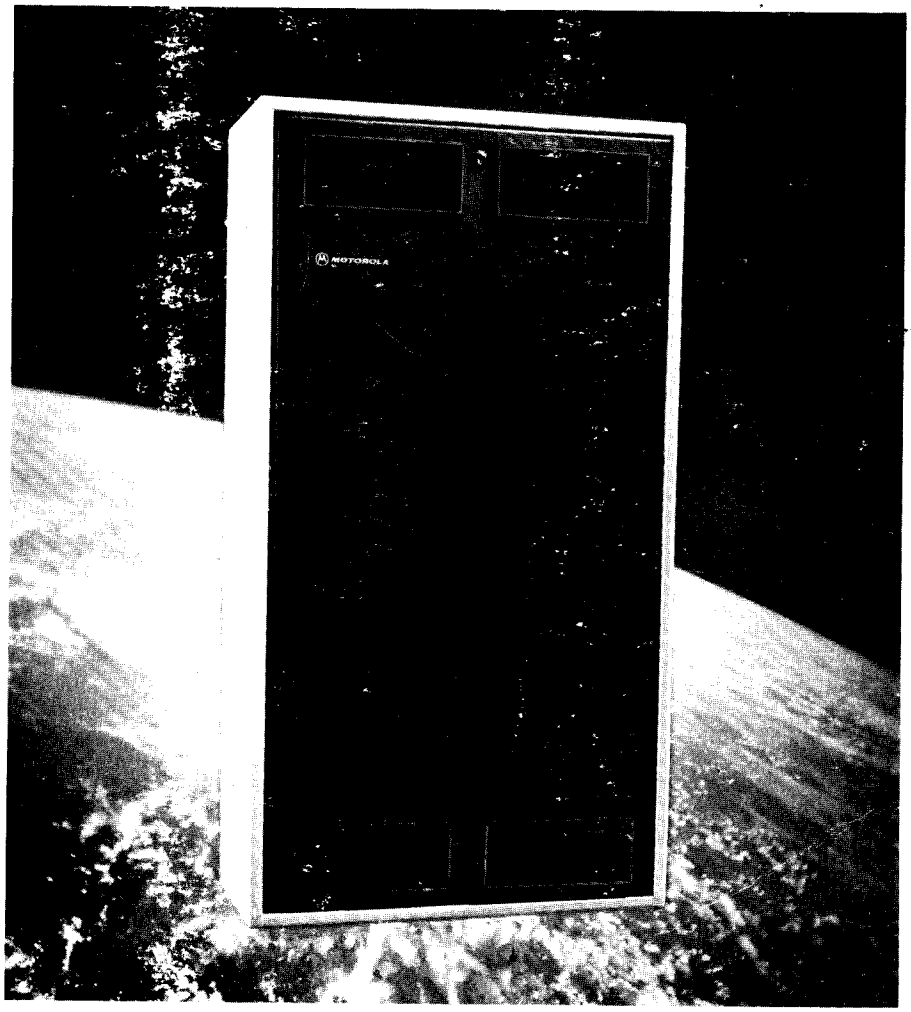
MOTOROLA

Note: This manual contains complete information on some components that are also found in non-DVP stations, such as the duplexer, preamplifier, A&S board, and various modules. Please note that the Station Control Module and the backplane PCB are not the same as those found in non-DVP stations.

All pages in this PDF file are full-size and are 11" in height to facilitate printing on a document (roll) printer. Use the Adobe "snapshot" tool to select and print portions of this file on a page-size printer.

SECURENET™
DIGITAL VOICE PROTECTION™ SYSTEMS
MICOR® BASE AND REPEATER STATIONS
132-174 MHz

68P81036E40-B



Instruction Manual

THIS MANUAL HAS BEEN
DISCONTINUED

MOTOROLA INC.
Communications Sector

SECURENET
DIGITAL VOICE PROTECTION SYSTEMS
MICOR BASE AND REPEATER STATIONS
132-174 MHz

CONTENTS

STATION DATA

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

68P81036E40-B
5/30/85- UP

TRANSMITTER

RECEIVER

POWER SUPPLY

DVP AND TONE REMOTE CONTROL APPLICATIONS

REMOTE CONTROL CHASSIS

MODULES

SPECIFICATIONS

GENERAL

Model Series		C53RXB	C73RXB
RF Power Output (Watts)		60	100
120 V ac (+20%, -40%), 60 Hz Input Power Requirements (Watts)		120	200
Input AC Current Requirements (Amps)	Standby	0.63	
	Transmit	3.15	5.46
Frequency Range (MHz)		150.8—174.0	132—174
No. Of Frequencies		Up to 4 frequencies	
Cabinet Dimension (Inches)	Indoor Cabinet	22 wide X 30-1/4 high X 10 deep	
	Indoor Cabinet	22 wide X 41 high X 10 deep	
	Output Cabinet	22 wide X 46 high x 20 deep	
Approx. Shipping Weight (lbs.)	Indoor Remote Control	190	
	Outdoor Remote Control	180	
Metering		Optional internal mounted meter used to measure all essential circuits for tuning and checking	

TRANSMITTER

RF Power Output	60 W, 100 W
Output Impedance	50 ohms
Oscillator Frequency Stability	Channel element maintains oscillator frequency within 0.0005% (±0.0002% optional) from -30°C to +60°C ambient (+25°C reference)
Transmitter Side Band Noise (Unmodulated Carrier)	90 dB @ ±30 kHz 105 dB @ ±1 MHz
Spurious & Harmonics	More than 85 dB below carrier
Modulation	15F2 and 16F3: ±5 kHz for 100% at 100 Hz (clear mode) 20F3Y: ±4 kHz for 100% at 1000 Hz (coded mode)
Audio Sensitivity	Local 0.165 volt ±3 dB for 60% maximum deviation at 1000 Hz Remote Telephone Line: -20 dBm max. for 60% maximum deviation at 1000 Hz
FM Noise (clear mode)	55 dB below 60% system deviation at 1000 Hz
Audio Response (clear mode)	+1, -3 dB from 6 dB/octave pre-emphasis, 300—3000 Hz, referenced to 1000 Hz
Audio Distortion (clear mode)	Less than 2% at 1000 Hz; 60% system deviation

SPECIFICATIONS (Cont'd.)

RECEIVER

		Without Preamp	With Preamp
Channel Spacing		30 kHz	
EIA Modulation Acceptance		± 7 kHz, minimum	
Oscillator Frequency Stability		Channel element maintains oscillator frequency with ± 0.0005% from -30°C to +60°C ambient (+25°C reference) ± 0.0002% AFC (optional)	
Input Impedance		50 ohms	
Sensitivity	20 dB Quieting	Less than 0.5 uV	Less than 0.25 uV
	EIA Sinad	Less than 0.35 uV	Less than 0.175 uV
Selectivity (EIA Sinad)		-95 at ± 30 kHz	-90 at ± 30 kHz
Intermodulation (EA Sinad)		-80 dB	-75 dB
Spurious & Image Rejection		100 dB, minimum	95 dB, minimum
Squelch Sensitivity	Carrier Squelch (Adjustable)	0.20 uV or less at threshold	0.10 uV or less at threshold
	Tone-Coded Squelch (Fixed)	0.20 uV or less	0.10 uV or less
Audio (Telephone Line)	Output	+11 dBm at 600 ohms	
	Response	+1, -3 dB	
	Distortion	3% at 1000 Hz	
	Hum & Noise	-50 dB	
	Local Speaker	10 watts at 8 ohms output available	

EPS-25485-O

MODEL CHART

FOR

DIGITAL VOICE PROTECTION

MICOR COMPA-STATION

REPEATER (RT) STATIONS

CONTINUOUS DUTY

CARRIER SQUELCH AND *PRIVATE-LINE*

TONE-CODED SQUELH

132-174 MHz

CODE:

[•] = ONE ITEM SUPPLIED

* = INDICATES A MODEL SERIES, SPECIFIC MODEL DEPENDS ON CARRIER FREQUENCY. (NOTE: 60-WATT STATIONS AVAILABLE ONLY FOR 150.8-174 MHz)

STATION MODEL VARIABLES

STATION MODELS ARE NOT AVAILABLE FOR ALL POSSIBLE LETTER & NUMBER COMBINATIONS

C53RXB-1106AT

- [6] = TONE REMOTE
- [1] = CARRIER SQUELCH
  [3] = *PRIVATE-LINE* TONE-CODED SQUELCH
- [X] = CONTINUOUS DUTY *DIGITAL VOICE PROTECTION*
- [5] = 60 W RF OUTPUT
  [7] = 100 W RF OUTPUT

STATION MODEL	RF OUTPUT POWER (WATTS)	TYPE OF SQUELCH	CONTROL TYPE
C53RXB-1106AT	60	CARRIER	TONE
C53RXB-3106AT	60	TONE-CODED	TONE
C73RXB-1106BT	100	CARRIER	TONE
C73RXB-3106BT	100	TONE-CODED	TONE

ITEM	DESCRIPTION	C53RXB-1106AT	C53RXB-3106AT	C73RXB-1106BT	C73RXB-3106BT
	TRANSMITTER				
*TLD1700C	POWER AMPLIFIER, 60-WATT CONTINUOUS DUTY	•	•		
*TLD1690D	POWER AMPLIFIER, 100-WATT CONTINUOUS DUTY			•	•
*TLD2170A	EXCITER-FILTER	•	•	•	•
TLN5902A	SHIELD, TRANSMITTER	•	•	•	•
KNX1019B	CHANNEL ELEMENT, TRANSMITTER	•	•	•	•
	RECEIVER				
*TLD5780A	RF AND IF BOARD, RECEIVER	•	•	•	•
TRN8095A	AUDIO AND SQUELCH BOARD	•	•	•	•
TLN4290B	AUDIO POWER AMPLIFIER RECEIVER	•	•	•	•
K1005A	CHANNEL ELEMENT, RECEIVER	•	•	•	•
TLN5654A	HARDWARE KIT, PL DECODER	•		•	
	MISCELLANEOUS				
TPN1110B	POWER SUPPLY	•	•	•	•
TKN6581A	RF CABLE	•	•	•	•
TKN6883A	RF CABLE KIT	•	•	•	•
THN6142A	CABINET	•	•	•	•
	PRIVATE-LINE				
TLN5731A	PL ENCODER	•		•	
TRN6002A	PL DECODER	•		•	
KLN6210A	VIBRASENDER RESONANT REED	•		•	
TLN8381A	VIBRASPONDER RESONANT REED	•		•	
	REMOTE CONTROL				
TCN1281A	UNIFIED CONTROL CHASSIS	•	•	•	•
TLN8799A	SERVICE BOARD	•	•	•	•
TLN5971A	LINE DRIVER MODULE 2-WIRE	•	•	•	•
TLN4662A	SQUELCH GATE MODULE	•	•	•	•
TLN5970A	STATION CONTROL MODULE	•	•	•	•
TLN4658A	F1 TONE CONTROL MODULE	•		•	
TLN4638A	F1-PL TONE CONTROL MODULE	•		•	
TLN1245B	GUARD TONE DECODER MODULE	•	•	•	•
TRN8684B	TIME-OUT TIMER MODULE	•	•	•	•
T1487AF	DUPLEXER	•	•	•	•
TLD8392A	CAVITY FILTER	4	4	4	4
TKN6471A	RF CABLE	2	2	2	2
TKN6473A	RF CABLE	•	•	•	•
TKN6474A	RF CABLE	•	•	•	•
TLN4566A	HARDWARE KIT, MOUNTING (2 OR 4 CAVITIES)	•	•	•	•
	DIGITAL VOICE PROTECTION				
TLN5972A	*DVP* CONTROL MODULE	•	•	•	•
TLN5973A	CODE PROCESSOR MODULE	•	•	•	•
TLN1890A	CODE DETECTOR MODULE	•	•	•	•
TLN5976B	VOICE PROTECTION MODULE	•	•	•	•
TRN6777B	ENCODE/DECODE HYBRID	•	•	•	•
TRN8497A	HARDWARE KIT	•	•	•	•
TRN8498A	SHIELD, RCVR	•	•	•	•
TRN8686A	CARD PULLER			•	•
TKN6808A	CABLE PL INHIBIT	•		•	
TRN6188A	HARDWARE PL ENCODER	•		•	

EPS-25486-A

MOTOROLA

MODEL CHART
FOR
DIGITAL VOICE PROTECTION
"MICOR" "COMPA-STATION"
BASE STATION-CONTINUOUS DUTY
CARRIER SQUELCH AND "PRIVATE-LINE" TONE-CODED SQUELCH
132-174 MHz

CODE:

X	ONE ITEM SUPPLIED
2	TWO ITEMS SUPPLIED
4	FOUR ITEMS SUPPLIED
*	INDICATES A MODEL SERIES. SPECIFIC MODEL DEPENDS ON CARRIER FREQUENCY, (NOTE: 60-WATT STATIONS AVAILABLE ONLY FOR 150.8-174 MHz)

STATION MODEL VARIABLES
STATION MODELS ARE NOT AVAILABLE FOR ALL POSSIBLE LETTER & NUMBER COMBINATIONS

C53RXB - 3126A

1	TONE REMOTE CONTROL
0	T1-R1
2	T2-R2
4	T3-R4
1	CARRIER SQUELCH
3	"PRIVATE-LINE" TONE CODED SQUELCH
X	CONTINUOUS DUTY DIGITAL VOICE PROTECTION
5	60 W RF OUTPUT
6	100 W RF OUTPUT

STATION MODEL	RF OUTPUT POWER WATTS	TYPE OF SQUELCH	T2 TWO XMIT FREQ. R2-TWO RCVR FREQ.	CONTROL TYPE	ITEM	DESCRIPTION
						TRANSMITTER
C53RXB1126A	60	C.S.	T2-R2	TONE	*TLD1700C	POWER AMPLIFIER, 60 WATT
C53RXB3126A	60	"PL"	T2-R2	TONE	*TLD1690D	POWER AMPLIFIER, 100 WATT
C53RXB1196A	60	C.S.	T4-R4	TONE	*TLD2170A	EXCITER-FILTER
C53RXB3196A	60	"PL"	T4-R4	TONE	TRN6188A	HARDWARE KIT, "PL" ENCODER
C73RXB1126B	100	C.S.	T2-R2	TONE	KXN1019B	TRANSMITTER CHANNEL ELEMENT
C73RXB3126B	100	"PL"	T2-R2	TONE		RECEIVER
C73RXB1196B	100	C.S.	T4-R4	TONE	*TLD5780A	RF & IF BOARD RECEIVER
C73RXB3196B	100	"PL"	T4-R4	TONE	TLN4290B	AUDIO POWER AMPLIFIER, RECEIVER
					TRN8095A	AUDIO & SQUELCH BOARD
					R1005A	RECEIVER CHANNEL ELEMENT
					TLN5654A	HARDWARE KIT, "PL" DECODER
						MISCELLANEOUS
					TLN8799A	SERVICE BOARD
					TLN4295A	ANTENNA SWITCH
					TKN6581A	RF CABLE
					TKN6882A	RF CABLE
					TRN8497A	HARDWARE KIT
					THN6142A	CABINET
					TPN1110B	POWER SUPPLY
						"PRIVATE-LINE"
					TLN5731A	"PL ENCODER"
					KLN6210A	SENDER
					TRN6003A	"PL DECODER"
					TLN8381A	"VIBRASPONDER" RESONANT REED
						REMOTE CONTROL
					TCN1280A	UNIFIED CONTROL CHASSIS
					TLN1245B	GUARD TONE DECODER MODULE
					TLN1248A	C2-R2 TONE CONTROL MODULE
					TLN5970A	STATION CONTROL MODULE
					TLN4638A	F1-"PL" TONE CONTROL MODULE
					TLN4658A	F1 TONE CONTROL MODULE
					TLN5971A	LINE DRIVER MODULE 2-WIRE
					TLN5292A	4-FREQ. CONTROL MODULE
					TLN5293A	F1 CONTROL MODULE (4-FREQ.)
					TLN5294A	F1 "PL" CONTROL MODULE (4-FREQ.)
						DIGITAL VOICE PROTECTION
					TLN5972A	DVP CONTROL MODULE
					TLN5973A	CODE PROCESSOR MODULE
					TLN1809A	CODE DETECTOR MODULE
					TLN5976A	VOICE PROTECTION MODULE
					TRN6777B	ENCODE/DECODE HYBRID
					TLN6808A	CARRIER PL INHIBIT
					TLN6338A	REGULATOR 5 V
					TRN8686A	CARD PULLER

EDS-25487-A

MOTOROLA

MODEL CHART

FOR

DIGITAL VOICE PROTECTION

CONTINUOUS DUTY

POWER AMPLIFIER

MODEL BREAKDOWN CHART

CODE:

[X] ONE INCLUDED

MODEL	DESCRIPTION	UNIT	DESCRIPTION
		TLD5960A	POWER CONTROL BOARD 90/100/110 W (FORMERLY TLD8620A)
		TLD8610A	POWER CONTROL BOARD 60 W
		TLD5952A	100 W POWER AMPLIFIER BOARD (132-150.8 MHz) FORMERLY TLD5902A
		TLD5953A	100 W POWER AMPLIFIER BOARD (150.8-162 MHz) FORMERLY TLD5903A
		TLD5954A	100 W POWER AMPLIFIER BOARD (162-174 MHz) FORMERLY TLD5904A
		TFD6101A	HARMONIC FILTER (132-150.8 MHz)
		TFD6102A	HARMONIC FILTER (150.8-174 MHz)
		TLN5604A	100 W PA HARDWARE
		TLN4780A	PA CASTING & HARDWARE ASSEMBLY
		TRN8012A	INPUT BRACKET & CABLE
		TLD8313A	60 W POWER AMPLIFIER BOARD (150.8-162 MHz)
		TLD8314A	60 W POWER AMPLIFIER BOARD (162-174 MHz)
		TLN4742A	60 W PA HARDWARE
		TRN6444A	RESISTOR-CAPACITOR NETWORK (60 W)
		TRN6445A	RESISTOR-CAPACITOR NETWORK (90-110 W)
		TLD5802A	RESISTOR-CAPACITOR NETWORK (110 W)
		TLD5802A	EXCITER BOARD (132-150.8 MHz)
		TLD5803A	EXCITER BOARD (150.8-174 MHz)
		TRN8049A	RESISTOR-CAPACITOR NETWORK (110 W)
TLD1692D	100 W POWER AMPLIFIER (132-150.8 MHz) FORMERLY TLD1692C	X	X
TLD1693E	100 W POWER AMPLIFIER (150.8-162 MHz) FORMERLY TLD1693D	X	X X X X X
TLD1694E	100 W POWER AMPLIFIER (162-174 MHz) FORMERLY TLD1694D	X	X X X X X
TLD1703C	60 W POWER AMPLIFIER (150.8-162 MHz)	X	X X X X X X X X X
TLD1704C	60 W POWER AMPLIFIER (162-174 MHz)	X	X X X X X X X X X

EPS-25488-B

MOTOROLA

MODEL CHART

FOR

DIGITAL VOICE PROTECTION

CONTINUOUS DUTY

EXCITER-FILTER

AND

UNIFIED CONTROL CHASSIS

MODEL BREAKDOWN CHART

CODE:

[X] ONE INCLUDED

* = INDICATES ITEM COVERED IN CONTROL AND APPLICATIONS MANUAL.

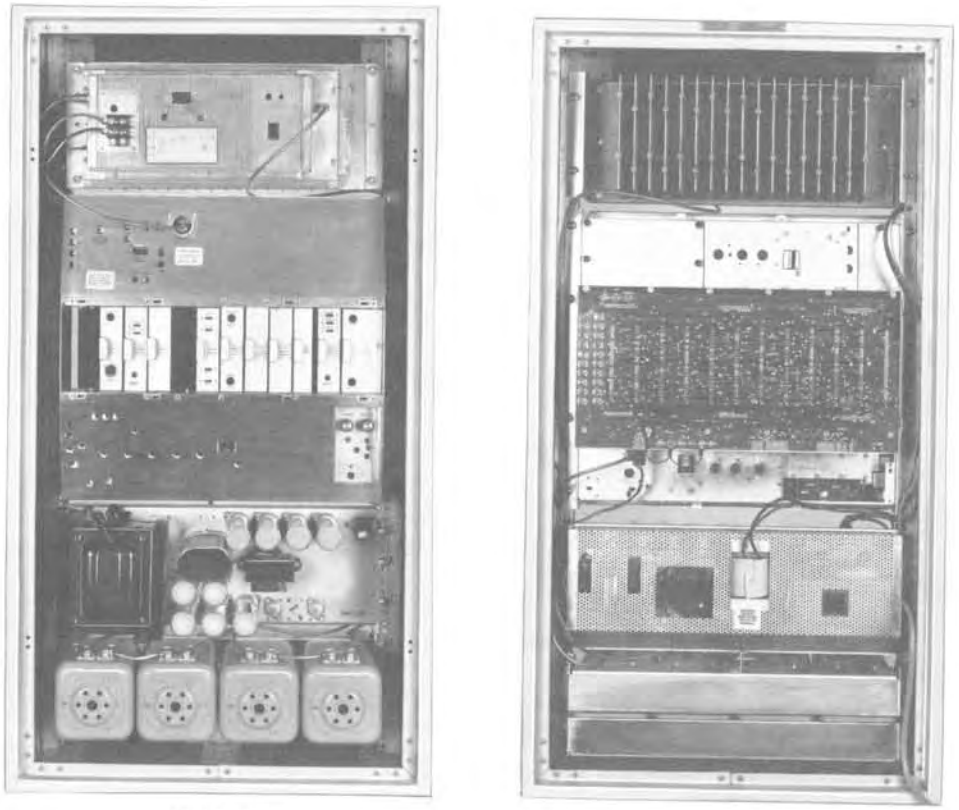
MODEL	DESCRIPTION	UNIT	DESCRIPTION																	
	EXCITER-FILTER																			
TLD2172A	(132-150.8 MHz)	TLD5802A	EXCITER BOARD (132-150.8 MHz)	X		X														
TLD2173A	(150.8-174 MHz)	TLD5803B	EXCITER BOARD (150.8-174 MHz)		X		X													
	UNIFIED CONTROL CHASSIS	TFD6111A	EXCITER FILTER (132-150.8 MHz)																	
TCN1280A	BASE STATION	TFD6112A	EXCITER FILTER (150.8-174 MHz)					X	X			X								
TCN1281A	REPEATER STATION	TLN5979A	*INTERCONNECT BOARD					X		X				X			X	X		
TCN1301A	BASE & RPTR STATIONS (FULL FILTERING OPTION)	TLN5648A	RECEIVER INTERCONNECT BOARD (BASE)					X			X				X			X	X	
		TLN5646A	RECEIVER INTERCONNECT BOARD (RPTR)						X			X				X	X	X		
		TRN6196A	RECEIVER INTERCONNECT BOARD (FULL FILTERING OPTION)							X			X							
		TLN5893A	TRANSMITTER INTERCONNECT BOARD (BASE)								X			X						
		TLN5894A	TRANSMITTER INTERCONNECT BOARD (RPTR)									X			X					
		TLN5895A	TRANSMITTER INTERCONNECT BOARD (FULL FILTERING OPTION)										X			X	X			
		TKN6570A	RF CABLE ASSEMBLY, RECEIVER											X		X	X			
		TPN9379A	*CHASSIS & HARDWARE KIT											X		X	X			

EPS-25489-A

FACTORY-INSTALLED OPTIONS

Option Plan Number Or Optional Kit Number	Description	Public Reference	
		Section Withn This Manual	Separate Publication
	Tone Remote Control Staton Options		
C06	Hi-Stability Ck. Element (Xmtr)	Exciter	—
C08	Hi-Stability Ck. Element (Rcvr)	RF & IF	—
C12	RF Preamplifier	Receiver Miscellaneous	—
C27	46" Outdoor Cabinet	Installation	—
C28	120 V, 60 Hz & + 12 V dc	—	68P81104E92
C29	Battery Saver & Alarm	—	68P81104E92
C36	75" Outdoor Cabinet	Installation	—
C40	70" Indoor Cabinet	Installation	—
C38	120/220/240 V, 50/60 Hz & —12 V dc	—	68P81104E92
C83	Delete Wireline Control From Rptr (CS)	—	—
C84	Delete Wireline Control From Rptr (PL)	—	—
C140	AND Squelch	Receiver Interconnect Unit	—
C144	4-Wire Audio	—	—
C149AT	Metering, Spkr & Intercom	68P81033E28	—
C226	Service Intercom	—	68P81105E20
C228	Shifted I-F	68P81114E53	—
C268	Delete *DVP* Encoder/Decoder	—	—
C303	Dual Code Select	—	—
C304	Proper Code Detect	—	—
TLD6340A	Crystal Filter	—	68P81104A86 and 68P81104E36
TLN1249A	Squlech Control Module	—	—
TLN1250A	Repeater Control Module	—	—
TLN1251A	PL Control Module	—	—
TLN1537A	Speaker & Intercom	—	68P81105E20
TLN4151A	Relay Kit	—	68P81025E60
TRN8684B	Time-Out Timer Module	—	—

EPS-25490-B



TYPICAL DIGITAL VOICE PROTECTION VHF RADIO

Figure 1. Typical ***Digital Voice Protection*** *VHF Radio*

1. MANUAL USAGE

This manual describes all aspects of 132-174 MHz *Micor* type Upright and *Compa-Station* radios with *Digital Voice Protection* (*DVP*). The manual is arranged with the rf equipment information first, followed by the remote control and digital voice protection equipment information.

2. EQUIPMENT DESCRIPTION INTRODUCTION

2.1 These Motorola *Micor* type base and repeater (RT) stations operate in the 132-174 MHz range. When these stations are operating in the non-coded (clear) mode, they are compatible with other Motorola equipment. In the coded mode, they can only be operated with equipment having the same encode/decode capability. These

stations are available in two basic model configurations—*Compa-Station* models and Upright models. Basic electrical characteristics of both are identical; the primary differences being that the upright models include a larger cabinet with hinged doors (front and back) and built-in metering with monitor intercom. *Compa-Station* models are shorter, incorporate non-hinged doors, and built-in metering with monitor intercom is available as an option. (*Compa-Station* metering is unique from upright station metering.)

2.2 Many models are available as shown in the station model chart at the front of this manual which designates equipment operational differences. These differences include transmitter rf power output level, type of receiver squelch, number of operating frequencies, etc.

3. TRANSMITTER

The transmitter generates a frequency modulated rf carrier signal of various power output levels depending upon the model. Refer to Figure 3 for functional operation. The transmitter consists of the following items:

- Channel Element - An unheated, temperature-compensated crystal oscillator plug-in module (channel element) provides a stable fundamental rf frequency for the transmitter. One channel element is used for each transmitter frequency.

