 25 V
C710	23-84762H08	3.9 uF ±20%; 15 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR701	48-83654H01	silicon
CR702	48-83654H01	silicon
CR703	48-83654H01	silicon
		CONNECTOR, receptacle:
J401		consists of 7 female contact terminals (Part No. 9-33011H01) mounted on edge of circuit board
		"VIBRASENDER" RESONANT REED:
E701	TLN6824A	"plug-in" unit
		TRANSISTOR: (SEE NOTE)
Q701, 702	48-869642	NPN; type M9642
Q703	48-869643	PNP; type M9643
Q704, 705	48-869642	NPN; type M9642
Q706	48-869643	PNP; type M9643
Q707	48-869328	PNP; type M9328
Q708	48-869642	NPN; type M9642
Q709	48-869643	PNP; type M9643
Q710	48-869653	FET; type M9653
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R701	6-129668	10k
R702	6-129669	4.7k
R703, 706	6-129708	1.2k
R704	6-124A05	15
R705	6-129709	470
R707	6-124A05	15
R708	6-124A63	3.9k
R709	6-129230	12k ±10%
R710	6-129667	22k
R711	6-124A95	82k
R712	6-124A89	47k
R713	6-129526	33k
R714	6-129752	270 ±10%
R715	6-129669	4.7k
R716	6-124C57	2.2k ±10%
R717	6-124C49	1k ±10%
R718	6-124A53	1.5k
R719	6-129236	15k
R720	6-129887	12k
R721	6-125A05	1k, 1/2 W
R722	6-129984	680
R723	6-129681	1.5k
R724	6-124C57	2.2k ±10%
R725	6-127806	27k ±10%
R726	6-128902	47k ±10%
R727	6-129147	220k
R728	6-129147	220k
	NON-REFERENCED ITEMS	
	42-84116B02	CLAMP & SOCKET ASSY.
	42-84284B01	RETAINER: 2 used
	3-139506	SCREW, tapping: 4-40 x 5/16"; 2 used
	5-84500B03	EYELET, special: 2 used

"Vibrasender" Resonant Reed PL-5260-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	KLN6210A	See FOREWORD section of this manual for ordering information. NOTE: When ordering crystal units, specify carrier frequency, crystal frequency and crystal type number.

1. TROUBLESHOOTING

1.1 If no deviation is measured in the performance tests, the trouble may lie in the tone oscillator or tone output circuit. The trouble may be isolated by the following steps.

Step 1. Check 9.6-volt input to encoder.

Step 2. Check ac signal voltage at collector of Q701.

Step 3. If signal is present, check Q704.

Step 4. If no signal is present any component in the oscillator loop could cause the trouble. Check the "Vibrasender" resonant reed in the SLN6221A "Private-Line" Tone Generator.

Step 5. If the tone generator does not produce an output signal, the reed may be defective. Check it by substituting another "Vibrasender" reed in its place, or by using it in another encoder circuit.

Step 6. If the reed is good, replace it in the encoder and make dc voltage measurements in the tone oscillator circuit to locate the defective component.

1.2 If low deviation is measured, check ac signal voltages and compare them with those given on the schematic diagram to find the source of trouble.

1.3 If deviation is normal, but your calls are not being received, check the frequency of the PL encoder tone. If the tone is off-frequency, replace the "Vibrasender" resonant reed.

1.4 If squelch-tail noise bursts are heard by all listening receivers, check dc voltages of Q703 and Q706 in keyed and unkeyed conditions.

1.5 If the transmitter cannot be keyed, and the trouble has been isolated to the PL encoder board, measure dc voltages in Q705 and Q707 stages.

1.6 If too much tone deviation is measured, check feedback amplifier Q708.

"PL" ENCODER

701. ALL AC VOLTAGE MEASUREMENTS ARE RMS VALUES. ALL AC VOLTAGES ARE SINUSOIDAL EXCEPT Q708 EMITTER. METER READING DEPENDENT UPON METER RESPONSE TO NON-SINUSOIDAL WAVE.

702. DC VOLTAGE MEASUREMENTS IN Q705, Q706 AND Q707 STAGES TAKEN WITH RESPECT TO A-. VOLTAGES FOR ALL OTHER STAGES TAKEN WITH RESPECT TO CHASSIS GROUND. ALL DC VOLTAGES MAY BE MEASURED WITH 20,000 OHM-PER-VOLTMETER OR HIGH IMPEDANCE DC VOLTMETER (11 MEGOHM) EXCEPT BASE OF Q704 WHICH CAN ONLY BE MEASURED WITH A HIGH IMPEDANCE METER.

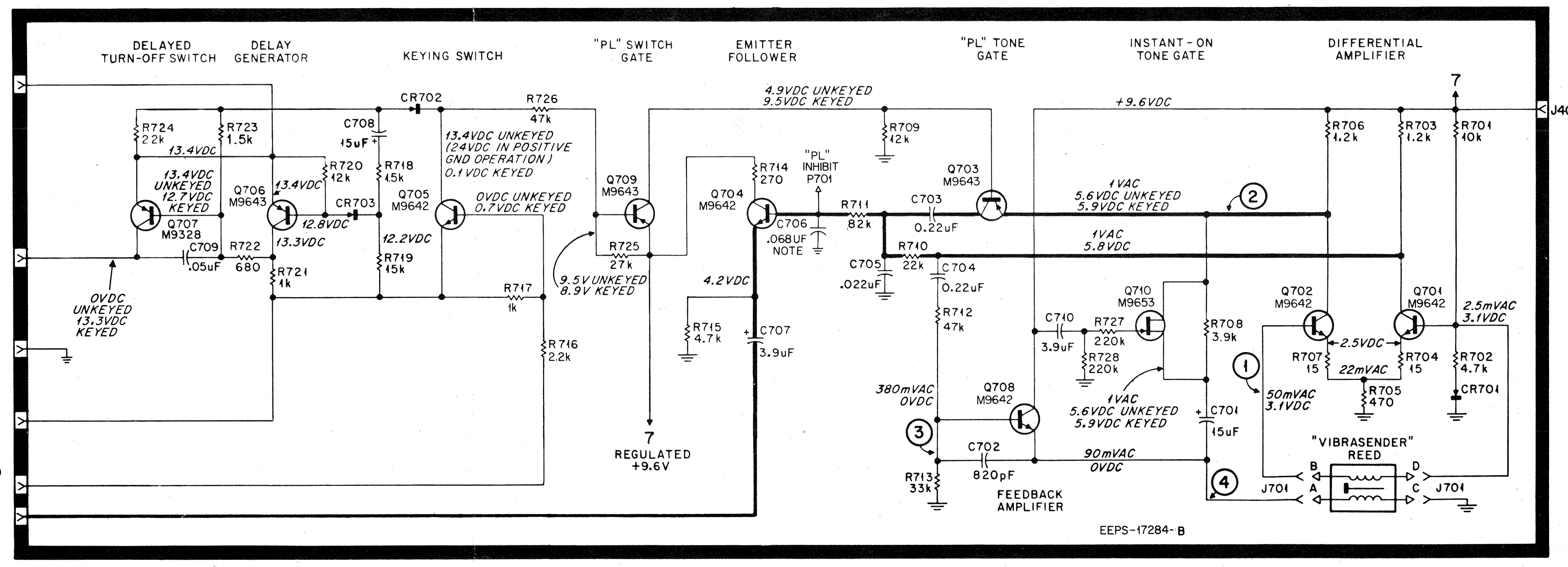
703. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.

704. PIN 701 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.

EPS-7051-A

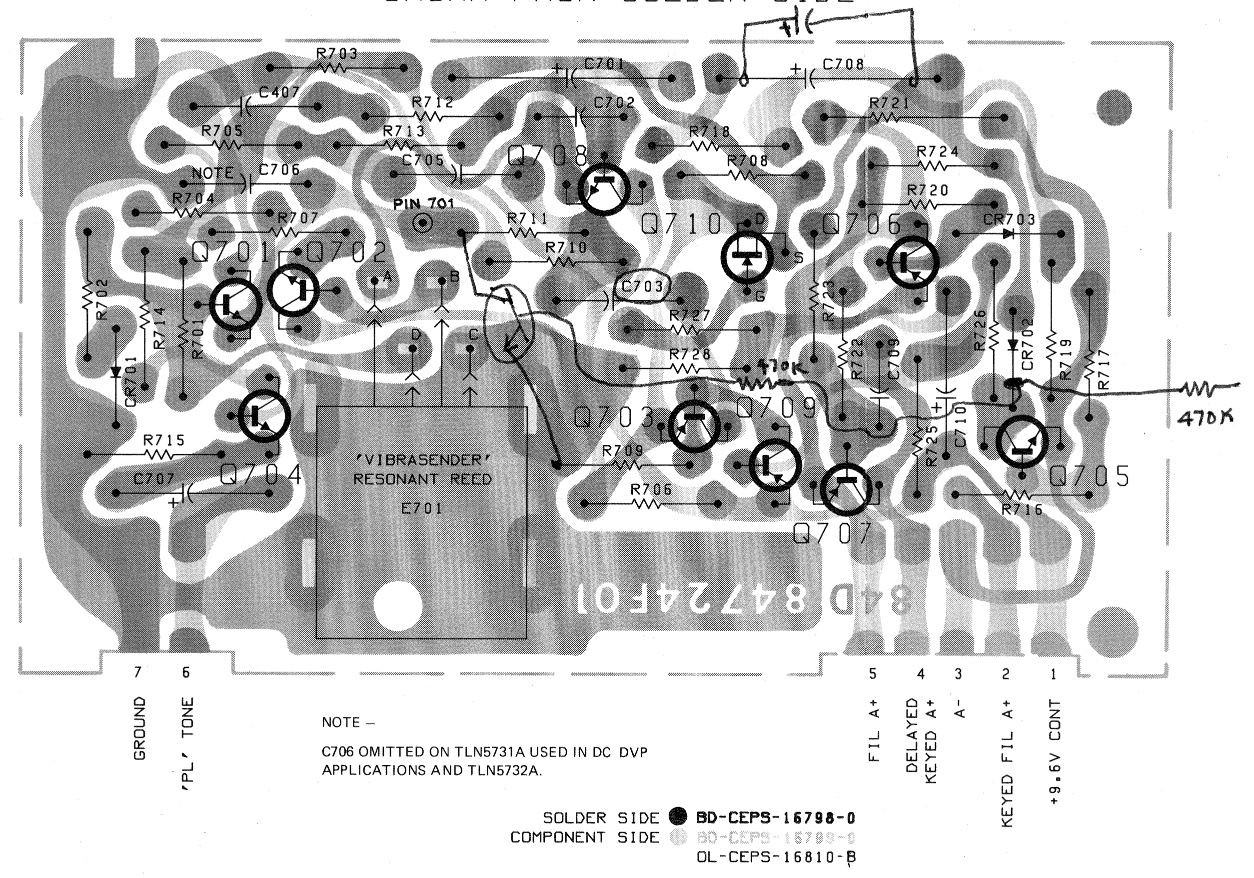
"PRIVATE-LINE" ENCODER

("PRIVATE-LINE" MODELS ONLY)
TLN5731A AND TLN5732A-1



NOTE: C706 OMITTED ON TLN5731A USED IN DIGITAL VOICE PROTECTION APPLICATIONS AND TLN5732A

SHOWN FROM SOLDER SIDE



NOTE -
C706 OMITTED ON TLN5731A USED IN DVP APPLICATIONS AND TLN5732A.

SOLDER SIDE ● BD-CEPS-16798-0
COMPONENT SIDE ● OL-CEPS-16810-B

TONE "PRIVATE-LINE" ENCODER

MODELS TLN5731A
AND TLN5732A

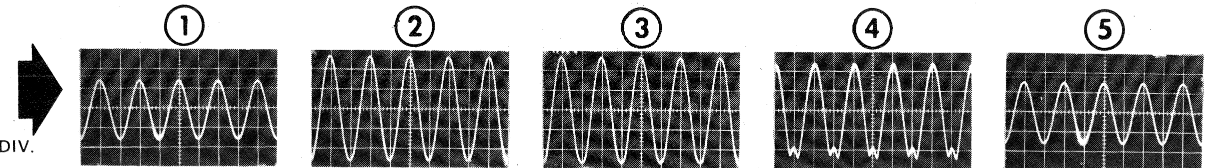
FUNCTION

The PL encoder generates a continuous subaudible tone each time the transmitter is keyed. A delayed turn-off circuit holds the transmitter keyed after the P-T-T is released for 150 mS so that a reverse burst tone can be transmitted. The reverse burst quick-kills the PL decoder to prevent squelch tails. Tone output is applied to the transmitter exciter.

"PL" ENCODER WAVEFORMS

OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. WAVEFORMS SHOWN USING 100-Hz "VIBRASENDER" RESONANT REED.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. HORIZONTAL DEFLECTION = 5 msec/DIV.
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.



EPS-6260-B 50 mV/DIV. .5 V/DIV. .2 V/DIV. 50 mV/DIV.

TONE "PRIVATE-LINE" DECODER

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4294A and
TLN4294B "Private-Line" Decoder PL-863-H

		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C801	21D82187B38	270 pF
C802	8D82905G32	0.22
C803	8D82905G08	.033; 100 V
C804	21-82187B39	470 pF; 500 V
C805	8D83813H06	0.1; 100 V
C806	8D82905G04	.068; 100 V
C807	8D82905G01	.01
C808	8D82905G04	.068; 100 V
C809	8D82905G04	.068; 100 V
C810	8D82905G02	.022
C811	8D92095G04	.068; 100 V
C812	23D83214C02	15 ±20%; 25 V
C813	8D82905G31	0.15
C814	8D82905G08	.033; 100 V
C815	8D82905G02	.022
C816	8D82905G30	0.1
C817	8D82905G30	0.1
C818	21-83406D51	3 pF ±0.25 pF 500 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE I)
CR801	48C83654H01	silicon
CR802	48C83654H01	silicon
		COIL, RF: choke
L801	24C84003A01	6 H
L802	24C84003A01	6 H
L803	24C84003A01	6 H
		TRANSISTOR: (SEE NOTE I)
Q801 thru 805	48R869642	NPN; M9642
	or 48R869570	NPN; M9570
Q806	48R869643	PNP; M9643
	or 48R869571	PNP; M9571
Q807	48R869642	NPN; M9642
	or 48R869570	NPN; M9570
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R801	6S128689	2.2K ±10%
R802	6S128687	6.8K ±10%
R803	6-124A63	3.9K
R804	6S129225	10K ±10%
R805	6S129225	10K ±10%
R806	6S131527	47K
R807	6S129709	470
R808	6S129667	22K
R809	6S131527	47K
R810	6S129709	470
R811	6S129667	22K
R812	6S129225	10K ±10%
R813	6-124A66	5.1K
R814	6S129431	180
R815	6S129669	4.7K
R816	6S124A97	100K
R817	6S129984	680
R818	6S129753	100 ±10%
R819	6S129669	4.7K
R820	6S124A97	100K
R821	6S131527	47K
R822	6S129804	2.2K
R823	6S124A13	33
R824	6S129225	10K ±10%
R825	6S128689	2.2K ±10%
NON-REFERENCED ITEMS		
	42-84116B01	CLAMP & SOCKET ASSY. ("Vibrasponder")
	3-139506	SCREW, tapping: 4-40 x 5/16" 2 used
	5-84500B03	EYELET, special: 2 used
	42-84284B01	RETAINER; 2 used

1. TROUBLESHOOTING

1.1 TESTING THE "VIBRASPONDER" RESONANT REED

One of the first tests should be a check of the "Vibrasponder" resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured.

1.2 DECODER TESTING

Step 1. To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point 1 on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an unmodulated rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

Step 2. With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

Step 3. If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

"Vibrasponder" Resonant Reed PL-2503-O

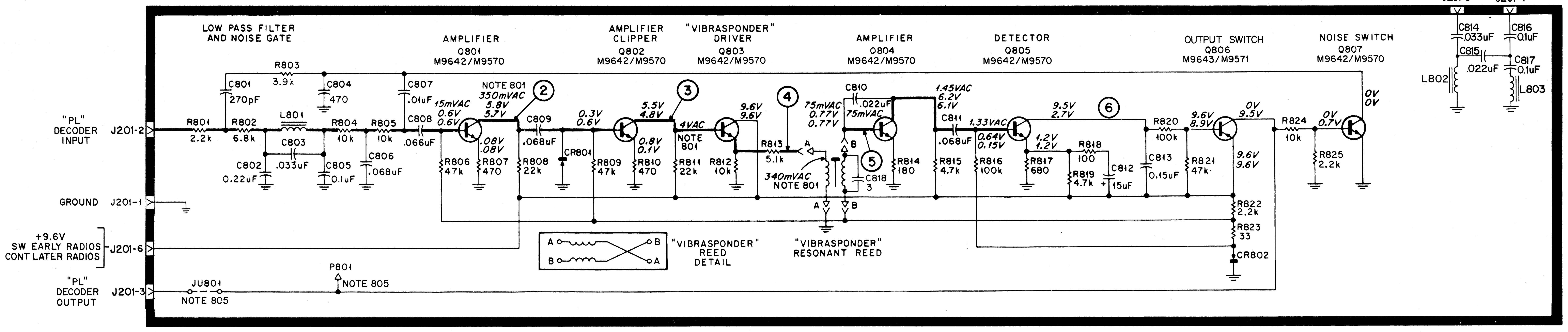
	TLN8381A	"VIBRASPONDER" RESONANT REED: 67-198.6 Hz

REVISIONS 68P81030E72-B

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4294B-2	C084	FROM 21-82187B26 .003 uF ±10%; 100 V TO 21-82187B39 470 pF ±10%; 500 V	INPUT CIRCUIT
	R803	FROM 6-129225 10k ±10%; 1/4 W TO 6-124A63 3.9k ±10% 1/4 W	
	R813	FROM 6-129819 3.9k ±10%; 1/4 W TO 6-124A66 5.1k ±10%; 1/4 W	Q803 EMITTER

"PRIVATE LINE" DECODER

TLN4294A AND B

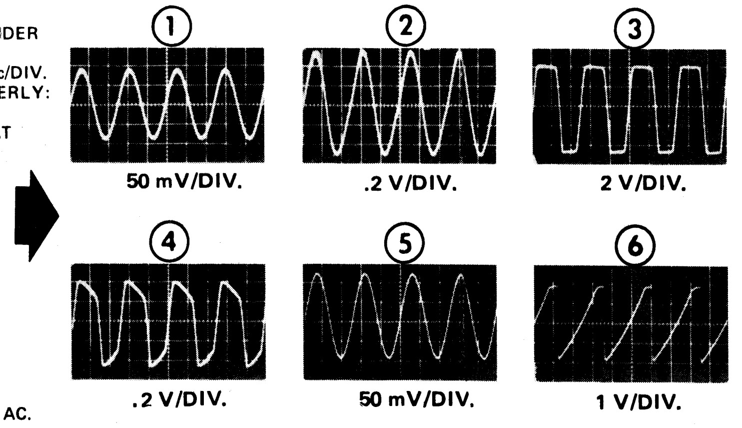


EEPS-13742-C

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

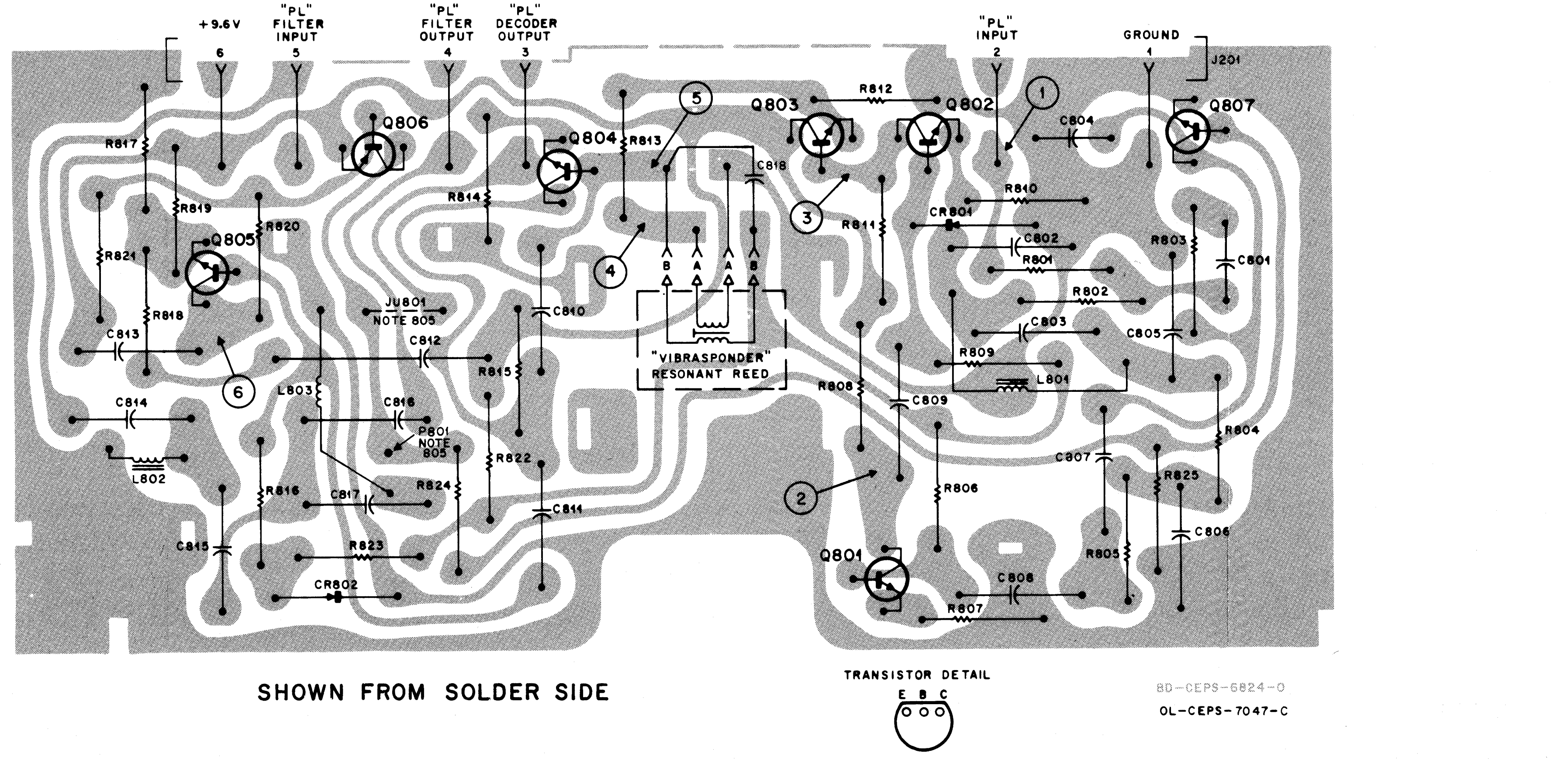
1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY:
   A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR.
   B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM (1); I.E. 60 mV rms (170 mV P-P) AT J201-2.
4. RECEIVER NOT USED:
   A. INJECT "PL" TONE AT J201-2.
   B. ADJUST TONE LEVEL FOR WAVEFORM (1).
5. OSCILLOSCOPE VERTICAL INPUT -- AC.
6. OSCILLOSCOPE SYNC -- INTERNAL.
7. MEASUREMENTS MADE WITH RESPECT TO CHASSIS GROUND.

"PL" DECODER WAVEFORMS



EPS-6182-B

MODEL TLN4294B "PL" DECODER



SHOWN FROM SOLDER SIDE

BD-CEPS-6624-O
OL-CEPS-7047-C

TONE "PRIVATE-LINE" DECODER

MODEL TLN4294B

FUNCTION

The PL decoder inhibits receiver audio until a transmission is received which contains a continuous subaudible PL tone which matches the frequency of the "Vibrasponder" resonant reed in this unit. The PL decoder then enables the received audio to be heard. A PL filter aids in rejecting PL tones from the receiver speaker.

"PL" DECODER

801. DUE TO SQUARE WAVE CHARACTERISTIC SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE.
802. AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT. USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.
803. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (11 MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.
804. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
805. JUMPER JU801 AND P801 ARE INCORPORATED IN MODEL TLN4294B ONLY. JU801 IS REMOVED AND P801 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.

EPS-6181-C

"DIGITAL PRIVATE-LINE" ENCODER

SIMPLEX OPERATION

MODELS TLN5723A, TLN5724A, TLN5726A

1. TROUBLESHOOTING

1.1 RECOMMENDED TEST EQUIPMENT

1. Motorola Model SLN6413A "Digital Private-Line" Test Set--used to encode and decode a "Digital Private-Line" code for test purposes.
2. Motorola Solid-State AC Voltmeter--used for tone level measurement.
3. General purpose oscilloscope--used to observe waveforms.
4. Motorola Solid-Stage DC Multimeter or Digital Voltmeter--used for dc voltage measurements.

1.2 PROCEDURES

Before you begin troubleshooting, inspect the encoder board and transmitter exciter board for visible defects. If any defects are found, correct them and check the encoder performance again. If the encoder performance is still unsatisfactory, use the following troubleshooting chart to help you isolate the defective circuit and component.