- Exciter - The exciter provides the low power excitation signal for the transmitter. An "IDC" (Instantaneous Deviation Control) circuit amplifies and limits audio signals from the microphone (or line) to prevent over deviation. Amplified audio is applied to the channel element to produce direct fm modulation. Coded voice data is processed in the Remote control chassis and is applied directly to the channel element (bypassing the IDC circuitry). Multipliers in the exciter multiply the channel element frequency 12 times to generate an output frequency signal(s) in the 132 to 174 MHz band.

- Bandpass Filter - The bandpass filter couples 132-174 MHz signals from the exciter to the power amplifier and attenuates any harmonics outside this band.

- Power Amplifier - The low power output of the exciter is amplified to the rated power output of the transmitter in this solid-state power amplifier. Class C amplifiers are used which are cut off until signal drive is applied. A controlled amplifier stage regulates the amount of signal drive to prevent over-dissipation in the final amplifier stages. An input from the power control board controls the amount of gain.

- Bandpass Filter - The bandpass filter couples 132-174 MHz signals from the exciter to the power amplifier and attenuates any harmonics outside this band.

- Power Control Board - The power control board automatically and instantaneously regulates the transmitter output power. It maintains output power should source voltage vary, and progressively reduces power when VSWR increases. The output of the board is applied to the controlled amplifier stage in the power amplifier to regulate the amount of gain.

4. RECEIVER

4.1 The receiver accepts rf carrier signals on a specific channel in the 132-174 MHz range. It provides clear voice audio in the 300 to 3000 Hz range and also digitally coded voice signals. Refer to Figure 3 for functional operation. The receiver consists of the following items:

- Channel Element - A plug-in crystal oscillator module (channel element) provides stable frequency control for each frequency of operation. One channel element is required for each receiver frequency.

- Receiver RF & IF Board - The single-conversion superheterodyne FM receiver includes a preselector (comprised of five cavities) and two crystal filters for excellent selectivity. Two integrated circuit i-f amplifiers and limiters give high sensitivity. A crystal discriminator demodulates the audio directly from an 11.7 MHz i-f signal.

- Audio & Squelch and Audio Power Amplifier Board - Up to 10 watts of audio power at less than 5% distortion is provided by this circuit. When no messages are being received, the squelch circuit turns off the audio amplifiers to eliminate annoying noise in the speaker. A squelch tail eliminator circuit prevents the noise burst at the end of a message for strong signals. For weak signals, the circuit is automatically inhibited to prevent loss of portions of messages. The audio power amplifier transistors are mounted on a separate circuit board and aluminum heat sink for good heat dissipation.

4.2 An optional receiver rf preamplifier is also available to improve receiver sensitivity by 6 dB.

5. VOLUME AND SQUELCH CONTROLS

Receiver VOLUME and SQUELCH controls are located on the receiver chassis (all other operational circuit and their controls are on plug-in modules inserted into the unified control chassis). The RECEIVER VOLUME control only affects local speaker operation (when used).

NOTE

The SQUELCH control affects local and remote operation.

6. DIGITAL VOICE PROTECTION OPERATION

6.1 The Motorola *Digital Voice Protection* (*DVP*) system when used in the base, mobile, and portable components of a communications system, provides the user with an extremely high level of communications security. In addition, the encode/decode equipment can be selectively defeated to provide compatibility with non-secured (standard clear mode) radio equipment.

6.2 When the coded mode is selected, the *DVP* system converts analog voice signals (transmit audio) into a digital form via a continuously variable slope delta modulator (CVSD). The CVSD samples the slope of the analog signal and performs the analog to digital conversion at a 12,000 bit per second rate (See Figure 2). This high analog to digital conversion rate provides excellent reconstructed voice intelligibility yet allows operation on narrowband RF channels.

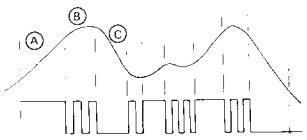


Figure 2. Typical CVSD Output

6.3 The digitized voice signal is then applied to a digital data scrambling device, where the data is rearranged by a complex, key dependent, multi-register, non-linear combiner algorithm. The scrambled digital data is then low pass filered in a unique splatter filter before application to the modulator. The modulator is of the direct-FM type, providing the relatively flat frequency response required to transmit the signal. The *DVP* signal is a digital, frequency shift keyed, waveform sent at a fixed deviation of ±4 kHz. It contains fundamental frequency components from approximately 20 Hz to 6000 Hz, and the energy is uniformly distributed in time throughout this frequency range. This signal, when received in a non-*DVP* equipped receiver sounds like unsquelched receiver noise. No voice components or syllabic content is apparent.

6.4 The encode/decode algorithm is programmable via an electronically inserted user controlled key. With the Motorola model T3010__X Series Code Inserter (available separately), the user can select any one of 2.36 x 10^{21} unique, independent code keys for use in this system. An external programming jack (on the Voice Protection Module) facilitates code entry. The code is retained in a volatile electronic memory with no possible visual or electronic readout. Loss of power for an extended time will completely erase the code key from the memory. However, the voice protection module may be unplugged from the chassis and placed on an extender card for servicing without code loss occurring. The code will be retained for approximately 20 seconds; sufficient time to accomplish removal and reinsertion of the module.

6.5 The decoding process involves digital unscrambling first, then CVSD reconstruction of the analog waveform from the digital signal. The decoded voice signal is then low-pass filtered to remove noise added in the reconstruction process, before application to the station audio outputs.

6.6 The *DVP* system utilized a unique turn-off signal (End of Message) that performs a function similar to reverse burst in PL systems, that of squelch tail elimination. When a transmitting *DVP* radio unkeys, the transmitter is held on for approximately 150 msec during which the turn-off signal is sent. This signal activates an End of Message detector in *DVP* base and mobile radios that closes down the decoded audio path.

7. *PRIVATE-LINE* TONE-CODED SQUELCH OPERATION

7.1 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 67-210 Hz range, which is below the 300-3000 Hz voice frequency range used in radio communication equipment.

IMPORTANT
Private-Line operation can be used only in the clear mode.

7.2 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. Thus, 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 so that it will not be heard.

7.3 In PL radio systems, the operator does not hear all on-frequency signals until the PL squelch circuitry in the receiver is disabled. The PL decoder is bypassed and the receiver reverts to carrier squelch operation. It is necessary to monitor the channel before transmitting to avoid interfering with other users.

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.

8. AUTOMATIC CLEAR/CODED VOICE OPERATION

This operation permits the radio user to hear clear voice output from the station regardless of the mode of the received signal. Circuitry within the station examines the received signal and determines whether it is clear voice or coded voice data and then automatically selects the correct signal path. This prevents an operator from hearing garbled messages or from missing messages entirely due to selecting the wrong mode.

9. POWER SUPPLY

The power supply utilizes a ferro-resonant (constant voltage) transformer and provides all the voltages necessary for operating the station. It automatically corrects for changes in load and input voltage thus maintaining a constant voltage output.

10. ACCESSORIES

In addition to the base and repeater stations described in this manual, some additional items are needed to complete the installation as follows:

10.1 ANTENNA AND TRANSMISSION LINE

An antenna and transmission line kit is available from Motorola on separate order. The type used should be detd by a qualified radio communications engineer and will depend upon local operating conditions.

10.2 REMOTE CONTROL CONSOLE

A tone remote control console is required at the control location for this station.

10.3 OPTIONAL ACCESSORIES

Many optional accessories are available as factory installed items in new stations, and as "add-to" items for field installation. Many of those optional accessories are described in this manual. Other accessories may become available after the printing of this manual. Also, other accessories are available which have more special application than those listed herein. See your local Motorola representative and the Factory-Installed Options chart for complete details.

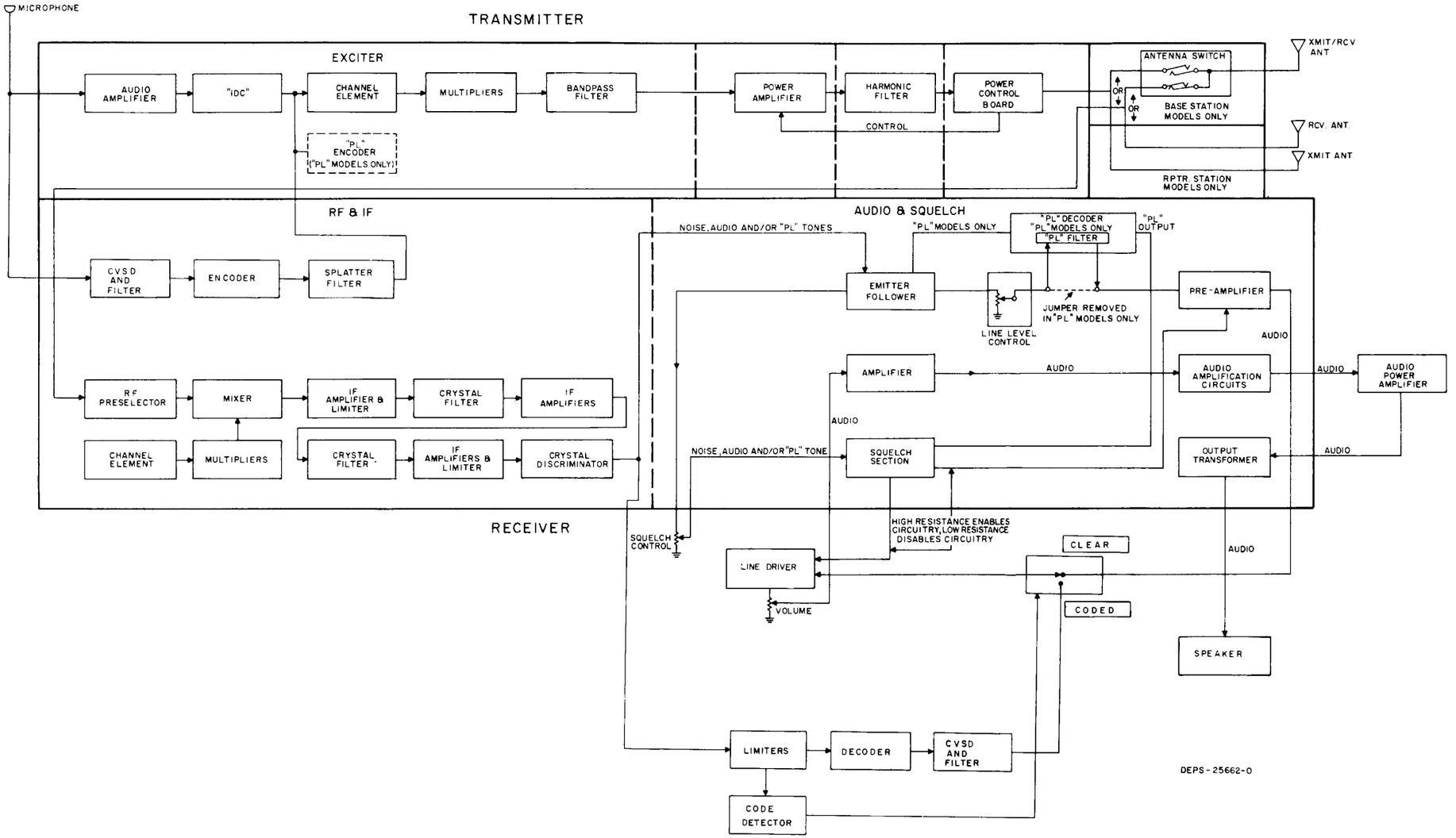


*Figure 3. **DVP** Station Block Diagram*

IMPORTANT

FCC regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a 1st or 2nd class commercial radiotelephone operator's license or by personnel working under their immediate supervision.

2. The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and local conditions.

3. Frequency, deviation and power of a base station transmitter must be check before it is placed in service and rechecked every year thereafter.

REMEMBER

The efficiency of the equipment depends upon a good installation.

1. INSPECTION

Inspect the equipment thoroughly as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately.

2. PLANNING THE INSTALLATION

Since a good installation is so important to obtain the best possible performance of the communications system, carefully plan the installation before actual work is started. Location of the station in relation to power, control lines, the antenna, convenience and access for servicing should be considered. The cabinet dimensional detail diagrams show the size of the various cabinets for planning the space requirements. Read the entire procedure and the many suggestions offered to help you plan your installation. Make sure all tools, equipment and facilities are available when the installation is begun.

3. VENTILATION

The radio equipment is operated without forced ventilation. The cabinets have vents which allow outside air to be drawn in through an opening in the bottom of the doors and expelled through an opening in the top of the doors. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the openings be kept free of obstructions so the air flow will not be restricted. The vents on outdoor type cabinets provide necessary station ventilation and in addition prevent rain, snow, etc. from entering the cabinet.

4. INSTALLATION OF 41-INCH INDOOR *COMPA-STATION* CABINETS

4.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

4.2 The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

4.3 All antenna, power and control lines may be brought through the notch at the bottom of the rear door. Any or all of these lines may be brought out through the bottom, side or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

CAUTION

Before drilling, check location of proposed hole and verify that equipment will not be damaged by the drilling.

5. INSTALLATION OF 70-INCH INDOOR UPRIGHT STATION CABINET

5.1 GENERAL

Refer to cabinet drawings at the end of this section for the cabinet dimensional detail. The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line loss.

5.2 REMOVAL AND REVERSING OF DOORS

Both front and rear doors are removable by simply unhooking the arm of the door stop from the door and pulling down on the upper hinge pin. If desired, both front and rear doors may be reversed from right hand opening to left hand opening as follows:

Step 1. Remove the door and unbolt the hing brackets from the cabinet.

Step 2. Remount these hinge brackets on the opposite side of the cabinet.

Step 3. Turn the door upside down and reinsert the hinge pins in the brackets.

Step 4. Remove the latch bar from the rear of the door lock and reinstall it 180° from its original position.

5.3 REMOVAL OF SIDE PANELS

The sides of the cabinet may be easily removed to aid in the installation or maintenance of the unit. Proceed as follows:

Step 1. Using a nut driver tool, remove the sheet metal screw located in the middle or the lower edge of the side panel, as viewed from inside the cabinet.

Step 2. Insert a large screwdriver between the lower edge of the side panel and the bright trim strip on the outside of the cabinet and pry up slightly to release the friction grips.

Step 3. Grasp the side panel at the edges with both hands and lift up several inches to remove it.

5.4 REPLACEMENT OF SIDE PANELS

Step 1. When replacing the side panel, position it over the frame with the top several inches above the top of the cabinet.

Step 2. Slowly slide the side panel down into position. When the top of the side panel is flush with the top of the cabinet, the panel is positioned properly.

Step 3. The locking screw should be replaced for security reasons.

6. INSTALLATION OF 46- AND 75-INCH "OUTDOOR" CABINETS

6.1 GENERAL

6.1.1 Refer to cabinet drawings at the end of this section for cabinet dimensional details.

6.1.2 The outdoor station may be installed in any convenient location (indoors or outdoors) which provides space to open the front and rear doors. If it is installed outdoors, the rain shield kit (which is packed with the cabinet) should be installed as described in this section. With these installed, the station is protected against all normally encountered elements such as rain, snow or sleet.

6.1.3 The station is not intended to withstand submersion in water. If pools of water could gather around the cabinet base, it is recommended that the cabinet be elevated on a suitable supporter platform.

6.1.4 Although the cabinet is built to be installed outdoors, it should be realized that maintenance of the station is not easily accomplished in inclement weather. It is therefore recommended that the station be installed inside of an enclosure which would provide protection for the service man and the test equipment he may be using. One such enclosure would be an elevator penthouse or a small building no less than six feet square and eight feet tall as measured on the inside.

6.1.5 The cabinet should be located on a solid, level surface convenient to the power source and the transmission line. The transmission line should be kept as short as possible to minimize line losses.

6.2 46-INCH CABINET RAIN SHIELD INSTALLATION

6.2.1 General

The rain shield kit is provided to cover the air vent openings at the top and bottom of both cabinet doors.

6.2.2 Procedure

The complete rain shield installation procedure is given in step form on the 46-inch outdoor cabinet dimensional detail at the end of this section.

6.3 75-INCH CABINET RAIN HOOD AND VENT SHIELD INSTALLATION

6.3.1 General

The rain hood is provided to cover the air vent in the top of the cabinet and the vent shield to cover the opening in the rear door.

6.3.2 Installation of Rain Hood

Step 1. Install the main section (largest fabricated assembly) over the opening in the top of the cabinet using the rectangular shaped gasket and 1/2-inch sheet metal screws provided.

Step 2. Mount the small rectangular cover inside the main section using the machine screws provided.

Step 3. Similarly, mount the larger cover on top of the whole assembly.

6.3.3 Installation of Vent Shield

Mount the awning-shaped vent shield over the opening in the rear door using the "u" shaped gasket and 3/8-inch sheet metal screws. Place the acorn nuts over the screws to cover exposed threads.

7. ANTENNA CONNECTIONS

7.1 INTRODUCTION

7.1.1 The antennas and transmission lines are not part of the station. Therefore, antenna installation instructions are not included in this section. Follow the instructions shipped with the antennas for applicable information.

7.1.2 In its primary application, the station is used for communications with mobile radios. Thus antennas having omni-directional characteristics are desirable. However, if the station is located at the outer perimeter of a communications area, or if it is to be used for communications with fixed stations, antennas with specific directional characteristics may be more suitable FCC requirements may also dictate the type of antenna to be used.

7.1.3 For base stations, the antenna coaxial cable connects to the antenna relay with a UHF type connector. For repeater stations without an optional duplexer, two antennas are required, one for the transmitter and one for the receiver. The antenna coaxial cables connect to the UHF connectors on the TKN6885A Adapter Cable. This adapter cable is added to stations without duplexers. For repeater stations with an optional factory installed duplexer, the antenna's coaxial cable connects to the duplexer with a type UHF connector. (Refer to Figure 1.)

7.2 41-INCH INDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. The antenna coaxial cable(s) may be brought through the notch at the bottom of the rear door. Cable(s) may be brought out through the bottom, side or top of the cabinet, if desired, by drilling a hole in the cabinet at the desired position.

CAUTION

Be careful to determine internal clearance before drilling access holes. A 3/4-inch diameter hole allows conduit to be installed for cable runs. If conduit is not used, install rubber grommets in the holes to protect the cable(s).

Step 2. Connect the antenna cable(s) as shown in Figure 1 and discussed in paragraph 7.1.3.

7.3 46-INCH OUTDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

This outdoor cabinet antenna cable routing and connection procedure is the same as described for indoor type cabinets except the entrance must be sealed and made as weatherproof as possible.

7.4 70-INCH INDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

7.4.1 General

Six knockouts in three sizes are provided on the cabinet top for ease of installation. Refer to Figure 2 Cabinet Knockout Detail for proper hole usage and to Figure 3 Indoor Cabinet Antenna Cable Installation Diagram for typical installation details. Determine the type of cable entry or entries required as described in paragraph 7.1.3 and select the most convenient knockout(s). The coaxial output lead must be kept as short as possible to keep power loss to a minimum.

7.4.2 Transmission Lines Terminated in Female Connector

Step 1. Secure the transmission line (through the appropriate knockout) directly to the cabinet top with the nut supplied.

Step 2. Measure and cut a piece of coaxial cable so that it will reach between the station output connector and the transmission line connector in the cabinet top.

Step 3. Install connectors as required.

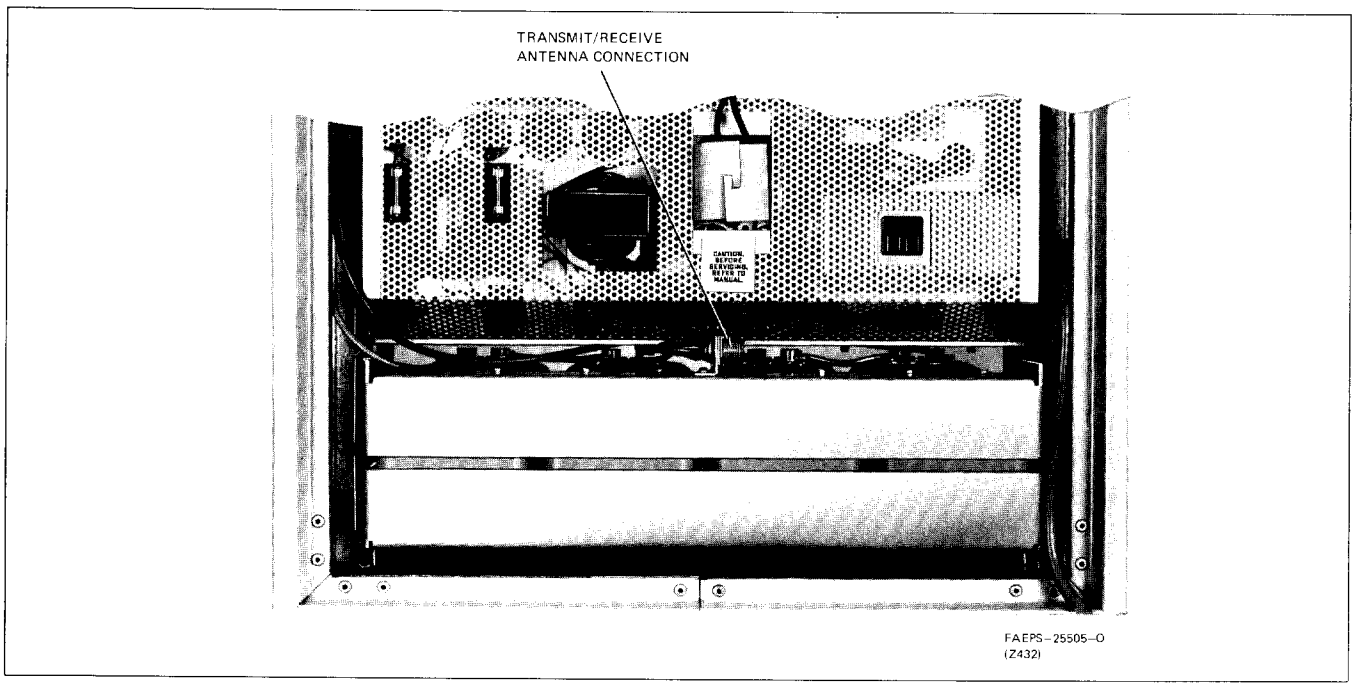


Figure 1. Antenna Connection Locations

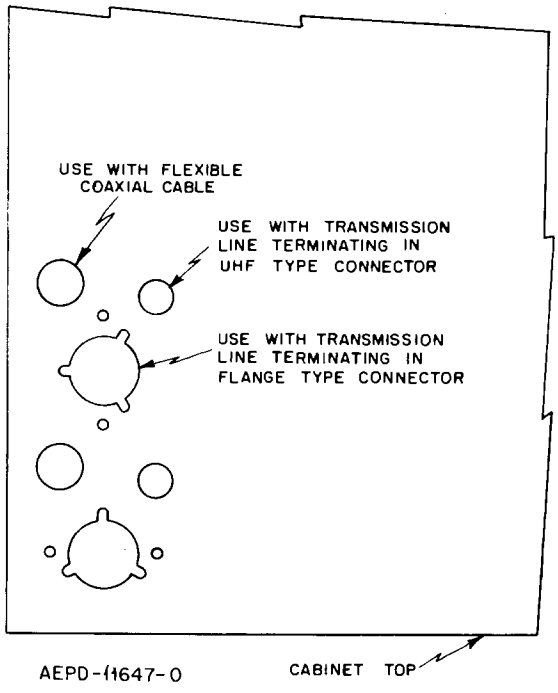


Figure 2. Cabinet Knockout Detail

7.4.3 Transmission Lines Terminated in Flange Type Connector

Step 1. Install the flange type connector in the cabinet top using the appropriate knockout.

Step 2. Measure and cut a piece of coaxial cable so that it will reach between the station output connector and the flange type connector in the cabinet top without any sharp bends.

Step 3. Install connectors as required.

7.4.4 Externally Terminated Transmission Line

The transmission line may be terminated adjacent to the cabinet, but must be within reach of the coaxial cable that connects to the radio equipment.

Step 1. Punch out the 7/8-inch knockout in the cabinet top.

Step 2. Install the rubber grommet (supplied) in the hole.

Step 3. Install a coaxial jumper cable of suffcient length to provide a proper connection.

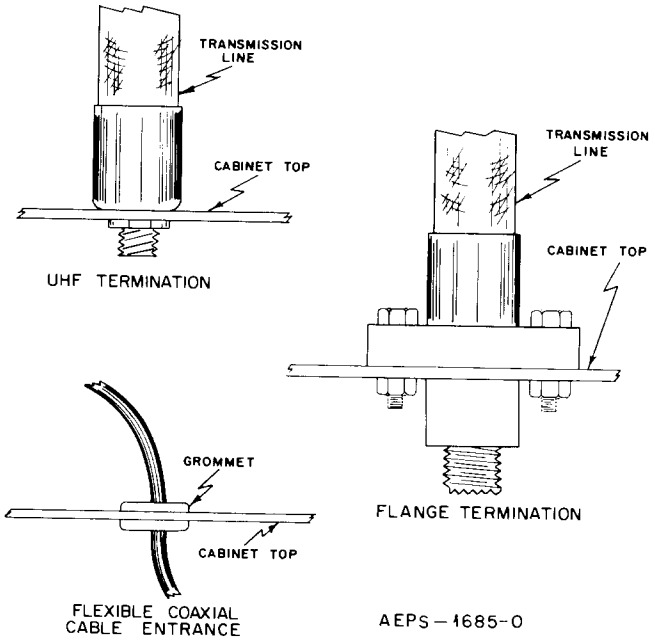


Figure 3. Indoor Cabinet Antenna Cable Installation

7.5 75-INCH OUTDOOR CABINET ANTENNA CABLE ROUTING AND CONNECTION

Step 1. A flange-type bulkhead fitting should be used to make a weatherproof entry for the antenna transmission line(s). The recommended location for the fitting is on the right side of the cabinet (as viewed from the front) with its center 21 inches from the top and 7 inches from the rear. Any alternate location must be selected with caution to insure that the area is clear of chassis, framework, etc.

Step 2. Install connectors as required.

8. AC INPUT POWER CONNECTIONS

8.1 INTRODUCTION

8.1.1 All stations should have a separate power circuit from a 20-ampere (minimum), 120-volt ac, 60 Hz power source. The power lines should be installed in accordance with local electrical codes.

8.1.2 The primary ac power line may be installed prior to installation of the cabinet and terminated near the location chosen for the station.

8.2 41-INCH INDOOR/46-INCH OUTDOOR CABINETS POWER CONNECTION

8.2.1 Indoor and outdoor power connections are identical except that outdoor station requires additional weatherproofing.

WARNING

If a three wire grounded primary ac power source is not available the radio equipment *must be grounded* separately to prevent electrical shock hazards and provide lightning protection.

8.2.2 Connect the three-wire ac line cord to the ac outlet. A power on-off switch is not provided in the equipment, therefore, with power applied, the equipment is in an operative condition.

8.2.3 The station fuse controls all power to the station except ac power to the outlet in the power supply.

8.3 70-INCH INDOOR CABINET POWER CONNECTION

8.3.1 If the station is located in a room with a utility trough in the floor, the station may be installed over the trough and the power and control leads brought up through the bottom of the cabinet into the station. Do not punch out the knockouts for such an installation.

8.3.2 Two knockouts are also provided on the rear panel of the cabinet base for rear entrance of the power and control lines. When facing the rear of the cabinet, the right hand knockout is intended for the entrance of ac power. Punch out the knockout. Install a 7/8-inch rubber grommet (supplied) in the hole to protect the cable.

8.4 75-INCH OUTDOOR CABINET POWER CONNECTIONS

8.4.1 For bottom cable entry, power and control cables may be brought in at almost any desired point through the bottom of the cabinet. Measure and center punch the desired cable entry locations. Using the center punch marks as the center of the holes, drill 3/4- inch holes with a hole saw. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

8.4.2 For rear cable entry, two punch marks are located on the rear panel of the cabinet base. Using these as centers, drill holes in the cabinet with a 3/4-inch hole saw. When facing the rear, the right-hand hole is intended for the entrance of ac power and the left-hand hole is intended for the entrance of control lines. Install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible.

9. OPTIONAL MODE JUMPERING

9.1 GENERAL

9.1.1 Jumpers on modules used with the station are identified and described in applicable sections at the rear of this instruction manual.

9.1.2 Many repeater (RT) station modes of operation are determined by jumper connections at the time of installation and are described in the following paragraphs.

9.2 TIME-OUT TIMER MODULE

Repeaters or base stations equipped with a time-out-timer module prevent unintentional continuous transmission. The timing jumpers on the module may be connected for 1/2, 1, 2, 4 or 8 *minute* operation. In repeaters, the time-out-timer will reset each time a new input signal arrives at the station, whether or not the dropout delay generator has shut off the transmitter. Repeater time-out time and line transmit time periods may be selected independently with the repeater select jumper and the line select jumper.

9.3 SQUELCH GATE

In repeater stations, the dropout delay generator in the squelch gate module prevents the transmitter from shutting off during loss or excessive fade of input signal for the length of time preset. The jumper can be set for 0, 1, 2, 4 or 8 *second* operation.

10. CONTROL LINE CONNECTIONS

10.1 INTRODUCTION

10.1.1 The station can be controlled from a remote point over wire line circuits. Simplex audio is used, meaning that the remote point can send audio to the station or receive audio from the station, but not both at the same time. Therefore, a single audio pair will suffice. This pair also carries the audio control tones.

10.1.2 Four-wire audio operation, wherein transmitter audio and receiver audio are carried on separate wire pairs, is possible with the 4-wire line driver module. In such operation, line 1 is the transmit audio and control pair and line 2 is the receive pair.

10.2 LINE SPECIFICATIONS

10.2.1 The audio wire line(s) must meet certain specifications for acceptable radio control and communications. Verify the characteristics of leased telephone lines with the company providing the service before installation.

10.2.2 As mentioned previously, *DVP* stations are of two basic types and each type has slightly different line requirements. The first type, termed an encode/decode station, performs all voice processing in the station and therefore all communications on the wire lines are either clear voice or decoded voice. The second type, the transparent station, requires that the voice processing be performed at the remote console which means that digitally coded data be sent and received on the wire line. (See the *DVP* and Tone Remote Control Applications section for further details.) This places more stringent specifications on the wire lines. The specifications are as follows:

10.2.3 Encode/Decode Type Wire Line Requirements

1. Frequency Response:
   500 to 2500 Hz

2. Impedance:
   600 ohm balanced line

10.2.4 Transparent Type Wire Line Requirements

1. Frequency Response:
   ± 3 dB 20-6000 Hz

2. Frequency Translation Error:
   0 Hz

3. Maximum Insertion Loss:
   20 dB

4. Relative Envelope Delay:
   20 usec maximum 200-6000 Hz
   Referenced to 1 kHz

5. Tone Remote signaling must be done via a separate line.

10.2.5 Tone Remote Control Operation

Frequency Response: 500 to 2500 Hz
Frequency Translation Error: ± 10 Hz max.
Impedance: 600-Ohm balanced line
Signal-To-Noise: 35 dB min.

Chart of Maximum Input and Loss

Phone-Company Specified Maximum Input	Maximum Phone Line Loss Usable With Remotely-Controlled Radio
+8 vu (14 dBm)	32 dB
0 vu (6 dBm)	24 dB
-8 vu (-2 dBm)	16 dB

10.2.6 As can be seen, voice grade telephone lines are not adequate for passage of *DVP* data. In addition, it is necessary that a separate wire line path be provided for transparent station installations to carry the remote control tone. This is necessary since the tone signaling cannot co-exist on the same line with *DVP* data.

10.2.7 Several alternatives to telephone lines are available. For an "on premise" installation shielded pairs of

#24 AWG wire are acceptable for runs of 5000 feet or less, provided that DC continuity can be maintained. For "off premise" capability, microwave radio using *DVP* compatible multiplex modems are suggested. Consult your Motorola Representative for assistance in determining the optimum configuration.

10.3 INSTALLATION

10.3.1 General

The control line may be installed prior to installation of the cabinet and terminated near the location chosen for the station. Conduit or two-wire cable can be used from this termination to the station cabinet.

10.3.2 Specific Connection Information

Connect the 600-ohm line(s) to the TBI screw terminals on the rear of the unified chassis interconnect board. In 2-wire applications, use line I connections (TB1-1 and -3). In 4-wire applications, line 1 connects to TB1-1 and -3 and line 2 connects to TB1-4 and -6. In applications using a transparent station, the wire-line pair carrying controls tones is connected to TB3-7 and -9.

10.3.3 Tone Control Line Levels

The control tone levels for the remotely controlled functions are adjusted at the remote control console. No additional adjustments are required.

11. CONTROL LINE LEVEL ADJUSTMENT

11.1 GENERAL INFORMATION

11.1.1 Most telephone companies limit the maximum signal amplitude which they will allow on their lines. The most common maximum level is 0 vu (volume units); check the telephone company for the maximum level to be used on your lines. Adjust the audio levels to the maximum permissible level which will give the best signal-to-noise ratio. For lines not subject to telephone company restrictions adjust speech levels to +8 vu.

11.1.2 The vu is the measurement for speech and can be measured only with a vu meter. This meter has special ballistics to control the rise and fall time and the overshoot of speech signal voltage. Since speech signals fluctuate so rapidly, special metering techniques are required. The vu meter responds in a series of "kicks" or deflections of varying amplitude. Over a period of time, a majority of peaks will reach approximately the same level. There will be a few very strong peaks which will exceed this level and a few peaks of lower level. These are ignored and the measured speech level equals the majority of the "kicks" or peaks reached. Measurements show that the instantaneous peaks of a speech signal are about 10 dB higher than the vu value (the instantaneous peaks of a 0 vu speech signal will equal the peaks of a sine wave signal of ± 10 dBm magnitude). Of course, a sine wave signal of ± 10 dBm would produce a much greater volume because every cycle of the signal goes to peak amplitude.

11.1.3 Adjustment of the audio line levels is very difficult using actual speech signals which fluctuate so greatly. A sine wave signal (1000 Hz continuous tone, for example) is much easier to use for adjustments. However, sine wave signals are measured in dBm and the telephone company specifies the maximum signal level in vu. THERE IS NO CONVERSION FROM VU TO DMB OR VICE VERSA when measuring speech. Speech cannot be measured in dBm or converted into dBm. The dBm is a unit to measure the sine wave power as referenced to 1 milliwatt of power. The power of a speech signal of a particular vu is not defined and is different for different speakers. IT IS POSSIBLE TO *CALIBRATE* A VU METER BY USING A SINE WAVE SIGNAL ON THE 600-OHM LINE, THEN MEASURING THE SAME SIGNAL IN DBM WITH A VOLTMETER. On a 600-ohm line, a sine wave signal that will produce a 0 vu reading will measure 0 dBm on a voltmeter. This does not mean 0 vu is equal to 0 dBm. Remember, the peaks of an actual 0 vu *speech* signal will have instantaneous peaks of +10 dBm amplitude.

11.1.4 We would normally conclude that sine wave signal levels would be adjusted 10 dB higher than the vu level specified for the line. EXPERIMENTAL MEASUREMENTS HAVE PROVEN THAT SINE WAVE SIGNAL LINE LEVELS SHOULD BE 6 DB HIGHER THAN THE VU LEVEL SPECIFIED FOR THE LINE (+8 vu speech level should be adjusted for +14 dBm tone level; 0 vu speech level should be adjusted for +6 dBm tone level).

11.2.1 General

11.2.1.1 A local speaker at the station may be used for testing and level settings. If the station is equipped with built-in metering, it includes a local speaker. If not, the speaker in a Motorola protable test set may be used by connecting the test set with *Micor* adapter to the control receptacle (J3) on the unified chassis interconnect board. Otherwise, a *Micor* mobile speaker can be connected to the local speaker pins (J4-1 and -12 of unified chassis interconnect board). The receiver VOLUME control sets the audio level at the local speaker only.

NOTE

In encode/decode stations, the *DVP* control switch *must* be set to the OFF position when performing adjustments.

11.2.1.2 Exciter audio should be measured at the input to the exciter and adjusted for the sensitivity value stamped on the exciter. This level should be measured at pins 12 and 19 of Exciter Board Plug P202.

600-Ohm Line vu, dBm, and Voltage Equivalency Chart

If Maximum Speech Level For Line Is	Adjust Tone Line Level For (1 mW ref)	Voltage Equivalent
+14 vu	+20 dBm	7.74 V
+12 vu	+18 dBm	6.15 V
+10 vu	+16 dBm	4.88 V
+8 vu	+14 dBm	3.88 V
+6 vu	+12 dBm	3.08 V
+4 vu	+10 dBm	2.44 V
+2 vu	+8 dBm	1.94 V
0 vu	+6 dBm	1.54 V
-2 vu	+4 dBm	1.22 V
-4 vu	+2 dBm	0.97 V
-6 vu	0 dBm	0.77 V
-8 vu	-2 dBm	0.61 V
-10 vu	-4 dBm	0.48 V
-12 vu	-6 dBm	0.38 V
-14 vu	-8 dBm	0.30 V
-16 vu	-10 dBm	0.24 V
-18 vu	-12 dBm	0.19 V
-20 vu	-14 dBm	0.15 V
-22 vu	-16 dBm	0.12 V
-24 vu	-18 dBm	0.09 V
-26 vu	-20 dBm	0.07 V

11.2.1.3 *Private-Line* receivers must be PL disabled during adjustments with the PL DISABLE switch on the station control module. In *Private-Line* repeaters, the squelch gate must also be set for carrier jumper JU14 to the active pin and JU15 to the dummy pin. Be sure to return the jumpers to the PL condition after adjustments are complete.

11.2.1.4 Encode/decode stations require only one more level adjustment than transparent station. This adjustment sets the level of the decoded audio applied to the line.

11.2.1.5 For best audio quality at the remote console, it is recommended that the line input level at the console be set *2 dB* below the compression level. Refer to the applicable console instruction manual for details.

11.2.2 Repeater Level Setting

Step 1. Set the receiver SQUELCH control at squelch threshold.

Step 2. Inject an on-frequency carrier signal into the receiver antenna input. Adjust the signal level to 20 dB quieting.

Step 3. Adjust the REPEATER SQUELCH KEY control (squelch gate module) so the transmitter just keys.

Step 4. Modulate the receiver input with a 1000 Hz tone at ±5 kHz deviation. Adjust the REPEATER LEVEL control (squelch gate module) so the exciter audio input (measured at pins 12 and 19 of Exciter Board Plug P902) is the value stamped on the exciter (modulator sensitivity +6 dB or approximately ±5 kHz transmitter deviation).

Step 5. On PL repeaters, return jumpers JU14 and JU15 to the PL condition.

11.2.3 Wire Line Controlled Base Stations and Repeater Stations

11.2.3.1 Determine the maximum allowable audio level permitted on the lines (use +8 vu for nonregulated lines) and set line audio levels to this amplitude Refer to the 600-OHM, VU, DBM AND VOLTAGE EQUIVALENCY CHART for tone levels to be used.

NOTE

The following procedures assume the +8 vu speech level (+14 dBm tone level). For other speech levels, use a tone level 6 dB higher than the vu level (for 0 vu use +6 dBm); refer to the equivalency chart. On some lines, tone levels are not permitted to exceed the speech levels, even for short test tones (for example, maximum speech level of 0 vu and maximum tone level of 0 dBm). When such regulations apply, use the special procedures for low level test tone.

11.2.3.2 As mentioned previously, the lines used to carry audio have an ac impedance of 600 ohms. The amplitude of signals is most conveniently measured in dBm. Zero dBm is equal to 1 milliwatt across 600 ohms. Most audio voltmeters, such as the Motorola Transistorized AC Voltmeter, are calibrated to read directly in dBm when measuring across a 600-ohm impedance. Never use a volt-ohm meter or multimeter.

Step 1. Apply a 1000 Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression. Adjust the output of the remote control console for +14 dBm (or maximum allowable audio level) at its output terminals. If the level at the station is above 0 dBm, remove JU25 on the line driver module.

Step 2. Adjust the XCTR LEVEL control (line driver module) so the exciter audio input (measured at pins 12 and 19 of Exciter Board Plug P902) equals the value stamped on the exciter. (Modulator sensitivity plus 3 dB or approximately ±5 kHz transmitter deviation.)

Step 3. Remove the 1000 Hz audio tone.

Step 4. Set the receiver SQUELCH control for squelch threshold.

Step 5. Inject a 1000 uV carrier frequency signal into the antenna input of the receiver. Modulate the signal with a 1000 Hz tone at ±5 kHz deviation.

Step 6. Adjust the LINE 1 OUTPUT (line driver module) for +11 dBm (2.7 V) or maximum allowable audio level as measured with an audio voltmeter across the line 1 terminals. If four-wire audio operation is used, with the receiver output applied to line 2, adjust the LINE 2 OUTPUT control while measuring across the line 2 terminals. This completes the line level adjustments for transparent base and repeater stations.

11.2.4. Code Insertion and Decoded Audio Level Adjustment (Encode/Decode Stations Only)

11.2.4.1 The following procedure should be used whenever the code is being changed or reinserted.

Step 1. Actuate the PL DISABLE switch on the station control module and set the *squelch* control to the point where the receiver is just squelched.

Step 2. If the station is not equipped with a local speaker (part of metering), add one as outlined previously (paragraph 11.2.1.1). Adjust the *volume* control to produce a comfortable listening level.

Step 3. Set the DECODED AUDIO LEVEL control on voice protection module to the middle of its range. Insert the code insertion plug into the socket on the front panel of this module. A noisy signal should now be heard at the speaker.

NOTE

If the station is equipped with the dual code selection option, actuate the CODE 1 switch on the code select module.

Step 4. Depress the ENTER switch on the code programmer and hold it until a 1-second burst of tone is heard in the speaker. This indicates that the code has been entered successfully.

Step 5. Remove the code insertion plug and return the station to the PL mode.

11.2.4.2 The following procedure should not be used when adjusting the level of the decoded audio signal applied to the line.

NOTE

The station and the *DVP* test set must be programmed with the same code. Refer to the preceding paragraph for code insertion instructions.

Step 1. Connect the coded output of the *DVP* test set to the modulation input of the rf signal generator.

Step 2. Inject a 1000 uV carrier frequency signal into the antenna input of the receiver. Modulate the signal with an encoded (scrambled) 1000 Hz tone at ±4 kHz deviation.

Step 3. Monitor the line output terminals and adjust the DECODED AUDIO LEVEL control (voice protection module) to produce the same output level as set previously (clear mode).

11.2.5 Special Procedure for Low Level Test Tone

NOTE

The following procedure is written for the 0 vu speech level and 0 dBm test tone level, but other levels may be used by substituting appropriate levels (levels across the 600-ohm load should be 6 dB higher than the specified line level).

Step 1. Terminate the remote control console in a 600-ohm load resistor rather than the line.

Step 2. Apply a 1000-Hz audio tone to the remote control console at a level sufficient to drive the amplifier into compression.

Step 3. Connect an audio voltmeter across the 600-ohm load resistor and adjust the line output for +6 dBm.

Step 4. Reduce the 1000 Hz audio tone input until the voltmeter reads 0 dBM.

Step 5. Remove the 600-ohm load resistor and reconnect the line. Readjust the line output for 0 dBm across the line. Do not change the 1000 Hz tone level.

Step 6. Connect the audio voltmeter to the exciter audio input at the station and adjust the XCTR LEVEL control for 6 dB less than the value stamped on the exciter.

Step 7. Disconnect the line at the station and connect a 600-ohm load resistor in its place.

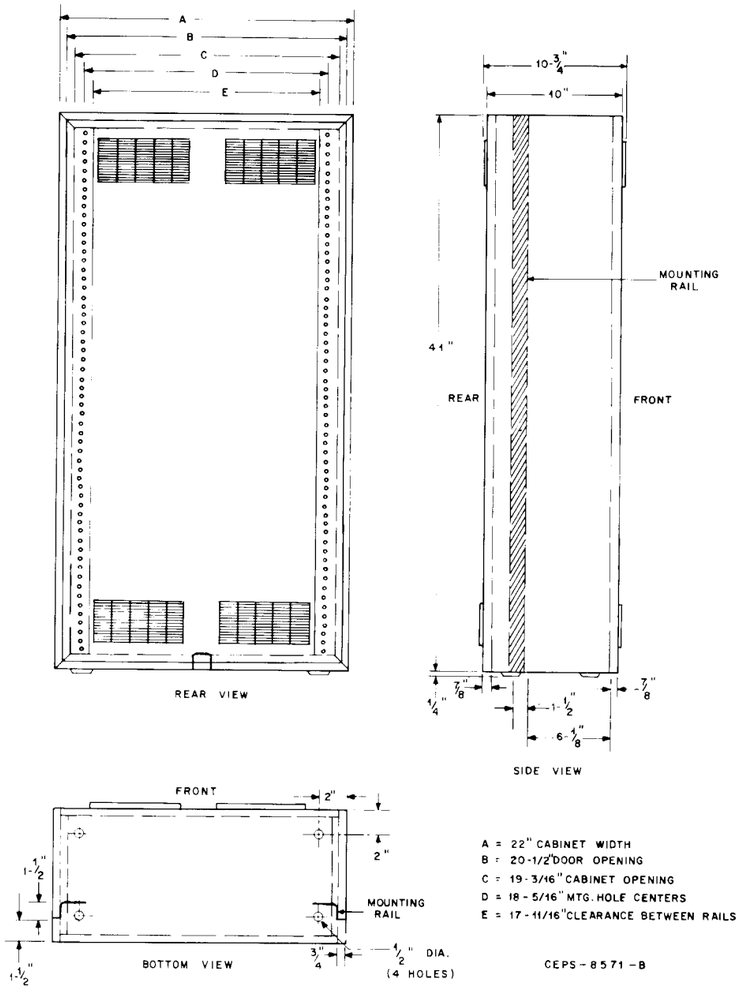
Step 8. Apply a 1000 uV carrier signal to the receiver antenna terminal from an FM signal generator. Modulate the carrier signal with a 1000 Hz tone at ±5 kHz deviation.

Step 9. Connect an audio voltmeter across the 600-ohm load resistor and adjust the LINE 1 OUTPUT control for +6 dBm.

Step 10. Reduce the deviation until the voltmeter reads 0 dBm.

Step 11. Remove the 600-ohm load resistor and reconnect the line. Readjust the LINE 1 OUTPUT for 0 dBM as measured across the line.

THN6142A CABINET (41-INCH) INDOOR



A = 22" CABINET WIDTH
B = 20-1/2" DOOR OPENING
C = 19-3/16" CABINET OPENING
D = 18-5/16" MTG. HOLE CENTERS
E = 17-11/16" CLEARANCE BETWEEN RAILS

CEPS-8571-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

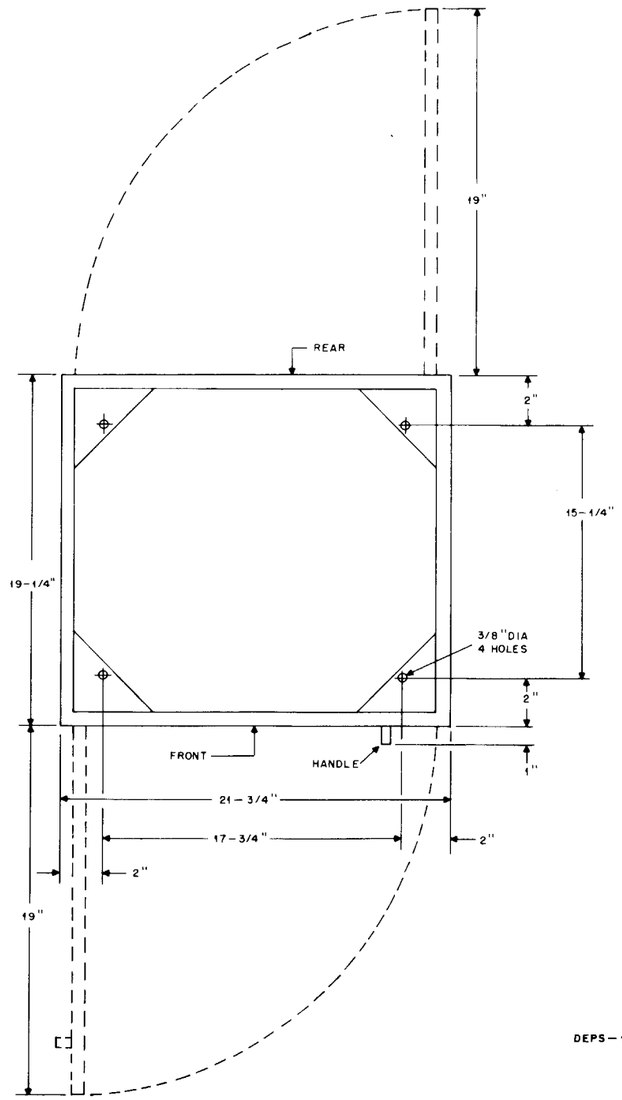
THN6142A Cabinet Kit (41-Inch) PL-1790-C

NON-REFERENCED ITEMS		
	15E84143D24	CABINET (41")
	13C84430D01	DOOR VENT (8 required)
	2S10101A55	SPEED NUT (48 required)
	1-80730D78	COVER, cabinet entry
	2-10101A73	NUT, speed; 36 used
	3-1930	SCREW, machine: 4-40x3/8"; 2 used
	3-7542	SCREW, tapping: 8-15x3/8"; 2 used
	42-10217A02	STRAP, tie; 2 used
	64-84884M01	PLATE, slide
	64-84885M01	PLATE, mounting

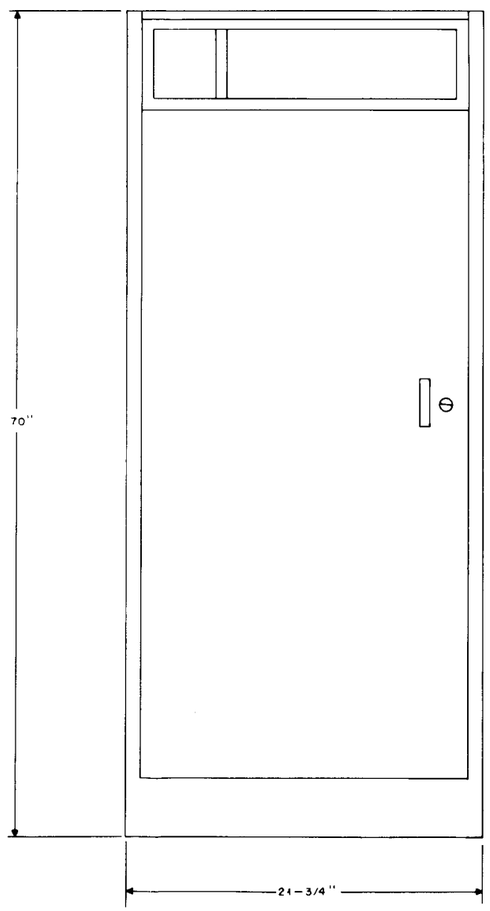
UPRIGHT INDOOR CABINET
OPTION C40 (FOR *COMPA-STATION* BASE RADIOS)

THN6194B CABINET (70-INCH) INDOOR

TOP VIEW
(VIEW WITH TOP OFF OF CABINET)



FRONT VIEW



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN6190A Cabinet Hardware Kit (70" and 75") PL-3396-A

	2-836540	NUT, speed: 2 req'd.
	3-839590	SCREW, special (washer-head) 2 req'd.
	2-84410P04	NUT, 1/4"-14; 4 req'd.
	3-135038	SCREW, tapping: 1/4"-14 x 3/4"; 4 req'd.
	3-115727	SCREW, machine: 10-32x1/2"; 2 req'd.
	4-7652	LOCKWASHER: No. 10; 2 req'd.
	37-107997	GROMMET: 2 req'd.
	33-82830H02	LOGO ("MOTOROLA")

NOTES:

1. FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT HAND OPENING TO LEFT HAND OPENING.
2. ON REAR DOOR, UPPER AIR DUCT OPENING MUST BE UNCOVERED AND BOTTOM AIR DUCT OPENING COVERED.
3. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.

DEPS-15048-B

UPRIGHT OUTDOOR CABINET

OPTION U27 (FOR UPRIGHT STATIONS)
OPTION C36 (FOR "COMPA-STATION" BASE RADIOS)

FEATURES

-- Water drainage holes
-- Thick door gaskets
-- Vent seal for stations with less than 110 W output
-- Vent kit for stations with greater than 110 W output

CABINET INSTALLATION

-- Mount on elevated support or platform
-- Shady or cool area if possible
-- Minimum of eight inches for all obstructions

INSTALLATION OF TRN6720A RAIN HOOD VENT KIT

-- Mount main section (largest assembly) over opening in top of cabinet using rectangular shaped gasket and 1/2-inch sheet metal screws provided.
-- Install small rectangular cover inside main section using machine screws provided.
-- Similarly, mount larger cover on top of entire assembly.
-- Mount awning-shaped vent shield over rear door opening using "U" shaped gasket and 3/8-inch sheet metal screws. Place acorn nuts over screws to cover exposed threads.