2. TLN6332A CODE DISABLE PLUG

The TLN6332A Code Disable Plug Kit is plugged into J701 and J702 to disable code while setting the carrier frequency. The assembly is non-repairable; order by model number.

DIGITAL "PRIVATE-LINE" ENCODER BOARD TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSES	ACTION
No delayed keyed A+ to exciter board.	1. No keyed A+ to encoder board (pin 2).	Check K901 (1st PTT relay) operation on control board.
	2. Malfunction in delayed keyed A+ generation circuitry.	Check delayed turn-off switch, delay generator and keying switch operation on encoder board.
Delayed keyed A+ remains high less than 160 msec or longer than 220 msec after unkeying.	Malfunction in delayed keyed A+ circuits.	Check C710. Then check delay generator circuit.
Delayed xmit code enable (pin 7) remains low when radio keyed.	1. A- not present at Q706 collector.	Check for keyed A+ at pin 2. Then check operation of keying switch Q706.
	2. Code enable switch Q705 is inoperative.	Check for +9.6 V at Q705 emitter. Then check Q705 and C708.
Delayed xmit code enable (pin 7) goes high less than 20 msec or longer than 40 msec after keying.	C708 is bad.	Replace C708.
No output on xmit code out (pin 10), keyed or unkeyed.	1. No input to encoder board pin 6 from decoder board.	On decoder board, check U801-5 for code signal. Check for 6.0 V dc at U801-24. If 6.0 V dc is present, check 50 kHz clock for proper operation (U801-4). If clock is ok, replace U801.
	2. Faulty inverter (Q702).	Check inverter operation.
	3. Active filter malfunction	Check Q703, Q704 operation.
Code (not turn-off code) is on encoder board pin 10 when the radio is unkeyed.	1. Encoder board pin 7 (delayed xmit enable) remains high.	Check encoder board pin 7.
	2. U801 code generator on decoder board is not switching.	Ground U801-9. If code is still present at U801-5, check 50 kHz clock output (U801-4). If clock is ok, replace U801.
Turn-off code (not code) is on encoder board pin 10 when the radio is keyed.	1. Encoder board pin 7 (delayed xmit enable) stays low.	Check encoder board pin 7.
	2. U801 code generator on decoder board is not switching.	Apply +9.6 V at J805 on decoder board. If turn-off code is still present at U801-5, replace U801.
Excessive "code sound" heard at the speaker of a radio listening to this transmitter.	1. Code deviation is greater than ±1 kHz.	Check the IDC setting (UHF), or replace channel element (LB & HB). Check for proper waveform amplitude at encoder board pin 10 (Xmit code out).
	2. Low pass active filter is not switching from 140 Hz to 85 Hz.	Replace Q709.
Squelch tails are heard at the speaker of a radio listening to this transmitter.	1. No turn-off code is being transmitted.	Check the delayed keyed A+ duration (170-250 mS). Then check U801-5 on decoder board for presence of the turn-off code.
	2. Low pass active filter is always switched low (85 Hz).	Replace Q709.
No other DPL radios in the system are enabled by this transmitter; code is being transmitted.	Wrong code is being transmitted.	Feed U801-5 from decoder board into a Motorola Model SLN6413A DPL Test Set. Check for proper decode. If proper decode is not obtained, check for an intermittent or bad code plug (TRN6005A) or resistor network (Z801) on the decoder board. Check U801-15 thru U801-23 for a proper octal code.

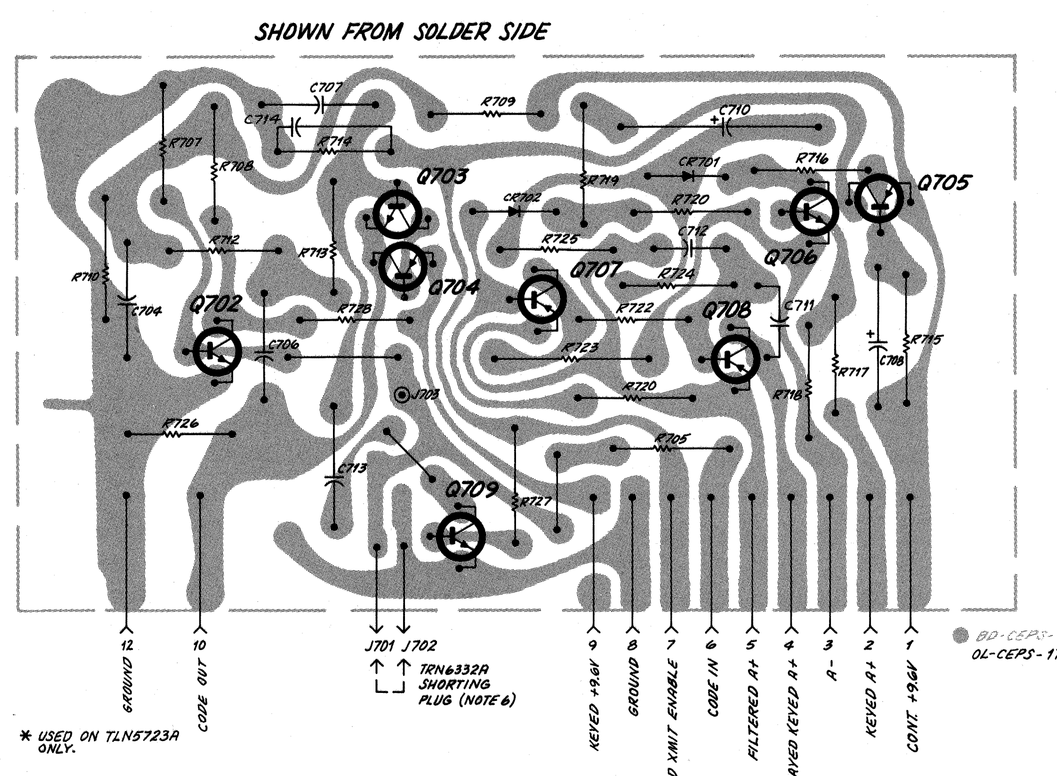
68P81030E71-A
(Sheet 1 of 2)
2/15/77-UP

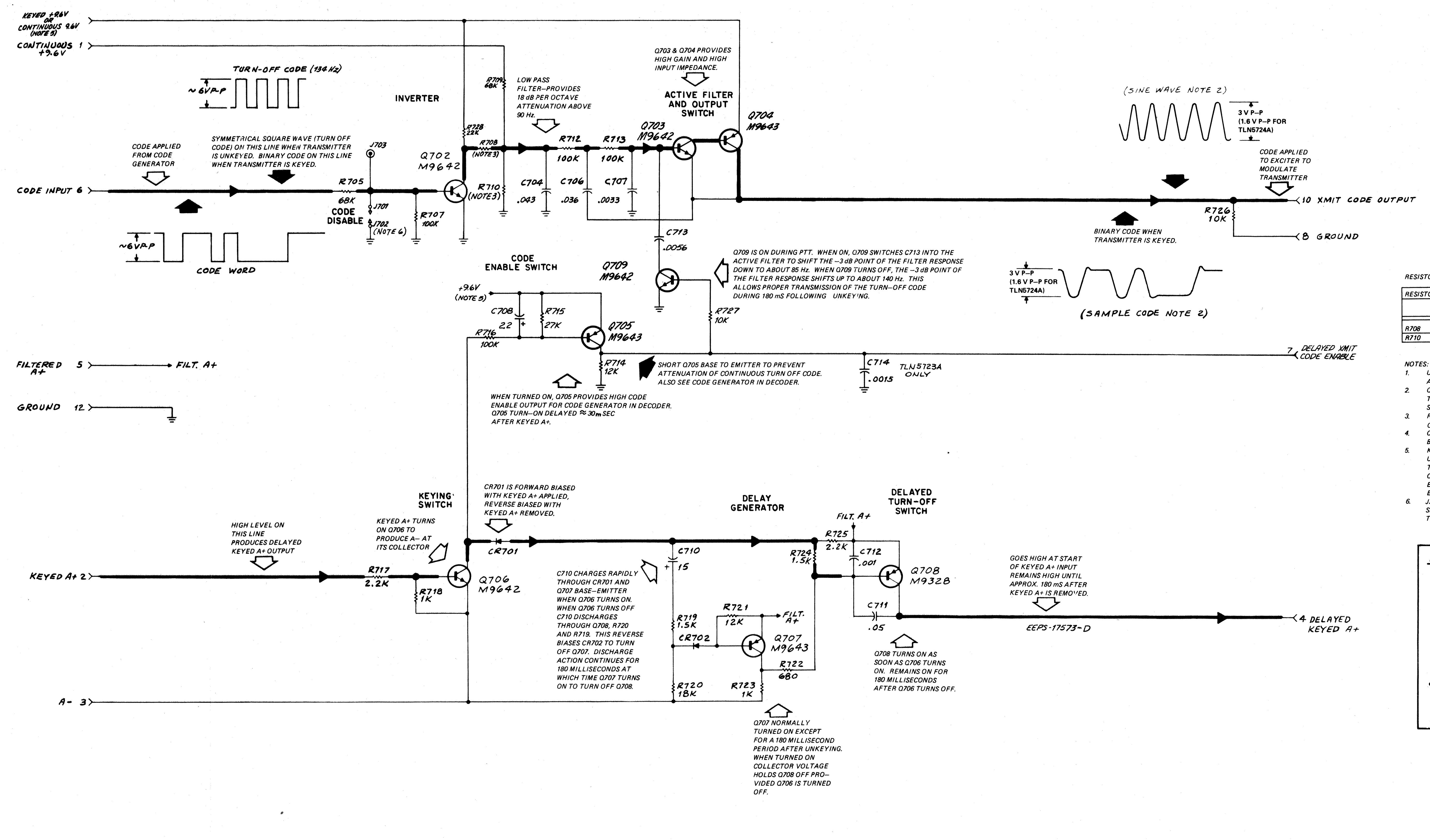
PARTS LIST

"DIGITAL PRIVATE-LINE" SIMPLEX ENCODER BOARD
TLN5723A (25-50 MHz)
TLN5724A (132-174 MHz)
TLN5726A (406-512 MHz, 806-866 MHz) PL-3413-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C703		NOT USED
C704	8-83813H14	.043 uF ±5%;50 V
C706	8-83813H24	.036 uF ±5%; 50 V
C707	8-83813H27	.0033 uF ±5%; 100 V
C708	23-82783B16	2.2 uF ±10%; 15 V
C710	23-83214C26	15 uF ±10%; 25 V
C711	21-82372C04	.05 uF +80-20%; 25 V
C712	21-83596E13	.001 uF ±10%; 100 V
C713	8-83813H26	.0056 uF ±5%; 50 V
C714	21-800801	.0015 uF +100-0%; 500 V (TLN5723A)
		DIODE: (SEE NOTE)
CR701, 702	48-83654H01	silicon
		TRANSISTOR: (SEE NOTE)
Q702, 703, 706, 709	48-869642	PNP; type M9642
Q704, 705, 707	48-869643	PNP; type M9643
Q708	48-869328	PNP; type M9328
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R705, 709	6-124A93	68k
R707	6-124A97	100k
R708	6-124A97 or 6-124B06	100k (TLN5723A and TLN5726A) 220k (TLN5724A)
R710	6-124A96 or 6-124A95	91k (TLN5723A and TLN5726A) 82k (TLN5724A)
R712, 713, 716	6-124A97	100k
R714, 721	6-124A75	12k
R715	6-124C83	27k ±10%
R717, 725	6-124C57	2.2k ±10%
R718	6-124A49	1k
R719, 724	6-124A53	1.5k
R720	6-124A79	18k
R722	6-124A85	680
R723	6-125A49	1k; 1/2 W
R726, 727	6-124A73	10k
R728	6-124A81	22k
	NON-REFERENCED ITEMS	
	1V80767B23	CIRCUIT BOARD ASSY. (eyeletted) TLN5723A, TLN5724A includes: 9-83011H01 CONNECTOR, board mtg., female; 11 req'd 28-84269C01 CONTACT, male; low profile 28-84269C02 CONTACT, male; high profile 7-84223B01 BRACKET, holding: 2 req'd
	or 1V80772B13	CIRCUIT BOARD ASSY. (eyeletted) TLN5726A includes: 9-83011H01 CONNECTOR, board mtg., female; 11 req'd 28-84269C01 CONTACT, male: low profile 28-84269C02 CONTACT, male: high profile 7-84223B01 BRACKET, holding: 2 req'd
	3-138162	SCREW, tapping: 4-40 x 3/8"; 2 req'd
	5-84500B03	EYELET, special: 2 req'd.
	42-84284B01	RETAINER: 2 req'd.

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number for optimum performance.





RESISTOR VALUE TABLE

RESISTOR		VALUE, OHMS	
	LOW–BAND (TLN5723A)	HIGH–BAND (TLN5724A)	UHF (TLN5726A)
R708	100K	220K	100K
R710	91K	82K	91K

NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. Q703–Q704 OUTPUT WAVEFORMS ARE CONTINUOUS, RATHER THAN SHORT BURSTS. THE WAVEFORM SHOWN IS ONLY A SMALL PORTION OF THE OVERALL WAVEFORM.
3. REFER TO THE RESISTOR VALUE TABLE FOR THE VALUES OF R708, AND R710 USED IN VARIOUS ENCODER MODELS.
4. C714 IS USED IN MODEL TLN5723A ENCODERS ONLY (LOW–BAND RADIO SETS).
5. KEYED +9.6 V IS APPLIED TO Q705 EMITTER IN ENCODERS USED IN LOW–BAND AND HIGH–BAND RADIO SETS (MODEL TLN5723A & TLN5724A ENCODERS, RESPECTIVELY). CONTINUOUS +9.6 V IS APPLIED TO Q705 EMITTER IN ENCODERS USED IN UHF RADIO SETS (MODEL TLN5726A ENCODER).
6. J701 AND J702 ARE SHORTED TOGETHER BY TRN6332A SHORTING PLUG TO DISABLE CODE WHILE SETTING TRANSMITTER CARRIER FREQUENCY.

LEGEND
= THEORY OF OPERATION DATA
= MAINTENANCE DATA
= PRIMARY SIGNAL FLOW

"DIGITAL PRIVATE-LINE" ENCODER

SIMPLEX OPERATION

MODELS TLN5723A, TLN5724A, & TLN5726A

The DPL encoder interfaces a digital code word generator on the DPL decoder with the exciter. The 23-bit code word provides a uniques identity for the transmitter for use in digitally-coded squelch systems.

The DPL encoder also contains an active low pass filter which filters code word harmonics. A turn-off delay circuit generates delayed keyed A+ for 180 mS after the PTT switch is released to enable transmission of a turn-off code which quick-kills the decoders to eliminate squelch tails.

APPLICATION

"Micor" Two-Way FM Radios:
"Micor" Super "Consolette" Control Stations:
TLN5723A used with 25-50 MHz radios (low band)
TLN5724A used with 132-174 MHz radios (high band)
TLN5726A used with 406-512 MHz and 806-866 MHz radios (UHF)

"DIGITAL PRIVATE-LINE" DECODER

MODEL TLN5729A

1. SERVICING

1.1 RECOMMENDED TEST EQUIPMENT

(1) Motorola Model SLN6413A "Digital Private-Line" Test Set--used to encode and decode a "Digital PL" code for test purposes.

(2) Motorola Solid-State Ac Voltmeter--used for tone level measurement.

(3) General purpose oscilloscope--used to observe waveforms.

(4) Motorola Solid-State Dc Multimeter or Digital Voltmeter--used for dc voltage measurements.

1.2 CMOS INTEGRATED CIRCUIT HANDLING PRECAUTIONS

1.2.1 Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

1.2.2 Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even in a system.

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions:

(1) Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

(2) Whenever possible avoid touching any electrically conductive parts of the circuit module with your hands.

(3) Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

(4) When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

(5) All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

(6) If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through a resistance of approximately 100k.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

(7) When soldering, be sure the soldering iron is grounded.

(8) Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

(9) When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

(10) All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

(11) Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER USE NONCONDUCTIVE MATERIAL for packaging these modules.

1.3 TRN6005A CODE PLUG

The TRN6005A Code Plug is a non repairable assembly which establishes the DPL code used. See ordering instruction in foreword of this manual. In standard operation one code plug is used, providing the same code for both transmit and receive operation. An optional two-code adapter can be used and is described in a separate section of this manual.

1.4 TROUBLESHOOTING

Before beginning a troubleshooting procedure, inspect the circuit board for visible defects. If any defects are found, correct them and check the decoder performance again. If the decoder performance is still subnormal, use the following troubleshooting procedure to help you identify the defective circuit and component.

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART

NOTES:

1. To obtain a test code for the following procedure apply a carrier frequency signal to the receiver rf input from an rf signal generator modulated by the code output of a Motorola SLN6413A "Digital Private-Line" Test Set. Be sure the signal generator is able to accept very low frequency modulation (less than 5 Hz).
2. Before you replace U801, use the following procedure to verify that U801 is malfunctioning:
   a. Connect U801-11 to the code input of a Motorola SLN6413A "Digital Private-Line" Test Set.
   b. Apply a carrier-frequency signal to the receiver rf input from a signal generator that is modulated by the code output of the test set.

   If proper decode is indicated, U801 must be replaced. If U801 must be replaced, refer to the CMOS handling precautions in this instruction section.

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART (Cont'd)

SYMPTOM	PROBABLE CAUSE	ACTION
No decode, but received audio is good when DPL is disabled.	1. Audio squelch is malfunctioning.	Remove the decoder board. Apply +9.6 V at P201-3 on audio & squelch board. If audio is not enabled, troubleshoot audio & squelch circuits.
	2. No 50 kHz clock.	Check U801-4 for 50 kHz clock pulses. Rise time must be ≤ 750 nsec.
	3. Audio enable switch is malfunctioning.	If U801-7 is high, but circuit board pin 5 is low when receiving code, replace Q810.
	4. Dump pin U801-1 is always high.	Check U801-1 - should always be 0 V.
	5. Wrong or bad code plug.	Replace with a known good code plug. Check U801-15 through U801-23 for proper octal code.
	6. No data into U801.	Check U801-11 for 0-6 V pulses. If pulses are not present, check Q806 and U802 operation.
	7. Transmit code enable input is high.	Ground U801-9. If a received code is properly decoded, check for a malfunction in the delayed transmit enable circuit on the encoder board.
	8. U801 has an internal malfunction.	If, after checking causes 1 through 7, the cause of the problem has not been isolated, replace U801. CAUTION: U801 is a CMOS device and may be damaged by improper handling. Refer to the CMOS handling precautions in this instruction section.
Excessive decoder falsing when monitoring an inactive channel (noise falsing).	1. Precision current source is low or inoperative.	Measure the dc voltages in the precision current source circuits. Current to U801-8 = $\frac{(V_{BE} \text{ of Q808})(R825+R826+RT802)}{R826\,(R825+RT802)}$
	2. Current source disable switch is always on.	Check for 8-10 V at Q809 collector. If Q809 collector is 0 V, replace Q809.
	3. Improper 140 Hz low pass filter response.	Check dc voltages in filter circuit. Check the filter frequency response measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	4. U802 supply voltage is too high.	Check U802-10 for +10.4 V ±0.2 V dc. If voltage is high, troubleshoot the +10.4 V regulator on the decoder board.

"DIGITAL PRIVATE-LINE" DECODER BOARD TROUBLESHOOTING CHART (Cont'd.)

SYMPTOM	PROBABLE CAUSE	ACTION
Excessive squelch tails (approx. 500 msec noise burst) at ends of received transmissions.	1. Turn-off code not being transmitted by other radio unit.	Monitor circuit board pin 4 (DATA IN) for presence of turn-off code at ends of transmissions.
	2. U802 lock-in malfunction.	Ground Q809 collector. With a 300 mV p-p signal at circuit board pin 4 (DATA IN), the waveform at U802-4 should be locked in to the input signal up to at least 175 Hz. If proper lock-in does not occur, replace C809, then check lock-in again. If lock-in is still bad, replace U802.
	3. U801 turn-off code detector is malfunctioning.	Check U801 (Note 2).
Poor detector sensitivity in poor quieting conditions.	1. Improper 140 Hz low pass filter response	Check dc voltages in filter circuit. Check the filter frequency response: measured at Q803 emitter, the filter response should be -1.0 to -4.0 dB at 134 Hz and -12 to -15 dB at 250 Hz with 50 mV rms signal at decoder input.
	2. Precision current source supplying too much current to U802-8.	Measure the dc voltages in the current source circuits. Current to U802-8 = $\frac{(V_{BE} \text{ of Q808})(R825+R826+RT802)}{R826\,(R825+RT802)}$
	3. Current source disable switch inoperative.	While detecting a valid code, check Q809 collector for 0 V dc. If 8-10 V is present, replace Q809.
Occasional squelch tail about 1 second after the end of a transmission from another radio.	Current source disable switch is staying on too long.	Check Q809 collector. Q809 collector should go from 0 V dc to 8-10 V within 1.5 seconds after loss of audio squelch disable.

PARTS LIST

TRN6112A Decoder Hardware Kit PL-4303-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	39-10184A24	CONTACT, chain form; 6 req'd.
	37-82603D60	SLEEVING, number blank; 6 req'd.

TLN5729A Decoder Circuit Board PL-3299-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF;
C801	21-83798B01	100 pF ±5%; 200 V
C802	21-82610C22	20 pF ±5%; 200 V
C803	21-82428B56	.0047 ±10%; 100 V
C804	23-82783B08	1.0 ±20%; 35 V
C805	8-82905G39	.023 ±5%; 50 V
C806	8-83813H23	.068 ±5%; 50 V
C807	8-83813H19	.0039 ±5%; 50 V
C808, 811	23-84762H03	10 ±10%; 20 V
C809	23-82783B48	0.68 ±5%; 35 V
C810	21-82187B20	1000 pF ±10%; 100 V
		DIODE: (SEE NOTE)
CR801, 802	48-84616A01	hot carrier
CR803	48-83654H01	silicon
CR804	48-82139G01	germanium
		TRANSISTOR: (SEE NOTE)
Q801	48-869653	field-effect; type M9653
Q802	48-869649	PNP; type M9649
Q803, 809, 810	48-869642	NPN; type M9642
Q804, 805, 806, 807	48-869643	PNP; type M9643
Q808	48-869841	PNP; type M9841
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R801, 804, 831	6-124C97	100k
R802, 806	6-124D14	470k
R803	6-124C77	15k
R805	6-124D04	180k
R807, 809	6-125C25	100 ;1/2 W
R808	6-124C37	330
R810, 811, 812	6-13755C64	56.2k ±1%
R813	6-124A48	910 ±5%
R814	6-124A45	680 ±5%
R815	6-124A49	1k ±5%
R816	6-124C43	560
R817, 822, 824, 830	6-124C73	10k
R818	6-124C35	270
R819	6-124C83	27k
R821	6-124A59	2.7k
R823	6-124A57	2.2k ±5%
R825	6-13755C67	5620 ±1%
R826	6-10621C59	4640 ±1%
R827, 829	6-124C83	27k
R828	6-124B10	330k ±5%
		THERMISTOR:
RT801	6-865641	300 ohm @ 25°C
RT802	6-82696B01	10k ohms @ 25°C
		INTEGRATED CIRCUIT: (SEE NOTE)
U801	51-84267A82	M6782
U802	51-84320A55	M2055
		VOLTAGE REGULATOR:
VR801	48-83696E07	Zener type; 6.2 V
VR802	48-82256C03	Zener type; 4.70 V
		CRYSTAL:
Y801	48-82003K01	resonator; 50.00000 KC
		RESISTOR NETWORK:
Z801	1-80772B36 or 51-82142K02	pull-up, 10-pin

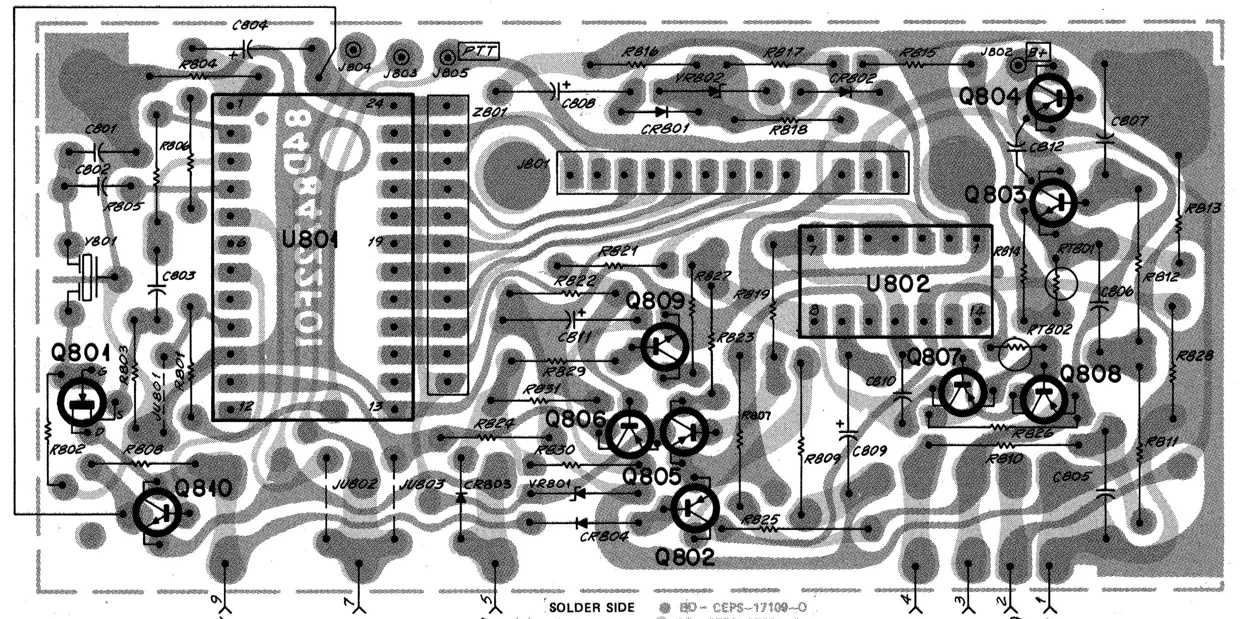
NOTE: For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