PERIODIC MAINTENANCE

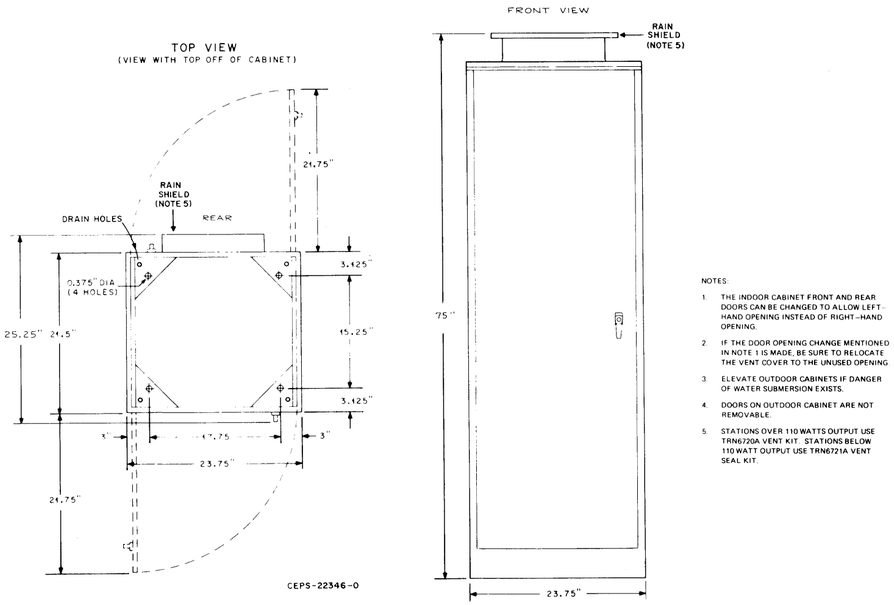
-- Use a paint scraper or putty knife to remove all loose paint and paint blisters from the cabinet. Use a wire brush or steel wool to remove remaining rust from the area. The surface must be cleaned to bare metal and free of all rust.
-- Wipe cleared surface with a clean cloth
-- Apply a thin even coat of primer, Part No. 11S1003A42, to all exposed metal. This coat should dry to the touch in minutes. Apply an even smooth coat of paint, Part No. 11S10026A33 (haze beige).

NOTE

Be sure water drainage holes are cleared of all paint and primer.

-- The above primer and paint are available from Communications Division Parts Department. Spray paint (Part No. 11-82716A05) and spray primer (Part No. ST-4330) are also available from Parts Department. However, spraying paint inside cabinet is not recommended.

-- The above kits and paint can be obtained from Motorola Communications Division Parts Department, 1313 East Algonquin Road, Schaumburg, Illinois 60196



NOTES:

1. THE INDOOR CABINET FRONT AND REAR DOORS CAN BE CHANGED TO ALLOW LEFT-HAND OPENING INSTEAD OF RIGHT-HAND OPENING.
2. IF THE DOOR OPENING CHANGE MENTIONED IN NOTE 1 IS MADE, BE SURE TO RELOCATE THE VENT COVER TO THE UNUSED OPENING.
3. ELEVATE OUTDOOR CABINETS IF DANGER OF WATER SUBMERSION EXISTS.
4. DOORS ON OUTDOOR CABINET ARE NOT REMOVABLE.
5. STATIONS OVER 110 WATTS OUTPUT USE TRN6720A VENT KIT. STATIONS BELOW 110 WATT OUTPUT USE TRN6721A VENT SEAL KIT.

MODEL	SUFFIX	DESCRIPTION
THN6203A		75" Cabinet
TRN6720A		Rain Hood Vent Kit (for stations over 110 W only)
TRN6721A		Vent Seal Kit (for stations under 110 W only)

PARTS LIST

THN6203A Cabinet (75-Inch) PL-5198-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-82123H05	CABINET, outdoor

TRN6721A Vent Seal Kit PL-5106-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-10080A03	NUT, spring; #8; 6 used
	3-132823	SCREW, tapping; #8-18 x 3/8" 4 used
	3-135014	SCREW, tapping; #8-18 x 1/2; 6 used
	26-83956H01	SHIELD (2 hole)
	26-83956H03	SHIELD (1 hole)
	32-82499L01	GASKET; 13.0 x 4.5"
	32-82499L02	GASKET; 13.0 x 7.25"

TRN6720A Rain Hood Vent Kit PL-5107-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-10080A03	NUT, spring, #8; 6 used
	3-9661	SCREW, machine; 8-32 x 3/8"; 8 used
	3-132823	SCREW, tapping; 8-18 x 3/8; 4 used
	3-135014	SCREW, tapping; 8-18 x 1/2; 8 used
	15-82433L01	HOOD, door vent
	15-82926H01	COVER, rain shield
	26-82929H01	SHIELD, rain top
	26-84084F01	SHIELD, cover top
	32-82499L01	GASKET; 13.0 x 4.5"
	32-82499L02	GASKET; 13.0 x 7.25"
	32-84180G01	GASKET; 6-hole; 2 used
	32-84180G02	GASKET; 4-hole; 2 used

68P81033E42-B
8/21/78-NPC

COMPA-STATION OUTDOOR CABINET
OPTION C27 (FOR *COMPA-STATION* BASE RADIOS)

FUNCTION

MODEL	SUFFIX	DESCRIPTION
THN6143A		46" Cabinet (vented for continuous duty
THN6303A		46" Cabinet (sealed for intermittent duty only)
TLN4862A		Outdoor Vent Kit
TRN6448A		Cabinet Hardware Kit

FEATURES

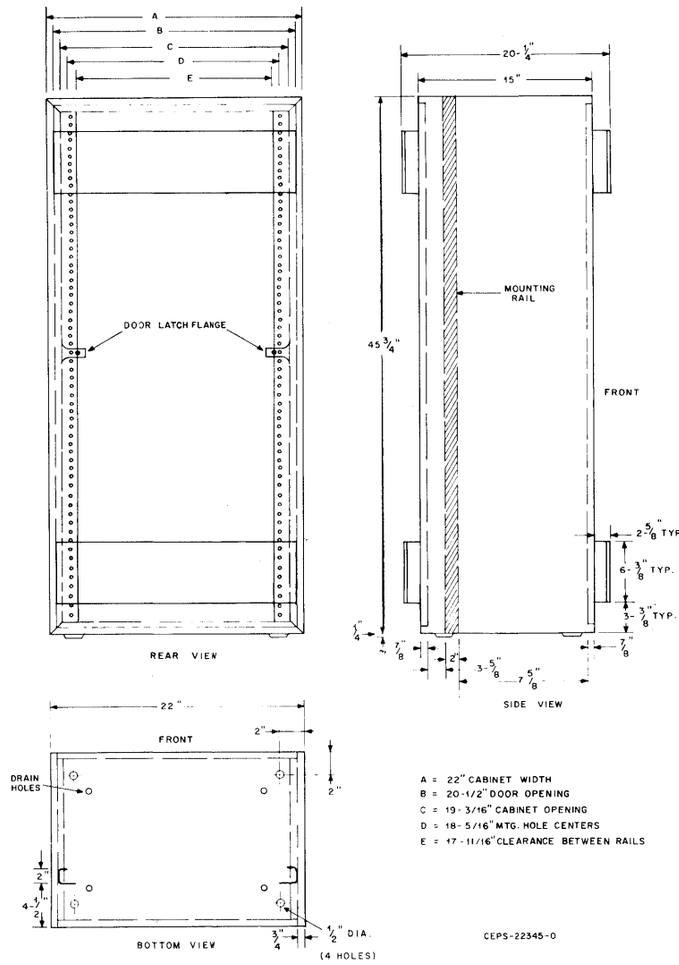
--Water drainange holes
--Rust resistant equipment mounting rails
--Thick door gaskets
--Screw and flange type door latches
--Vent seal for intermittent duty stations
--Vent kit for continuous duty stations
--Sealed cabinet corner joints

CABINET INSTALLATION

--Mount on elevated support or platform
--Shady or cool are if possible
--Minimum of eight inches for all obstructions

CAUTION
LOSSEN *BOTH* LATCHES BEFORE OPENING CABINET OR DAMAGE TO THE DOOR MAY RESULT.

68P81033E46-B
5/30/85- **UP**



parts list

TRN6448A Cabinet Hardware Kit — PL-3626-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-82360B34	SPEED NUT; (4 req'd.)
	3-135499	SCREW, tapping: 1/4-14 x 5/8"; (4 req'd.)
	2-84410P04	NUT: 1/4 x 14; (4 req'd.)

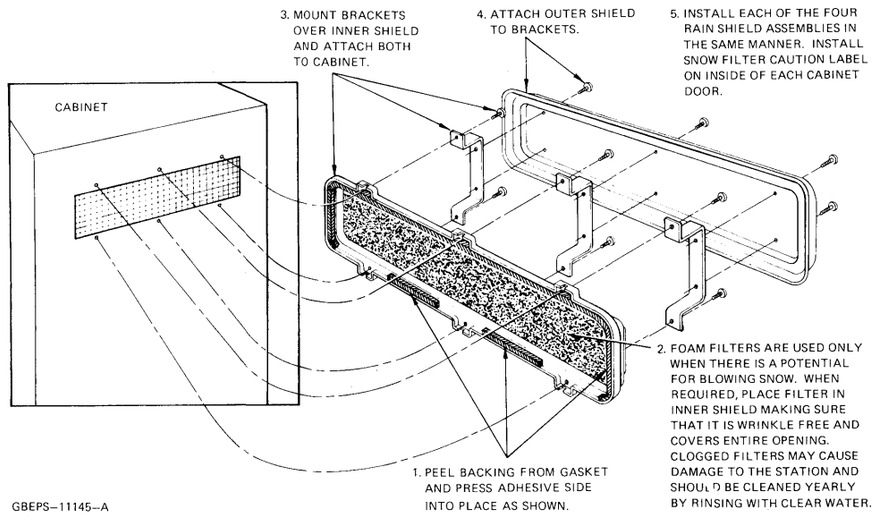
THN6143A Vented 46-Inch Cabinet
(For Continuous Duty Stations) — PL-5104-O

	15-84144D08	CABINET, outdoor

THN6303A Sealed 46-Inch Cabinet
(For Intermittent Duty Station) — PL-5105-O

	15-84144D11	CABINET, outdoor

Outdoor Vent Kit



parts list

TLN4862A Outdoor Vent Kit — PL-1797-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	15-84188D01	COVER, outdoor vent (No. 1); 4 req'd.
	15-84189D01	COVER, outdoor vent (No. 2); 4 req'd.
	32-84452D01	GASKET; 4 req'd.
	32-84452D02	GASKET; 8 req'd.
	7-84187D01	BRACKET, vent cover, 12 req'd.
	4-490775	FLATWASHER; 24 rec'd.
	4-9795	LOCKWASHER; 24 req'd.
	3-138674	SCREW, machine: 6-32 x 11/16"; 24 req'd.
	3-138209	SCREW, tapping: 6-32 x 3/8"; 24 req'd.
	2-7005	NUT, hext: 6-32 x 1/4"; 24 req'd.

1. INTRODUCTION

This section of the manual describes local operation techniques required to perform maintenance checks. Overall station maintenance and troubleshooting is detailed in this section while specific chassis maintenance (transmitter, receiver or power supply, etc.) is provided with the applicable section. Maintenance checks, operational details, and schematic diagrams for control modules are given with the applicable module in the MODULES section of this manual.

2. LOCAL OPERATION FOR TESTING & MAINTENANCE

2.1 Once power is applied and the station is properly adjusted, this base or repeater station is normally operated entirely unattended from a remote control point. However, the station may be locally operated utilizing controls on control modules in the unified chassis. This type of operation may be necessary to accomplish station maintenance and testing.

2.2 Local operation of the station is primarily accomplished utilizing controls on the station control module located in the unified chassis. The controls and function are listed in the table on this page.

WARNING
The transmitter can be keyed remotely. To prevent unexpected transmitter keying while servicing the station, be sure the LINE DISABLE switch is actuated (direction of arrow).

2.3 The following are procedures pertaining to the local operation of a remotely controlled station or repeater station.

2.3.1 Transmitter Control

To prevent the transmitter from being keyed remotely, set station control module LINE DISABLE switch in the direction of the arrow. At conclusion of local operation, ensure that the LINE DISABLE switch is returned to its normal position (opposite arrow).

2.3.2 Local Microphone

2.3.2.1 STATIONS WITHOUT BUILT-IN METERING

Connect a *Micor* microphone (Motorola Model TMN6054A or equivalent) to the microphone receptacle on the unified chassis interconnect board (part of J4, pins 3, 4, 5, 14, 15 and 16).

2.3.2.2 STATIONS WITH BUILT-IN METERING

Connect a Motorola Model TMN6071A microphone, or equivalent) to the MICROPHONE receptacle on the metering chassis.

2.3.3 Local Speaker

2.3.3.1 STATIONS WITHOUT BUILT-IN METERING

Connect any 8-ohm, 10-watt test speaker to J4, pins 1 and 12, on the unified chassis interconnect board. This speaker is used to monitor all receivedmessages. A Motorola *Micor* speaker (Models TSN6016A or B, TSN6020A) plugs directly into these pins without requiring any adapter.

2.3.3.2 STATIONS WITH BUILT-IN METERING

Place the SPEAKER ON-OFF switch to the ON position.

2.3.4 Portable Test Set (For Stations Without Built-In Metering)

A Motorola S1056B-S1059B Series Portable Test Set with TEK-37 or TEK-37A Adapter Cable can be used as a local control facility. Connect the red "control" plug of the adapter cable to the metering receptacle (J3) on the unified chassis interconnect board. The speaker in

STATION CONTROL MODULE CONTROLS

Control	Position	Functions Possible
Xmit	Normal (not actuated)	Normal mode of operation
	Actuated (hold to right)	Turns on transmitter with no modulation. Use test microphone connected to local mike receptacle to modulate transmitter
PL DISABLE* (functional only in *Private-Line* stations)	Normal (left)	Only PL tone-coded on-frequency signals accepted by receiver.
	Actuated (right)	All on-frequency signals accepted by receiver.
LINE DISABLE*	Normal (left)	Transmitter can be operated by: 1. XMIT switch 2. Local microphone 3. Remote control console
	Actuated (right)	Transmitter can *not* be operated by remote control console over control line.

*The DISABLE LIGHT is illuminated with the LINE DISABLE or PL DISABLE switch is actuated.

the test set can be used for monitoring received signals and a *Motrac* microphone (Model TMN6071A) connected to the microphone receptacle on the test set can be used for originating transmissions. The XMIT button on the test set can be used to key the transmitter without voice modulation.

2.3.5 Frequency Selection

For stations with a two-frequency transmitter, the frequency can be locally selected by the F1-F2 switch on the F2 tone decoder module. For stations with a two-frequency receiver, frequency selection is made by momentarily operating the REC F1 SELECT or REC F2 SELECT switch on the F2 tone decoder module. For four-frequency stations, the frequency is selected by *momentary* operation of the desired frequency select switch on the four-frequency module *after* the XMIT switch on the station control module is operated.

2.3.6 Transmit Coded/Clear Selection

For encode/decode type stations, either the clear or coded mode of transmission may be selected locally by operating the "ON" and "OFF" switches on the *DVP* Control Module. *DVP* "ON" will cause MIC audio to be digitally scrambled, and *DVP* "OFF" will cause the audio to be transmitted clear.

2.3.7 Selection of Other Modes

All other functions that can be activated by remote control can also be activated locally. Each module has test switches to activate any such functions, such as RPTR ON and RPTR OFF. Most of these switches are momentary action, which allows the station to continue operating in the selected mode until reset.

2.3.8 Received Audio

After the local speaker is turned on or connected, the station is ready to receive audio or coded modulation. The receiver PL feature, if used, can be defeated by setting the station control module PL DISABLE Switch in the direction of the arrow. (This also provides a proper code detect disable for encode/decode stations equipped with that option.) If necessary, the receiver can be unsquelched utilizing the receiver SQUELCH control on the receiver chassis. The VOLUME control on the receiver chassis sets the audio output level of the local speaker. All *DVP* stations contain a Code Detector Module that allows automatic reception of either clear or coded signals. In an encode/decode station, clear audio will be heard at the local speaker, regardless if the incoming signal is clear or coded. A transparent station will provide either clear voice or the encoded (scrambled) voice at the local speaker. To aid in maintenance and troubleshooting, the code detector module may be forced into either mode by first moving the AUTO-MANUAL switch to the MANUAL position, then selecting either coded or clear with the other switch. The AUTO MANUAL switch *must* be returned to the AUTO position for the Code Detector to operate properly.

2.3.9 Transmitting

NOTE

Before transmitting, monitor the channel to ensure that it is clear of other transmissions.

The transmitter is keyed locally by either activating the station control module XMIT switch or activating the push-to-talk microphone switch. Voice is transmitted using the local microphone.

2.3.10 Concluding Local Operation

At the conclusion of local operation, perform the following operations and checks to ensure that the station is ready for remote operation.

Step 1. Reset receiver squelch level per procedures in Receiver Section (Audio & Squelch) of this manual.

Step 2. Ensure that station control module switches are positioned for normal operation (reference table). Also ensure that the audo††manual switch on the code detector module is in the "Auto" position.

Step 3. Disconnect microphone and test speaker (if used).

Step 4. Set all external power switches ON.

Step 5. Ensure that station is operable from remote location.

Step 6. Turn local speaker OFF (if applicable).

Step 7. Disconnect or remove any metering plugs or test set.

Step 8. Ensure that cabinet doors are locked.

Step 9. Ensure that vents in cabinet are unobstructed.

NOTE

It is recommended that the console operator cycle the Scrambler On-Off switch after any local maintenance is performed. This is to be certain that the mode of transmission set at the station matches that displayed at the console.

3. MAINTENANCE TECHNIQUES

3.1 GENERAL

Maintenance procedures for individual chassis which comprise this station are contained in the applicable section of this manual. Module maintenance information is provided in the MODULES section of this manual. As an aid to isolating a malfunction to a specific chassis or module, a variety of techniques are appropriate.

3.2 TRANSMITTER AND RECEIVER

Most troubles in the transmitter or receiver can be quickly isolated with metering checks. A log of normal meter readings *for this station* should be maintained. Each time maintenance is performed, the meter readings should be entered into the log. Variations from the previous readings can isolate a malfunction or may indicate an impeding failure. If no previous meter readings are available, typical or minimum meter readings may be found with the receiver rf & i-f, exciter, power amplifier or power control board instruction sections, as well as metering procedures.

3.3 POWER SUPPLY

A check of power supply voltages under load and no-load conditions (transmit and standby) should quickly isolate any malfunction.

3.4 REMOTE CONTROL UNIT

Isolation of a malfunction in the control portion of the unified chassis requires a functional understanding of the overall station operation and the interrelationship between the various modules and chassis of the station. The *DVP* and Tone Remote Control Applications section along with the MODULES section of this manual provide necessary information. With a basic understanding of station operation, troubles may be isolated by analyzing the following questions:

- Can the station be operated locally but not remotely? If so, this eliminates many circuits as possible sources of trouble.
- How many modes are inoperable? Concentrate testing on circuits that are common to the inoperable modes.
- Are adjustments properly set? This includes audio level adjustments at the station *and at the remote control point*.
- Are jumpers properly installed? The many jumpers in this equipment provides vast flexibility, but could be a source of trouble if improperly added, removed, or not removed as the case may be.

4. ROUTINE MAINTENANCE CHECK LIST

Receiver	Measure the signal level required to obtain 20 dB quieting.
	Compare meter readings with the minimum value and all previous readings taken. Realign the receiver, if necessary.
	For PL stations, check for proper operation of the PL decoder. Does the squelch open when the proper PL tone is detected?
Transmitter	Measure transmitter output power.
	Compare meter readings with the minimum value and all previous reading taken. Realign the transmitter, if necessary.
	Varify that each transmitter channel is on frequency and adjust if necessary.
	Tune and load the transmitter to the antenna.
	Measure transmitter frequency deviation for both clear or coded voice and PL coded modulation. Adjust the IDC control, if necessary.
	Measure the exciter modulator sensitivit.
System Operation	Measure and adjust the audio input to the exciter.
	Measure and adjust the receiver audio output to the control line.
	Check control line levels and functions for proper operation.
	Adjust receiver on frequency with the distant transmitter(s) in the system.
	Check for proper repeater operation on repeater models.
	Check all accessary equipment for proper operation.
After Performing Maintenance	Check all items listed in the *Concluding Local Operation* paragraph of this section of the instruction manual.

5. TABLE OF RECOMMENDED TEST EQUIPMENT

Type Of Equipment Or Type Of Measurement	**Equipment Characteristics**	**Recommended Type**
Transmitter Frequency Measurement	Frequency - 132-174 MHz Accurancy - ±00005% or better	Any of the following Motorola Test Equipment: R2200B Service Monitor R1035 Frequency Counter
Transmitter Deviation Measurement	Peak reading type for voice or sinusoidal wave; scales for accurate reading of ±5 kHz deviation (and ± kHz deviation for *Private-Line* models) ±4 kHz (coded voice)	Any of the following Motorola Test Equipment: R2200B Service Monitor R1035A Frequency Counter
Transmitter Power Output Measurement	132-174 MHz; 50 ohms; at least 0-100 watts 50-ohm dummy load; at least 100 watts	Motorola Model S1350 Wattmeter (with appropriate element) Motorola Model T1013 RF Load Resistor
RF Signal Generator for receiver testing	132-174 MHz; FM; high-stability- (±0002% or better); adjustable output 0 to 1000 microvolts	Motorola Model R2200B/HS Service Monitor Motorola R1041A Series FM Signal Generator
Encoded Signal Source to Modulate RF Generator for Line Level Adjustments	1000 Hz tone generator with *DVP* encoder	Motorola R1012A *DVP* Test Set

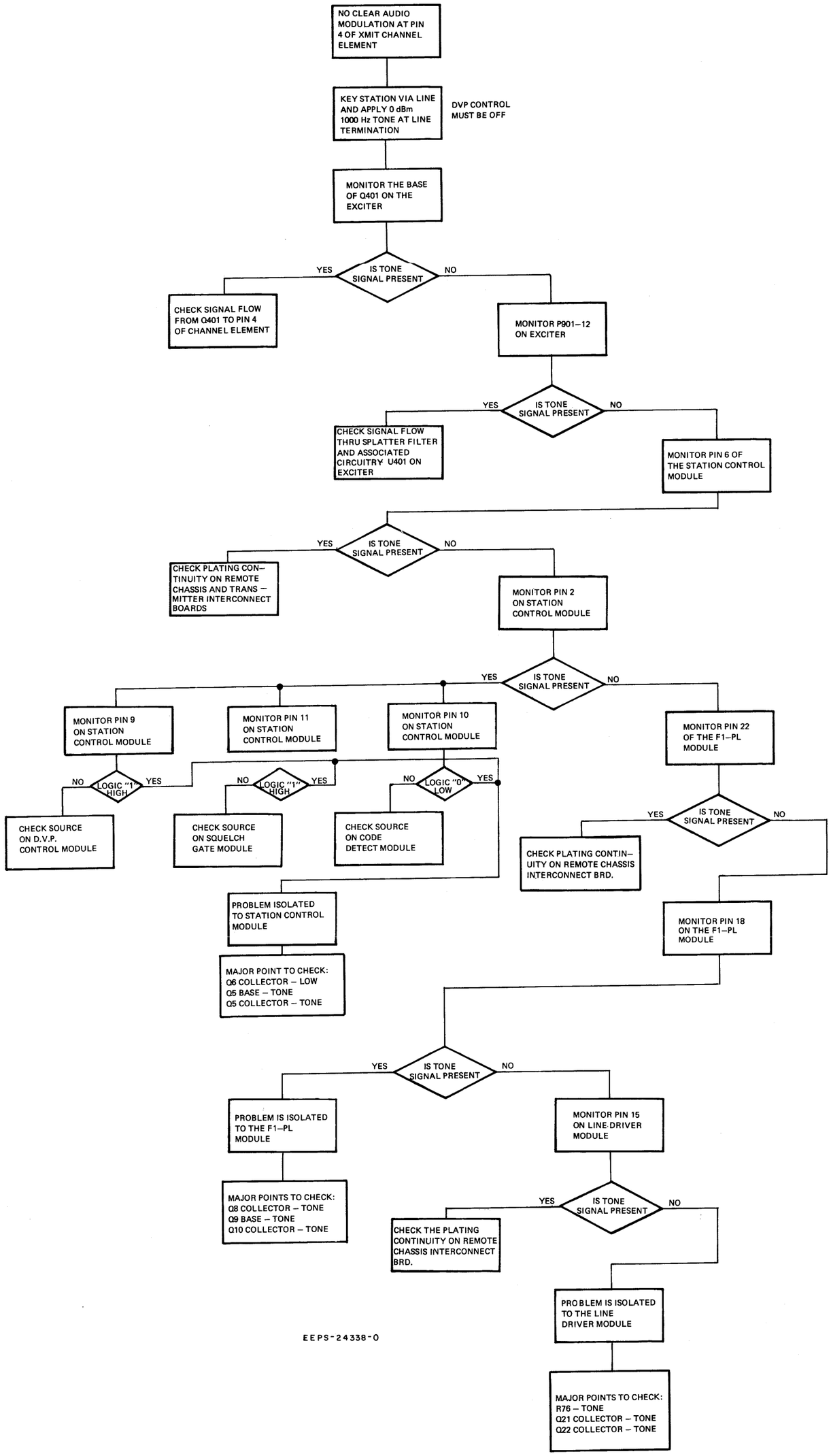
5. TABLE OF RECOMMENDED TEST EQUIPMENT (Cont'd.)

Type Of Equipment Or Type Of Measurement	Equipment Characteristics	Recommended Type
Audio Voltage Measurements Audio Signal Generator for Audio Circuit Testing in Receiver and Transmitter	High impedance (10 megohm); dBm scale Variable amplitude 0 to 1 volt; 1000 Hz tone (300- to 3000-Hz preferred); sinusoidal wave	Motorola Model S1053 Solid State AC Voltmeter Motorola Model R1150A Solid-State Audio Oscillator Motorola Model R2200B Service Monitor
DC Voltage Measurement, Resistance Measurement, RF Voltage Measurements	High impedance (11 megohm) dc multimeter	Motorola Solid-State DC Multimeter with RTL4142A RF Probe Motorola Model R1047A Digital Multimeter
Waveform Measurements	Oscilloscope: Audio Circuit measurements RF circuit measurements, at least 50 MHz bandwidth	A very high quality instrument is required
Tone *Private-Line* 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 R1150A *Private-Line* Tone Generator
Tuning Tool	Used for adjusting all tunable components during equipment alignment	Motorola part number 66A84387C01
Contact Removal Tool	Used to remove female wire terminals from metering cable connector	Motorola part number 66B84690C01

6. OVERALL STATION TROUBLESHOOTING

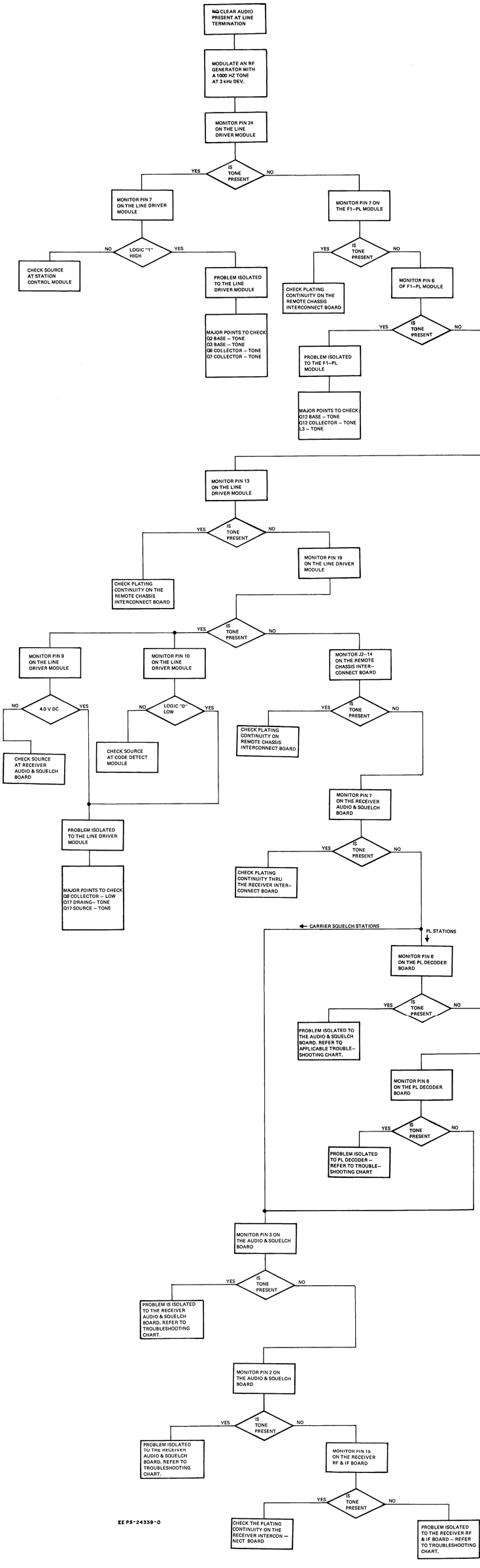
The following troubleshooting charts may be helpful in isolating a problem to a specific module. Once the faulty module is determined, several points to check are given. When troubleshooting a module, consult the schematic diagrams for voltages and proper operating conditions.

BASE STATION CLEAR MODE TRANSMIT TROUBLESHOOTING CHART

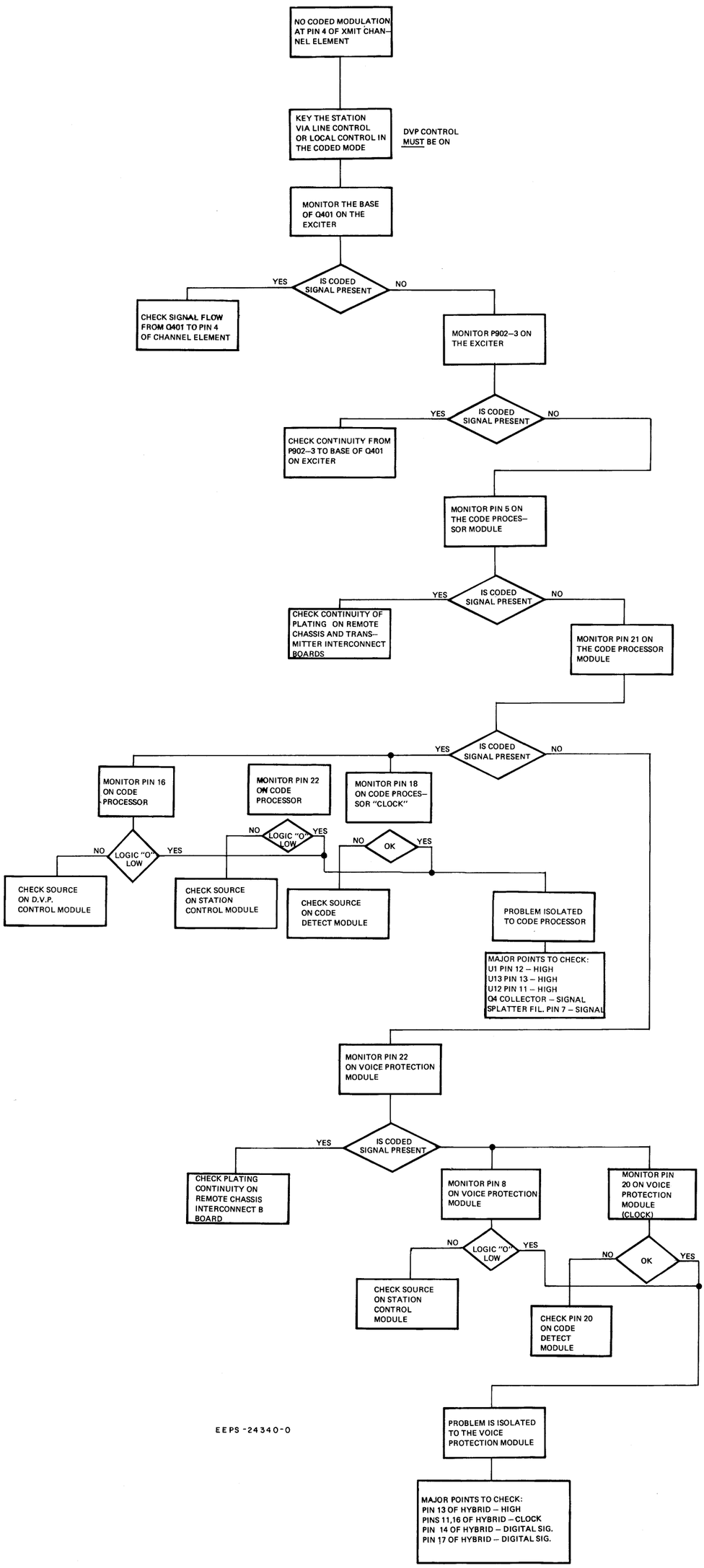


EEPS-24338-O

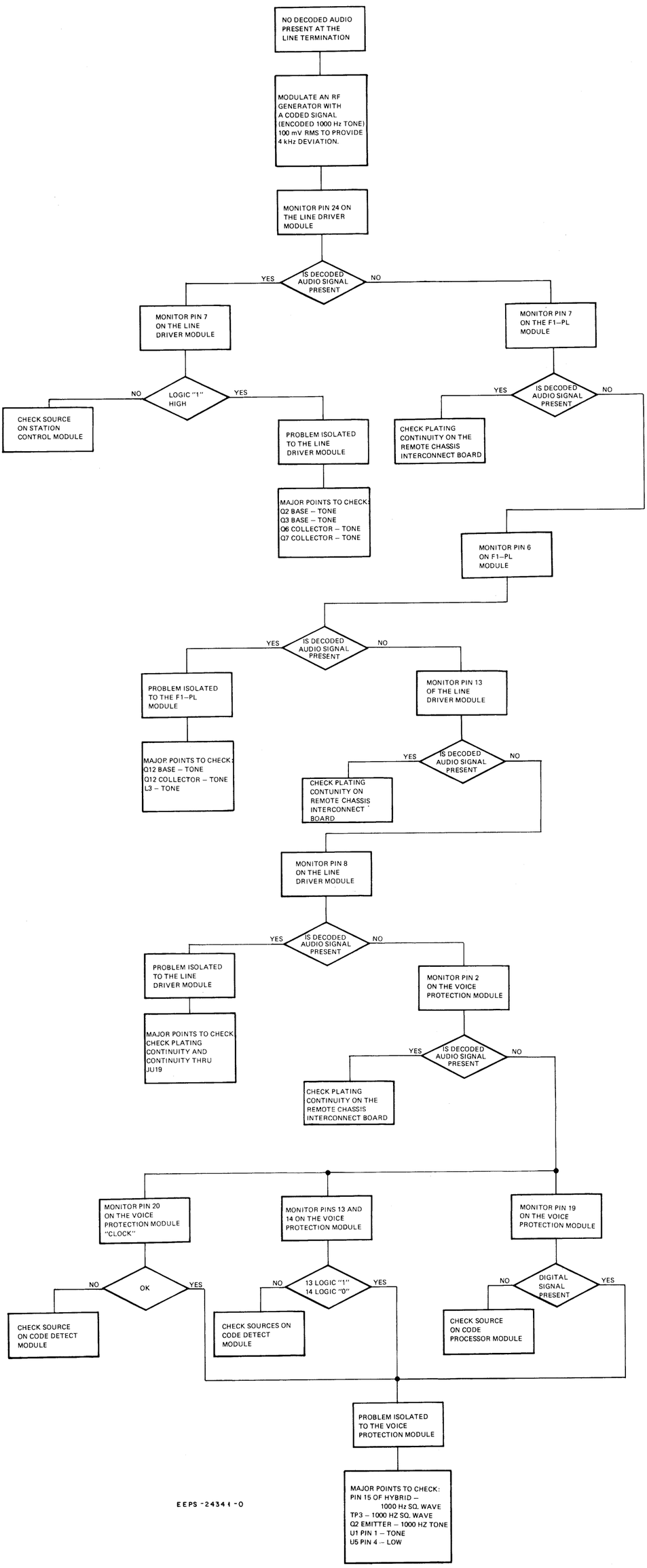
BASE STATION CLEAR MODE RECEIVE TROUBLESHOOTING CHART



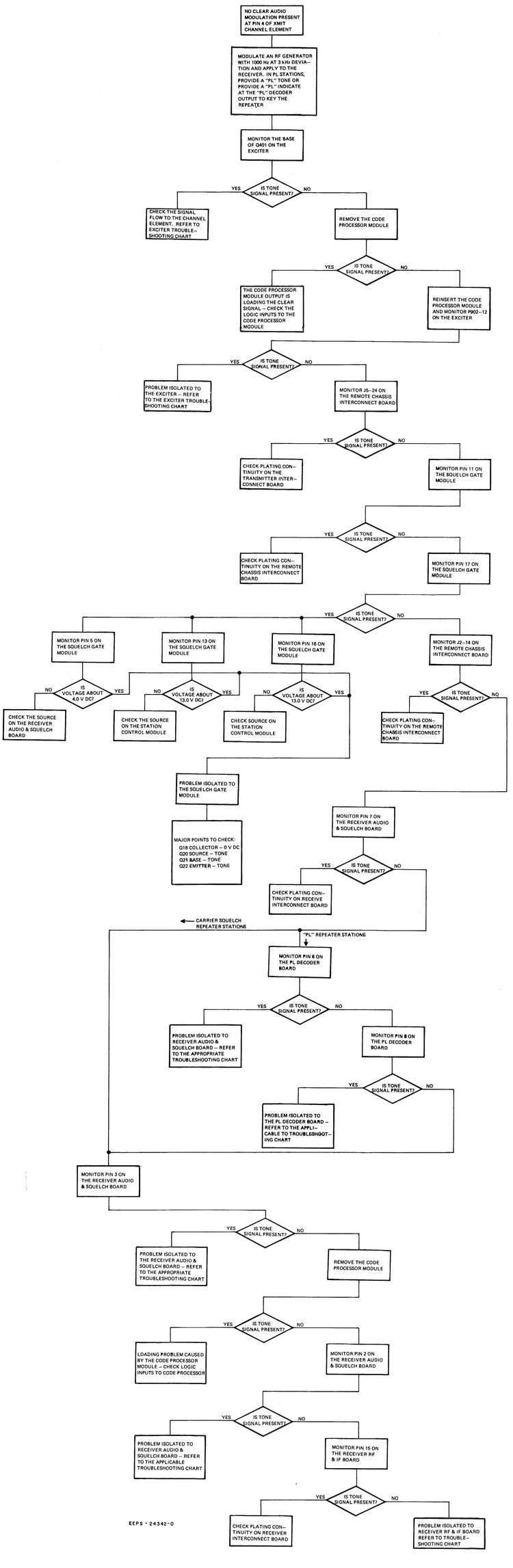
BASE STATION CODED MODE TRANSMIT TROUBLESHOOTING CHART



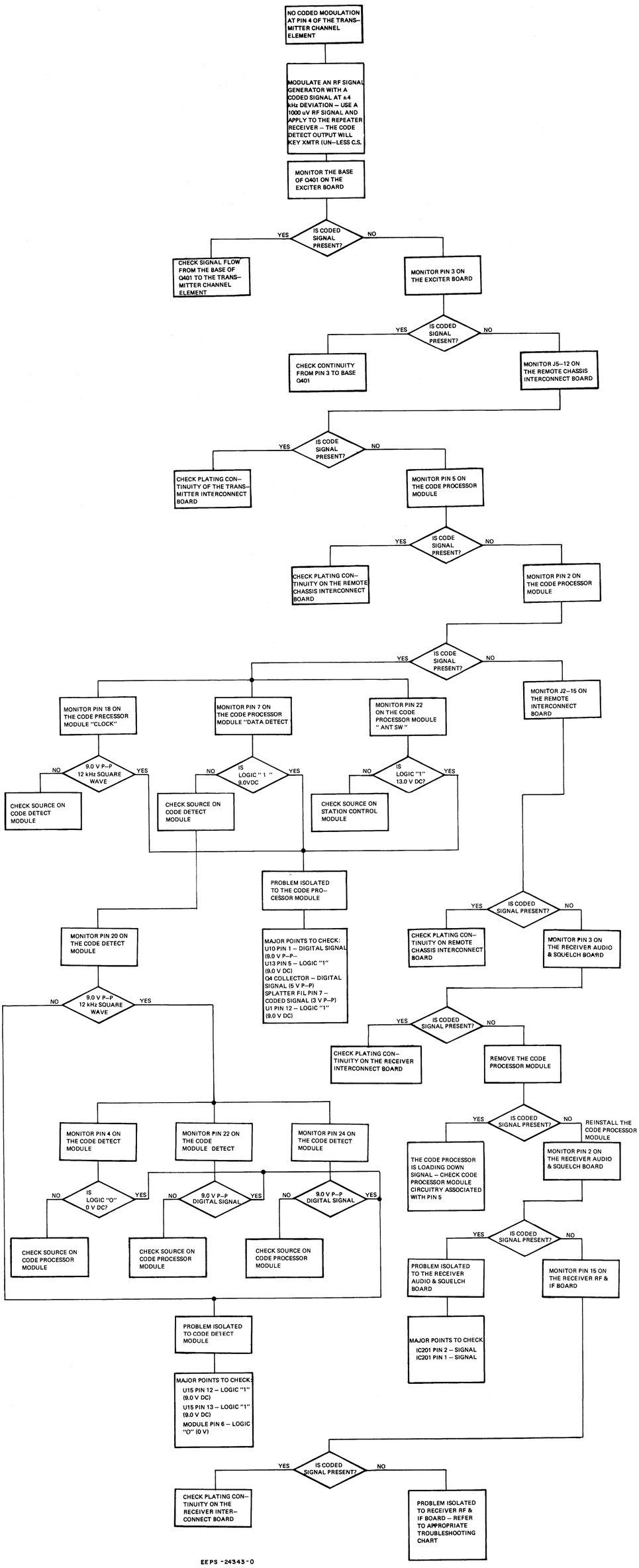
BASE STATION CODED MODE RECEIVE TROUBLESHOOTING CHART



REPEATER STATION CLEAR MODE TROUBLESHOOTING CHART

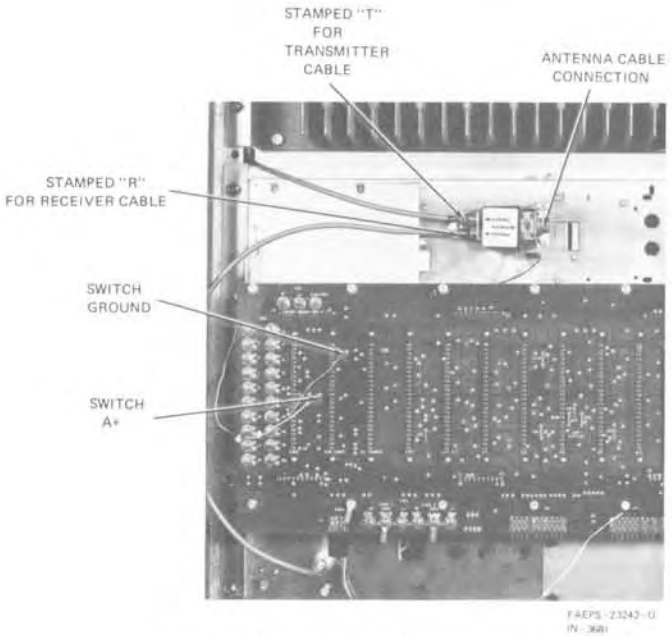


REPEATER STATION CODED MODE TROUBLESHOOTING CHART

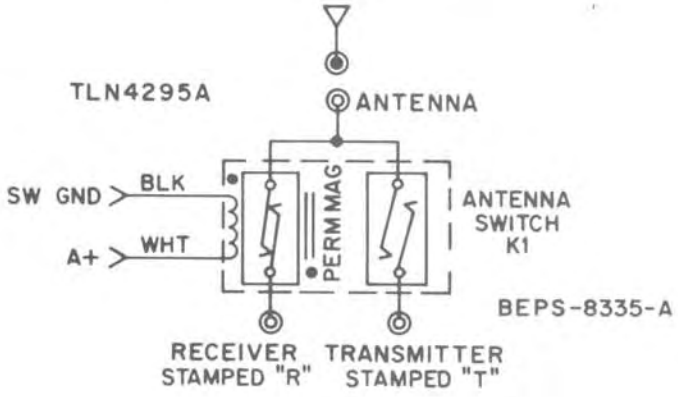


EEPS -24343-0

ANTENNA SWITCH
MODEL TLN4295A
& MISCELLANEOUS HARDWARE



Antenna Switch Installation and Connection



Antenna Switch Schematic Diagram

PARTS LIST SHOWN ON BACK OF THIS PAGE

MOTOROLA INC.
Communications Division

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

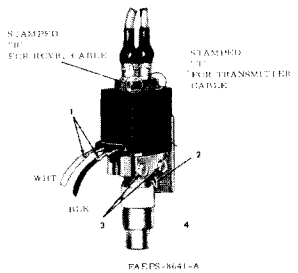
USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

Antenna Switch PL-1731-O

K1	TLN4295A	REED SWITCH: antenna switch NOTE Field servicing of this item not recommended, must be replaced as a unit.

Mechanical Items (not part of antenna switch)

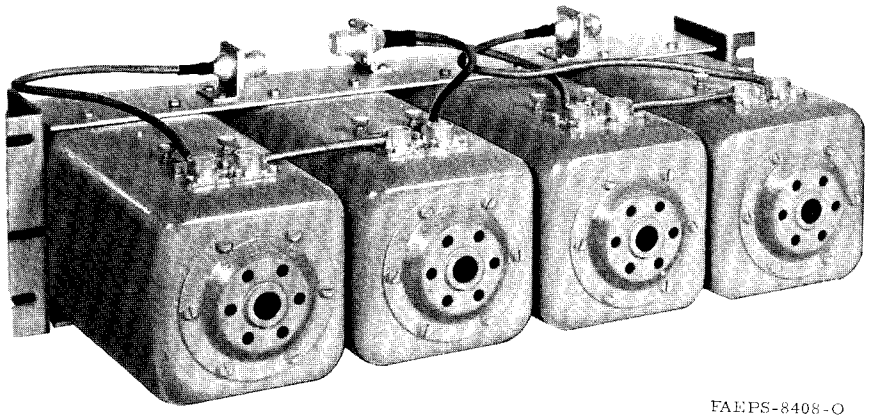
1	29-82010D01	TERMINAL, female
2	3-131965	LOCKSCREW: tapping, 8-32 x 3/8" pln hex
3	3-135841	LOCKSCREW: tapping, 6-32 x 1" pln hex
4	7-84266D01	BRACKET



PARTS-8641-A

FILTERS AND DUPLEXERS

T1480A SERIES
148-174 MHz



FAEPS-8408-O

1. INTRODUCTION

These filters and duplexers are for use with "Motorola" FM two-way radio communications equipment operating in the 148-174 MHz frequency range. They utilize cavity resonators with a special internal loading construction to achieve a size much less than one-quarter wavelength and are tuned with an adjustable center conductor. The resonators use a unique temperature compensating mechanism and uniquely adjustable coupling loops. Specially designed low-profile cable connectors are used to obtain an extremely compact package.

These units may be used in the antenna circuit of a base station or repeater to eliminate or minimize receiver desensitization or intermodulation from strong signals. Similarly, they may be used to reduce transmitter noise or intermodulation products.

2. INSTALLATION

a. Bracket-Mounted Filters

(1) Carefully unpack the unit and check for concealed damage.

(2) Select a mounting location near the associated equipment or inside the equipment cabinet that will permit using the shortest cabling between the filter and the equipment.

(3) Using the mounting bracket as a template, mark the locations of the desired mounting holes.

(4) Drill the mounting holes required by the type of mounting hardware to be used.

(5) Mount the filter using the hardware supplied.

(6) Connect the filter to the transmitter or receiver. Cables external to the filter are not of a critical length.

MOTOROLA INC.
Communications Division

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

7/3/85-NPC

68P81102E85-F

b. Rack Panel-Mounted Units

(1) Carefully unpack the unit and check for concealed damage.

(2) The units are designed to mount on any standard 19-inch relay rack. Select position in rack for best location of unit, i.e., closest proximity to associated equipment inputs and outputs.

(3) Mount unit in place in rack with appropriate mounting hardware. The hardware supplied is intended for use with "Motorola" base stations.

(4) Connect the filter or duplexer to the transmitter and receiver.

(5) Duplexers and filters must be installed with appropriate lengths of 50-ohm coaxial cable (not supplied) to fit the individual installation.

3. THEORY OF OPERATION

Each resonant cavity, technically a re-entrant quarter-wave resonator, is a very high Q (low loss) tunable tank circuit. A special internal construction uses two different characteristic impedances for the center conductor to achieve an overall length considerably less than a quarter-wavelength. The dimensions are designed for minimum loss. The cavities are tuned to the required pass frequency by an adjustment which changes the length of the center conductor. Lower frequencies have more of the center conductor inside the cavity, higher frequencies have correspondingly less. Special bimetal washers are used for temperature compensation to minimize detuning due to ambient temperature changes.

Each resonant cavity is fitted with a specially designed pair of coupling elements (loops). These loops efficiently convert energy from the 50-ohm coaxial cable to the correct mode inside the resonant structure. When the cavity is not tuned to resonance, most of the energy is reflected. Only a small portion is able to excite the correct mode and reach the output element.

The input and output coupling loops are placed very close to each other, to take advantage of mutual coupling. A small amount of energy is always being transferred between coupling loops because of their proximity. At one frequency, the energy transferred by mutual coupling cancels the energy transferred across by the resonant mode within the cavity. Thus, at one frequency, there is a reject notch in addition to the normal selectivity of the cavity. The proximity of the loops provides inductive coupling. In addition, a precision high Q trimmer capacitor is connected across the loops. This capacitor can adjust the net coupling to be inductive or capacitive. When the net coupling is inductive, the notch occurs above the pass frequency. When the net coupling is capacitive, the notch occurs below the pass frequency.

Cavities are used on each side of a duplexer. The cavities tuned to pass the lower frequency have the coupling loops tuned to notch out the higher frequency, while the cavities tuned to pass the higher frequency have the coupling loops tuned to notch out the lower frequency. Quarter-wave coupling is used between cavities to obtain minimum pass band bandwidth and minimum insertion loss.

4. REMOVAL/REPLACEMENT OF COUPLING LOOPS

Coupling loops are factory-installed in all T1480A Series Cavity Filters and Duplexers. If it becomes necessary to change coupling loops, refer to Figure 1 and PEPS-8095 and use the following procedure.

a. Removal Procedure

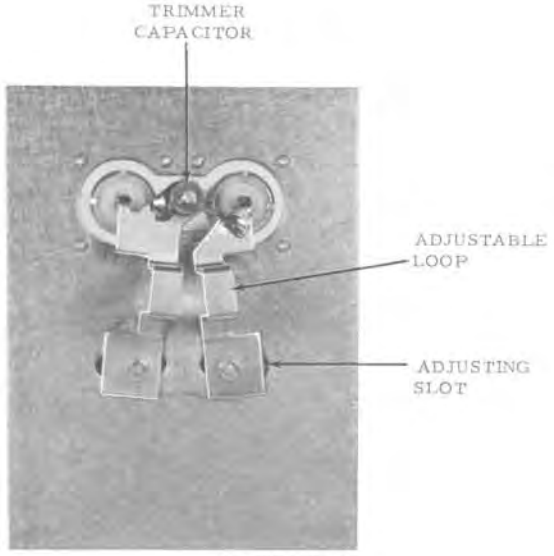
The cable shields are soldered to the connector portion of the loops. These shields must first be unsoldered before the loops can be removed. The shields cannot be unsoldered while the connectors are attached to the cavity body because the cavity body acts as a heat sink.

(1) Remove the eight screws securing the connectors to the cavity body.

(2) The two coupling loops are internally connected and must be removed together. Using a 150-watt soldering iron, first unsolder and remove the connector covers from the two connectors.

(3) Grasp the center conductor of the cable (at the point where it enters the center pin of the connector) with long nose pliers. Melt the solder around the cable shield and pull the cable off the connector. Do the same for the other connector.

(4) Remove the two knurled adjusting knobs taking care not to lose the washers. Now the loops are completely free and can be removed from the can.