Code Plug PL-5238-O

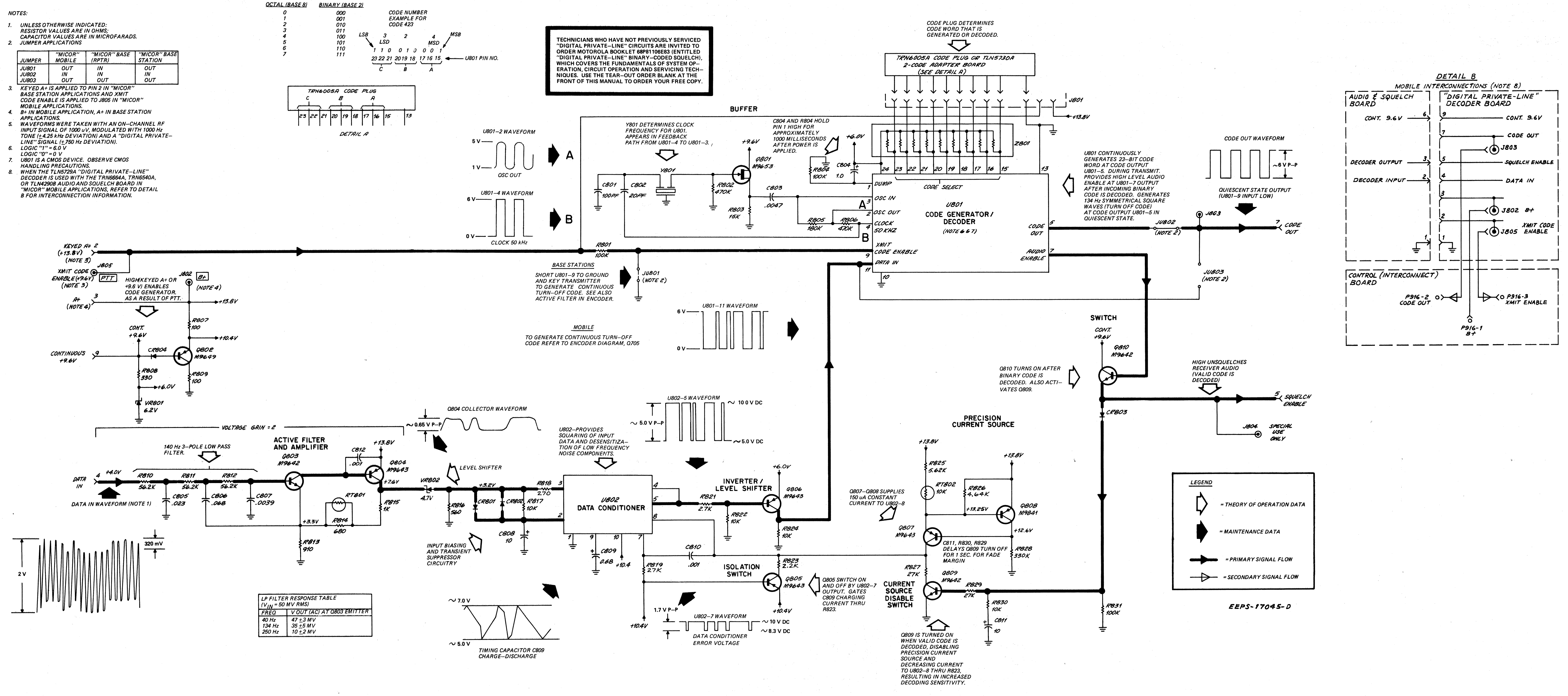
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	TRN6005A	CODE PLUG (DPL Models)

"DIGITAL PRIVATE-LINE" DECODER

MODEL TLN5729A



SHOWN FROM COMPONENT SIDE



FUNCTION

The DPL Decoder squelches the receiver audio until a message is received which contains a 23-bit binary-coded word which matches the 23-bit code word set by the code plug in this decoder. When matched, the receiver audio is enabled. The code word is present during the entire transmission after which the code changes to a special turn-off code which quick-kills the decoder to eliminate squelch tails.

In radios with simplex DPL operation, the decoder also generates a 23-bit code word when the transmitter is keyed which is coupled to the DPL encoder board. The code generated is set by the code plug or the two-code adapter (if used).

"DIGITAL PRIVATE-LINE" DECODER/"DIGITAL PRIVATE-LINE" TWO-CODE ADAPTER

"DIGITAL PRIVATE-LINE" TWO-CODE ADAPTER

MODEL TLN5730A

FUNCTION

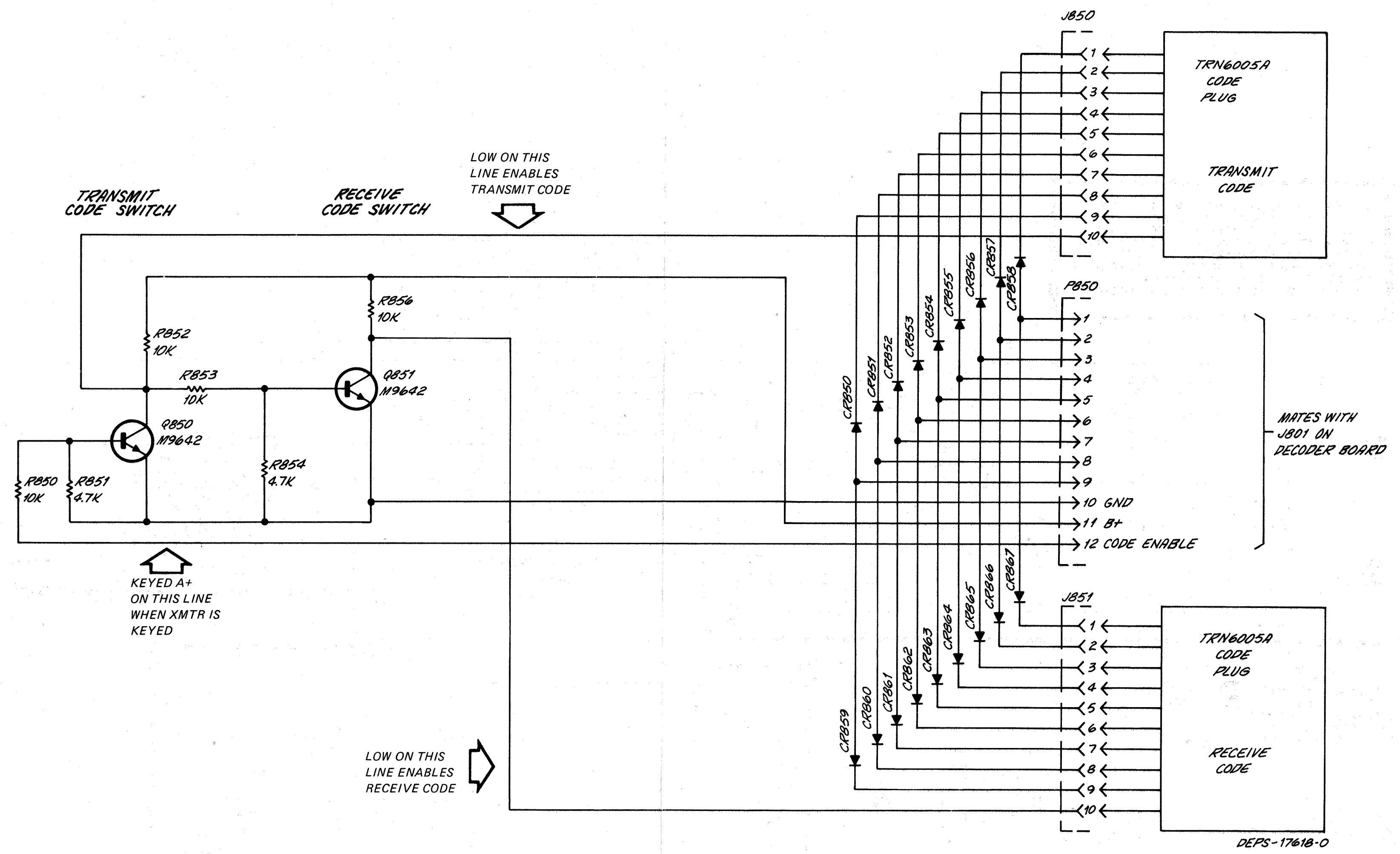
The two-code adapter plugs into the code plug receptacle on a "Digital Private-Line" Decoder or Encoder/Decoder to allow separate "Digital Private-Line" codes for transmit and receive. Code plugs for the two codes then plug into the receptacles on the two-code adapter board.

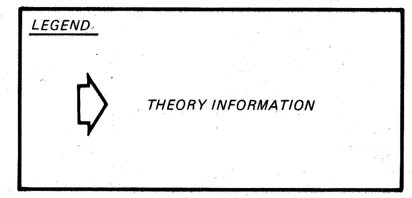
PARTS LIST

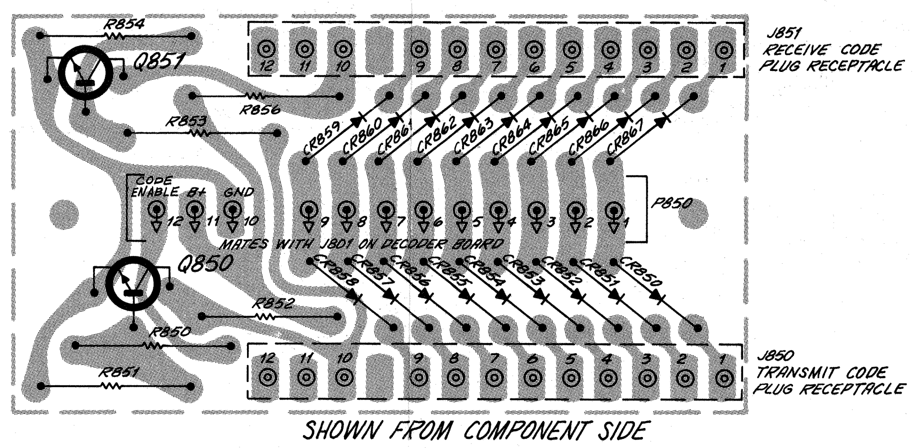
TLN5730A 2-Code Adapter Board PL-3414-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR850 thru 867	48-83654H01	DIODE: (SEE NOTE) silicon
J850, 851	9-82071K01	CONNECTOR, receptacle: female; 12-contact
P850		CONNECTOR, plug: consists of: 28-82070K01 CONTACT, male; 13 req'd.
Q850, 851	48-869642	TRANSISTOR: (SEE NOTE) NPN; type M9642
R850, 852, 853, 856	6-124A73	RESISTOR, fixed: 10k ±5%; 1/4 W
R851, 854	6-124A65	4.7k ±5%; 1/4 W
		NON-REFERENCED ITEMS
	1V80769B88	CIRCUIT BOARD ASSY., incl. referenced item P850
	3-138804	SCREW, machine: 4-40 x 5/16"; 2 req'd.

NOTE: For optimum performance, diodes and transistors must be ordered by Motorola part number.







SHOWN FROM COMPONENT SIDE

COMPONENT SIDE 3D-CEPS-17620-O
OL-CEPS-17621-O

POSITIVE GROUND CONVERTER

MODEL TLN4390B

FUNCTION

The positive ground converter operates from a negative 12-volt battery input with reference to radio chassis potential. It converts that input to a positive 12-volt output with reference to the chassis. This is accomplished by a chopper which develops an approximate 7 kHz alternating voltage, then rectifies the alternating voltage to produce a positive dc output. A short-circuit protector prevents excessive current if the output voltage becomes shorted.

PARTS LIST

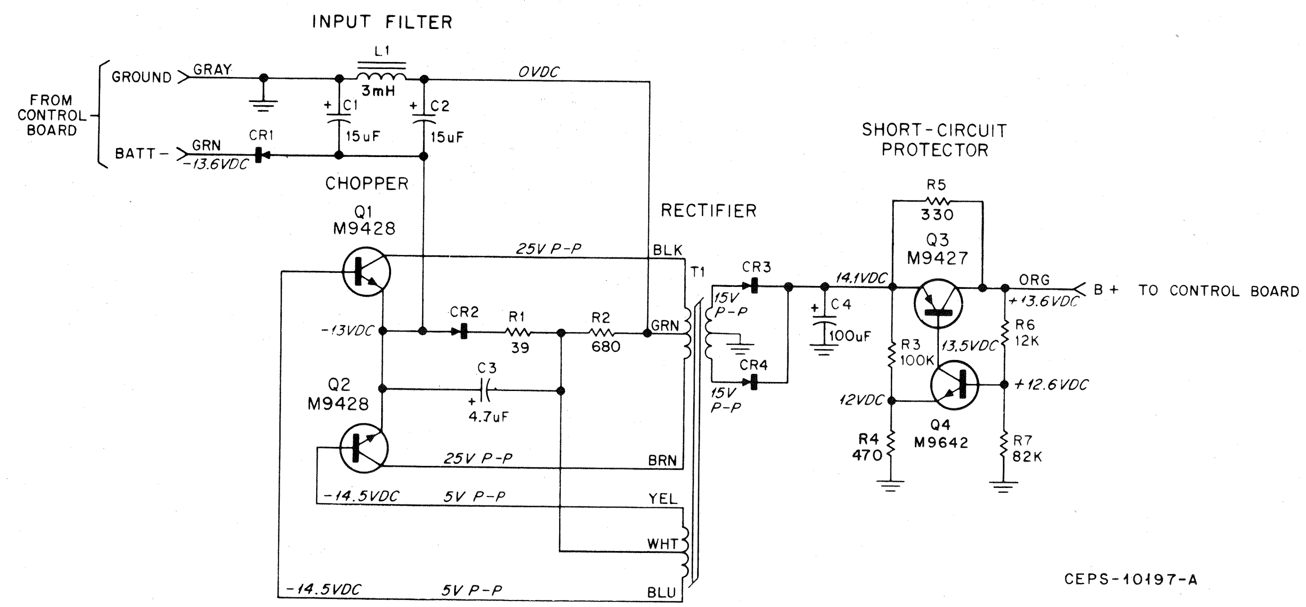
IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN4390B Positive Ground Converter Board PL-2035-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	23-84538G04	15 uF ±20%; 25 V
C2	23-84538G04	15 uF ±20%; 25 V
C3	23-84538G02	4.7 uF ±20%; 25 V
C4	23D82783B04	100 uF ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48D82466H12	silicon
CR2	48C83654H01	silicon
CR3	48D82466H12	silicon
CR4	48D82466H12	silicon
		CHOKE:
L1	25B84796G01	3 mH; res .75 ohms max.
		TRANSISTOR: (SEE NOTE)
Q1	48R869428	NPN; type M9428
Q2	48R869428	NPN; type M9428
Q3	48R869427	PNP; type M9427
Q4	48R869642	NPN; type M9642
		RESISTOR, fixed: ±10%; 1/4 W unless otherwise stated
R1	6S131652	39
R2	6S6040	680; 1/2 W
R3	6S129226	100k
R4	6S6090	470; 1/2 W
R5	6S6254	330; 1 W
R6	6S129230	12k
R7	6S129145	82k
		TRANSFORMER, power:
T1	25D83633D02	transistor-controlled; toroidal type; ferrite core; incl. pri: BRN, BLK w/GRN center tap: res 0.16 ohm ±15% feedback: BLU, YEL w/WHT center tap; res .087 ohm ±15% sec: ORG, ORG w/RED center tap; res 0.339 ohm ±15%
		NON-REFERENCED ITEMS
	42C84284B01	RETAINER: (screw captivator) 3 req'd.
	3S136905	SCREW, tapping: No. 4 x 5/16" "Phillips" round head; incl. captive lockwasher; 3 req'd.
	26B83379H01	HEAT SINK (2 req'd.)
	26-82476L01	SHIELD, transformer

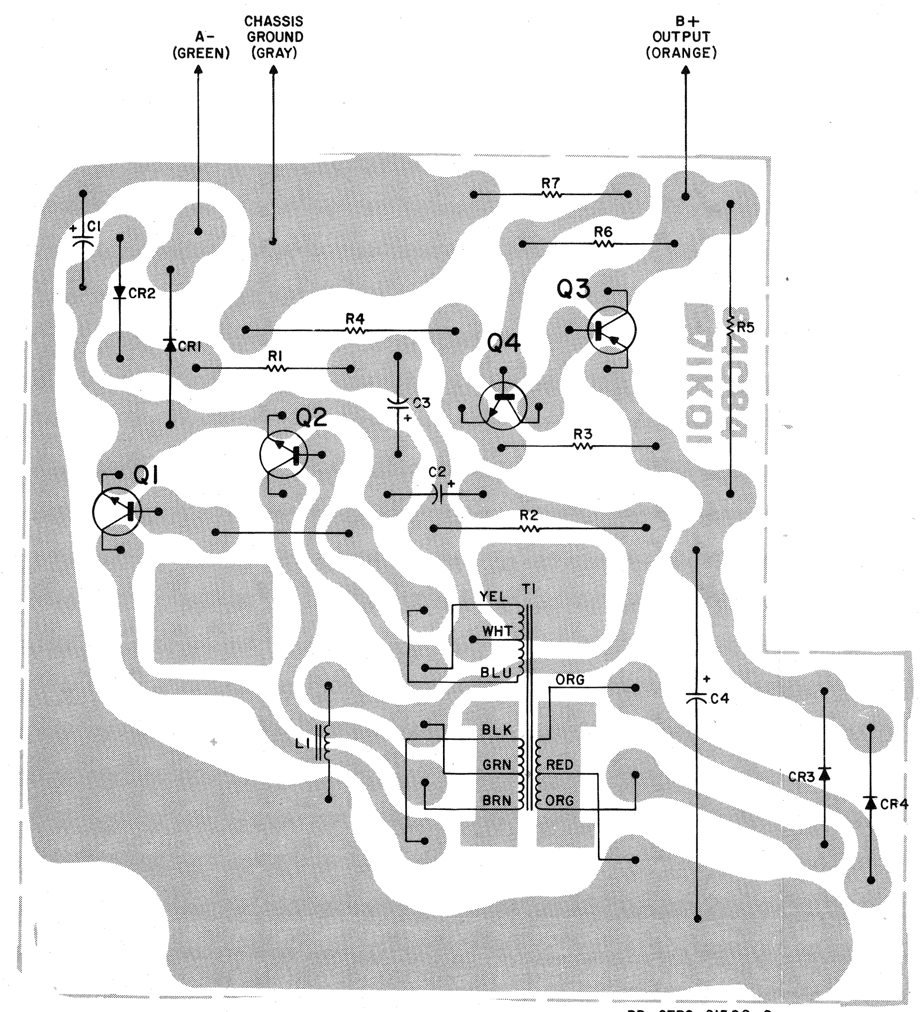
NOTE: For optimum performance, diodes, transistors must be ordered by Motorola part number.



POSITIVE GROUND CONVERTER NOTES:

1. P-P (PEAK-TO-PEAK) VOLTAGES ARE MEASURED WITH AN OSCILLOSCOPE WITH RESPECT TO CHASSIS REFERENCE.
2. DC VOLTAGES ARE MEASURED WITH A HIGH IMPEDANCE (11 MEGOHMS) DC MULTIMETER WITH RESPECT TO CHASSIS REFERENCE.

EPS-6456-C



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BD-CEPS-21560-0
OL-CEPS-21561-0

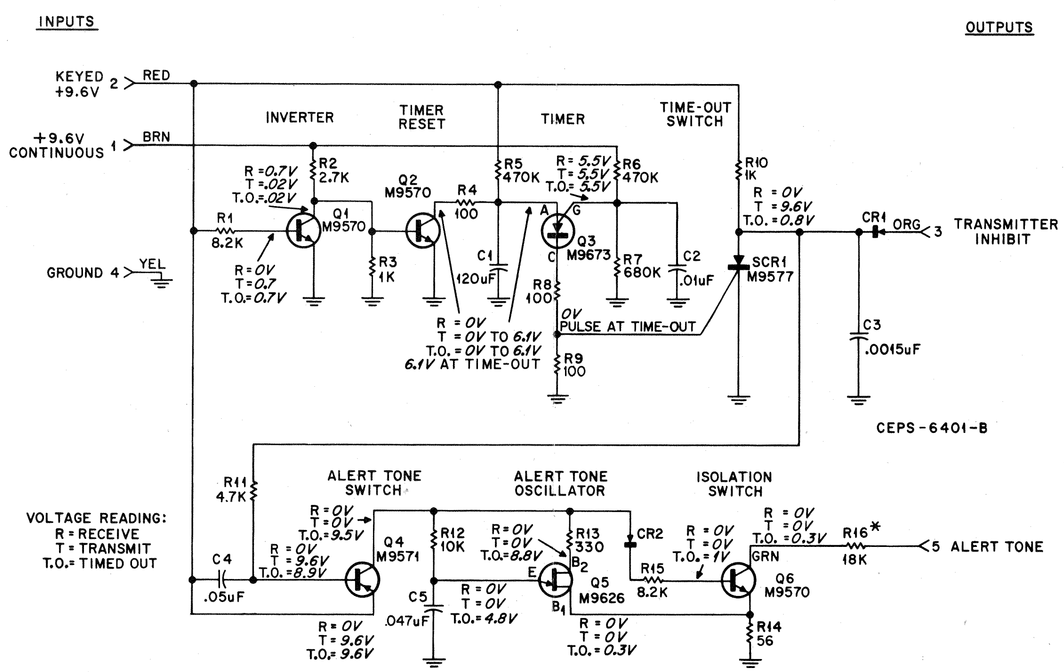
POSITIVE GROUND CONVERTER/TIME-OUT TIMER

TIME-OUT TIMER

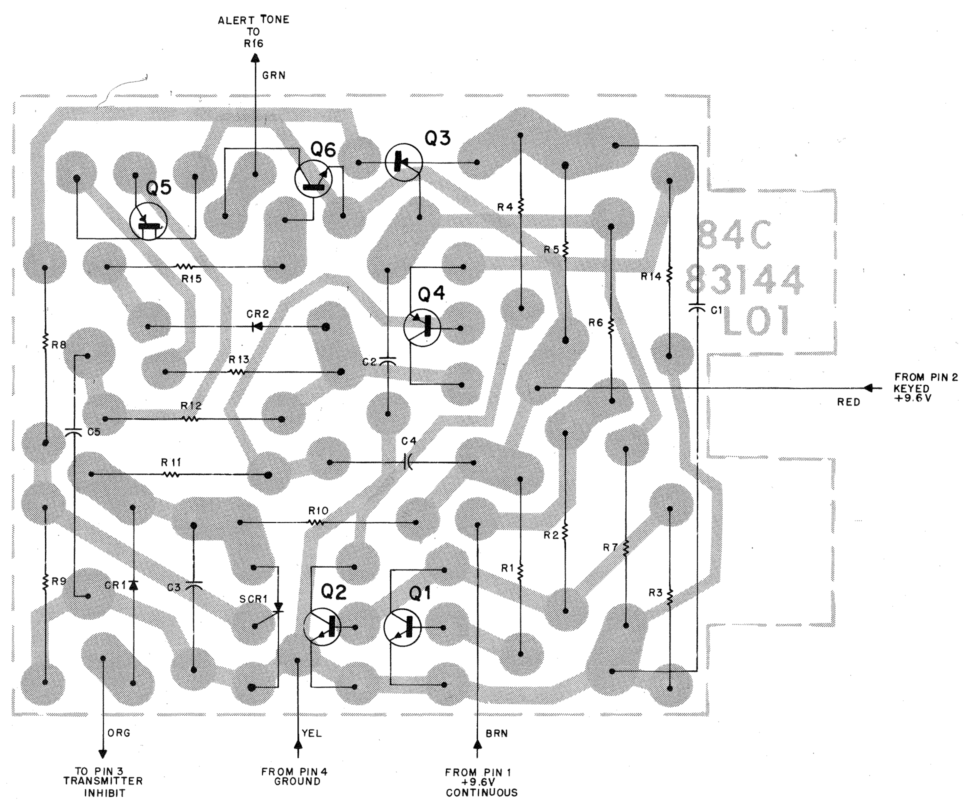
MODEL TLN1361A

FUNCTION

The time-out timer times a one-minute period starting when the PTT switch is actuated. When the time expires, the unit operates a switch in the exciter to turn off +9.6 V to the transmitter. The unit also supplies an alert tone to signal the local operator that time has expired.



VERSION-1



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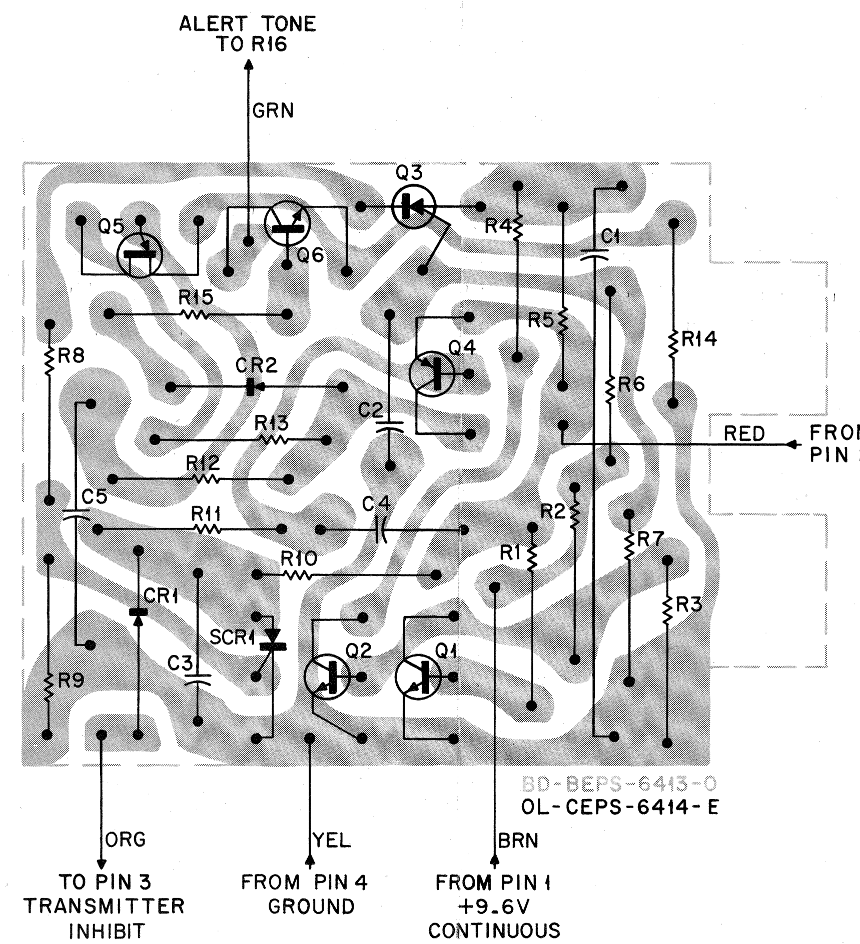
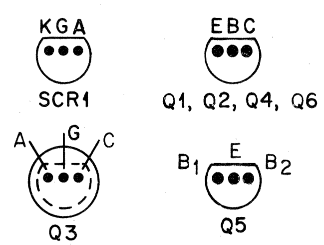
SOLDER SIDE BD-CEPS-22041-O
COMPONENT SIDE BD-CEPS-22042-O
OL-CEPS-22043-O

VERSION-O

TIME-OUT TIMER



SHOWN FROM SOLDER SIDE



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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TIME—OUT TIMER

TLN1361A Time-Out Timer PL-999-G

		CAPACITOR, fixed: uF; ±10%; unless otherwise stated
C1	23D83185D01	120; 15 V
C2	21D82428B59	.01 +80-20%; 200 V
C3	21D82187B31	.0015; 100 V
C4	21C82372C07	.05 +80-20%; 25 V
C5	8D82905G30	0.1; 50 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48C83654H01	silicon
CR2	48C83654H01	silicon
		CONNECTOR, receptacle:
J1	1V80763A66	female; 5-contact (mounting base)
J911	39S10184A24	Push pin; female
		TRANSISTOR: (SEE NOTE)
Q1	48R869570	N-P-N; type M9570
Q2	48R869570	N-P-N; type M9570
Q3	48R869673	programmable unijunction; type M9673
Q4	48R869571	P-N-P; type M9571
Q5	48R869626	P-N unijunction; type M9626
Q6	48R869570	N-P-N; type M9570
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R1	6S124C71	8.2K
R2	6S185B84	2.7K; 1/8 W
R3	6S124C49	1K
R4	6S124C25	100
R5	6S185B14	470K ±5%; 1/8 W
R6	6S124B14	470K ±5%
R7	6S124B18	680K ±5%
R8	6S124C25	100
R9	6S124C49	1K
R10	6S124C49	1K
R11	6S124C65	4.7K
R12	6S185B91	10K; 1/8 W
R13	6S124C37	330
R14	6S124C11	27
R15	6S124C71	8.2K
R16	6S124C63	3.9K
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
SCR1	48R869577	silicon; controlled; type M9577

NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola Part Numbers.

TLN5868A Tune-out Timer Installation PL-5234-O

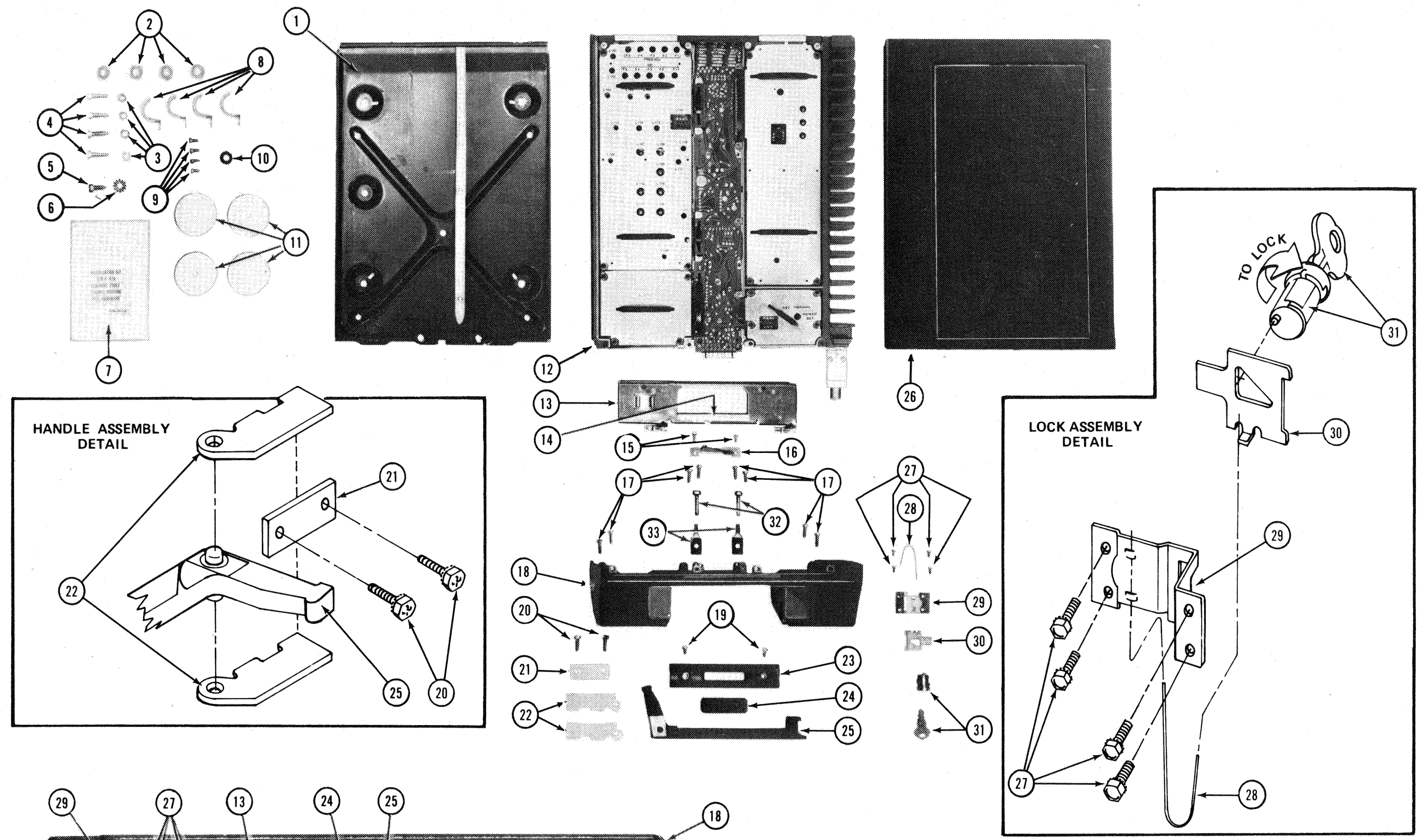
	2-131435	NUT, 4-40 x 1/4 x 3/32"; 2 used
	3-134184	SCREW, tapping; 4-40 x 5/16"; 2 used
	3-134212	SCREW, tapping; 4-40 x 5/16"; 2 used
	7-82318L01	BRACKET
	42-10217A01	STRAP, cable harness; 3 used

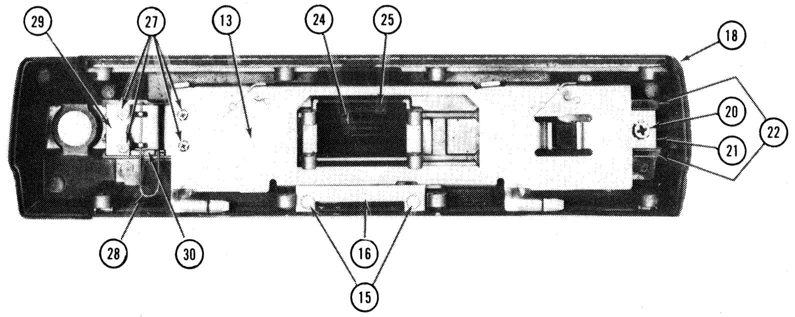
"MICOR" MODEL HARDWARE KITS

MODEL TLN5096B STANDARD (CARRIER SQUELCH)
MODEL TLN4931B STANDARD ("PRIVATE-LINE")
MODEL TLN5097B WIDE-SPACED (CARRIER SQUELCH)
MODEL TLN4932B WIDE-SPACED ("PRIVATE-LINE")
MODEL TLN5665A STANDARD (45/100 WATT)
MODEL TLN5663A WIDE-SPACED (45/100 WATT)

FUNCTION

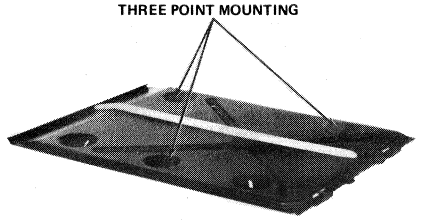
The model hardware kits include the housings and housing parts used with the "Micor" radio sets. Separate kits are used for one and five frequency models and for carrier squelch, (CS), "Private-Line" (PL) squelch, and "Digital Private-Line" (DPL) squelch.





ASSEMBLED LOCKING MECHANISM

CLOSE-QUARTER BOTTOM PLATE THREE POINT MOUNTING



USE OF THREE POINT MOUNTING ELIMINATES BOTTOM COVER WARPING WHEN MOUNTED ON UNEVEN SURFACES

FCEPS-20634-B

PARTS LIST

MECHANICAL PARTS

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	1V80719B58	COVER, bottom
2	43-893898	BUSHING, spacer
3	4-119331	LOCKWASHER: 1/4" split
4	3-129278	SCREW, tapping: 14-10 x 1" plain hex head
5	3-125947	SCREW, tapping: 14-10 x 3/4" plain hex head
6	4-7688	LOCKWASHER: 1/4" internal-external
7	56-84158A28	BAG, plastic: imprinted
8	42-19376	CLAMP, cable
9	3-7467	SCREW, tapping: 8-18 x 3/8" plain hex head
10	37-82633B03	GROMMET, rubber: 0.625" x 0.500" x 0.375"
11	4-122238	WASHER, metallic: 2.125" x 0.257" x .095"
12		"MICOR" MOBILE RADIO SET
13	64-84122D01	SLIDE PLATE, cover locking
14	64-84965C01	DETENT CHANNEL
15	3-134186	SCREW, tapping: 6-32 x 5/16" "Phillips" hex head (ext. lock-washer)
16	1V80722B40	DETENT BRACKET & SPRING ASSEMBLY
17	3-138295	SCREW, tapping: 8-32 x 3/8" "Phillips" binder head
18	64-84087B01	FRONT PANEL
19	3-138295	SCREW, tapping: 8-32 x 3/8" "Phillips" binder head
20	3-136909	SCREW, tapping: 10-32 x 11/16" plain hex head
21	55-84301B01	JAM PLATE
22	64-84289B01	PIVOT PLATE, handle
23	43-84273B01	HAND GRIP, handle
24	75-84424B01	CUSHION, hand grip
25	55-84667B01	HANDLE
26	15-82384M01	COVER, top
27	3-134184	SCREW, tapping: 4-40 x 5/16" "Phillips" hex head (ext. lockwasher)
28	41-84246D01	SPRING, locking bar tensioning
29	42-84244D01	RETAINER, locking bar guide
30	45-84245D01	LOCKING BAR
31	55-84101B01	CYLINDER ASSEMBLY, key-operated: incl. two keys, part no. 55-893872 (one key)
32	3-138006	SCREW, tapping: 8-32 x 1-1/16" "Phillips" fillister head
33	46-84294B01	BLOCK, Wedge
	75-83951F01	BUMPER, rubber: 2 used (NOT SHOWN)

MOBILE SPEAKER

MODEL TSN6016B (8 FEET)
MODEL TSN6020A (25 FEET)

PL OR DPL HANG-UP SWITCH BOX

MODEL TLN5181A

FUNCTION

The mobile speaker reproduces received audio. The speaker is rated at 15 watts and has an 8-ohm impedance.

The hang-up switch box is used in "Private-Line" (PL) and "Digital Private-Line" (DPL) coded squelch systems to hold the microphone when not in use. When the microphone is removed for use, a switch in the box automatically disables the coded squelch to permit channel monitoring before transmission.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TRN8588A Hardware Kit		PL-6206-O
3	7-84569B01	BRACKET, wall mounting
10	7-84567B01	BRACKET, hanger
11	3-121103	SCREW, machine: 6-32 x 3/8"
16	3-3660	SCREW, tapping: 6-20 x 1/2"; 2 used

PARTS LIST HANG-UP BOX

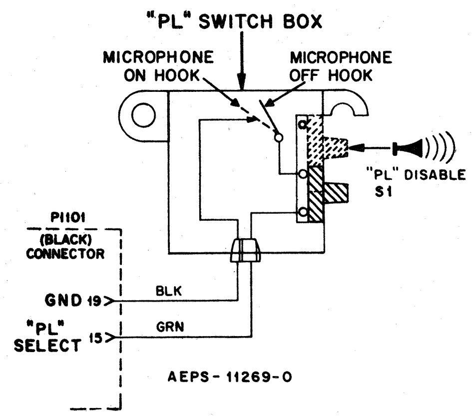
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN5181A Hang-Up Box		PL-2034-B
S1	40-84622B04	SWITCH, spst, slide
NON-REFERENCED ITEMS		
	1-80742B93	HOUSING ASSEMBLY (hang-up box) includes ref. part S1
	1-80709B97	CABLE ASSEMBLY: includes 30S10136A15 CABLE, 2-conductor: 3 ft. length 9C84151B01 CONNECTOR, plug: female: 2 req'd
	3-122830	SCREW, tapping: No. 8 x 1/2" (2 req'd) (mounting screws)
	42-82018H07	RETAINER, cable
	40-84198C01	SWITCH, stack
	3-135495	SCREW, machine 2-56 x 3/8" (2 req'd)

PARTS LIST

MECHANICAL AND ELECTRICAL PARTS

TSN6016B Mobile Speaker (8 ft. cables)
TSN6020A Mobile Speaker (25 ft. cables) PL-1046-E

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	1V80712B91	HOUSING ASSEMBLY (rear): includes:15D84981B01 HOUSING (rear): 3-140001 SCREW, tapping: 6-19 x 7/8"; Phillips pan head; 4 required
2	7C84568B01	BRACKET, trunnion
4	3S136756	SCREW, tapping: No. 10 x 5/8" plain hex head; 3 required
5	3B84244C01	THUMBSCREW, machine: 10-32 x 3/8"; 2 required
6	50D84561B01	LOUDSPEAKER, magnetic; 5"; "pincushion" type; 15 Watt
	or 50-84561B06	LOUDSPEAKER, magnetic; 5"; "pincushion" type; 20 Watt
7	32C84564B01	GASKET, speaker-mounting
8	13B82671M01	BEZEL, speaker
9		CONNECTOR, plug: female; consists of: 14C84566B01 BODY, connector 9C84151B01 TERMINAL, contact: 2 required
12	42B82018H05	RETAINER, cable entrance
13	33B82599D01	NAMEPLATE
14	42A84081A03	CLAMP, cable: includes "S" hook
15	1V80709B98	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2-conductor (8 ft); each conductor No. 18 ga. stranded; ("zip" cord); also includes coded items 9 and 14 (TSN6016B)
	or 1V80717B50	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2 conductor (25 ft); each conductor No. 18 ga. stranded; ("zip" cord); also includes coded items 9 and 14 (TSN6020A)



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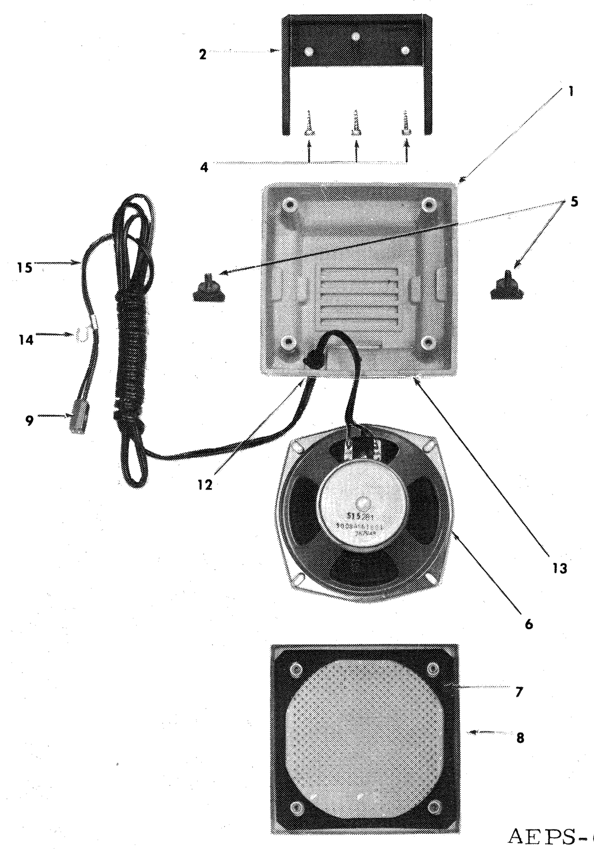

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MOBILE DYNAMIC MICROPHONE

MODELS TMN6054A AND TMN6111A

FUNCTION

The mobile microphone converts speech to audio signals for transmission. The microphone includes a hang-up clip and hardware used in carrier squelch applications to hold the microphone.

ELECTRICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

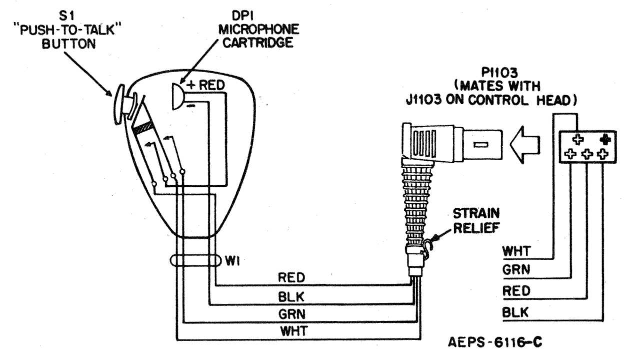
MICROPHONE

TMN6111A and TMN6054A Microphone PL-797-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CARTRIDGE, microphone:
DP1	59-83272G01 or59-84013A01 or59-82933C01 or59-82933C02	dynamic: includes transistor preamplifier
		CONNECTOR, plug:
P1103		part of W1
		CORD, microphone: coiled
W1	1-84135C01	4-conductor; includes ref. part P1, CLAMP, cable "S" hook (ref. part 13), SPRING, strain relief (ref. part 12), and non-ref. LUG (4 req'd) 29B83277G02
		SWITCH, push:
S1	40-82263G02	dpst
	NON-REFERENCED ITEMS	
	29-83277G02	LUG, insulation piercing: 4 req'd (p/o W1)
	33-82599D01	NAMEPLATE
	13-84599B01	EMBLEM

TMN6111A, TMN6054A Microphone PL-1305-F

CODE	MOTOROLA PART NO.	DESCRIPTION
1	38A84559B01	PUSHBUTTON
2	3S140000	SCREW, tapping: No. 6-19 x 3/8"; 3 req'd.
		WASHER, flat: 1/4" x 0.156" x 0.015"; 3 req'd.
5	3S122830	SCREW, tapping: No. 8 x 1/2"; 2 req'd.
6	1V851094	BRACKET & SPRING ASSY. (eyeletted)
7	1V80709B93	HOUSING, microphone (front and rear) TMN6054A (PEARL)
	or1V80720A95	HOUSING, Microphone (front and rear) TMN6111A (BLK)
8	3S129498	SCREW, lock: No. 6-32 x 5/16" "Phillips" round head
9	4S7666	LOCKWASHER: No. 6 external
10	42A852710	STRAP, strain relief
11	3S139999	SCREW, tapping: No. 6-19x3/4" "Phillips" round head 2 req'd.
12	41A852707	SPRING, strain relief (p/o W1)
13	42A893647	CLAMP, cable "S" hook (p/o W1)
15	42B82702B02	RETAINER, cartridge
16	32A82703B01	GASKET, neoprene
17	11S2506	TUBING, No. 9 black; 5" length req'd.



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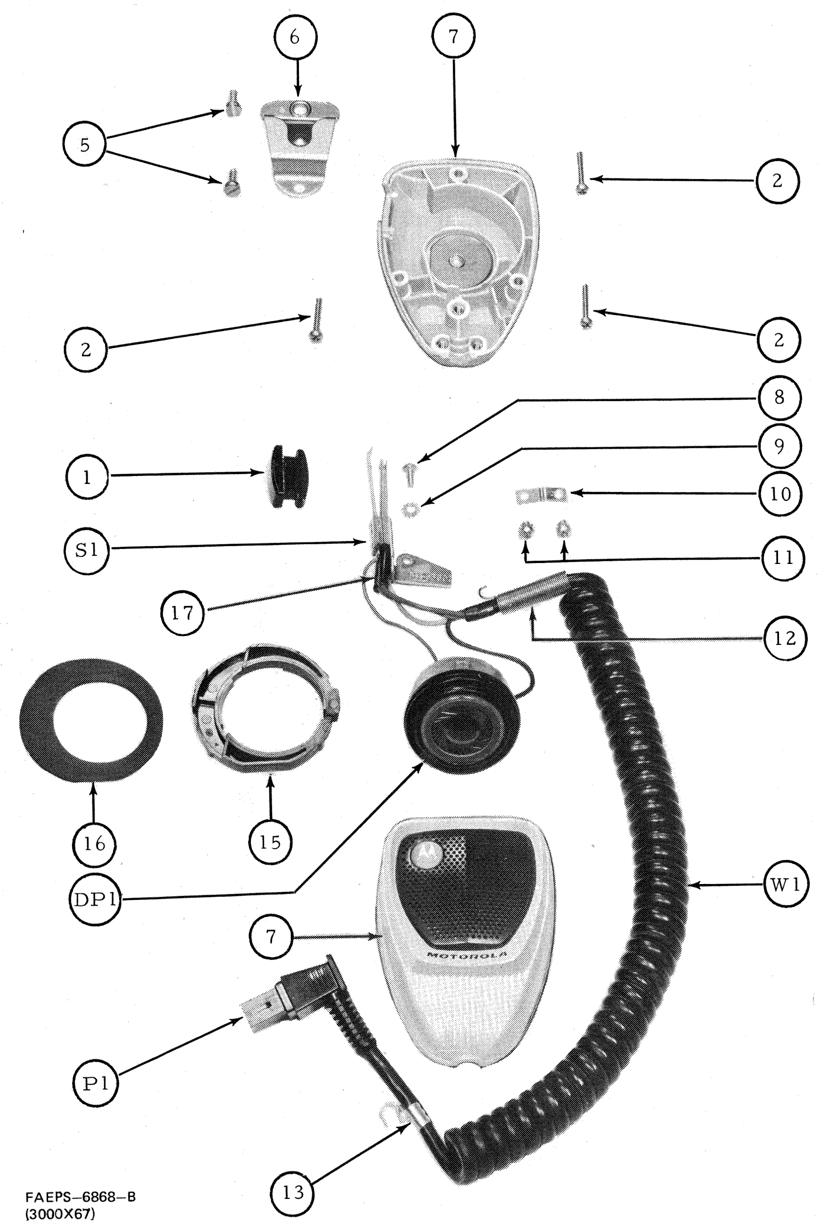

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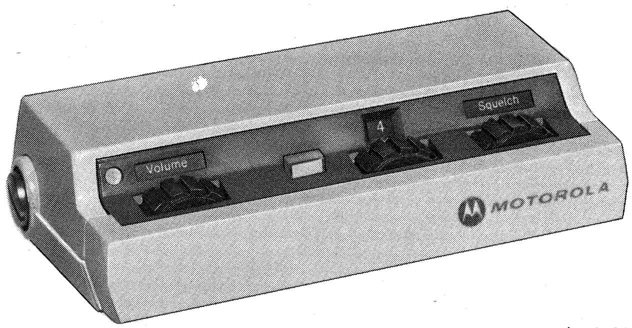
(3000X67)

CONTROL HEAD FOR "MICOR" RADIO



AEPS-6474-O

TCN1092B Control Head

MODEL TABLE

MODEL NUMBER	NO. OF FREQUENCIES
TCN1091B	1
TCN1092B	4
TCN1095A	1
TCN1096A	4
TCN1106A	8
TCN1112A	8
TCN1119A	12
TCN1124A	12
TCN1183A	5
TCN1184A	5

TECHNICAL CHARACTERISTICS

Dimensions (excluding mounting bracket)	6-7/8" wide x 2" high x 3-3/4" deep
Weight	1 pound
Temperature Range	-30°C to +60°C
Current Drain	145 mA @ 13.8 V
Safety	Meets or exceeds Federal Safety Standards FS-201 & SAEJ921

1. DESCRIPTION

These Motorola mobile radio control heads are durable units providing ease of operation, illuminated labelling of controls (graphics), maintenance-free circuitry, and impact safety. A rugged circuit board eliminates virtually all wires, while a slide-switch, two potentiometers, and a rotary switch provide almost complete operator control of the radio set. A durable two-piece plastic housing encloses the circuit board and control head components while a resilient front bumper provides protection during accidental contact.