FAEPS-8415-O

Figure 1.
Coupling Loop (Interior View)

(5) Maneuver both loops to the left so that the trimmer capacitor can fit through the left side of the hole and then remove the two loops together.

b. Replacement Procedure

(1) Insert the loop assembly into the mounting holes and maneuver both loops to the left so that the trimmer capacitor will fit through the left side of the hole.

(2) Position the loops so that the tapped holes in the end of the loops are visible through the adjusting slots.

(3) Insert the knurled adjusting screw, along with the nylon and lock washers, into the tapped hole.

(4) Attach the connectors to the can using the eight self-tapping screws making certain that the connector cable slot is facing in the proper direction to insert the cable.

(5) Insert the cable into the connector cable slot while pressing the center conductor into the center pin of the connector.

(6) Place the connector cover over the connector and solder the cable shield and connector cover to the connector.

5. RECOMMENDED TUNING PROCEDURE

All filters and duplexers are tuned to the customer-specified frequencies prior to shipment from the factor. If system performance indicates that the duplexer is detuned, one of the following procedures may be used. Do not attempt to retune unless the following procedures have been read and it is certain that performance does not meet specifications.

The following tuning procedures assume that the entire duplexer is to be retuned. If it is desired to perform a minor "touch-up", refer to paragraph e. of this tuning procedure. When left and right are used in the following procedures, this shall mean facing the tuning shaft end and with the connectors facing up.

a. Method 1 (Models T1485A, AF and T1487A, AF)

(1) Recommended Test Equipment

(a) "Motorola Model R1201 Series Signal Generator.

(b) Tunable receiver or two "Motorola" receivers, one tuned to each of the frequencies to be duplexed.

(2) Tuning Procedure

(a) Move sliding screws as far apart as possible on each cavity and then tighten the screws.

(b) Turn trimmer capacitors fully counterclockwise.

(c) Tune the signal generator and the receiver to the duplex receive frequency.

(d) Connect the signal generator to the antenna port and the receiver to the right-hand port.

(e) Tune the right-hand cavity(s) for minimum insertion loss by adjusting the tuning rod screw.

(f) Tune the signal generator and the receiver to the duplex transmit frequency.

(g) Connect the receiver to the left-hand port.

(h) Tune the left-hand cavity(s) for minimum insertion loss by adjusting the tuning rod screw.

(i) Connect the receiver to the right-hand port.

(j) Tune the right-hand cavity(s) for maximum attenuation by using procedure 5.f., "Tuning the Notch".

(k) Tune the signal generator and the receiver to the duplex receive frequency.

(l) Connect the receiver to the left-hand port.

(m) Tune the left-hand cavity(s) for maximum attenuation by using procedure 5.f.

(n) Repeat steps (c) through (m), but only tune the trimmer capacitors when tuning the notches.

b. Method 2 (Models T1485A, AF and T1487A, AF)

(1) Recommended Test Equipment

(a) Mixer circuit constructed as shown in Figure 4.

(b) "Motorola" R1201 Series Signal Generator.

(c) IF output from R1201 Series Signal Generator equal to the duplex frequency separation or a "Motorola" S1056B Portable Test Set with a crystal frequency equal to the duplex frequency separation.

(d) "Motorola" S1350A Wattmeter.

(e) "Motorola" T1013A RF Load Resistor.

(f) Isolated Tee connector (construct this by removing the Tee port center pin of a UHF Tee connector). This provides 30 to 40 dB of isolation between the shunt path and the direct path through the Tee to protect the receiver when the transmitter is keyed.

(g) Transmitter and receiver from the station to be duplexed.

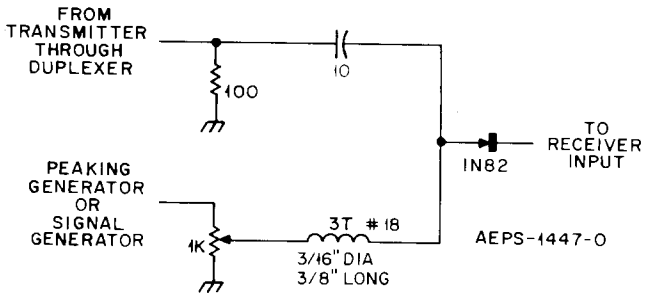


Figure 2.
Mixer Circuit

(2) Operation of the Mixer Circuit

Alignment of the duplexers can be simplified by using the mixer circuit shown in Figure 4. The mixer receives inputs from the transmitter and a low frequency source. The outputs from the mixer are frequencies above and below the transmitter frequency at separations equal to the output of the low frequency generator.

The receiver will respond to one of the mixer products and thus can be used indirectly to detect the transmitter frequency.

(3) Tuning Procedure

(a) Move sliding screws as far apart as possible on each cavity and then tighten the screws.

(b) Turn trimmer capacitors fully counterclockwise.

(c) Connect the equipment as shown in Figure 3.

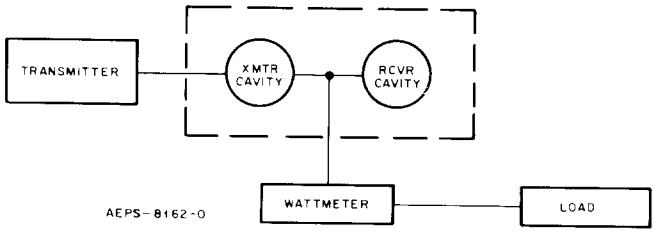


Figure 3.
Method 2 Transmitter Branch
Pass Test Set-Up

(d) Tune the left-hand cavity(s) for a maximum power reading on the wattmeter by adjusting the tuning rod screw.

(e) Connect the equipment as shown in Figure 4.

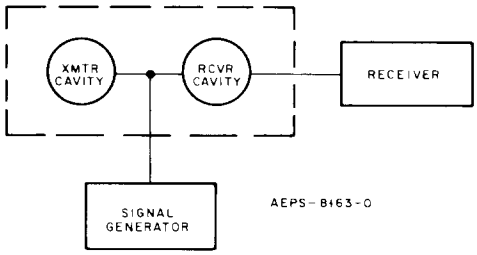


Figure 4.
Method 2 Receiver Branch
Pass Test Set-Up

(f) Tune the signal generator to the receive frequency.

(g) Tune the right-hand cavity(s) for a minimum insertion loss (maximum signal at the receiver) by adjusting the tuning rod screw.

(h) Connect the equipment as shown in Figure 5.

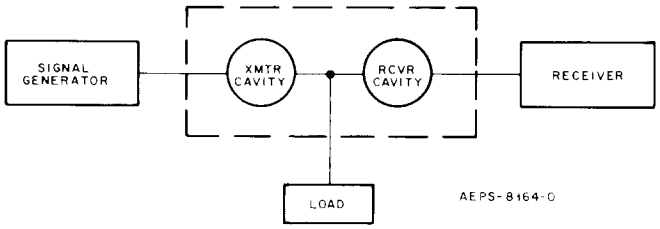


Figure 5.
Method 2 Transmitter Branch
Reject Test Set-Up

(i) Tune the left-hand cavity(s) for maximum attenuation by using procedure 5.f., "Tuning the Notch".

(j) Connect the equipment as shown in Figure 6.

(k) Set the local oscillator source to the exact duplex frequency separation.

(l) Tune the right-hand cavity(s) for maximum attenuation by using procedure 5.f.

(m) Repeat steps (c) through (l) but only tune the trimmer capacitors when tuning the notches.

(4) Connect the duplexer to the transmitter, receiver and antenna with 50-ohm coaxial cable. Adjust the transmitter final amplifier for rated power into the duplexer.

c. Model T1481A

This model may be tuned by using only steps (1) and steps (2)(a) through (e) and (j) and (k) of Method 1.

d. Model T1482A

(1) Recommended Test Equipment

(a) "Motorola" R1201 Series Signal Generator.

(b) Tunable receiver.

(2) Tuning Procedure

(a) Move sliding screws as far apart as possible on each cavity and then tighten the screws.

(b) Turn the trimmer capacitors fully counterclockwise.

(c) Tune the signal generator and the receiver to the pass frequency.

(d) Connect the equipment as shown in Figure 7.

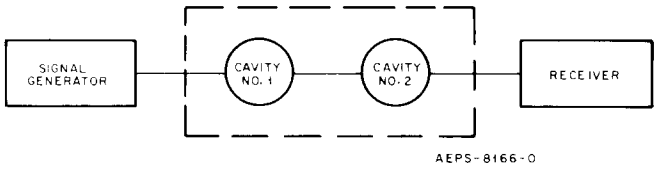


Figure 7.
Model T1482A Test Set-Up

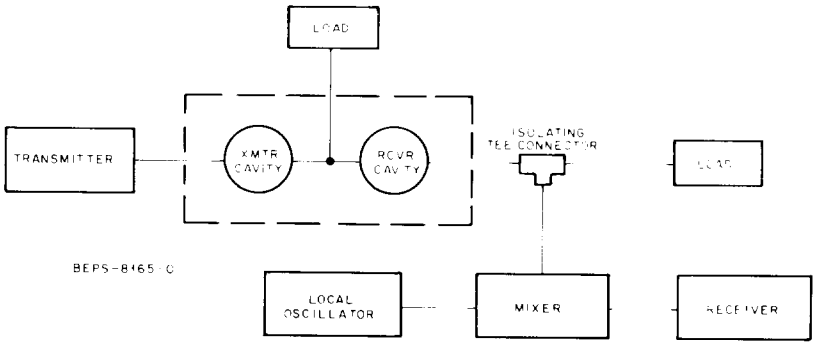


Figure 6.
Method 2 Receiver Branch Reject Test Set-Up

(e) Tune both cavities for minimum insertion loss by adjusting the tuning rod screw.

(f) Tune the signal generator and the receiver to the lower notch frequency.

(g) Tune the left-hand cavity for maximum attenuation by using procedure 5.f.

(h) Tune the signal generator and the receiver to the higher notch frequency.

(i) Tune the right-hand cavity for maximum attenuation by using procedure 5.f.

(j) Repeat steps (c) through (i) but only tune the trimmer capacitors when tuning the notches.

e. Minor "Touch-Up" Procedures (Models T1485A, AF and T1487A, AF)

(1) Method A

(a) Using the Recommended Test Equipment given for Method 1, tune the signal generator and the receiver to the duplex receive frequency.

(b) Connect the signal generator to the antenna port and the receiver to the right-hand port.

(c) Tune the right-hand cavity(s) for minimum insertion loss by adjusting the tuning rod screw.

(d) Tune the signal generator and the receiver to the duplex transmit frequency.

(e) Connect the receiver to the left-hand port.

(f) Tune the left-hand cavity(s) for minimum insertion loss by adjusting the tuning rod screw.

(g) Connect the receiver to the right-hand port.

(h) Tune the trimmer capacitor(s) on the right-hand cavity(s) for maximum attenuation.

(i) Tune the signal generator and the receiver to the duplex receive frequency.

(j) Connect the receiver to the left-hand port.

(k) Tune the trimmer capacitor(s) on the left-hand cavity(s) for maximum attenuation.

(2) Method B

(a) Using the Recommended Test Equipment given for Method 2, connect the equipment as shown in Figure 3.

(b) Tune the left-hand cavity(s) for a maximum power reading on the wattmeter by adjusting the tuning rod screw.

(c) Connect the equipment as shown in Figure 4.

(d) Tune the signal generator to the receive frequency.

(e) Tune the right-hand cavity(s) for a minimum insertion loss (maximum signal at the receiver) by adjusting the tuning rod screw.

(f) Connect the equipment as shown in Figure 5.

(g) Tune the trimmer capacitor(s) on the left-hand cavity(s) for maximum attenuation.

(h) Connect the equipment as shown in Figure 6.

(i) Set the local oscillator source to the exact duplex frequency separation.

(j) Tune the trimmer capacitor(s) on the right-hand cavity(s) for maximum attenuation.

f. Tuning the Notch

(1) If the Notch (Reject) Frequency is Below the Pass Frequency:

(a) Move the sliding screws as far apart as possible and then tighten the screws.

(b) Tune the trimmer capacitor for maximum attenuation at the notch frequency.

(2) If the Notch (Reject) Frequency is Above the Pass Frequency:

(a) Turn the trimmer capacitor completely counterclockwise and then clockwise two full turns.

(b) Adjust the sliding screws for maximum attenuation at the notch frequency and then tighten the screws.

(c) Tune the trimmer capacitor for maximum attenuation at the notch frequency.

MOTOROLA

MODEL CHART

FOR

FILTERS AND DUPLEXERS

148-174 MHz

CODE:

[X] = ONE ITEM SUPPLIED.

[2] = NUMBER INDICATES QUANTITY OF ITEMS SUPPLIED.

MODEL	DESCRIPTION	TLD8392A	TKN6471A	TKN6472A	TKN6473A	TKN6474A	TLN4565A	TLN4566A
	DESCRIPTION	CAVITY FILTER KIT	CABLE KIT	CABLE KIT	CABLE KIT	CABLE KIT	MOUNTING HARDWARE KIT	MOUNTING HARDWARE KIT
	ITEM							
T1481A	PASS-REJECT FILTER	X		X			X	
T1482A	DUAL-REJECT FILTER	2	X	X				X
T1485A	TWO-CAVITY PASS-REJECT DUPLEXER	2		X	X			X
T1485AF	TWO-CAVITY PASS-REJECT DUPLEXER (FACTORY-INSTALLED)	2			X	X		X
T1487A	FOUR-CAVITY PASS-REJECT DUPLEXER	4	2	X	X			X
T1487AF	FOUR-CAVITY PASS-REJECT DUPLEXER (FACTORY-INSTALLED)	4	2		X	X		X

EPS-8410-O

PERFORMANCE SPECIFICATIONS

FILTERS

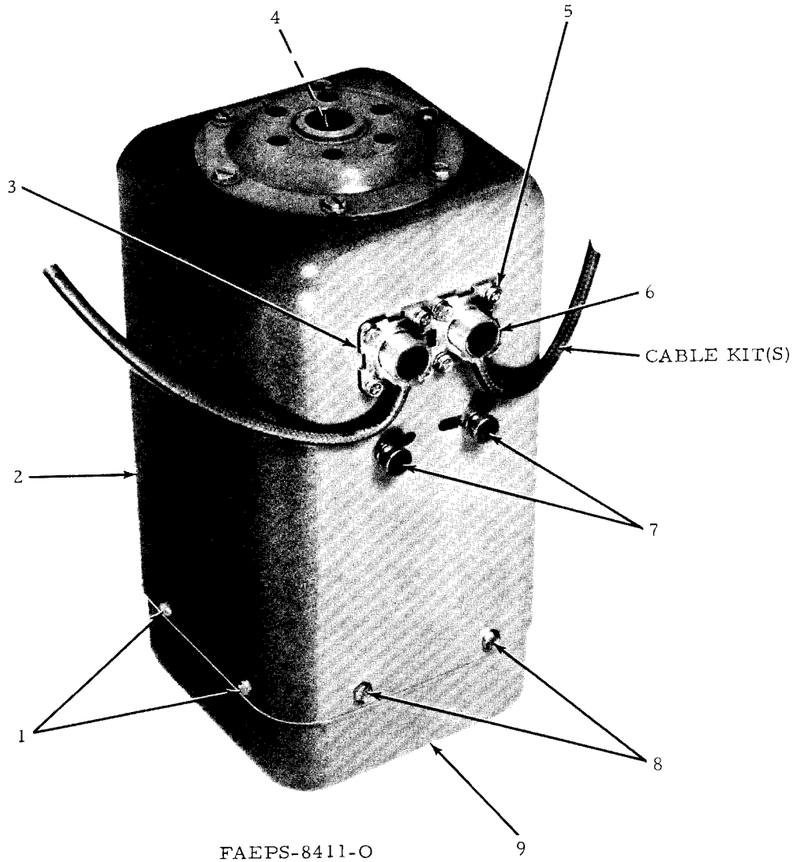
MODEL NUMBER	T1481A	T1482A
INSERTION LOSS	0.6 dB	1.3 dB
MAXIMUM POWER INPUT	125 W	125 W
MINIMUM PASS-REJECT SEPARATION	1.5 MHz	±1.5 MHz
MINIMUM REJECT ATTENUATION	35 dB @ 1.5 MHz	42 dB @ 1.5 MHz
TEMPERATURE RANGE	-30°C to +60°C	-30°C to +60°C
SIZE	6" x 5" x 8-1/2"	19" x 5-1/2" x 8-1/2"
TERMINATION	N Female	N Female

DUPLEXERS

MODEL NUMBER	T1485A	T1485AF	T1487A	T1487AF
INSERTION LOSS	0.7 dB	0.9 dB	1.5 dB	1.7 dB
ISOLATION AT TRANSMIT FREQUENCY	52 dB		82 dB	
ISOLATION AT RECEIVER FREQUENCY	52 dB		82 dB	
MINIMUM TRANSMITTER RECEIVER ISOLATION	35 dB		52 dB	
MINIMUM FREQUENCY SEPARATION	3 MHz		1.5 MHz	
VSWR MAXIMUM	1.5:1		1.5:1	
MAXIMUM POWER INPUT	125 W		125 W	
TEMPERATURE RANGE	-30°C to +60°C		-30°C to +60°C	
SIZE	19" x 5-1/2" x 8-1/2"		19" x 5-1/2" x 8-1/2"	
TERMINATION	N Female		N Female	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

EPS-8409-O

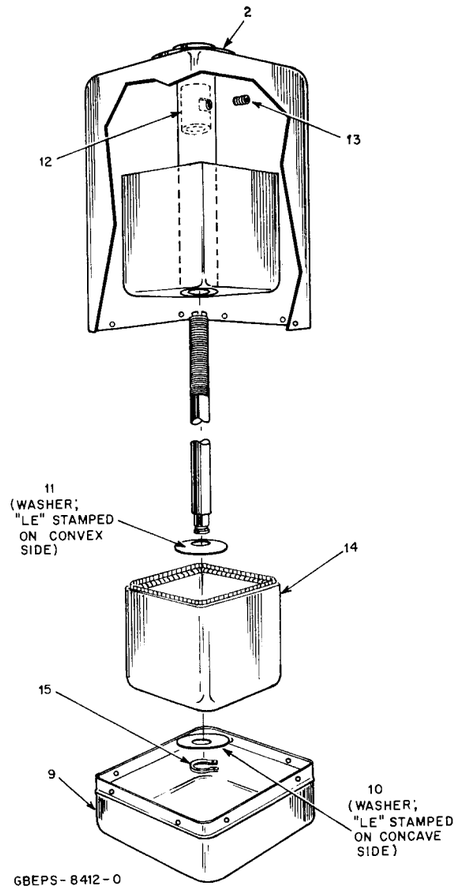


FAEPS-8411-O

NOTE:

THE OVERALL DIMENSIONS AND THE STRIPPING OF CABLES ARE CRITICAL, AND IT IS THEREFORE RECOMMENDED THAT AN ENTIRE CABLE KIT BE ORDERED USING THE CORRECT TKN NUMBER (TKN6471A, TKN6472A, TKN6473A OR TKN6474A). THE CONNECTOR COVERS (CODE NO. 6) ARE INCLUDED IN THE CABLE KIT.

EPS-8086-O



GBEPS-8412-O

parts list

TLD8392A Cavity Filter PL-1677-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	3-3375	SCREW, tapping: 6-20 x 5/16" plain hex head (4 req'd.)
2	1-84312D01	CAVITY ASSEMBLY
3	1-80723B90	LOOP ASSEMBLY, coupling
4	47-84313D01	TUNING SHAFT
5	3-134168	SCREW, tapping: 4-32 x 1/4" Phillips hex head; internal lockwasher (8 req'd.)
7	3-82245E04	SCREW, knurled head (2 req'd.)
7	4-9746	LOCKWASHER: No. 8 med. split (2 req'd.)
7	4-82418B01	WASHER, nylon (2 req'd.)
9	15-84993C02	COVER, housing
10	4-84994C01	WASHER, temperature compensating ("LE" stamped on concave side)
11	4-84994C02	WASHER, temperature compensating ("LE" stamped on convex side)
12	1-84985C01	LOCKING NUT ASSEMBLY
13	3-7110	SCREW, set: 8-32 x 3/16" allen head
14	1-84314D01	TUNING CAN ASSEMBLY
15	42-824977	RING, truarc
	3-400356	SCREW, tapping: 4 x 24 x 1/4
	4-9777	WASHER, lock #4

TLN4565A Mounting Hardware Kit (1-Cavity) PL-1678-O

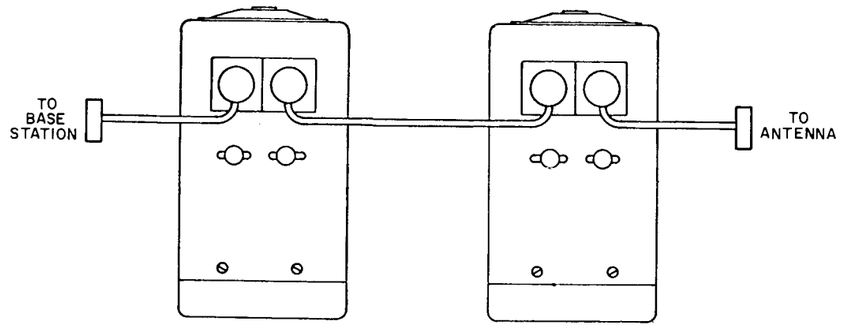
CODE	MOTOROLA PART NO.	DESCRIPTION
	7-84395D01	BRACKET, cavity mtg
8	3-3398	SCREW, tapping: 6-20 x 3/8" plain hex head (4 req'd)
	3-1209	SCREW, machine: 10-32 x 1/2" slotted binder head (4 req'd)
	3-7658	LOCKWASHER: No. 10 internal (4 req'd)
	2-7048	NUT, machine: 10-32 x 5/16" hex (4 req'd)
	3-136716	SCREW, wood: No. 10 x 1-1/2" slotted round head (4 req'd)
	33-84002B01	NAMEPLATE, cavity
	66-82846D01	TOOL, tuning

TLN4566A Mounting Hardware Kit (2 or 4-Cavities) PL-1679-A

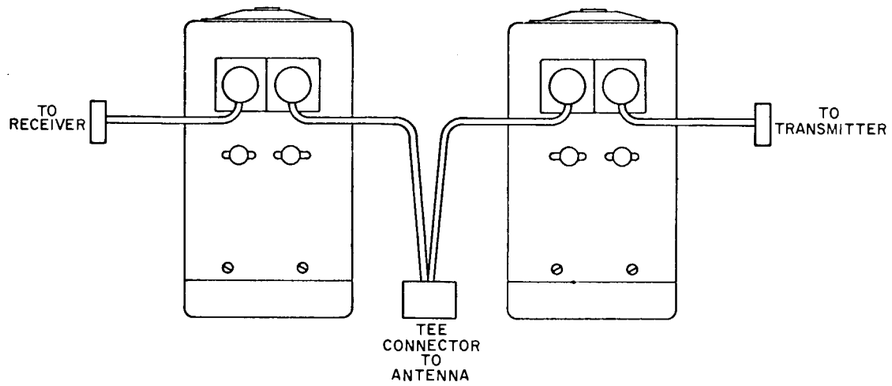
CODE	MOTOROLA PART NO.	DESCRIPTION
	64-84003D01	PANEL, cavity mtg (top)
	64-84004D01	PANEL, cavity mtg (bottom)
8	3-3398	SCREW, tapping: 6-20 x 3/8" plain hex head (16 req'd)
	3-128109	SCREW: 6-32 x 1/4" slotted round head; external lockwasher (6 req'd)
	3-135038	SCREW, tapping: No. 14 x 3/4" Phillips pan head (4 req'd)
	8-84410P04	NUT, 1/4 x 14 (4 req'd)
	4-812732	WASHER, cushion (4 req'd)
	33-84333B01	NAMEPLATE
	66-82846D01	TOOL, tuning

Cavity Filter
Parts Location Detail and Parts List
Motorola No. PEPS-8095-A
7/3/85-NPC

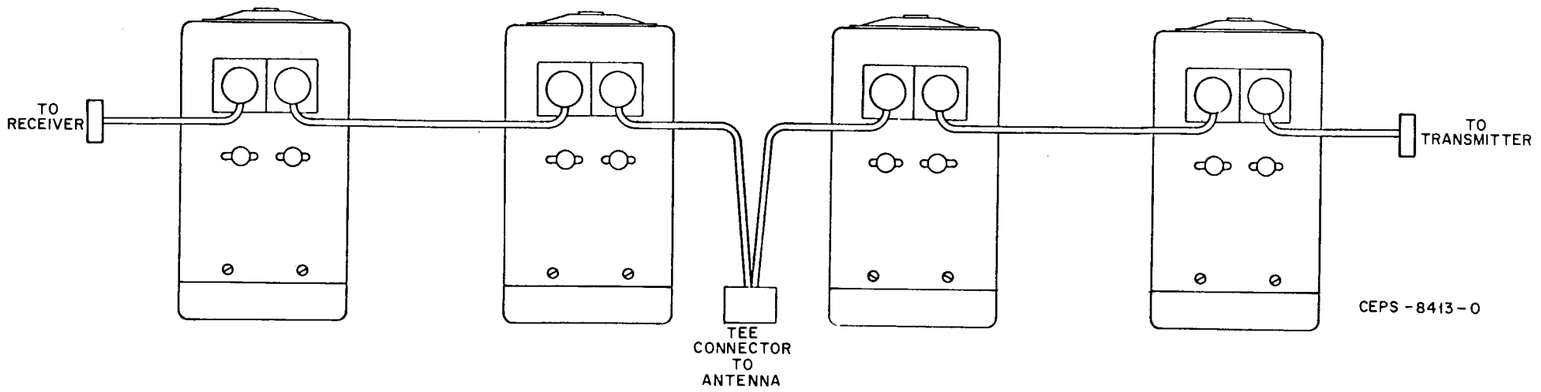
MODEL T1482A



MODEL T1485A

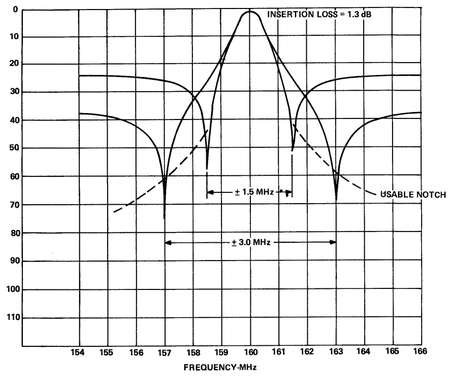


MODEL T1487A



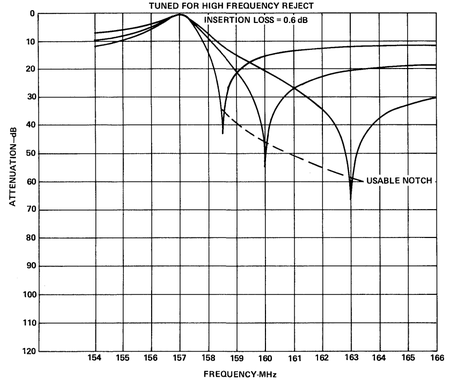
Duplex Cabling Detail
Motorola No. CEPS-8413-O
2/15/78 UP