The recessed knurled VOLUME, frequency selector, and SQUELCH knobs project both above and below to permit adjustment by the operator. The power switch on-off actuator projects from the top when in the on position, below when off. Rotation of the frequency selector knob (multi-frequency models only) selects the desired receive and transmit frequency. The channel selected is numerically indicated on the frequency indicator dial directly above the selector knob. Rotation of the VOLUME control clockwise increases the volume. Clockwise rotation of the SQUELCH control increases the squelch threshold (requires a stronger signal before audio is heard). Labelling of controls is provided by visual graphics which are visible in the daylight and illuminated at night, while the red transmit indicator will be seen whenever the push-to-talk function is activated.

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

Breakaway and non-breakaway trunnion mounts are available for control head mounting. These two brackets offer a limitless choice of operating positions. Both mounts allow continuous adjustment in the vertical plane and the breakaway mount also affords continuous adjustment in the horizontal plane.

Four holes are provided on the bottom of the control head to mount a microphone hang-up clip or PL hang-up switch box.

2. INSTALLATION

a. Tools Required

-- Center Punch
-- Hammer
-- Drill (1/4" Chuck)
-- #22 (0.157") Drill
-- Screwdriver (Flat Blade)
-- 5/16" Nut Driver

b. Installation Procedure (With Non-Breakaway Mount)

(1) Determine the location for mounting the control head. The control head should be positioned within easy reach of the operator.

(2) Remove the trunnion bracket and retainer assembly from the control head by removing the two trunnion side screws (see Figure 1).

CAUTION

Care must be taken in removing the trunnion bracket from the control head. After removing the side screws from the trunnion bracket, spread the bracket slightly to prevent damage to the circular friction action between the cup on the control head and the clutch facing on the bracket.

(3) Disassemble the retainer and breakaway disc assembly from the trunnion bracket by using a 5/16" nut driver to remove the #10-32 x 1/2" lockscrew.

(4) Remove the tapping screws from the control head retainer. (Discard the paper retainers.)

(5) The retainer, breakaway disc, and 10-32 x 1/2" lockscrew will not be used in this installation (retain for future use).

(6) Use the trunnion bracket as a template and mark the locations of the holes to be drilled.

(7) Center punch and drill two 0.157" (#22 drill) holes at the positions marked previously.

(8) Secure the trunnion bracket to the vehicle with two 10-16 x 5/8" tapping screws.

(9) Reassemble the control head to the trunnion bracket using caution as advised in step (2).

NOTE

Before tightening the two trunnion side screws, rotate the control head into the desired vertical position.

(10) Fasten the appropriate cable connectors to the rear of the control head.

c. Installation Procedure (With Breakaway Mount)

(1) Determine the location for mounting the control head. The control head should be positioned within easy reach of the operator.

(2) Remove the trunnion bracket and retainer assembly from the control head by removing the two trunnion side screws (see Figure 2).

CAUTION

Care must be taken in removing the trunnion bracket from the control head. After removing the side screws from the trunnion bracket, spread the bracket slightly to prevent damage to the circular friction action between the cup on the control head and the clutch facing on the bracket.

(3) Disassemble the retainer and breakaway disc assembly from the trunnion bracket by using a 5/16" nut driver to remove the #10-32 x 1/2" lockscrew.

(4) Remove the tapping screws from the control head retainer. (Discard the paper retainers.)

(5) Remove the backing from the self-adhesive mounting template and fasten the template at the location where the control head is to be mounted.

NOTE

This template locates the mounting holes for drilling and should be left in place to show the re-assembly of the trunnion bracket if the installation is changed at a later date.

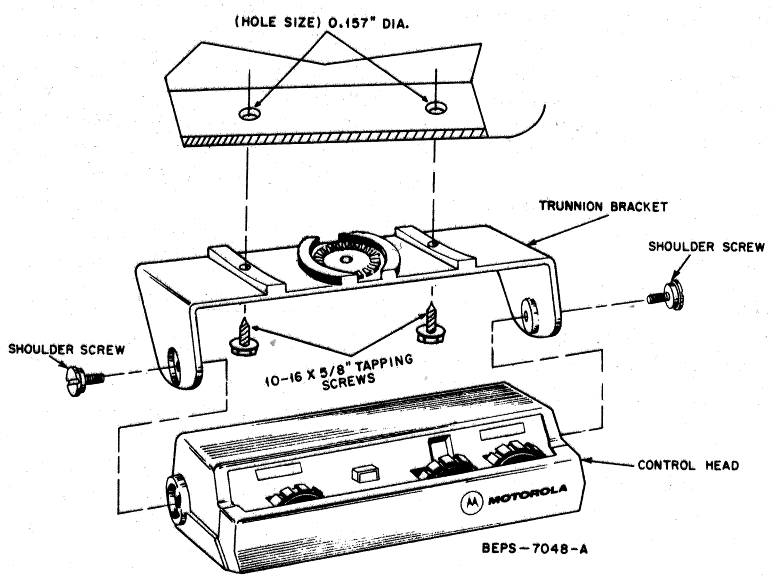


Figure 1.
Non-Breakaway Mounting

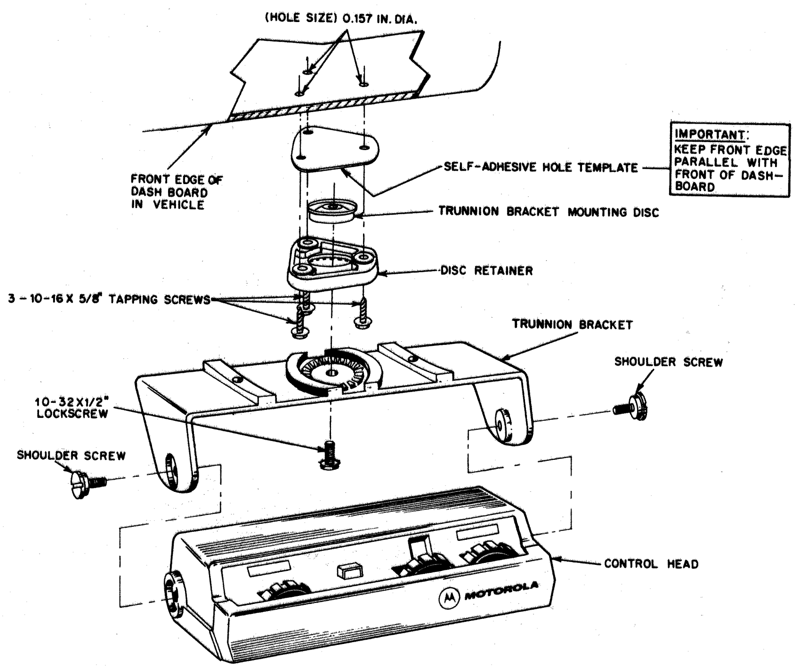


Figure 2.
Breakaway Mounting

CONTROL HEAD

(6) Center punch and drill two 0.157" (#22 drill) holes at the position located on the template.

(7) Mount the control head retainer and breakaway disc assembly with the supplied hardware (two #10 x 5/8" tapping screws) using a 5/16" nut driver.

(8) Mount the trunnion bracket to the control head retainer assembly using the #10-32 x 1/2" lockscrew removed in step (3).

NOTE

Before tightening the lockscrew, rotate the trunnion bracket to the desired horizontal position; then tighten the lockscrew.

(9) Reassemble the control head to the trunnion bracket using caution as advised in step (2).

NOTE

Before tightening the two trunnion side screws, rotate the control head into the desired vertical position.

(10) Fasten the appropriate cable connectors to the rear of the control head.

3. OPERATION

a. To Turn "On" the Equipment

Apply power to the radio set by pressing upward on the on-off switch actuator projecting from the bottom of the control head (see Figure 3). The frontal area of the actuator will appear and the graphics will be illuminated (visible only during dim ambient light conditions), indicating that power has been applied to the radio. On Multi-frequency models, rotate the frequency selector knob until the number on the frequency indicator dial corresponds to the number associated with the desired frequency.

b. To Receive

NOTE

Omit steps (1) and (5) for radio sets without "Private-Line" operation.

(1) To hear all on-frequency signals, set the "Private-Line" switch (on the side of the hang-up switch box) in the PL disable position, [🔈].

(2) Turn the SQUELCH control to the fully counterclockwise position.

(3) Turn the VOLUME control clockwise until noise is heard.

(4) With no signal being received, adjust the SQUELCH control by turning the control slowly clockwise until the noise is just squelched (cuts out).

(5) To hear "Private-Line" signals only, set the "Private-Line" switch on the hang-up switch box in the operate position and place the microphone in the hang-up box.

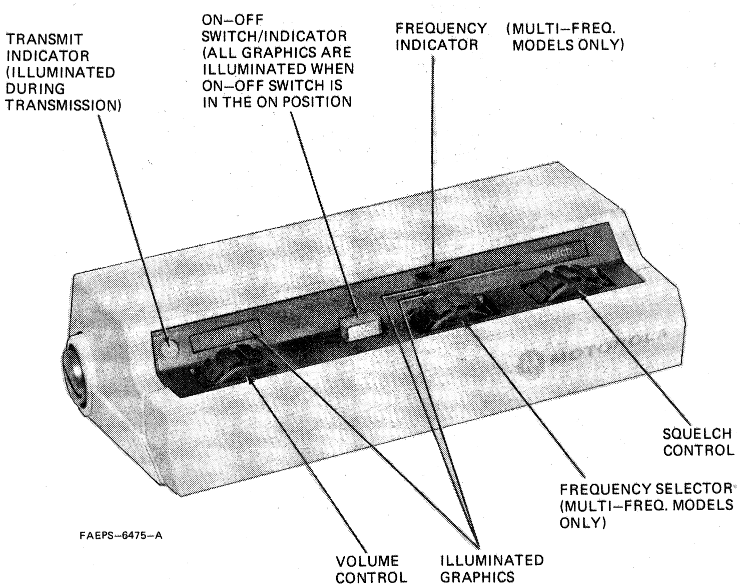


Figure 3.
Operator's Controls and Indicators

(6) Set the VOLUME control to the desired listening level with a received signal.

c. To Transmit

(1) "Private-Line" Radio Sets

(a) Turn "on" the radio set. Turn "on" the vehicle ignition switch (if required). To conserve the battery, the engine should be running while transmitting.

(b) Lift the microphone on handset out of the hang-up switch box. Listen for other stations which may be transmitting. If signals are heard, wait until the communication channel is clear before proceeding. Hold the microphone about one inch from the lips and turned about 30° away from the face. Press the push-to-talk button on the microphone. The red transmit indicator will illuminate and the radio will transmit a carrier. Speak slowly and clearly across the microphone in a normal or slightly louder-than-normal voice. At the end of the message, release the push-to-talk button and replace the microphone. This returns the radio receiver to PL tone-coded squelch operation.

(2) Carrier Squelch Radio Sets

(a) Turn "on" the radio set. Turn "on" the vehicle ignition (if required). To conserve the battery the engine should be running while transmitting.

(b) Remove the microphone or handset from the hang-up bracket. Hold the microphone about 1" from the lips and turned about 30° away from the face. Press the push-to-talk button on the microphone. The red transmit indicator will illuminate and the radio will transmit a carrier. Speak slowly and clearly across the microphone in a normal or slightly louder-than-normal voice. At the end of the message, release the push-to-talk button and replace the microphone.

d. To Turn "Off" the Equipment

Depress the on-off switch actuator until the frontal area of the actuator disappears and the light illuminating the graphics goes out.

4. MAINTENANCE

The "Micor" control heads are rugged passive units that should require little or no maintenance. If a problem is suspected in the control head, the following instructions provide directions for disassembly of the unit.

Refer to Figure 4. The two captivated "Phillips" head screws hold the upper and lower halves of the housing together. Four optical prisms are factory mounted and aligned into the top cover of the housing. These prisms require no service and must not be tampered with for any reason.

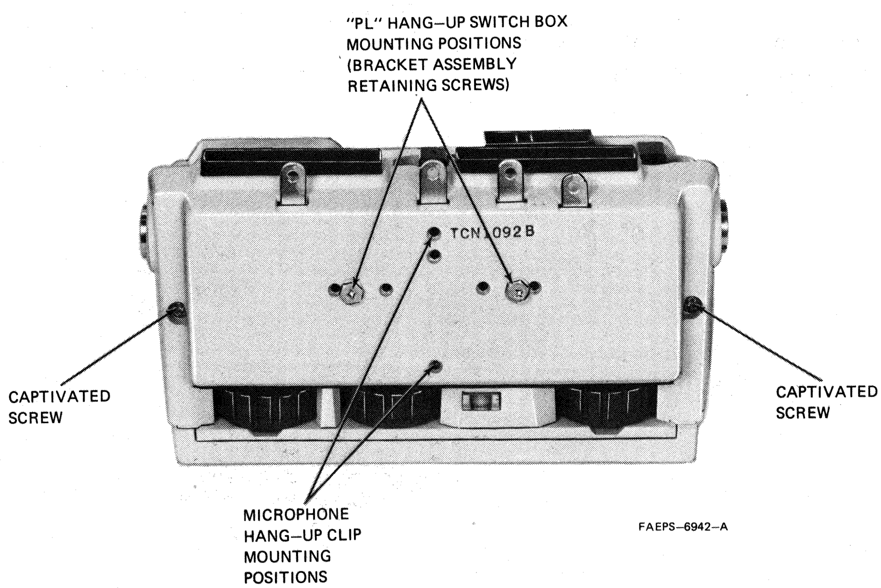


Figure 4.
Disassembly Detail

CONTROL HEAD

a. Bulb Replacement

Pilot bulbs can be replaced from the rear of the control head. Rotate the socket counterclockwise 45° and withdraw from the circuit board. Use the fingers to remove the wedge-type bulb by pulling straight out of the socket.

b. Circuit Board & Bracket Assembly Removal

Refer to the following procedure for removal of the circuit board and bracket assembly:

(1) Loosen the two captive screws and remove the upper half of the housing (refer to Figure 4).

(2) Remove two bracket assembly retaining screws and lift out assembly (refer to Figure 5).

(3) Reverse procedure to replace assembly.

c. Circuit Board Removal

If the circuit board must be removed, use the following procedure:

(1) Remove the circuit board and bracket assembly from the housing as described in the preceding paragraph.

(2) Remove the circuit board from the bracket assembly (refer to Figure 6).

(3) Service components mounted on the circuit board and/or bracket assembly.

(4) Reverse procedure to reassemble (refer to Figure 6).

d. Slide Switch and/or Frequency Selector Removal

If the slide switch and/or frequency selector must be removed, use the following procedure:

(1) Remove the VOLUME and SQUELCH control knobs.

(2) Remove the mounting nuts and lockwashers from both the VOLUME and SQUELCH controls (leave the slide switch and frequency selector switch mounted to the bracket).

(3) Slide the circuit board and attached controls out of the bracket.

(4) Disconnect the leads from the slide switch and frequency selector switch to the circuit board.

(5) Remove two "Phillips" head screws holding the slide switch to the bracket then remove the switch assembly.

(6) Remove the frequency selector knob, indicator dial, mounting nut, and lockwasher; then remove selector switch assembly.

(7) Reverse procedure to reassemble.

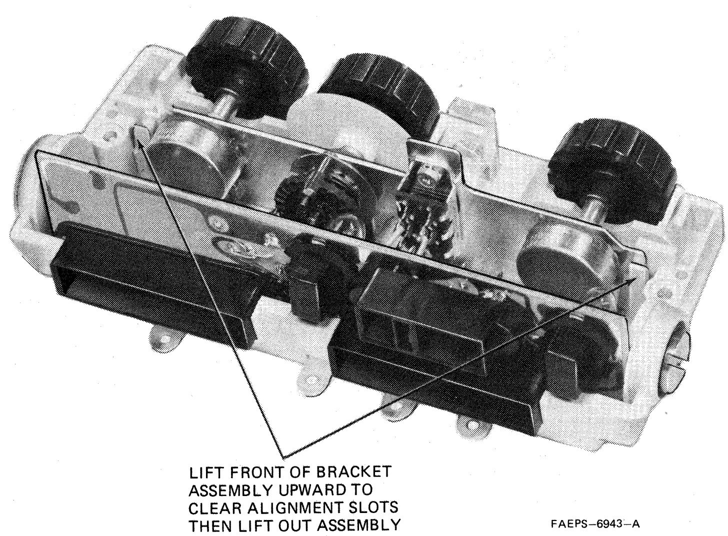


Figure 5.
Circuit Board & Bracket Assembly Removal

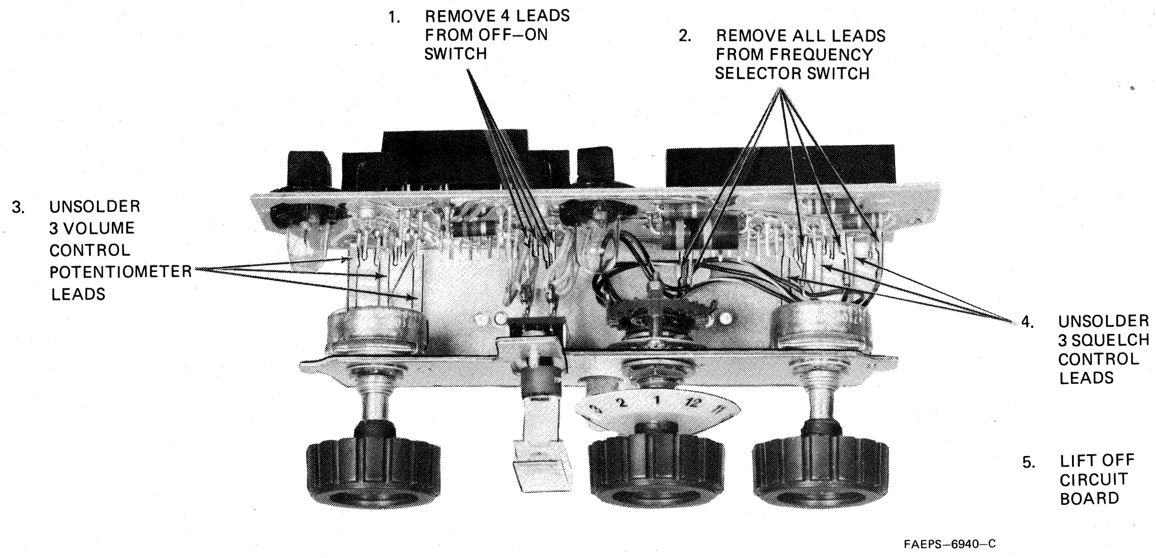


Figure 6.
Circuit Board Removal

e. Frequency Selector Switch Stop Adjustment

The multi-frequency control heads have a mechanical stop on the frequency selector switch. This stop is set for four, five, or eight-frequency operation as shipped from the factory. If less than four positions are desired, or if the selector switch is replaced, the mechanical stop must be properly set. Refer to Figure 7 for proper orientation of the switch and positioning of the mechanical stop. The stop is omitted in 12-frequency models to allow continuous rotation.

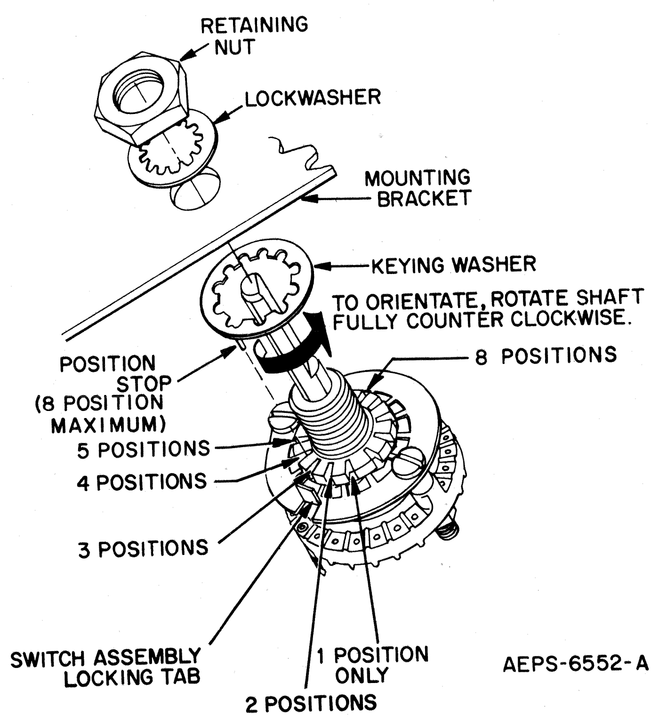
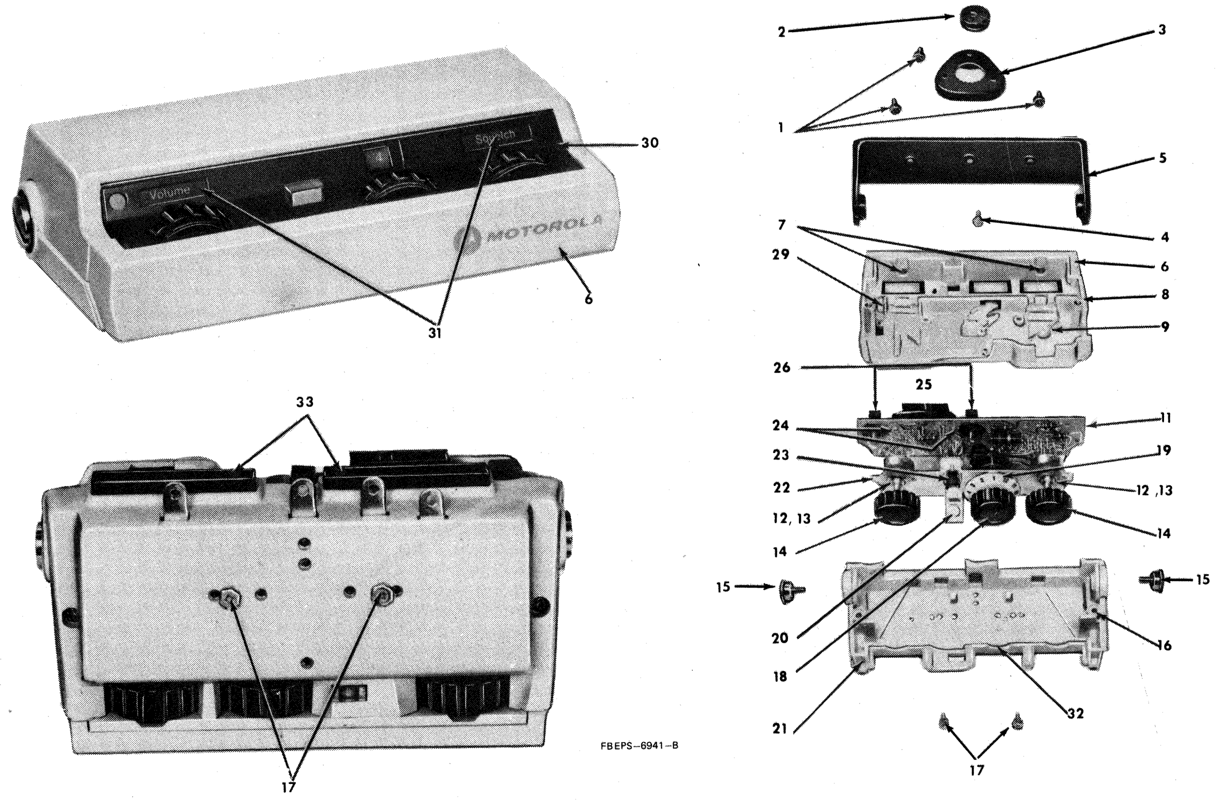


Figure 7. Frequency Switch Stop Adjustment

CONTROL HEAD



MECHANICAL PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

CONTROL HEAD MODELS

TCN1091B (Single-Freq.)	TCN1106A (8-Freq.)
TCN1092B (4-Freq.)	TCN1112A (8-Freq.)
TCN1095A (Single-Freq.)	TCN1119A (12-Freq.)
TCN10961 (4-Freq.)	TCN1124A (12-Freq.)
	TCN1184A (5-Freq.)

PL-1048-M

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	3S136756	SCREW, tapping; 10-16 x 5/8" plain hex flanged head; does not include 4S7652 LOCKWASHER; No. 10 external
2	49C84961C01	DISC, trunnion bracket mounting; "breakaway" type (TCN1091B and TCN1092B)
3	42D84963C01	COLLAR, trunnion bracket mounting (TCN1091B, TCN1092B)
4	3S115727	LOCKSCREW, machine; 10-32 x 1/2" plain hex head (TCN1091B, TCN1092B)
5	7C84576B01	BRACKET, trunnion (TCN1091B, TCN1092B)
6	75-82619M01	FRONT COVER, housing
7	3S136963	SCREW, tapping: 6-20 x 5/16" "Phillips" flat head
8	1V80712B88	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 27, 28, 29, 31 (multi-freq. models)
	or 1V80757B65	TOP COVER ASSEMBLY, housing; includes items coded 6, 7, 9, 28, 29 and 31 (single-freq. models)
9		PRISM, optical (SEE NOTE)
11	TLN4369B	PLATED CIRCUIT BOARD ASSEMBLY; includes contact terminals
12	2S136272	NUT, machine; 3/8-32 x 1/2" hex
13	4S8210	WASHER, metallic; 0.39" x 0.562" x 0.16"
14	36D84001C02	KNOB, control (volume & squelch)
15	3B84546B01	SCREW, machine; shoulder type (trunnion-mount)
16	3B84548B01	SCREW, machine; 6-32 x 1/2" "Phillips" round head; "captive" type
17	3S136138	LOCKSCREW, machine; 6-32 x 3/8" "Phillips" hex head
18	36D84001C01	KNOB, control; (freq. selector) (requires use of item coded 19)
19	36D84006C01	DISC, switch position indicator (used with item coded 18)
20	45C84004C01	ACTUATOR, switch
21	15E84920B01	HOUSING, (bottom section)
22	7C84005C01	BRACKET (chassis)
23	1V80712B89	SWITCH ASSEMBLY: (slide switch); includes wires, contact terminals and mounting screws
24	3S135084	LOCKSCREW, tapping; 4-40 x 5/16" "Phillips" fillister head
25	42D84067C01	RETAINER, connector
26	9B84627B01	LAMPHOLDER
29		PRISM, optical; includes RED LENS (SEE NOTE)
30	13D84000C02 or 13D84000C01	BEZEL (single-frequency) BEZEL (multi-frequency)
31	33C84038C01	MARKER STRIP (VOLUME, SQUELCH)
32	38B84357C01	PLUG, SNAP-IN (single-freq.)
33	42C84962C01	RETAINER, connector
	NON-CODED ITEM	
	54B84111D01	MOUNTING TEMPLATE (TCN1091B, TCN1092B)

NOTE: Items coded 9, and 29 are not individually replaceable. For field-replacement, order item No. 8 (TOP COVER ASSEMBLY).

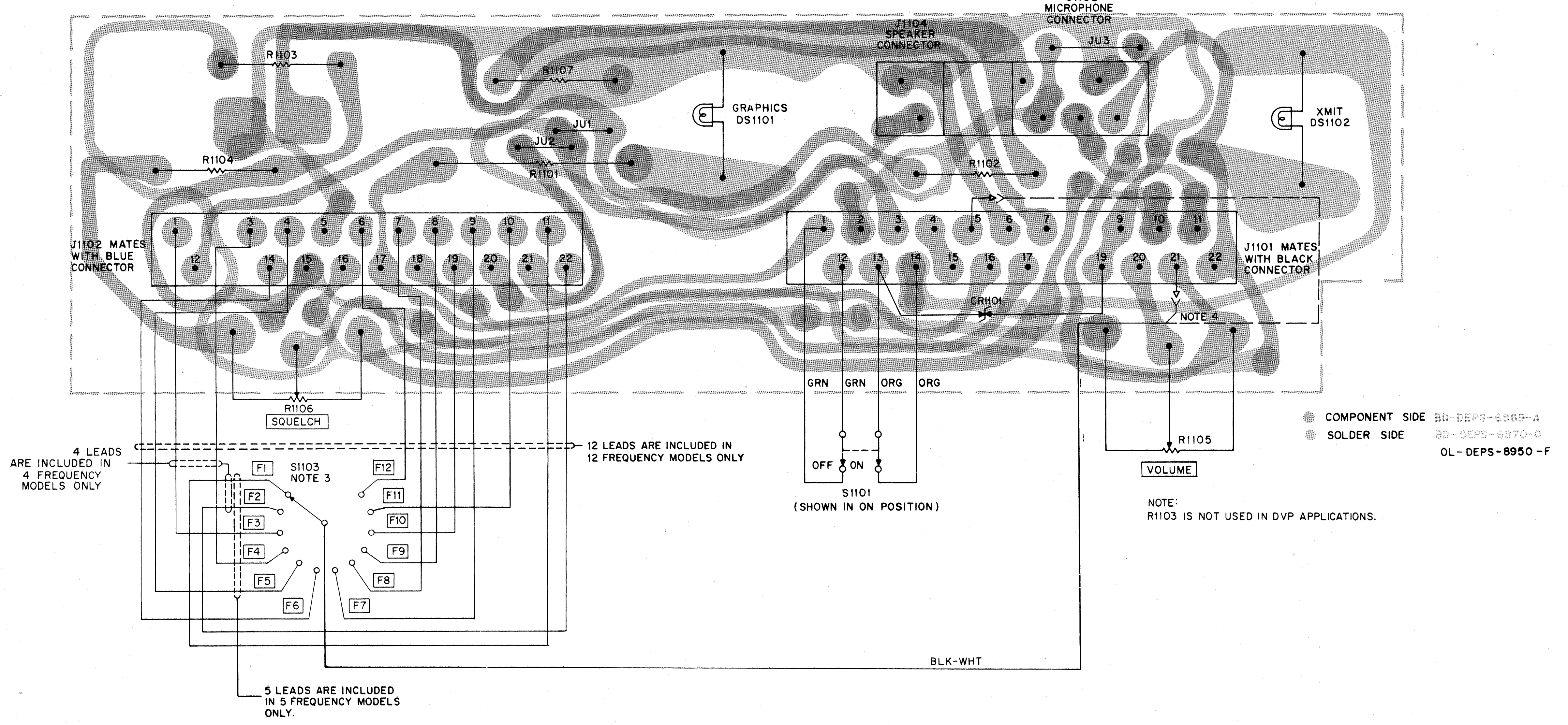
ELECTRICAL PARTS LIST

TLN4369B Circuit Board PL-1049-I

		DIODE: SEE NOTE
CR1101	48D83461E45	diode; Zener type; nom. 25 V
		LAMP, incandescent: miniature wedge base:
DS1101	65B83554G01	12 V; 0.19 A; type No. 161
DS1102	65B83554G01	12 V; 0.19 A; type No. 161
		CONNECTOR, receptacle:
J1101		c/o (20) 29B84547B01 TERMINALS, pin: male
J1102		c/o (20) 29B84547B01 TERMINALS, pin: male
J1103		c/o (5) 29B84547B01 TERMINALS, pin: male
J1104		c/o (2) 29B84547B01 TERMINALS, pin: male
		RESISTOR:
R1101	6S488090	fixed: 56 ±10%; 2 W
R1102	6S6291	fixed: 560 ±10%; 1/2 W
R1103	6S5581	fixed: 3.3k ±10%; 1/2 W
R1104	6S5581	fixed: 3.3k ±10%; 1/2 W
R1105	18C84584A02	variable: 25k ±30%; 1/4 W
R1106	18C84584A02	variable: 25k ±30%; 1/4 W
R1107	6S6373	fixed: 150 ±10%; 1/2 W
R1108	6-127C25	fixed: 100 ±10%; 2 W
		SWITCH:
S1101	40C84622B02	slide: dpst; does not include 29S10134A86 LUG, connector: female; 4 required
S1103	40C84149C01	rotary; 4-position; non-shorting includes mounting hardware & adjustable stopwasher (not available separately)
	40C84149C02	rotary; 8-position; non-shorting includes mounting hardware and (2) adjustable stopwashers (not available separately)
	40C84149C03	rotary; 12 position; non-shorting includes a fixed non-adjustable stop; does not include mounting hardware
	NON-REFERENCED ITEMS	
	1V80776B48	PRINTED CIRCUIT BOARD ASSEMBLY; includes 29B84547B01 TERMINAL, contact; male; 47 required 42C84962C01 RETAINER, connector; 2 required
	4-2636	LOCKWASHER: 3/8" internal tooth (for 12-freq. switch)
	2-136272	NUT, hex: 3/8"-32 x 1/2" (for 12-freq. switch)

NOTE:
Replacement diodes must be ordered by Motorola part number only for optimum performance.

SHOWN FROM SOLDER SIDE



NOTES:

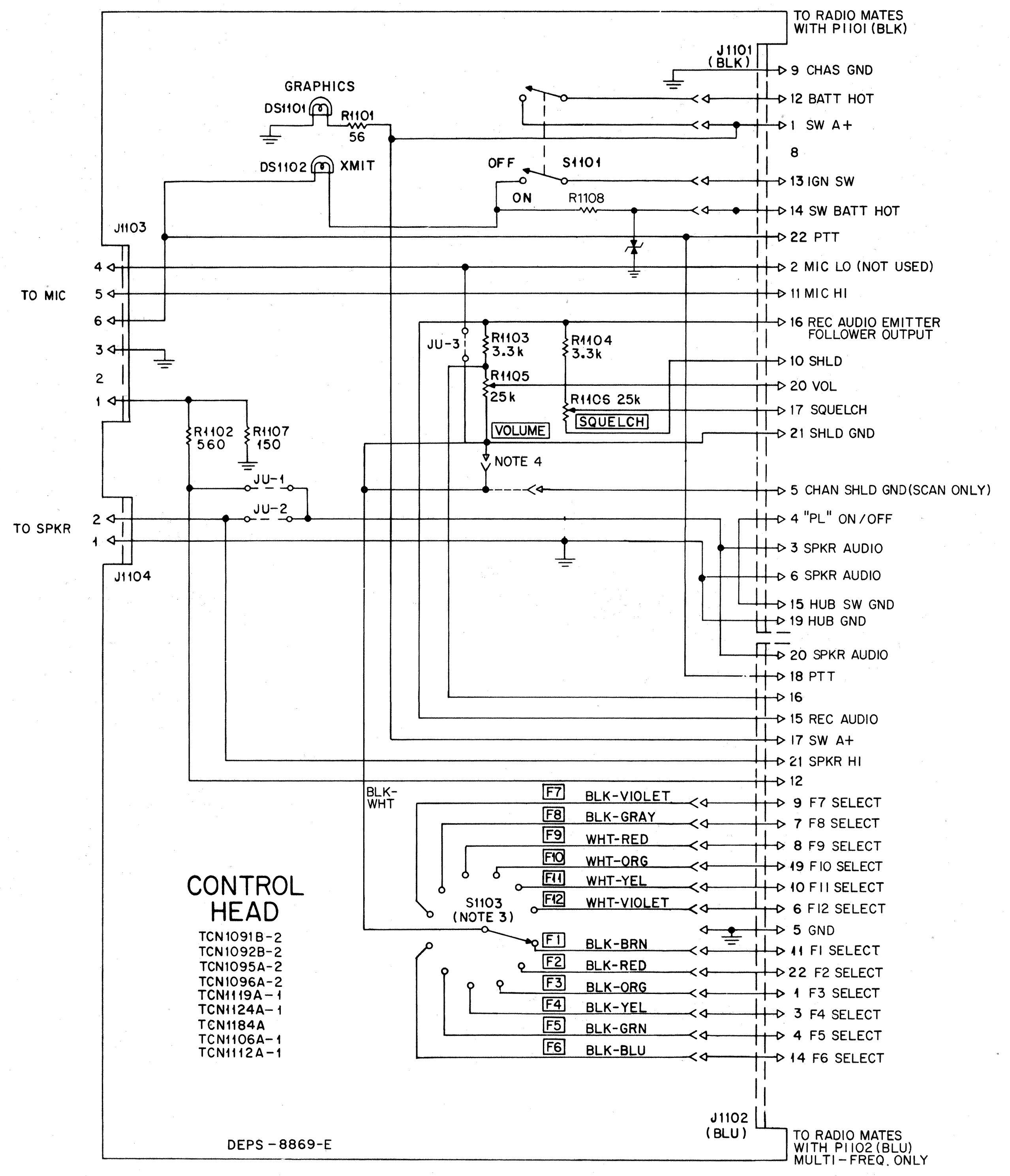
1. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH HANDSET (TMN6057A) AND HANDSET HANG-UP SWITCH BOX (TLN4504A) REFER TO THEIR RESPECTIVE MANUALS.
2. FOR PROPER OPERATION OF THIS CONTROL HEAD WITH VOICE PRIVACY ADAPTER (TLN1400A) REFER TO VPA MANUAL.
3. S1103 USED ONLY FOR MULTIPLE FREQUENCY CONTROL HEADS:
   - POSITIONS 1–4 WIRED FOR 4 FREQUENCY MODELS
   - POSITIONS 1–5 WIRED FOR 5 FREQUENCY MODELS
   - POSITIONS 1–8 WIRED FOR 8 FREQUENCY MODELS
   - POSITIONS 1–12 WIRED FOR 12 FREQUENCY MODELS
4. BLK WHT CHAN SEL GROUND LEAD CONNECTED TO 21 NORMALLY OR TO 5 FOR CHANNEL SCAN OR OTHER SP APPLICATIONS'.

EPS–6944–B

REVISIONS

63P81019E29-G

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN1091B-2 TCN1092B-2 TCN1095A-2 TCN1096A-2 TCN1119A-1 TCN1124A-1	CR1101	ADDED 48D83461E45 ADDED BLK/WHT LEAD BETWEEN R1105 and S1103	S1101
TCN1184A		ADDED MODEL	SCHEMATIC DIAGRAM AND PARTS LIST
		MINOR BOARD CHANGES	



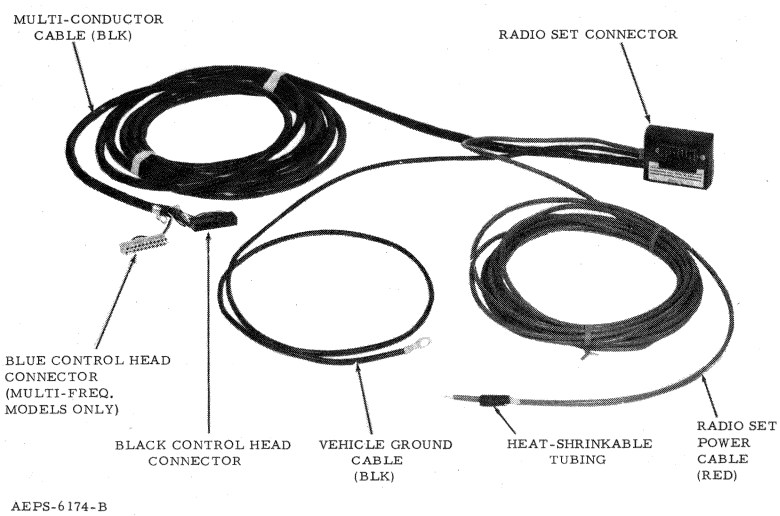
Notes:

1. For proper operation of this control head with handset (TMN6057A) and handset hang-up switch box (TLN4504A) refer to their respective manuals.
2. For proper operation of this control head with voice privacy adapter (TLN1400A) refer to VPA manual.
3. S103 used only for multiple frequency control heads:
   - Positions 1-4 wired for 4 frequency models
   - Positions 1-5 wired for 5 frequency models
   - Positions 1-8 wired for 8 frequency models
   - Positions 1-12 wired for 12 frequency models
4. Blk-Wht CHAN SEL ground lead connected to 21 normally or to 5 for channel scan or other SP applications.

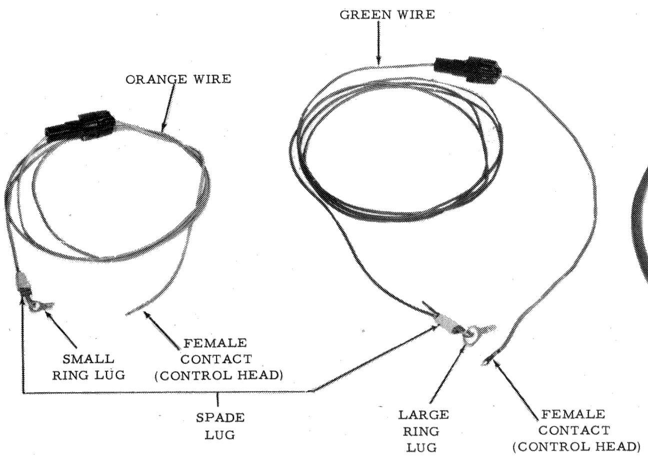
Control Head Schematic Diagram and Circuit Board Detail
Motorola No. 63P81019E29-H
9/29/78-UP

CONTROL HEAD

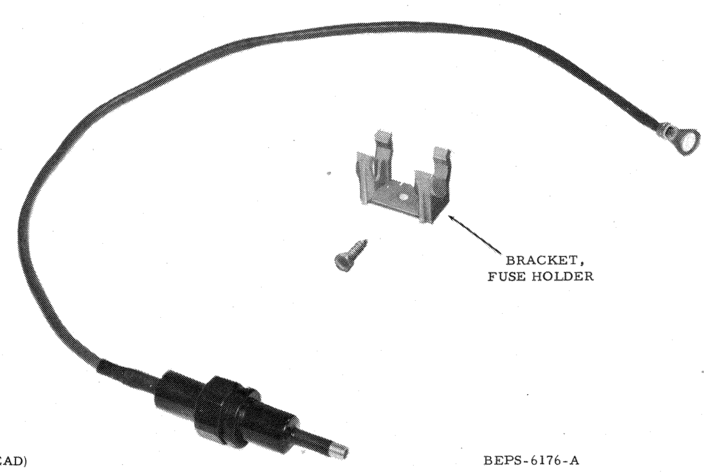
"MICOR" RADIO CABLES



Multi-Conductor Cable Kit



TKN6456A Cable Kit



TKN6457A Cable & Fuse Kit

MICOR RADIO CABLES

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

MODEL TABLE

MODEL NUMBER	LENGTH	NO. OF FREQS.	CABLE COLOR	NO. OF CONDUCTORS	APPLICATION
TKN6452B	18 ft.	1	BLK	Multi	Connect Radio to Control Head
TKN6453B	22 ft.	1	BLK	Multi	Connect Radio to Control Head
TKN6454B	18 ft.	4	BLK	Multi	Connect Radio to Control Head
TKN6455B	22 ft.	4	BLK	Multi	Connect Radio to Control Head
TKN6470B	22 ft.	4	BLK	Multi	Connect Radio to Control Head (Positive Ground)
TKN6606A	18 ft.	12	BLK	Multi	Connect Radio to Control Head
TKN6607A	22 ft.	12	BLK	Multi	Connect Radio to Control Head
TKN6608A	22 ft.	12	BLK	Multi	Connect Radio to Control Head (Positive Ground)
TKN6456A	69 in.	All	ORG	1 (fused)	Supply Power to Transmitter
	100 in.	All	GRN	1 (fused)	Supply Power to Receiver
TKN6457A	18 in.	All	RED	1 (fused)	Supply Power to Radio (45 w, 136-174 MHz Radios Only
TKN6458A	18 in.	All	RED	1 (fused)	Supply Power to Radio (All other "Micor" radios)

INSTALLATION INSTRUCTIONS

CAUTION

In positive ground vehicles, an optional ground converter is required and a positive ground cable kit must be used. A negative ground cable kit can be converted for positive ground operation if required. Refer to Figure 5 for conversion details.

STEP 1

CABLE ROUTING (Refer to Figures 1, 2, 3, 4, and 7.)

CAUTION

Before the cable is routed forward from The trunk compartment, the green and orange (fused) leads MUST be removed from the black connector block. Also, on PL models, the green and black leads from the PL hang-up switch box must be removed from the black connector block. Refer to Figure 2 for the proper method for lead removal.

When routing cables from the trunk compartment into and through the passenger compartment, it is recommended that cables, connector block(s) and "fish" wire be taped together as shown in Figure 1.

Determine the position that the radio set will occupy in the trunk compartment and leave enough

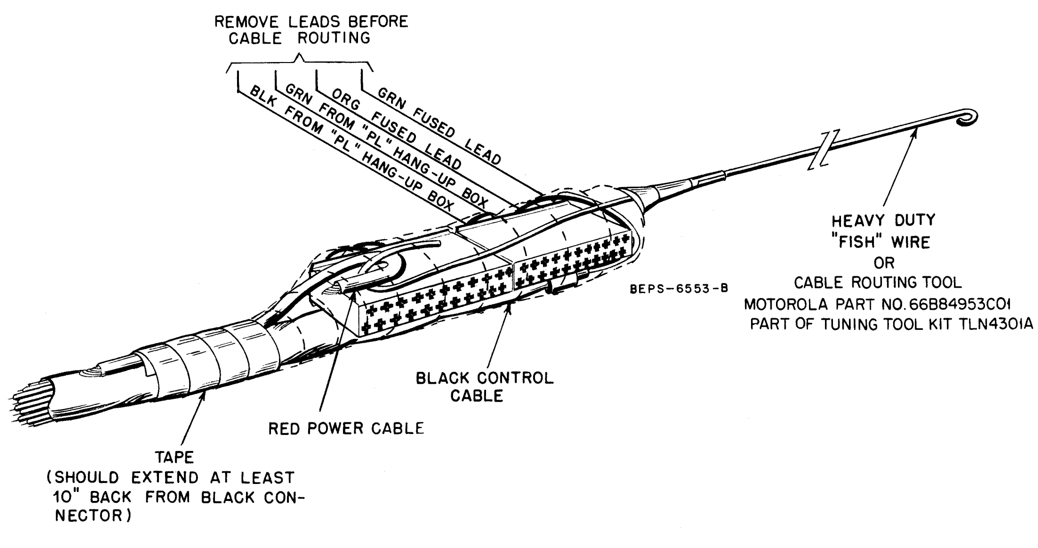


Figure 1.

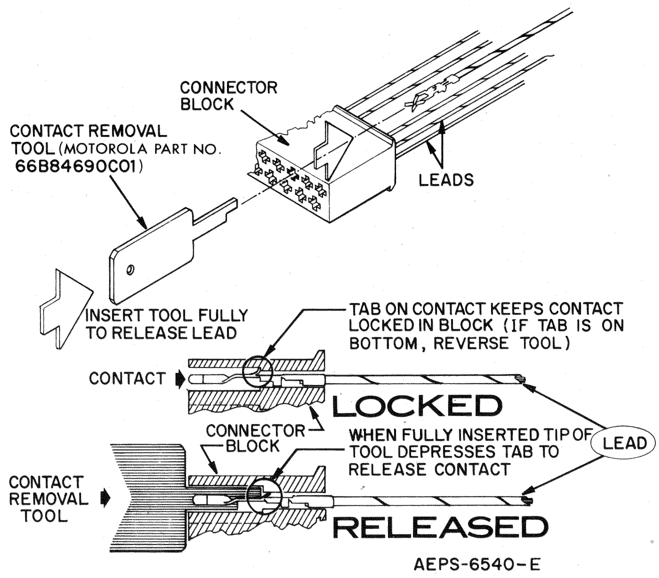


Figure 2.

slack cable to permit the plug to be easily connected or disconnected from the radio set as shown in Figure 3.

Work from the trunk space forward. In some cars there is enough room below the fiberboard trunk partition to admit the cables. If this is not the case, make an opening through the partition. Remove the back seat.

Figure 3.
Typical Radio Placement

Pull the cables into the back seat area, under the floor mats and front seat, out to the top of the floor mat under the dash. Where no specific channel is provided, route the cables under the floor mat along the side of the drive-shaft tunnel. Pull the control head end of the multi-conductor cable to the approximate location of the control head. Route the red power cable into the engine compartment through any convenient hole already in the firewall. If necessary, make a 1/2-inch diameter hole elsewhere in the firewall, install the supplied grommet, and route the cable through the grommet.