T1482A DUAL-REJECT FILTER



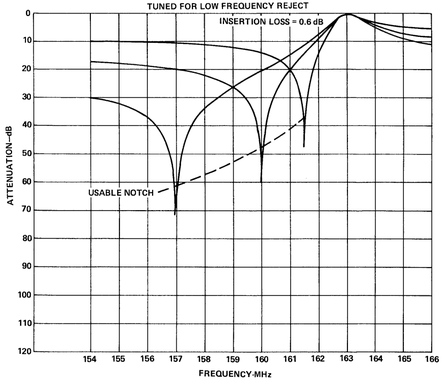
T1481A PASS-REJECT FILTER

TUNED FOR HIGH FREQUENCY REJECT



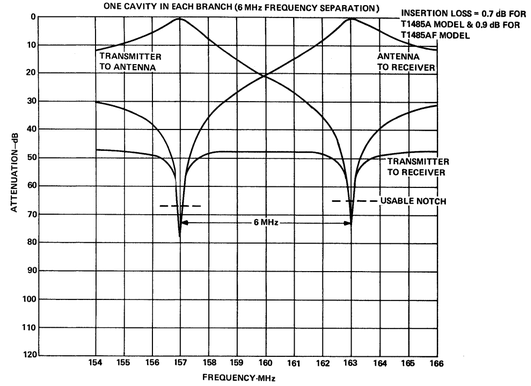
T1481A PASS-REJECT FILTER

TUNED FOR LOW FREQUENCY REJECT



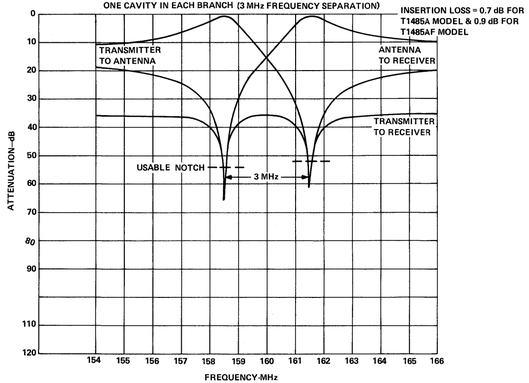
T1485A, AF PASS-REJECT DUPLEXER

ONE CAVITY IN EACH BRANCH (6 MHz FREQUENCY SEPARATION)



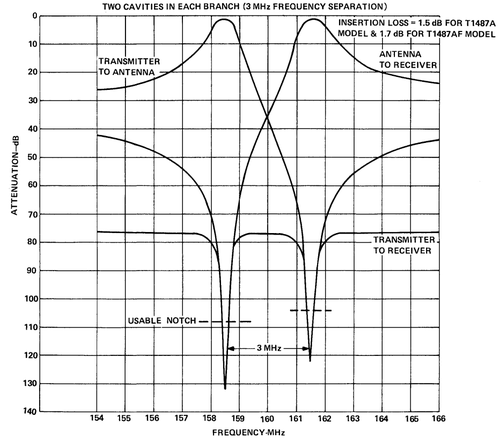
T1485A, AF PASS-REJECT DUPLEXER

ONE CAVITY IN EACH BRANCH (3 MHz FREQUENCY SEPARATION)



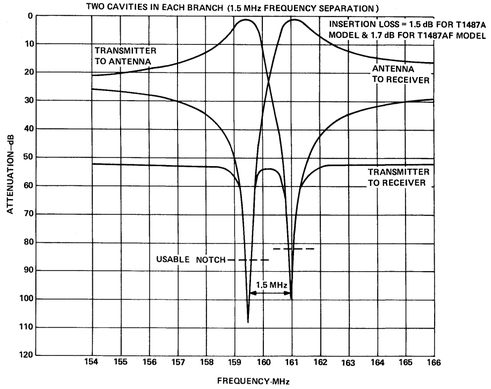
T1487A, AF PASS-REJECT DUPLEXER

TWO CAVITIES IN EACH BRANCH (3 MHz FREQUENCY SEPARATION)



T1487A, AF PASS-REJECT DUPLEXER

TWO CAVITIES IN EACH BRANCH (1.5 MHz FREQUENCY SEPARATION)



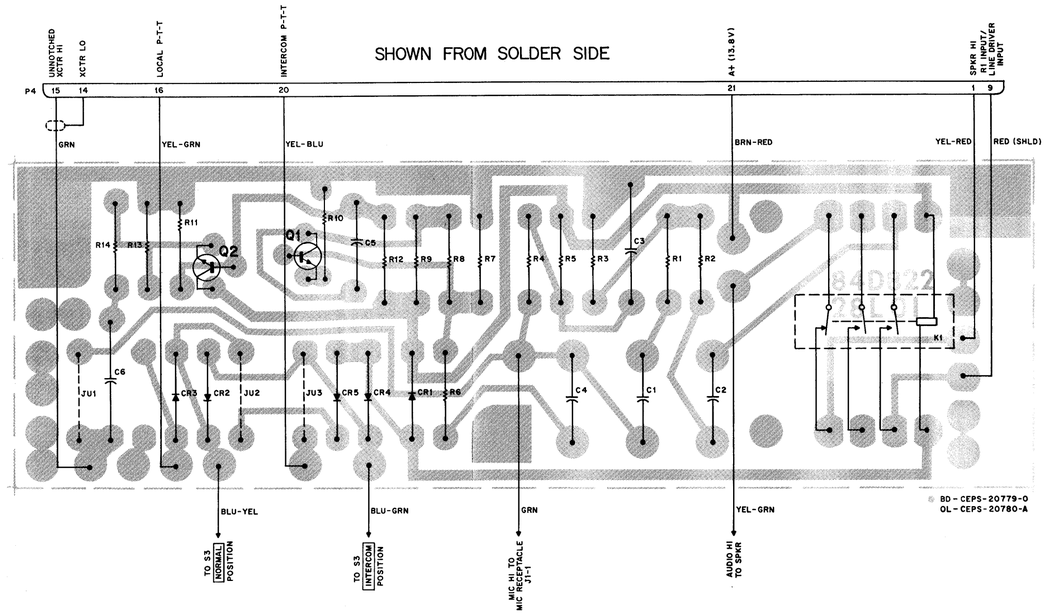
EEPS-8176-O

parts list

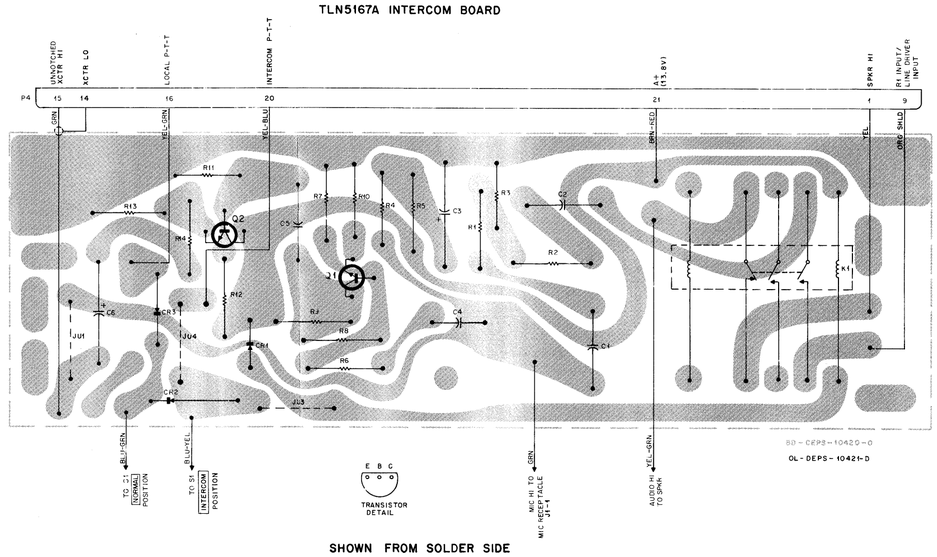
TLN5167A Intercom Board — PL-5076-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed; uF:
C1, 2	8-82905G11	0.22 ± 10%; 50 V
C3	23-865137	4.7 ± 20%; 25 V
C4, 5	8-82905G11	0.22 ± 10%; 50 V
C6	23-865137	4.7 ± 20%; 25 V
		semiconductor device, diode:
CR1 thru 5	48-83654H01	silicon
		switch, magnetic reed; 13.4 V dc:
K1	80-82617M02	dual-coil; 2 form "A", 1 form "B"; resistance of each coil 285 ohms ± 10%
		transistor:
Q1, 2	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W:
R1	6-1009C69	6.8k
R2	6-11009C51	1.2k
R3	6-11009C53	1.5k
R4	6-11009C43	560
R5	6-11009C49	1k
R6	6-11009C69	6.8k
R7	6-11009C83	27k
R8	6-11009C93	68k
R9	6-11009C43	560
R10	6-11009C19	56
R11	6-11009C85	33k
R12	6-11009C75	12k
R13	6-11009C49	1k
R14	6-11009C45	680

CURRENT VERSION



EARLIER VERSION



SHOWN FROM SOLDER SIDE

parts list

TLN5900A Meter Kit
TLN5993A Meter Kit

NOTE

This parts list covered two meter kits. Where differences appear the model number of the applicable kit is indicated in the description column.

PL-5077-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C100	21-82428B24	**capacitor, fixed:** .01 uF +80-20%, 500 V
CR100, 101	48-82420C03	**diode: (see note)** silicon
J1	9-830418	**connector, receptacle:** 4-contact
LS1	50-84710G01	**loudspeaker; permanent:** dynamic type; 3"; square 16 ohms voice coil impedance
M100	72-83120C01	**meter, dc:** scale; 0-50 microamperes
P100	29-82676C01	**connector, plug:** test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contacts
R100	6-84640C61	**resistor, fixed:** 499k ±0.5%; 1/4 W
R101	6-13756D88	100k ±1%; 1/2 W
R102	6-124A33	220 ohm ±5%; 1/4 W
R103	17-82177B55	8 ±10%; 7 W
R104	17-82177B44	13 ±10%; 15 W
S1	40-83158C01	**switch:** rotary; 2 section
S2, 3	40-83890A01	slide; dpdt

non-referenced items

	1-80775R56	DIODE & CAPACITOR ASSEMBLY includes: DIODES CR100 & CR101 CAPACITOR C100
	1-80775B58	CABLE ASSEMBLY includes:
	3-129674	SCREW, machine; 4-40 x 3/16"; 2 used
	3-132341	SCREW, machine: 4-36 x 1/4"; 2 used
	15-83947K01	COVER, connector; 2 used
	30-83678K01	CABLE, 7-conductor; 42" lg.
	42-83948K01	CLAMP, cable; 2 used
	1-80775B61	VOLTMETER PROBES includes: CONNECTORS P100 & P101
	1-80792B23	SWITCH ASSEMBLY, wire (TLN5900A) includes: SWITCH S1
	1-80795B11	SWITCH ASSEMBLY, wired (TLN5993A) includes: SWITCH S1
	1-80792B24	CHASSIS ASSEMBLY includes:
	4-7555	WASHER, flat: 0.128 x 0.250 x .033"; 2 used
	27-83008K03	CHASSIS, metering
	31-490181	TERMINAL STRIP: 2-terminal; 2 used
	31-823389	TERMINAL STRIP; 2 used
	42-871154	CLIP, mounting; 2 used
	1-80793B04	SWITCHES S2, S3, & S4
	1-80793B05	COVER ASSEMBLY includes:
	15-82734L01	COVER SUBASSEMBLY includes: COVER
	3-136138	SCREW, tapping: 6-3 x 3/8"; 2 used
	42-83123F01	RETAINER, screws; 2 used
	75-838826	BUMPER, rubber; 4 used
	2-7005	NUT, hex: 6-32 x 1/4 x 3/32"
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32"
	2-132616	NUT, hex: 6-32 x 1/4 x 3/32"; 4 used
	2-83896G01	NUT, special: 13/16-27 x 0.05 x 0.110"
	4-7615	WASHER, flat: 0.141 x 0.438 x .067
	3-7331	SCREW, machine: 6-32 x 3/8
	3-129498	SCREW, machine: 6-32 x 5/16; 4 used
	3-134169	SCREW, tapping: 4-40 x 1/4; 3 used
	3-134212	SCREW, tapping: 4-40 x 5/16; 6 used
	3-135111	SCREW, tapping: 4-40 x 3/8
	4-7568	WASHER, flat: 0.376 x 0.562 x .067"
	4-7569	WASHER, flat: 0.145 x 0.312 x .027; 2 used
	4-7615	WASHER, flat: 0.141 x 0.438 x .067; 8 used
	4-7650	WASHER, lock: #6 (internal tooth)
	407698	WASHER, lock: #3/8 (internal tooth)
	4-7699	WASHER, lock: #13/16 (internal tooth)
	4-114057	WASHER, flat: 0.125 x 0.312 x 0.032"
	4-868060	WASHER, insulating: 0.125 x 7/32 x .060"; 3 used
	5-483208	GROMMET, rubber; 1/2" ID
	7-83186K01	BRACKET, meter
	14-84717F01	INSULATOR: 0.68 x 0.40"
	29-5247	LUG, soldering: #14 L; 2 used
	35-84530G01	GRILLE, speaker
	36-84356C01	KNOB, pointer
	42-859067	CLAMP, cable: 1/2" OD (black)
	42-10217A02	STRAP, cable harness; 4 used
	42-82143C02	CLAMP, cable: 1/4" OD (black)
	54-83147L01	LABEL, caution
	4-7615	WASHER: 0.141 x 0.438 x .067
	4-7569	WASHER: 0.145 x 0.312 x .027
	29-5248	LUG; solder

TKN6780A Cable Kit PL-3418-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
P4	—	**connector:** includes:
	9-84151B03	CONTACT, receptacle; 10 req'd.
	14-84556B02	HOUSING

non-referenced items

	42-10217A02	STRAP, cable harness; 7 used

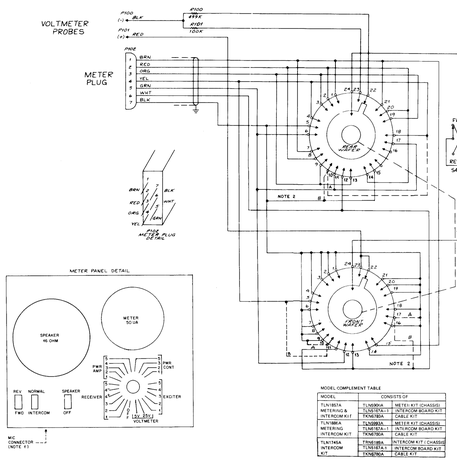
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TRN6189A Intercom Chassis Kit PL-3452-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J1	9-830418	**connector, receptacle:** 4-contact
LS1	50-84710G01	**speaker:** 3; 16 ohm
R103	17-82177B55	**resistor, fixed: ±10%:** 8; 7 W
R104	17-82177B44	13; 15 W
S2, 3	40-11589	**switch, slide:** spst

non-referenced items

	1-80775B59	CHASSIS (riveted) incl. ref. item S2 and S3
	1-80775B51	COVER ASSEMBLY
	2-132616	LOCKNUT, speaker (No. 6-32); 4 req'd.
	2-83896G01	NUT, hex (used with J1)
	4-7699	LOCKWASHER (used with J1)
	5-483208	GROMMET, rubber
	35-84530G01	GRILLE, speaker
	42-82143C02	CLAMP, cable (1/4")
	42-10217A02	TY-WRAP, cable; 4 req'd.
	3-134169	SCREW, machine: No. 4-40 x 1/4"; 7 req'd.
	3-129498	SCREW, machine: No. 6-32 x 5/16"; 4 req'd.
	29-3094	LUG, solder
	31-823389	TERMINAL, strip; 2 used



MODEL	CONSISTS OF
TLN1857A	METER KIT (CHASSIS)
TLN5993A	INTERCOM BOARD KIT
TKN6780A	CABLE KIT
TLN1886A	METER KIT (CHASSIS)
TLN5993A	INTERCOM BOARD KIT
TKN6780A	CABLE KIT
TLN1745A	INTERCOM KIT (CHASSIS)
TRN6189A	INTERCOM BOARD KIT
TKN6780A	CABLE KIT

OPERATING INSTRUCTIONS

1. METERING

Step 1. Select the function to be metered with the METER switch.

Step 2. Select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board or the power amplifier.

NOTE

Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used.

Step 3. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 4. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 5. To measure miscellaneous station voltages, use the voltmeter probes (P100 and P101) on either the 5 V or 25 V positions. Divide the 5 V full scale reading by 10 to obtain actual voltage and divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speaker into the microphone to send a message. Release the button to listen; replies will be head in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER-OFF switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

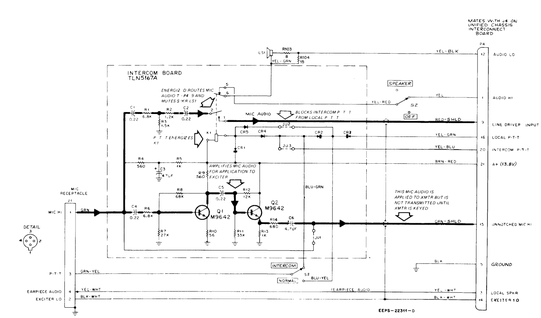
Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER-OFF switch in the SPEAKER position.

Step 3. Place the NORMAL-INTERCOM switch in the NORMAL position.

Step 4. The unit is now ready for "ON-THE-AIR" testing. If the microphone PUSH-TO-TALK switch is closed, the stations transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALK switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER-OFF switch to OFF before leaving the station unattended.



NOTE
+8 (+10 W) IS MUTED. FINAL PA CURRENT IS METERED AT PWR CONT MTR S. WITH ALL OTHER STATIONS, FINAL PA CURRENT IS METERED AT PA MTR S.

NOTE:
1. THIS OPTION REQUIRES THE USE OF A MOTOROLA MODEL TKN6577A MICROPHONE OR EQUIVALENT

JUMPER TABLE

JUMPER	NORMAL	WHEN "SPECTRA TAC" IS ADDED (OUT CKT)
J1,0	OUT	OUT
J2,0	OUT	IN
J3,0	OUT	IN

2. LEADS A CONNECTED FOR TLN5900A, LEADS B CONNECTED FOR TLN5993A.

LEGEND
THEORY OF OPERATION DATA
PRIMARY SIGNAL FLOW

COMPA-STATION
METERING & INTERCOM
MODELS TLN1857A AND TLN1886A
INTERCOM
MODEL TLN1745A

FUNCTION

--Models TLN1857A and TLN1886A provide built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

--Model TLN1745A provides intercom between the station and the remote control point.

4. MONITORING

To monitor audio quality, etc., place the SPEAKER-OFF switch in the SPEAKER position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

METER SELECT TABLE

P102 METER PLUG CONNECTED TO	METER SELECTOR SWITCH		LOW BAND-MID BAND TLN1186A/TLN1188A		HIGH BAND TLN1187/TLN1189A		820 MHz/UHF TLN1185A/TLN1898A	
	MTR. NO.	POS.	POL.	FUNCTION METERED	POL.	FUNCTION METERED	POL.	FUNCTION METERED
RCVR AND IF BOARD	RCVR	1	REV	EXTENDER CHANNEL ELEMENT	REV		FWD	CHANNEL ELEMENT OUTPUT
		2	REV		REV		FWD	FIRST DOUBLER OUTPUT
		3	REV	CHANNEL ELEMENT OUTPUT	REV		FWD	SECOND DOUBLER OUTPUT
		4	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		5	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		6	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	FWD	LIMITER OUTPUT
POWER AMP	PWR AMP	1	FWD	P.A. INPUT	REV	PA INPUT	FWD	PREDRIVER CURRENT
		2	FWD		REV	CONTROLLED AMP OUTPUT	FWD	25 W DRIVER CURRENT (TS W)
		3	FWD		REV	INPUT FINAL AMP	FWD	FINAL AMP CURRENT (EXCEPT 12 W MODELS)
		4	FWD	CONTROL VOLTAGE	REV	FINAL AMP	FWD	
		5	FWD	FINAL AMPLIFIER CURRENT	REV	FINAL AMPLIFIER CURRENT	FWD	CONTROLLED (ADJ.) STAGE VOLTAGE FINAL AMPLIFIER CURRENT (12 W ONLY)
POWER CONTROL BOARD	POWER CONT	5	FWD	CONTROL VOLTAGE	FWD	CONTROL VOLTAGE	FWD	ADJ. VOLTAGE (ALL OTHERS)
		3	FWD				FWD	ADJ. VOLTAGE NOT USED (800 MHz ONLY)
		2	FWD	REFLECTED POWER	FWD	REFLECTED POWER	FWD	REFLECTED POWER
		1	FWD	FORWARD POWER	FWD	FORWARD POWER	FWD	FORWARD POWER
	—	—	—		—	UNUSED	—	UNUSED
EXCITER	EXCTR	5	FWD	SECOND AMPLIFIER - (LB) DRIVER INPUT - (MB)	FWD	EXCITER OUTPUT	FWD	EXCITER OUTPUT
		4	FWD	FIRST AMPLIFIER - (LB) DOUBLER INPUT - (MB)	FWD	FIRST DOUBLER INPUT	FWD	DOUBLER INPUT
		3	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT
		2	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT
		1	FWD	IOC AUDIO OUTPUT	FWD	IOC AUDIO OUTPUT	FWD	IOC AUDIO OUTPUT
	VOLT METER	25 V	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE	FWD	25 VOLTS FULL SCALE
		5 V	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0-50	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0-50	FWD	5 VOLTS FULL SCALE NOTE METER IS LABELLED 0-50
	OFF	—	24	OFF		OFF		OFF

EPS-23014-A

68P81033E28-J
(Sheet 2 of 3)
5/30/85-UP

COMPA-STATION METERING & INTERCOM

UPRIGHT STATION METERING & INTERCOM

MODELS TLN1859A AND TLN1887A

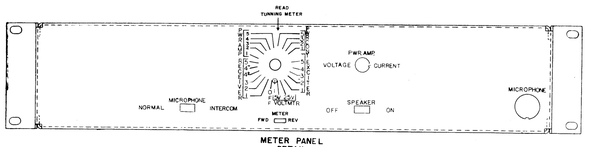
FUNCTION

Provides built-in metering of over 20 major test points in the transmitter and receiver(s), plus intercom between the station and the remote control point.

METER SELECT TABLE

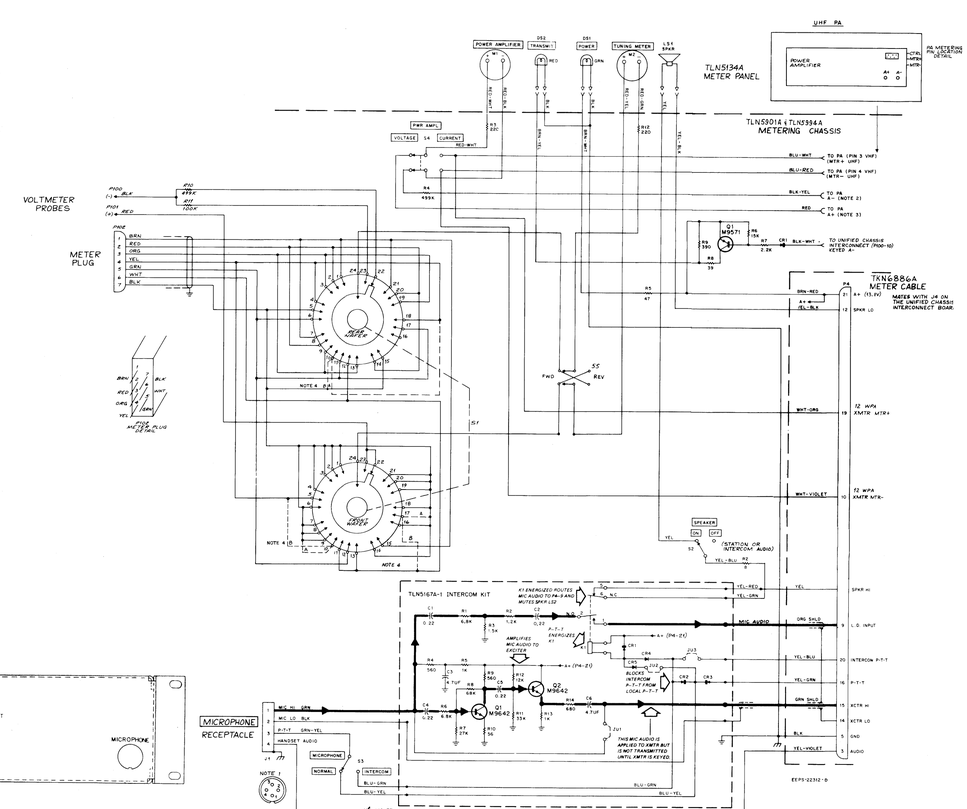
P102 METER PLUG CONNECTED TO	METER SELECTOR SWITCH		LOW BAND–MID BAND TLN1886A/TLN1887A		HIGH BAND TLN1857/TLN1858A		800 MHz/UHF TLN1857A/TLN1858A	
	MTR. NO.	POS.	POL.	FUNCTION METERED	POL.	FUNCTION METERED	POL.	FUNCTION METERED
RCVR AND IF BOARD	RCVR	1	REV	EXTENDED CHANNEL ELEMENT	REV	–	FWD	CHANNEL ELEMENT OUTPUT
		2	REV		REV	–	FWD	FIRST DOUBLER OUTPUT
		3	REV	CHANNEL ELEMENT OUTPUT	REV	CHANNEL ELEMENT OUTPUT	FWD	SECOND DOUBLER OUTPUT
		4	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		4A	REV	DISCRIMINATOR OUTPUT	REV	DISCRIMINATOR OUTPUT	FWD	DISCRIMINATOR OUTPUT
		5	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	REV	THIRD IF OUTPUT AND LIMITER OUTPUT	FWD	LIMITER OUTPUT
POWER AMP	PWR AMP	1	FWD	P.A. INPUT	REV	PA INPUT	FWD	PREDRIVER CURRENT
		2	FWD	–	REV	CONTROLLED AMP OUTPUT	FWD	25 W DRIVER CURRENT (TS-W)
		3	FWD	–	REV	INPUT FINAL AMP 90/100 W/60 W PREDRIVER	FWD	FINAL AMP CURRENT (EXCEPT 12 W MODELS)
		4	FWD	CONTROL VOLTAGE	REV	INPUT FINAL AMP	FWD	CONTROLLED (ADJ.) STAGE VOLTAGE
		5	FWD	FINAL AMPLIFIER CURRENT	REV	FINAL AMPLIFIER CURRENT (12 W ONLY)	FWD	FINAL AMPLIFIER CURRENT
POWER CONTROL BOARD	POWER CONT.	5	FWD	CONTROL VOLTAGE	FWD	CONTROL VOLTAGE	FWD	ACL VOLTAGE (ALL OTHERS)
		12	FWD	–	FWD	–	FWD	ACL VOLTAGE NOT USED (800 MHz ONLY)
		14	FWD	REFLECTED POWER	FWD	REFLECTED POWER	FWD	REFLECTED POWER
		15	FWD	FORWARD POWER	FWD	FORWARD POWER	FWD	FORWARD POWER
–	–	–	16	UNUSED		UNUSED		UNUSED
EXCITER	EXCTR	5	17	SECOND AMPLIFIER – (LB) DRIVER INPUT – (MB)	FWD	EXCITER OUTPUT	FWD	EXCITER OUTPUT
		4	18	FIRST AMPLIFIER – (LB) DOUBLER INPUT – (MB)	FWD	FIRST DOUBLER INPUT	FWD	DOUBLER INPUT
		3	19	TRIPLER INPUT	FWD	TRIPLER INPUT	FWD	TRIPLER INPUT
		2	20	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT	FWD	CHANNEL ELEMENT OUTPUT
		1	21	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT	FWD	IDC AUDIO OUTPUT
	VOLT-METER	25 V 5 V	22 23	25 VOLTS FULL SCALE 5 VOLTS FULL SCALE NOTE: METER IS LABELLED 0–30	FWD FWD	25 VOLTS FULL SCALE 5 VOLTS FULL SCALE NOTE: METER IS LABELLED 0–30	FWD FWD	25 VOLTS FULL SCALE 5 VOLTS FULL SCALE NOTE: METER IS LABELLED 0–30
	OFF	–	24	OFF		OFF		OFF

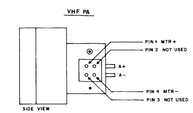
EPS-23014-A



METER PANEL DETAIL

68P81033E28-J
(Sheet 3 of 3)
5/30/85- UP





MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF:	
TLN1887A	TLN5901A	METER KIT (CHASSIS)
METERING & INTERCOM KIT	TLN5167A-4	INTERCOM BOARD KIT
	TKN6886A	CABLE KIT
TLN1887A	TLN5994A	METER KIT (CHASSIS)
METERING & INTERCOM KIT	TLN5167A-4	INTERCOM BOARD KIT
	TKN6886A	CABLE KIT

NOTES

1. INTERCOM REQUIRES THE USE OF A MOTOROLA MODEL TMN8021A MICROPHONE OR EQUIVALENT.
2. ON 12- WATT UHF STATIONS, BLK - YEL A1 - LEAD IS CONNECTED TO TB2-11 (ON UNIFIED CHASSIS INTER-CONNECT BOARD.
3. ON 12- WATT UHF STATIONS, RED A1+ LEAD IS CONNECTED TO TB2-11 (ON UNIFIED CHASSIS INTERCONNECT BOARD.
4. LEADS A CONNECTED FOR TLN5901A. LEADS B CONNECTED FOR TLN5994A.