Pull the red power cable into the engine compartment. A cable fuse kit has been supplied with a ring tongue lug on one end and an in-line fuse holder on the other. A small section of heat-shrinkable tubing is supplied with each cable. Any excess red cable length should be trimmed at this time. Slide the heat-shrinkable tubing over the red power lead from the radio. Slide the stripped portion of the red cable into the end of the in-line fuse holder and crimp the joint as shown in Figure 5 using a Burndy Model Y10B (indent "U" crimp). If this tool is not available soldering is required.

Slide the heat-shrinkable tubing over the connection and shrink the tubing using a Motorola Model ST697 Heat Gun or equivalent heated air source. Remove the fuse from the fuse holder and reconnect the holder. Fasten the ring-tongue lug on the end of the cable to the battery's ungrounded terminal or to some point directly connected to the ungrounded terminal of the battery (such as the starter solenoid). Move the in-line fuse holder to a convenient location on one of the sheet metal parts of the engine compartment. Center punch and drill a 9/64" (.140") hole through the mounting surface. Then use the supplied #10-16-3/4" self tapping sheet metal screw to mount the bracket. Do not replace the fuse until the entire installation of the radio set is complete.

The control head power cable kit contains two separate wires, each equipped with an in-line fuse. The orange wire is 69 inches long and the green wire is 100 inches long. Taped to the lugless end of each cable are a crimp-on type ring tongue lug and a crimp-on type spade lug. The spade lug allows connection to hot leads at the fuse block of the vehicle and the ring tongue lug permits attachment to screws or terminals. Determine from Table A of Figure 7 which radio functions are to be switched through the vehicle ignition switch. A typical hook-up provides for ignition switch control of the transmitter function only, thus permitting the receiver to operate whenever the radio set is turned on. In this case, the orange wire is connected to the accessory terminal of the ignition switch and the green wire will be connected directly to the ungrounded terminal of the battery or starter solenoid.

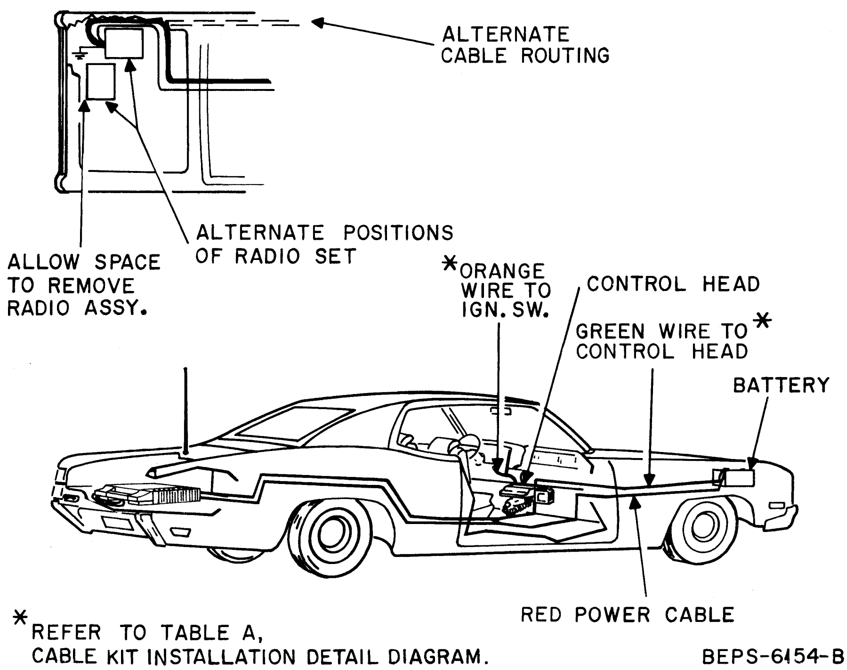


Figure 4.
Typical Mobile Radio Cable Routing

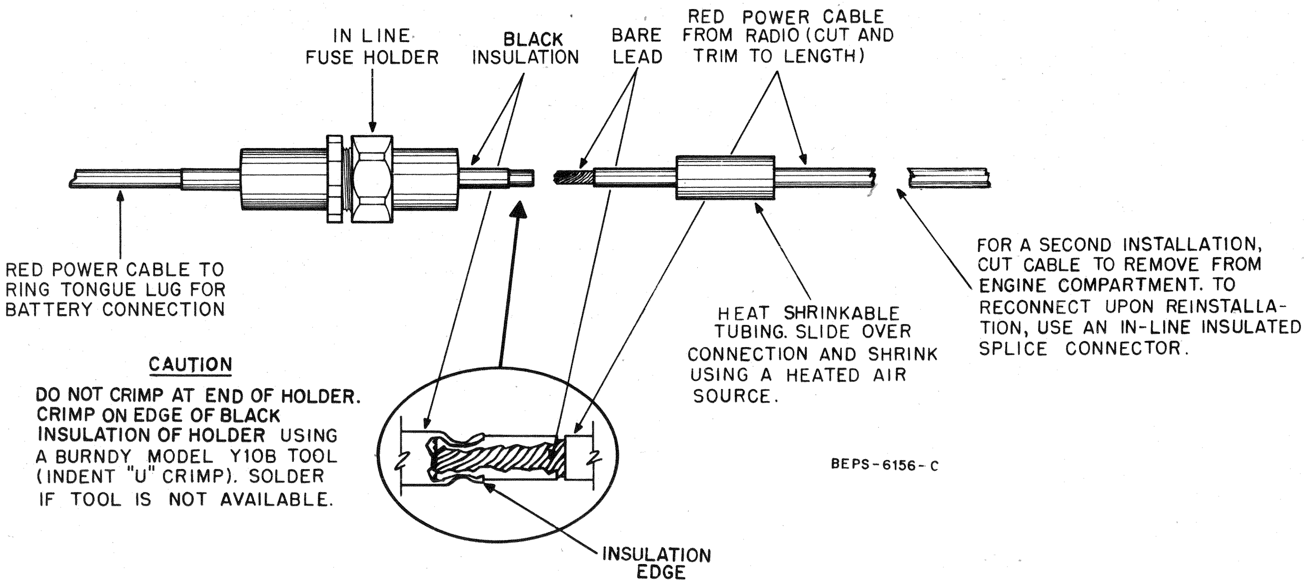


Figure 5.
Power Lead Connection

CAUTION

Do NOT connect either lead to the ungrounded terminal of the battery at this time.

If either wire is to be connected in the engine compartment, pass the lugless end of the wire through the same firewall hole that the red power cable uses, trim to length and crimp on the ring lug. If directed to a point within the passenger compartment, route cable to the point, leaving some extra length, trim; strip and crimp on either the spade or the ring tongue lug whichever is required. As an extra precaution the wire and lug may be soldered after crimping.

Do not dress the wires at this time, but proceed to locate and install the radio set itself.

STEP 2

RADIO GROUND CONNECTION (See Figure 6.)

After the radio set has been secured in place, connect the black ground cable lug to a convenient location on the trunk floor. Throughly clean the trunk floor surface before proceeding. Center punch and drill a 3/16" (.187") hole through the mounting surface. Use the supplied #14 x 3/4" self-tapping screw and 1/4" lockwasher to mount the cable lug.

CAUTION

A good ground connection of the black cable is essential for radio operation and to prevent damage to the radio and cable kit. Grounding to the vehicle frame is desirable.

The finished installation of the radio should look like the unit shown in Figure 6. All cables (including the antenna lead-in) should be dressed out of the way as much as possible to prevent damage and the radio heat sink should be placed to have the largest available supply of air possible for cooling.

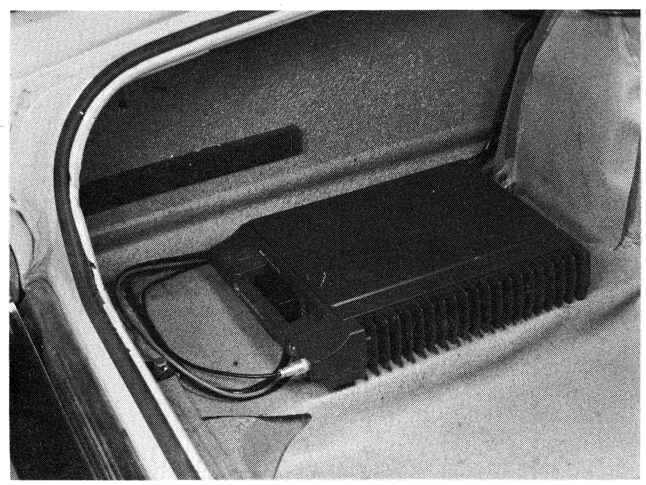


Figure 6.
Typical "Micor" Radio Set Installation

STEP 3

CONTROL HEAD CONNECTIONS

Install the control head next. Pull more control cable into the area, if necessary. At this time, insert the female contacts from the green and orange fused wires into the proper position in the black connector housing. (Refer to Figure 7 for location of these two wires in the connector housing.) Be sure that all wires are clear of the instrument panel where holes are to be drilled.

After the control head has been installed, insert the connector housings into the proper locations on the back of the control head (refer to Figure 7). Now connect the control cable "S" hook to the proper hole in the cable strain relief bracket on the rear of the control head.

STEP 4

POWER CONNECTIONS (Refer to Figures 3 and 7)

Replace the fuse in the in-line fuse holder of the red power cable coming from the radio in the trunk. Also connect the green (and/or orange) fused wire(s) coming from the control head to the ungrounded terminal (or source) of the battery.

Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis using the cable clamps supplied. To secure the clamps four tapping screws (#8-3/8") and four lockwashers (#1/4) are used. A 1/8" (0.125") hole is needed for the tapping screws. Make certain that all in-line fuses are installed.

DUPLEX MODELS
REPEATER MODELS
WIDE-SPACED RECEIVER MODELS

	P1102 MULTI-FREQ. MODELS ONLY		P1101		
POS.	WIRE COLOR	TERMINATION	WIRE COLOR	TERMINATION	POS.
1	GRAY	F3 SELECT	YEL	SW BATT (HOT)	1
2	---	KEYING BLANK	EMPTY	**	2
3	BLK	F4 SELECT	ORG	SPKR AUDIO INPUT (+)	3
4	ORG	F5 SELECT	BLK-BLU	"PL" SELECT	4
5	EMPTY	**	VIO	EXTRA WIRE (N.C. EITHER END)	5
6	EMPTY	**	GRN	SPKR AUDIO OUTPUT (-)	6
7	GRN	F8 SELECT	BLK-GRAY	EXTENDER SELECT	7
8	EMPTY	**	---	KEYING BLANK	8
9	RED	F7 SELECT	BLK-VIO	(GROUND)	9
10	BLK	SPARE	SHIELD	SHIELD (SPIRAL) GROUND	10
11	BLU	F1 SELECT	BLK-YEL	MIC AUDIO OUTPUT	11
12	EMPTY	**	GRN***	BATT HOT (SEE TABLE A)	12
13	---	KEYING BLANK	ORG***	BATT HOT IGN SW (SEE TABLE A)	13
14	BRN	F6 SELECT	BLK-RED	SW BATT (HOT)	14
15	EMPTY	**	GRN* & ***	"PL" HANG-UP SWITCH BOX	15
16	EMPTY	**	BLK-BRN	DISCR. EMIT. FOLLOWER OUTPUT	16
17	EMPTY	**	BRN	SQUELCH	17
18	EMPTY	**	---	KEYING BLANK	18
19	EMPTY	**	BLK* & ***	"PL" HANG-UP SWITCH BOX	19
20	EMPTY	**	BLK-GRN	VOLUME	20
21	EMPTY	**	SHIELD	SHIELD (3 CONDUCTOR) GROUND	21
22	WHT	F2 SELECT	BLK-ORG	PUSH-TO-TALK	22

*"PL" MODELS ONLY
**FOR EXTRA DASH ACCESSORIES
***SEPARATE WIRE - NOT PART OF THE MULTI-CONDUCTOR CABLE

EPS-7454-A

WIDE-SPACED TRANSMITTER MODELS
NON-WIDE SPACED RECEIVER MODELS

	P1102 MULTI-FREQ. MODELS ONLY		P1101		
POS.	WIRE COLOR	TERMINATION	WIRE COLOR	TERMINATION	POS.
1	GRAY	F3 SELECT	YEL	SW BATT (HOT)	1
2	---	KEYING BLANK	EMPTY	**	2
3	BLK	F4 SELECT	ORG	SPKR AUDIO INPUT (+)	3
4	EMPTY	**	BLK-BLU	"PL" SELECT	4
5	EMPTY	**	VIO	EXTRA WIRE (N.C. EITHER END)	5
6	EMPTY	**	GRN	SPKR AUDIO OUTPUT (-)	6
7	EMPTY	**	BLK-GRAY	EXTENDER SELECT	7
8	EMPTY	**	---	KEYING BLANK	8
9	EMPTY	**	BLK-VIO	(GROUND)	9
10	EMPTY	**	SHIELD	SHIELD (SPIRAL) (GROUND)	10
11	BLU	F1 SELECT	BLK-YEL	MIC AUDIO OUTPUT	11
12	EMPTY	**	GRN***	BATT HOT (SEE TABLE A)	12
13	---	KEYING BLANK	ORG***	BATT HOT IGN SW (SEE TABLE A)	13
14	EMPTY	**	BLK-RED	SW BATT (HOT)	14
15	EMPTY	**	GRN* & ***	"PL" HANG-UP SWITCH BOX	15
16	EMPTY	**	BLK-BRN	DISCR. EMIT. FOLLOWER OUTPUT	16
17	EMPTY	**	BRN	SQUELCH	17
18	EMPTY	**	---	KEYING BLANK	18
19	EMPTY	**	BLK* & ***	"PL" HANG-UP SWITCH BOX	19
20	EMPTY	**	BLK-GRN	VOLUME	20
21	EMPTY	**	SHIELD	SHIELD (3 CONDUCTOR) GROUND	21
22	WHT	F2 SELECT	BLK-ORG	PUSH-TO-TALK	22

*"PL" MODELS ONLY
**FOR EXTRA DASH ACCESSORIES
***SEPARATE WIRE - NOT PART OF THE MULTI-CONDUCTOR CABLE

EPS-7323-A

ALL UHF "MICOR" RADIO SET MODELS

	P1102 MULTI-FREQ. MODELS ONLY		P1101		
POS.	WIRE COLOR	TERMINATION	WIRE COLOR	TERMINATION	POS.
1	GRAY	F3 SELECT	YEL	SW BATT (HOT)	1
2	--	KEYING BLANK	EMPTY	**	2
3	BLK	F4 SELECT	ORG	SPKR AUDIO INPUT (+)	3
4	WHT-BLK	F5 SELECT	BLK-BLU	"PL" SELECT	4
5	WHT-GRAY	EXTRA WIRE****	VIO	EXTRA WIRE (N.C. EITHER END)	5
6	WHT-VIO	F12 SELECT	GRN	SPKR AUDIO OUTPUT (-)	6
7	WHT-ORG	F8 SELECT	BLK-GRAY	EXTENDER SELECT	7
8	WHT-YEL	F9 SELECT	---	KEYING BLANK	8
9	WHT-RED	F7 SELECT	BLK-VIO	(GROUND)	9
10	WHT-BLU	F11 SELECT	SHIELD	SHIELD (SPIRAL) (GROUND)	10
11	BLU	F1 SELECT	BLK-YEL	MIC AUDIO OUTPUT	11
12	RED	HANDSET SW BOX***	GRN***	BATT HOT (SEE TABLE A)	12
13	---	KEYING BLANK	ORG***	BATT HOT IGN SW (SEE TABLE A)	13
14	WHT-BRN	F6 SELECT	BLK-RED	SW BATT (HOT)	14
15	EMPTY	**	GRN* & ***	"PL" HANG-UP SWITCH BOX	15
16	EMPTY	**	BLK-BRN	DISCR. EMIT. FOLLOWER OUTPUT	16
17	RED-BLU	EXTRA WIRE****	BRN	SQUELCH	17
18	EMPTY	**	---	KEYING BLANK	18
19	WHT-GRN	F10 SELECT	BLK* & ***	"PL" HANG-UP SWITCH BOX	19
20	YEL	HANDSET SW BOX***	BLK-GRN	VOLUME	20
21	BRN	HANDSET SW BOX***	SHIELD	SHIELD (3 CONDUCTOR) GROUND	21
22	WHT	F2 SELECT	BLK-ORG	PUSH-TO-TALK	22

*"PL" MODELS ONLY
**FOR EXTRA DASH ACCESSORIES
***SEPARATE WIRE - NOT PART OF THE MULTI-CONDUCTOR CABLE
****NO CONNECTION ON RADIO END

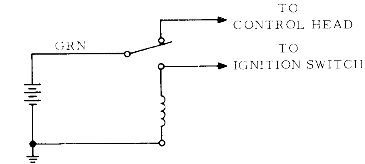
NOTE
CONNECTOR POSITIONS DO NOT CORRESPOND TO WIRE COLOR CODE NUMBERS.

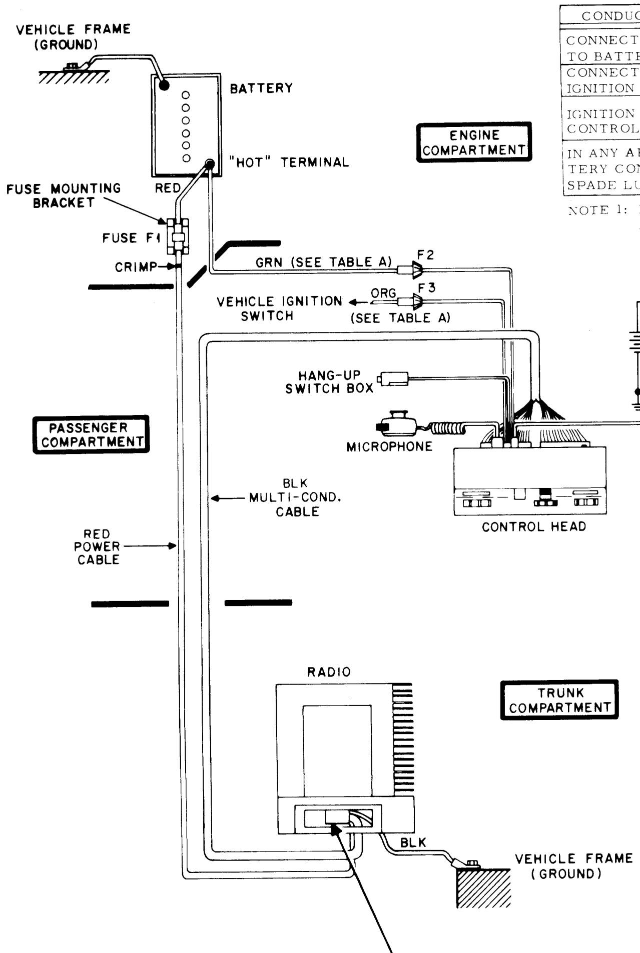
EPS-8852-O

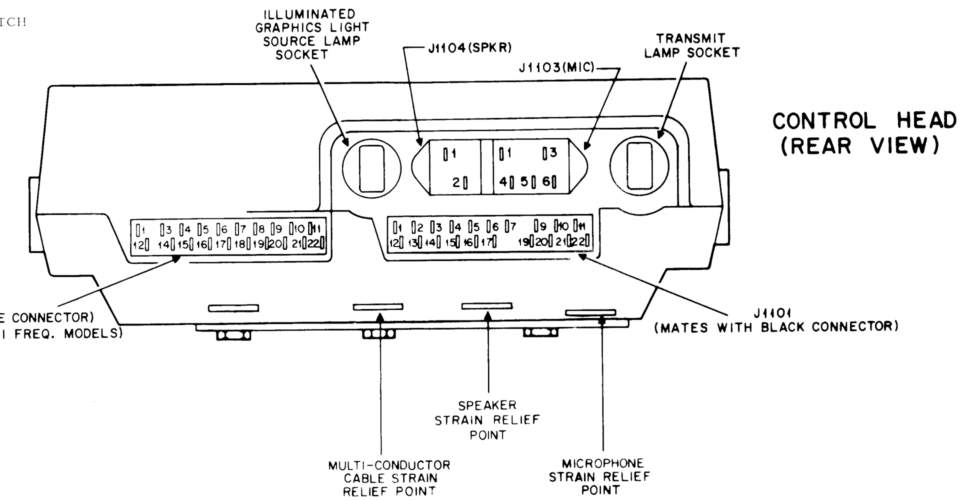
TABLE A

CONDUCTOR	GREEN	ORANGE	GREEN	ORANGE	GREEN	ORANGE
CONNECTED TO BATTERY	●	●	●			
CONNECTED TO IGNITION SWITCH				●	NOTE 1	●
IGNITION SWITCH CONTROLS	NO SWITCH CONTROL		XMTR SWITCH CONTROLLED		COMPLETE RADIO SWITCH CONTROLLED	
IN ANY APPLICATION, TRIM AND STRIP WIRES. CRIMP ON RING LUG FOR BATTERY CONNECTIONS. FOR IGNITION SWITCH CONNECTIONS, CRIMP ON RING OR SPADE LUG (WHICHEVER IS REQUIRED).						

NOTE 1: IN CASES WHERE ALTERNATOR WHINE OR OTHER INTERFERENCE IS A PROBLEM, THE GREEN LEAD CAN BE ISOLATED WITH A RELAY (MOTOROLA PART NO. 59-813674).







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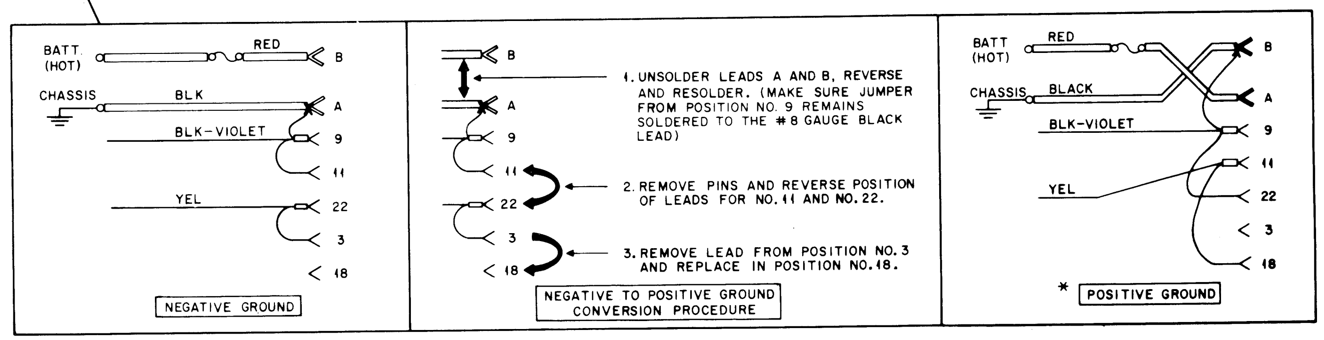
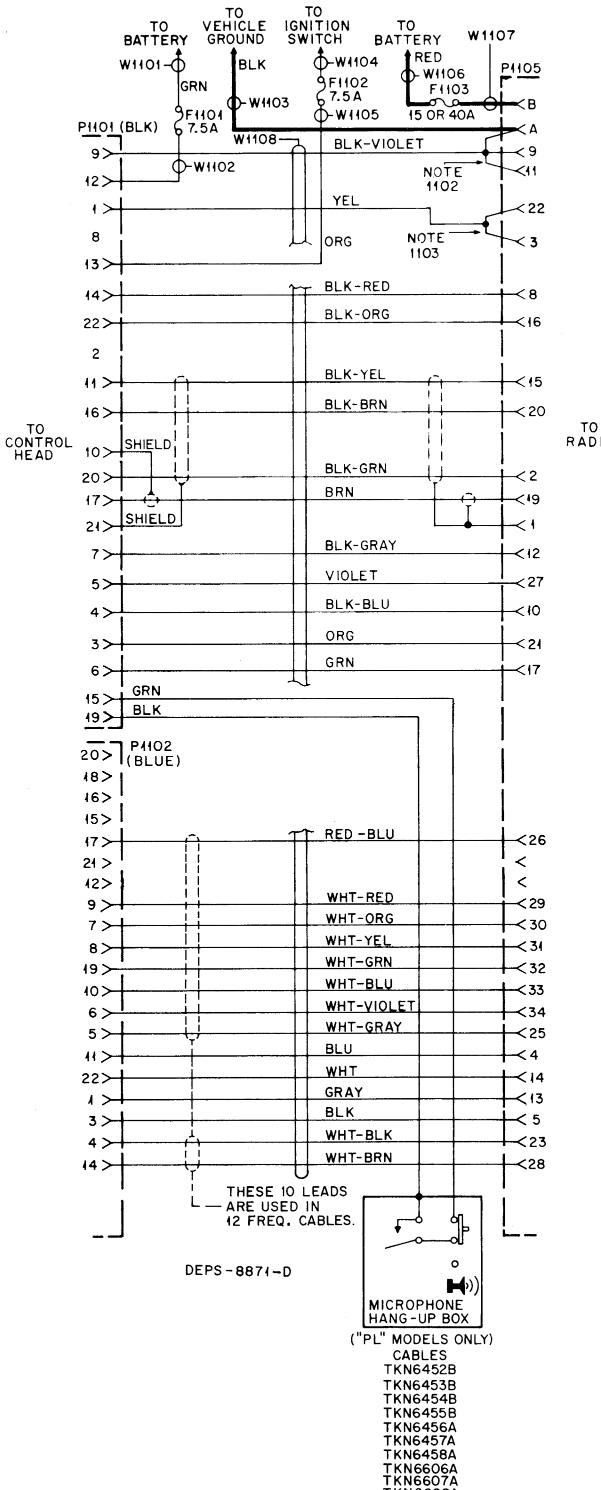


* USE ONLY RADIOS THAT ARE EQUIPPED WITH A POSITIVE GROUND CONVERTER (TLN4300A) IN VEHICLES HAVING A POSITIVE GROUND SYSTEM OR AN INOPERATIVE RADIO WILL RESULT.

Figure 7.
Cable Installation Detail
Motorola No. PEPS-6493-E
8/18/78-UP



PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS.

CABLE KITS

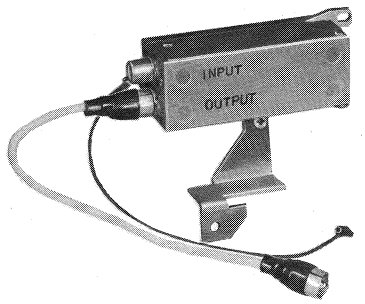
TKN6452A, B (18 ft.) 1-Frequency
TKN6453A, B (22 ft) 1-Frequency
TKN6454A, B (18 ft.) 4-Frequency
TKN6455A, B (22 ft.) 4-Frequency
TKN6470A, B (22 ft.) 4-Frequency, Positive Ground
TKN6606A (18 ft.) 12-Frequency
TKN6607A (22 ft.) 12-Frequency
TKN6608A (22 ft.) 12-Frequency, Positive Ground
TKN6456A Control Head Power Cable
TKN6457A Power Cable & Fuse (45-Watt High Band Only)
TKN6458A Power Cable & Fuse (All Other Radios)

PL-1047-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		FUSE, cartridge:
F1101	65K86099	7.5 Amp
F1102	65K86099	7.5 Amp
F1103	65S136969	15 Amp; 32 V (TKN6457A only)
	or65C84161B01	special; 40 Amp; 32 V (TKN6458A only)
		CONNECTOR, plug:
P1101	14C84556B01	BLACK; does not incl. 9C84151B01 CONTACT, female (TKN6452B, TKN6453B, TKN6454B and TKN6455B only)
P1102	14C84556B02	BLUE; does not incl. 9C84151B01 CONTACT, female (TKN6454B and TKN6455B only)
P1105	1V84307A89	incl. 9C84086B01 CONNECTOR, plug: female; 37 cont; 15D84044C03 HOUSING (front); 15D84045C01 HOUSING (rear); 3-139999 SCREW, machine: No. 6-32 x 5/16"; 2 req'd; 3-140000 SCREW, machine: No. 6-32 x 3/4"; 42C84046C01 CLAMP, strain relief (TKN6452B, TKN6453B, and TKN6470B only) or 42C84933E01 CLAMP, strain relief (TKN6606A, TKN6607A, and TKN6608A only) 3S132127 SCREW, tapping: No. 6-20 x 3/4" plain hex head (TKN6452B, TKN6453B, TKN6454B, TKN6455B, and TKN6470B only)
		OR
		incl. 9C84086B01 CONNECTOR plug; female; 37 cont; 15D84278A01 HOUSING (front); 15D84279B01 HOUSING (rear); 3S7178 SCREW, machine: No. 6-32 x 5/16"; 2 req'd. 3S7346 SCREW, machine: No. 6-32 x 3/4"; 42C84280B02 CLAMP, strain relief; 3S3350 SCREW, tapping: No. 4 x 1/2"; 3S136970 SCREW, tapping: No. 4 x 3/4" (TKN6452A, TKN6453A, TKN6454A and TKN6455A only)
		CABLE ASSEMBLY:
W1101	1V80711B09	incl. 30S10286C70 WIRE, #16 ga. str. (GRN) 88" long; 14A82882A01 BODY, fuse-holder, 41A82885A01 SPRING,' fuseholder, 42A82884A01 CLIP, fuseholder (TKN6456A only)
W1102	1V80711B08	incl. 30S10310A63 WIRE, #18 ga. str. (GRN) 12" long, 14A82883A01 CAP, fuseholder, 42A82884A01 CLIP, fuseholder, 9C84151B01 CONTACT, female (TKN6456A only)

RF PREAMPLIFIER

MODELS TLE8191A AND TLE8192A
FOR UHF MICOR® RADIOS



FAEPS-14155-O

TECHNICAL CHARACTERISTICS

IMPEDANCE	50-ohm input, 50-ohm output
CURRENT DRAIN	7.5 mA at 13.8 V
FREQUENCY	406-450 MHz, 450-512 MHz
POWER GAIN	10 dB

RECEIVER WITH PREAMPLIFIER

SENSITIVITY	-20 dB QUIETING	0.25 uV
	EIA SINAD	0.175 uV
SELECTIVITY (EIA SINAD)		-90 dB at ±25 kHz
INTERMODULATION (EIA SINAD)		-80 dB
SPURIOUS AND IMAGE REJECTION		-100 dB minimum
SQUELCH SENSITIVITY		Threshold 0.125 uV max. at 6 dB max. quieting
		Tight 0.6 uV max. at 14 dB min. quieting

MOTOROLA INC.
Communications Division

service publications
1301 E. Algonquin Road, Schaumburg, IL 60196

1. DESCRIPTION

The rf preamplifier is an optional accessory that increases the useful operating range of the receiver. The rf preamplifier kit includes a printed circuit board, a housing, a 6-1/2 inch coaxial cable with rf phono-type connectors, and a mounting bracket with hardware. All electrical components are accessible by removing cover plates. The rf preamplifier circuit consists of two tuned-lines and a grounded gate FET amplifier. It improves the receiver sensitivity from the specified 20 dB quieting sensitivity of 0.5 microvolt to 0.25 microvolt.

2. INSTALLATION

a. Tools Required

--#1 Phillips screwdriver or,
--7/32" Nut driver.

b. Procedure

Step 1. Disconnect the power/control cable from the radio and remove both top and bottom covers.

Step 2. Disconnect the rf input cable from the rf pre-selector.

Step 3. Position mounting bracket on the bottom side of the radio and secure it to the chassis with the mounting screw. Refer to the mounting detail illustration.

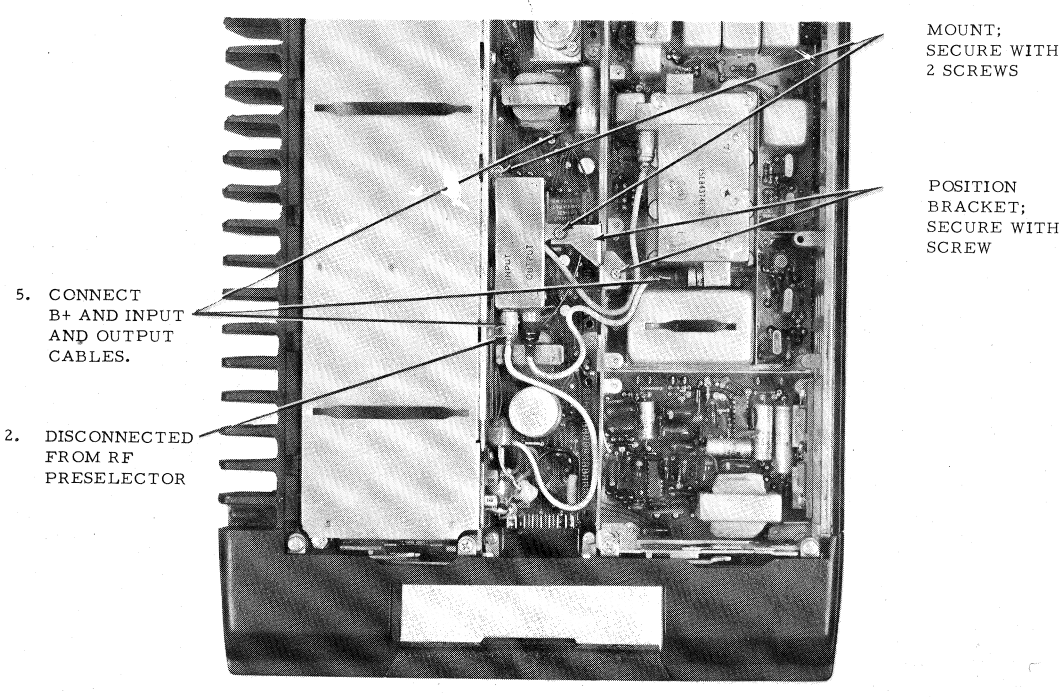
Step 4. Position the rf preamplifier as shown in the illustration and secure it to the bracket and chassis with the two mounting screws.

Step 5. Connect the B+ lead to P911 on the control board, rf input cable to the rf preamplifier input, and output cable to the pre-selector.

Step 6. Align the rf preamplifier (refer to the maintenance paragraph in this section).

3. THEORY

The signal from the antenna is coupled directly into the input tuned-line of the preamplifier through the INPUT jack. This tuned-line passes the desired signal and matches the relatively low FET input impedance to the 50-ohm input line. The signal is capacitively coupled to the source terminal of the FET where it is amplified and then capacitively coupled to the output tuned-line. The output tuned-line is a high Q tank circuit. It passes the desired signal and matches the relatively high FET output impedance to the 50-ohm output line.



Installation Detail

4. MAINTENANCE

a. General

This section provides the maintenance shop type procedures for the rf preamplifier. These bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting.

b. Alignment

Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable, from the antenna switch, directly to the rf preselector input. Check and align the pre-selector according to the alignment procedure described in the receiver section of the manual. After the receiver has been aligned disconnect the receiver input cable from the pre-selector and reconnect the preamplifier input and output cables. While monitoring position 5, align the preamplifier for maximum meter indication by adjusting C1 and C2. For final tuning, repeak C1, C2, and L111 for maximum quieting.

c. Realignment

It is not necessary to bypass the preamplifier when aligning to the same frequency or to a new frequency if it is within ±1.0 MHz of the previously tuned frequency. Align the rf pre-selector first, then adjust the preamplifier as described in the preceding paragraph.

d. Troubleshooting

With the preamplifier connected, and the test set on position 5, perform the following:

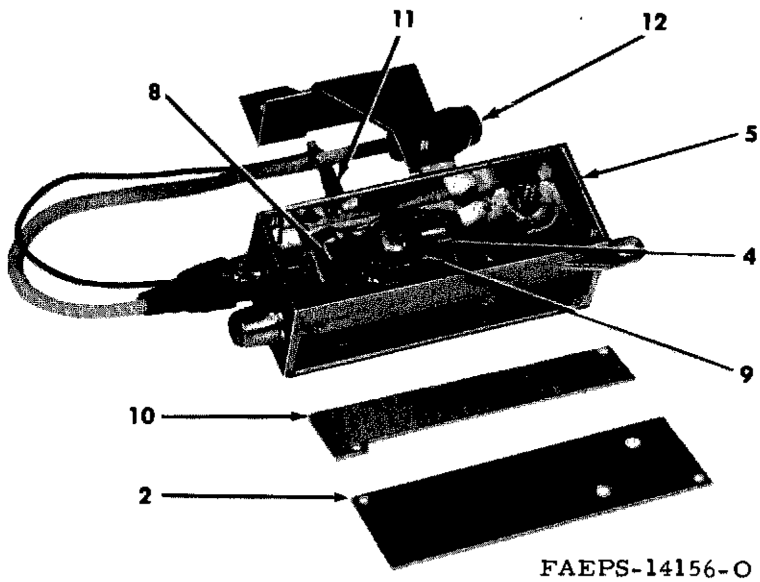
(1) Increase the signal generator output for a maximum indication on the test set meter (saturation), then decrease until a convenient reference point is reached on the test set meter (not more than 10 uA below the saturation point). Note both the test set meter indication and the signal generator output level setting.

(2) Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable, from the antenna switch, directly to the rf pre-selector input.

(3) Increase the signal generator output until the same reference point is obtained on the test set meter. Note the signal generator output level setting, it should be at least 3 times greater than the previous setting for a preamplifier gain of approximately 9 to 10 dB.

(4) Reconnect the preamplifier and check the alignment if the above indications are not obtained.

(5) If there is no output or insufficient gain after the preamplifier is aligned, check for faulty components or solder connections on the printed circuit board.



FAEPS-14156-O

PREAMPLIFIER

TLE8191A Preamplifier (406-450 MHz)
TLE8192A Preamplifier (450-512 MHz) PL-2018-B

CODE NO.	MOTOROLA PART NO.	DESCRIPTION
1	3S490352	SCREW, machine: No. 2-56 x 5/32: cover mounting screws, 6 req'd
2	15B84322B01	COVER, top
3	7B84444E01	BRACKET, mounting
4	42B83660C01	CLIP, transistor mounting
5	15B84501G01	HOUSING, preamplifier
6	3S1234212	SCREW, tapping #4 x 5/16: "Phillips" hex nut (3 req'd)
7	3S129841	SCREW, machine: #4-40 x 1/4: "Phillips" binder head; 1 req'd
8	1V80708B85	CIRCUIT BOARD ASSEMBLY
9	4K844123	SPACER, insulator (under board)
10	15B84323B01	COVER, side: 2 req'd
11	11-10184A24	PIN
12	24C84282D01	CONNECTOR plug, male; coaxial miniature type p/o cable 1V80739B37

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

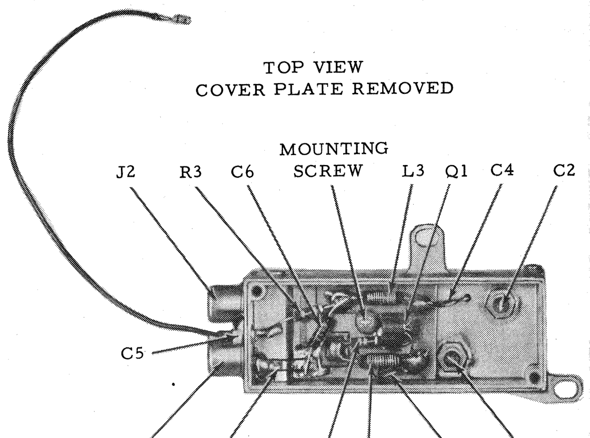
PREAMPLIFIER

TLE8191A Preamplifier (406-450 MHz)
TLE8192A Preamplifier (450-512 MHz) PL-2707-B

		CAPACITOR, variable: (includes standard tuning "piston");
C1, 2	20-83693H03 or 20-83693H02	0.9-9.0 pF (406-450 MHz) 0.8-3.8 pF (450-512 MHz)
		CAPACITOR, fixed:
C3, 4	21-861441	500 pF ±10%; 75 V; N4700
C5	21-861219	.001 uF +100-0%; 500 V; coded RED
C6	23-84762H04	2.2 uF ±20%; 25 V
		CONNECTOR, receptacle:
J1, 2	9-84135B01	female; coaxial; miniature type
		COIL, RF:
L1	47-84330B02	(straight rod; 1.75" long)
L2, 3	24-800484	choke; 0.31 uH
L4	47-84330B03	(straight rod; 2.19" long)
		CONNECTOR, plug:
P2, 104	28-84282D01	male; coaxial; miniature type
		TRANSISTOR: (SEE NOTE I)
Q1	48-869533	field-effect "N Channel"; type M9533; does not include 42-83660C01 CLIP, transistor retaining
		RESISTOR, fixed:
R1	6-10401C25	100 ±10%; 1/4 W
R2	6-185B73	330 ±10%; 1/8 W
R3	6-10401C17	47 ±10%; 1/4 W
		LINE, RF transmission:
W1	1-80739B37	includes P2, P104 and 30-83794C01 CABLE, RF: coaxial; 6-1/2" length required

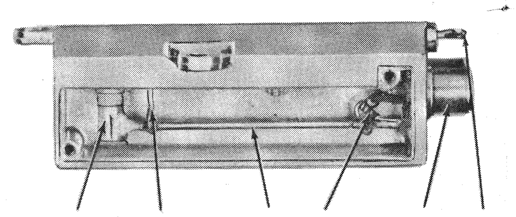
NOTE : I. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TOP VIEW
COVER PLATE REMOVED

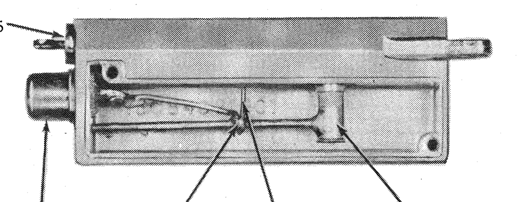


AEPS-11247-A

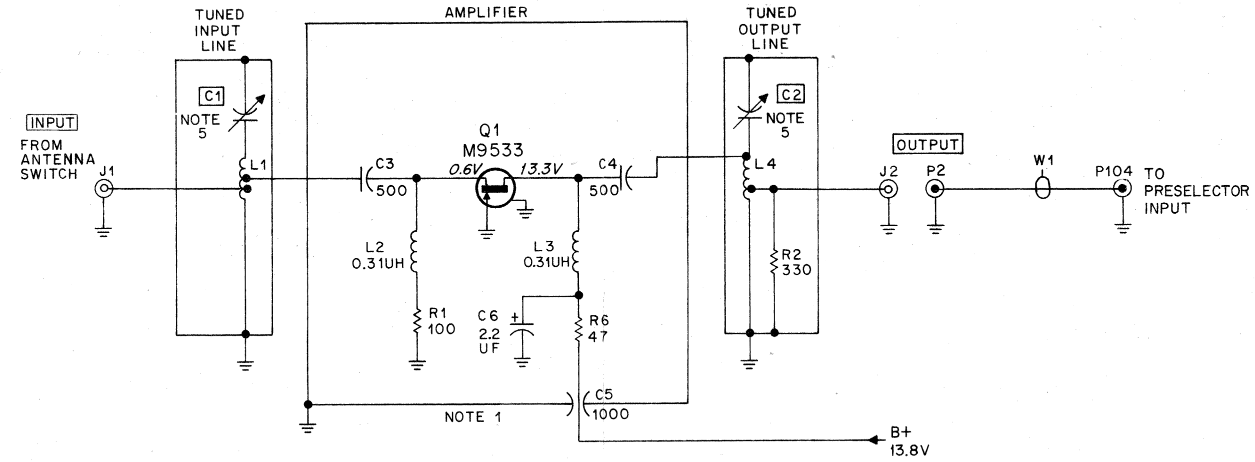
OUTPUT SIDE
(COVER PLATE REMOVED)



INPUT SIDE
(COVER PLATE REMOVED)



AEPS-11285-O



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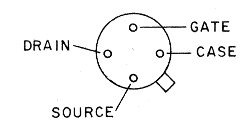


TRANSISTOR DETAIL
(BOTTOM VIEW)

NOTES:
1. ALL COMPONENTS WITHIN THIS BOX ARE PHYSICALLY MOUNTED ON PRINTED CIRCUIT BOARD.
2. REFERENCES OUTLINED BY A RECTANGLE INDICATE MARKINGS ON CHASSIS.
3. ALL CAPACITOR VALUES ARE IN pF UNLESS OTHERWISE STATED.
4. ALL VOLTAGE READINGS MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER.
5. SEE PARTS LIST.

EPS-11341-A

TLE8191A and TLE8192A RF Preamplifier
Schematic Diagram and Component Location
Motorola No. PEPS-11249-D
9/29/78-UP

AUDIO FILTER BOARD

MODEL TLN4581A

1. DESCRIPTION

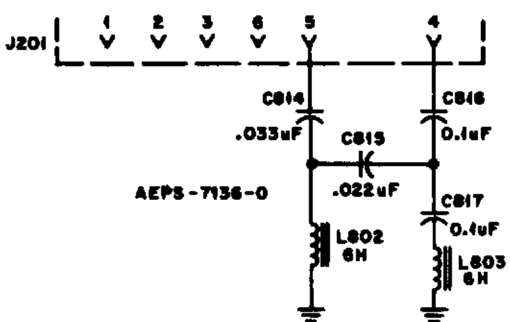
This audio filter circuit board can be used in carrier squelch radios to bypass the low frequency background noise of a PL tone present on the received carrier. The high-pass characteristics of this filter will allow voice signals above 300 Hz to pass but will block the lower frequency PL tones. Since this filter is connected in series with the audio signal path, the PL tones will not be heard in the speaker.

2. INSTALLATION

Physically, the audio filter board is plugged into the receiver audio and squelch board in the location normally occupied by the "Private-Line" decoder board in PL radio sets.

NOTE

WHEN USING THE AUDIO FILTER BOARD, JU201 ON THE RECEIVER AUDIO AND SQUELCH BOARD MUST BE REMOVED.



PARTS LIST

TLN4581A Audio Filter Board — PL-1345-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%: 50 V; unl. stated
C814	8-82905G08	.033
C815	8-82905G02	.022
C816	8-82905G30	0.1
C817	8-82905G30	0.1
J201		for reference only
		COIL, RF: choke:
L802	24-84003A01	6 H
L803	24-84003A01	6 H
	NON-REFERENCED ITEMS	
	9-83011H01	TERMINAL, pin: female; 6 req'd.
	3-138162	SCREW, lock: No. 4 x 3/8"; 2 req'd.
	42-84284B01	RETAINER, Nylon: 2 req'd.
	7-84223B01	BRACKET, retainer

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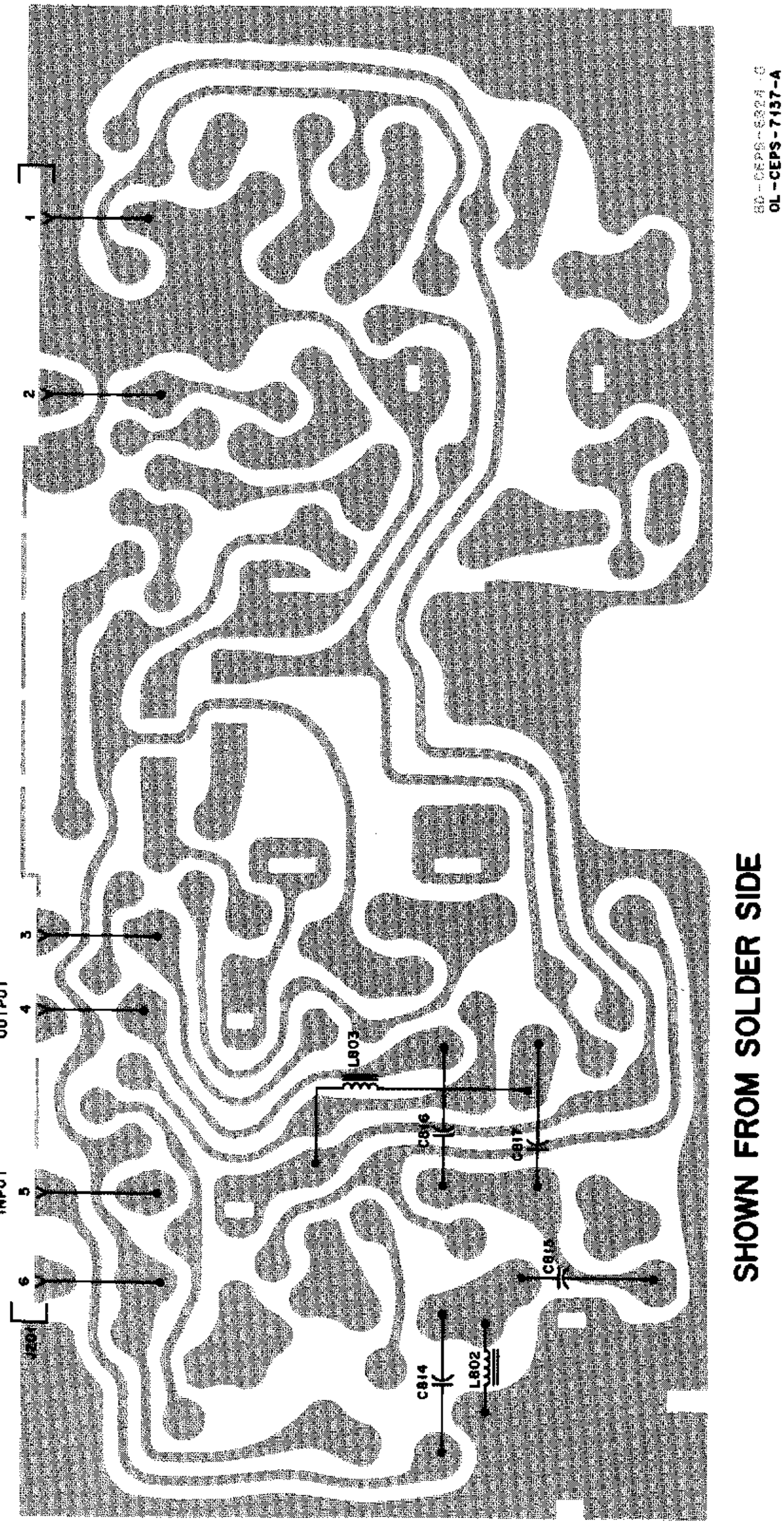

Audio Filter Board
Circuit Board Detail
Motorola No. PEPS-7138-A
8/27/76-UP

END OF DOCUMENT