LEGEND
- THEORY OF OPERATION DATA
- PRIMARY SIGNAL FLOW

OPERATING INSTRUCTIONS

1. METERING

Step 1. Tuning Meter Usage — Select the function to be metered with the meter switch. Next, select the chassis to be monitored by placing the metering plug (P102) into the metering receptacle of the receiver, exciter, power control board, or the power amplifier. NOTE: Metering plug P102 should be plugged in only when tuning. Unplug it when it is not being used. For receiver discriminator adjustment, use both 4(+) and 4(-) and adjust for meter zero.

Step 2. PWR AMP Meter Usage — Select PA current/voltage monitoring by placing the VOLTAGE/CURRENT switch in the applicable position.

Step 3. Refer to the Transmitter and Receiver sections of this manual for typical or minimum readings. Better yet, keep a log of all meter readings each time the station is serviced. Use the last set of readings as a reference and note any degradation in performance.

Step 4. Voltmeter Usage — Use either the 5 V or 25 V scales as applicable. Divide the 5 V full scale reading by 10 to obtain actual voltage. Divide the 25 V full scale reading by 2 to obtain actual voltage.

2. INTERCOM

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3. Place the NORMAL-INTERCOM switch in the INTERCOM position.

Step 4. The unit is now ready for intercom operation between the station and the remote control point. Close the PUSH-TO-TALK switch on the microphone and speak into the microphone to send a message. Release the button to listen; replies will be heard in the speaker. The console operator at the remote point must also switch to an intercom mode to prevent keying the station during replies.

Step 5. Return the SPEAKER switch to the OFF position before leaving the station unattended.

3. "ON-THE-AIR" TESTING

Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

Step 2. Place the SPEAKER switch in the ON position.

Step 3 Place the NORMAL-INTERCOM in the NORMAL position.

Step 4. The unit is now ready for "on-the-air" testing. If the microphone PUSH-TO-TALK switch is closed, the stations transmitter will be keyed. Speak into the microphone to transmit a message. Release the PUSH-TO-TALk switch to listen. Receiver audio will be heard on the speaker.

Step 5. Return the SPEAKER switch to OFF before leaving the station unattended.

parts list

TLN5901A Meter Kit
TLN5994A Meter Kit

NOTE
The parts lists covers two meter kits. Where differences appear the model number of the applicable kit is indicated in the description column.

PL-5078-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR1	48-82392B03	**diode: (see note)** silicon
J1	9-830418	**connector, receptacle:** 4-contact
Q1	48-869571	**transistor: (see note)** PNP; type M9571
P100	29-82676C01	**connector, plug:** test probe; BLACK
P101	29-82676C02	test probe; RED
P102	28-84208B01	7-contact
R1		**resistor, fixed: ± 10%; 1/2 W:** unless otherwise stated
R2	17-82177B55	NOT USED
R3	6-124A33	8.7 W
R4, 10	6-84640C61	220
R5	6-125C17	499k ± 1%
R6	6-124A77	47
R7	6-124A57	15k ± 5%; 1/4 W
R8	6-125C15	2.2k ±5%; 1/4 W
R9	6-125A39	39
R11	6-12756D88	390
R12	6-125A33	100k ± 1%
S1	40-83158C01	220 ±5%
S2, 3	40-83890A01	**switch:** rotary; 2 section
S4	40-8117151	slide; dpdt
S5	40-83890A01	toggle; dpdt
		slide; dpdt

		non-referenced items
	1-80775B55	CABLE ASSEMBLY includes:
	3-129674	SCREW, machine: 4-40 x 3/16"; 2 used
	3-132341	SCREW, machine: 4-36 x 1/4"; 2 used
	15-83947K01	COVER, connector; 2 used
	30-83678K01	CLAMP, cable; 2 used
	1-80775B60	CONNECTOR P102 VOLTMETER PROBES includes: CONNECTORS P100 & P101
	1-80792B39	SWITCH ASSEMBLY, wired (TLN5901A)
	1-80795B12	SWITCH ASSEMBLY, wired (TLN5994A) includes: SWITCH S1
	1-80793B03	CHASSIS ASSEMBLY includes:
	4-7555	WASHER, flat: 0.128 x 0.250 x .033"; 3 used
	27-83400K02	CHASSIS, metering
	29-3094	LUG, soldering
	31-490101	TERMINAL STRIP: 2-terminal; 2 used
	42-87184	CLIP, mounting; 3 used
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32
	2-115190	NUT, hex: 15/32-32 x 9/16 x 564"; 2 used
	2-121841	NUT, hex: 6-32 x 5/16 x .764"
	2-83896G01	NUT, special: 13/16-27 x 0.90 x 0.110"
	3-134185	SCREW, tapping: 6-32 x 1/4; 2 used
	3-134212	SCREW, tapping: 4-40 x 5/16; 3 used
	3-136934	SCREW, tapping: 6-32 x 3/8"
	4-7698	WASHER, lock: #3/8 (internal tooth)
	4-7699	WASHER, lock: #13/16 (internal tooth)
	4-8324	WASHER, lock: #15/32 (split)
	14-84717F01	INSULATOR: 0.68 x 0.40"
	29-5279	LUG, soldering: #7/8
	31-835961	TERMINAL STRIP: 18-terminal
	36-82630H01	KNOB, control
	42-8904991	CLAMP, cable: 3.18 x 0.62"
	42-10217A02	STRAP, cable harness

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TKN6886A Cable Kit		PL-5207-A
P4	- 9-841151B03 1-84156B02	CONNECTOR: Includes: CONTACT, receptacle: 12 used HOUSING, connector
	NON-REFERENCED ITEMS	
	14-859051	INSULATOR, lug: .313 x .945"; 6 used
	29-5247	LUG, soldering: #1/4 I.; 4 used
	29-824456	LUG, ring tongue: 2 used
	29-859118	LUG, receptacle: .295 x .750"; 6 used
	37-82603D60	SLEEVE, numbered; blank
	39-10184A24	CONTACT, female
	42-10217A02	STRAP, cable harness; 3.62" lg.; 28 used
	42-10217A10	STRAP, cable harness; 7.78" lg.; 4 used
	9-84234E10	JACK, test; white; 3 used

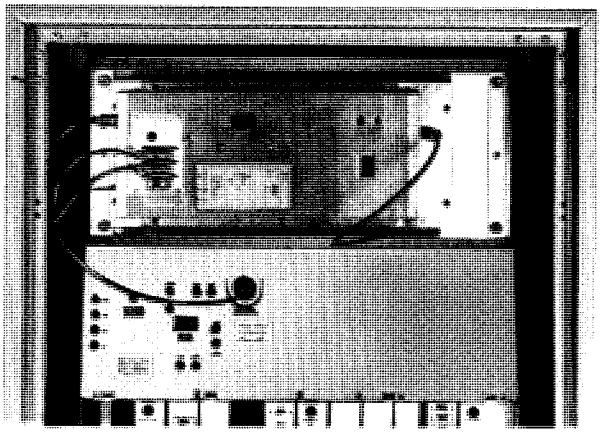
TLN5134A Meter Panel PL-2233-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		non-referenced items
DS1	65-83183G02	**light, indicator:** includes lamp and GRN lens
DS2	65-83183G04	includes lamp and RED lens
LS2	50-83562A01	**loudspeaker, permanent magnet:** dynamic type; 4"; square; 4 ohms voice coil impedance
		meter, electrical: 50 uA movements:
M1	72-84864B10	scale: 0-25 volts/amps
M2	72-84864B09	scale: 0-50 microampere
		non-referenced items
	13-84616G01	GRILLE, speaker
	13-83207F01	CLOTH, speaker grille
	42-83112A01	CLIP, indicator light retaining; 2 used
	2-7009	NUT, hex: 10-32 x 3/8 x 1/8"; 4 used
	3-119916	SCREW, machine: 10-32 x 7/16"; 4 used
	3-131964	SCREW, tapping: 6-32 x 3/8; 12 used
	4-7658	WASHER, lock: #10 (split); 4 used
	7-84620G01	FRAME, top
	7-84620G03	FRAME, bottom
	7-84620G05	FRAME, end; 2 used
	13-83054C10	GRILLE, meter panel
	64-83152C03	PANEL, meter

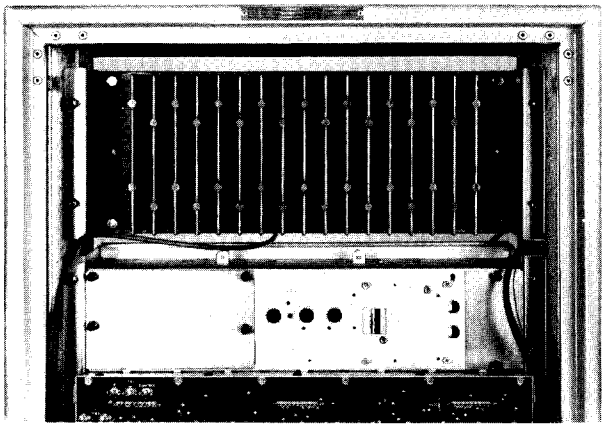
4. MONITORING

To monitor audio quality, etc., place the SPEAKER switch in the ON position. Both receiver audio and line audio from the remote control point will be heard in the speaker.

TRANSMITTER INTRODUCTION



FRONT VIEW



BACK VIEW

FCEPS-25503-O
(Y432, D433)

CONTINUOUS DUTY TRANSMITTER

Continuous duty version transmitters can be used in the Motorola *Digital Voice Protection (DVP) Micor Compa-Station* base repeater stations. Transmitter model breakdown is shown in the model charts at the end of this section. Continuous duty transmitters provide 60- or 100-watt capability with no OFF time required except as dictated by operating procedure. Extra space is required in continuous duty stations to provide additional power amplifier heat dissipation capability. The power amplifier/power control boards are mounted separate from the exciter which permits the use of a larger heat sink.

Transmitter cabling is detailed in the rf intercabling section at the rear of this manual under station diagrams. Electrical parts list information accompanies the applicable schematic diagram. Transmitter mechanical items are parts listed in the transmitter hardware kits section under the transmitter miscellaneous tabs.

Continuous duty stations use a transmitter that consists of two separate assemblies; the exciter-driver and power amplifier are separate assemblies, each occupying a "shelf" of the station.

MOTOROLA

TRANSMITTER

MODEL CHART

FOR

132-174 MHz

DIGITAL VOICE PROTECTION

"MICOR" "COMPA-STATION" BASE RADIO

AND REPEATER STATIONS

CODE:

[X] — ONE INCLUDED

MODEL	DESCRIPTION	UNIT	DESCRIPTION: CONTINUOUS DUTY MODELS	EXCITER BOARD (132-150.8 MHz)	EXCITER BOARD (150.8-174 MHz)	POWER CONTROL BOARD 90/100/110 W (Formerly TLD8620A)	POWER CONTROL BOARD 60 W	EXCITER FILTER (132-150.8)	EXCITER FILTER (150.8-174)	100 W POWER AMPLIFIER BOARD (132-150.8 MHz) Formerly TLD8302A	110 W POWER AMPLIFIER BOARD (150.8-162 MHz) Formerly TLD5483A	110 W POWER AMPLIFIER BOARD (162-174 MHz) Formerly TLD5484A	HARMONIC FILTER (132-150.8 MHz)	HARMONIC FILTER (150.8-174 MHz)	100 W PA HARDWARE	PA CASTING & HDW ASSEMBLY	INPUT BRACKET & CABLE	60 W POWER AMPLIFIER BOARD (150.8-162 MHz)	60 W POWER AMPLIFIER BOARD (162-174 MHz)	60 W PA HARDWARE	R-C REGEN SUPPRESSOR KIT (110 W, 132-162 MHz)	R-C REGEN SUPPRESSOR KIT (110 W, 162-174 MHz)	R-C REGEN SUPPRESSOR KIT (60 W)	R-C REGEN SUPPRESSOR KIT (110 W)
TLD2172A	EXCITER AND FILTER (132-150.8 MHz)	TLN5802A		X				X																
TLD2173A	EXCITER AND FILTER (150.8-174 MHz)	TLD5803A			X				X															
TLD1692D	100 W POWER AMPLIFIER (132-150.8 MHz) Formerly TLD1692C	TLD5960A				X				X					X	X	X				X			
TLD1693F	110 W POWER AMPLIFIER (150.8-162 MHz) Formerly TLD1693D	TLD8610A				X					X			X	X	X	X				X			X
TLD1694F	110 W POWER AMPLIFIER (162-174 MHz) Formerly TLD1694D	TFD6011A				X						X		X	X	X	X					X		
TLD1703C	60 W POWER AMPLIFIER (150.8-162 MHz)	TFD6112A					X							X		X	X	X		X			X	
TLD1704C	60 W POWER AMPLIFIER (162-174 MHz)	TLD5952A					X							X		X	X		X	X				
		TLD5953A						X																
		TLD5954A							X															
		TFD6101A								X														
		TFD6102A									X													
		TLN5604A										X												
		TLN4280A											X											
		TKN8012A												X										
		TLD8313A													X									
		TLD8314A														X								
		TLN4742A															X							
		TRN8069A																X						
		TLD5502A																	X					
		TRN6444A																		X				
		TRN6445A																			X			

EPS-25497-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

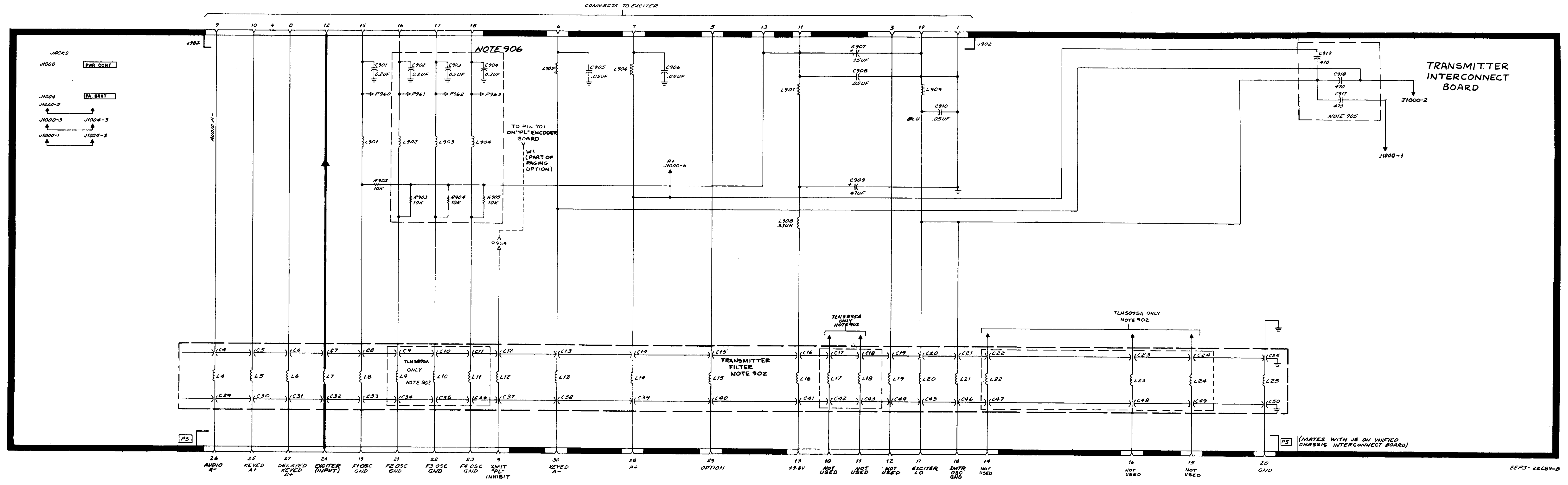
Transmitter Interconnect Board
TLN5893A (Base Station)
TLN5894A (Repeater Station)
TLN5895A (Full Filtering Option)

NOTE

This parts list covers three models of the Transmitter Interconnect Board. Where differences exist, the model number of the applicable unit is given in the Description Column. PL-5087-O

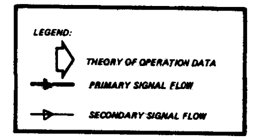
		CAPACITOR, fixed: pF +100-0% 500 V: unless otherwise stated
C1, 2, 3		NOT USED
C4 thru 8	21-861219	1000 (TLN5894A & TLN5895A)
C9, 10, 11	21-861219	1000 (TLN5895A)
C12 thru 16	21-861219	1000 (TLN5894A & TLN5895A)
C17, 18	21-861219	1000 (TLN5895A)
C19	21-82812H01	100 (TLN5894A & TLN5895A)
C20, 21	21-861219	1000 (TLN5894A & TLN5895A)
C22, 23, 24	21-861219	1000 (TLN5895A)
C25	21-861219	1000 (TLN5894A & TLN5895A)
C26, 27, 28		NOT USED
C29 thru 33	21-861219	1000 (TLN5894A & TLN5895A)
C34, 35, 36	21-861219	1000 (TLN5895A)
C37 thru 41	21-861219	1000 (TLN5894A & TLN5895A)
C42, 43	21-861219	1000 (TLN5895A)
C44	21-82812H01	100 (TLN5894A & TLN5895A)
C45, 46	21-861219	1000 (TLN5894A & TLN5895A)
C47, 48, 49	21-861219	1000 (TLN5895A)
C50	21-861219	1000 (TLN5894A & TLN5895A)
C901	21-82372C02	0.2 uF +80-20%; 25 V
C902, 903, 904	21-82372C02	0.2 uF +80-20%; 25 V (TLN5893A & TLN5895A)
C905, 906	21-82372C04	.05 uF +80-20%; 25 V
C907	23-83214C02	15 uF ±20%; 25 V
C908	21-82372C04	.05 uF +80-20%; 25 V
C909	23-82783B31	47 uF ±20%; 20 V
C910	21-82372C04	.05 uF +80-20%; 25 V
C911thru 916		NOT USED
C917, 918, 919	21-82187B07	470 pF ±10%; 500 V
		CONNECTOR:
J1000	28-83441F01	male; 6-contact (white)
J1001, 1002, 1003		NOT USED
J1004	28-83441F06	male; 6-contact (red)
		COIL, rf:
L1, 2, 3		NOT USED
L4, 5, 6	24-83977B01	1-1/2 turns (TLN5894A & TLN5895A)
L7, 8	24-83961B01	3 turns (TLN5894A & TLN5895A)
L9, 10, 11	24-83961B01	3 turns (TLN5895A)
L12	24-83961B01	3 turns (TLN5894A & TLN5895A)
L13, 14	24-83977B01	1-1/2 turns (TLN5894A & TLN5895A)
L15	24-83961B01	3 turns (TLN5894A & TLN5895A)
L16	24-83977B01	1-1/2 turns (TLN5894A & TLN5895A)
L17, 18	24-83961B01	3 turns (TLN5895A)
L19, 20	24-83977B01	1-1/2 turns (TLN5894A & TLN5895A)
L21	24-83961B01	3 turns (TLN5894A & TLN5895A)
L22	24-83977B01	1-1/2 turns (TLN5895A)
L23, 24	24-83961B01	3 turns (TLN5895A)
L25	24-83977B01	1-1/2 turns (TLN5894A & TLN5895A)
L901	24-80900A61	0.62 uH
L902, 903, 904	24-80900A61	0.62 uH (TLN5894A & TLN5895A)
L905, 906, 907	24-83961B01	3 turns
L908	24-854314	33 uH
L909	24-83961B01	3 turns
		RESISTOR, fixed: ±10%; 1/4 W:
R901		NOT USED
R902	6-124C73	10k
R903, 904 905	6-124C73	10k (TLN5893A & TLN5895A)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		NON-REFERENCED ITEMS
	1-80793B15	CIRCUIT BOARD ASSEMBLY (TLN5893A) includes:
	9-83011H01	CONTACT, female; 49 used
	14-84966D01	INSULATOR: .760 x .240"; 8 used
	39-10184A10	CONTACT, male: 3 used
	3-139495	SCREW, tapping: 6-20 x 5/16"; 4 used
	7-82626K01	BRACKET, filter (TLN5893A)
	14-82621K01	INSULATOR: 17.15 x .76" (TLN5893A)
	14-83375K01	INSULATOR: 9.560 x .900"
	42-83629G01	FASTENER, drive; 2 used
	1-80775B75	COVER ASSEMBLY, filter (TLN5894A & TLN5895A) includes:
	15-82173K01	COVER, filter
	1-80793B13	BRACKET ASSEMBLY, filter (TLN5894A) includes:
	7-82626K01	BRACKET, filter CAPACITORS C4-8, C12-16, C20, C21, C25, C29-33, C37-41, C45, C46, C50
	1-80793B16	CIRCUIT BOARD ASSEMBLY (TLN5894A & TLN5895A) includes:
	9-83011H01	CONTACT, female; 49 used
	14-84966D01	INSULATOR: .760 x .240"; 8 used
	39-10184A10	CONTACT, male; 3 used
	3-138162	SCREW, tapping: 4-40 x 3/8"; 6 used (TLN5894A & TLN5895A)
	42-84284B01	RETAINER, screw: 5 used (TLN5894A & TLN5895A)
	1-80793B14	BRACKET ASSEMBLY, filter (TLN5895A) includes:
	7-82626K01	BRACKET, filter CAPACITORS C4-25, C29-50



NOTES:

901. UNLESS OTHERWISE SPECIFIED, CAPACITOR VALUES ARE IN PICOFARADS.
902. FILTERING COMPONENTS ARE USED ONLY WITH THE TLN5895A AND TLN5894A MODELS. THE TLN5895A MODEL USES ALL FILTERING COMPONENTS (C1--C50 AND L1--L25). THE TLN5645A MODEL USES ALL FILTERING COMPONENTS EXCEPT AS INDICATED ON THE SCHEMATIC DIAGRAM AND PARTS LIST. THE TLN5647A (BASE) MODEL DOES NOT USE ANY OF THESE FILTERING COMPONENTS BUT INCORPORATES "THRU" PLATING INSTEAD. (PLATING RUNS AND FILTERING COMPONENTS DO NOT EXIST SIMULTANEOUSLY.)
903. FILTERING CHOKES AND BYPASS CAPACITORS ARE USED ON VOLTAGE AND GROUND RUNS TO PREVENT RF RADIATION FROM BEING CONDUCTED TO THE UNIFIED CHASSIS INTERCONNECT BOARD AND AFFECTING STATION OPERATION.
904. FILTERING CHOKES L910 AND L911 (FUNCTIONAL WITH 12-WATT STATIONS ONLY) PROVIDE FILTERING FOR BUILT-IN STATION METERING.
905. CAPACITORS C917, C918 AND C919 SHUNT RF ENERGY ON THE A+, KEYED A- AND POWER CONTROL LEADS TO GROUND.
906. CAPACITORS C902--C904, CHOKES L902--L904 AND RESISTORS R903--R905 NOT USED ON TLN5894A (REPEATER) MODEL.



TRANSMITTER INTERCONNECT BOARD

MODEL TLN5894A (RPTR)
MODEL TLN5893A (BASE)
MODEL TLN5895A (FULL FILTERING OPTION)

FUNCTION -

--Interconnects most transmitter circuit boards to each other (except PA).

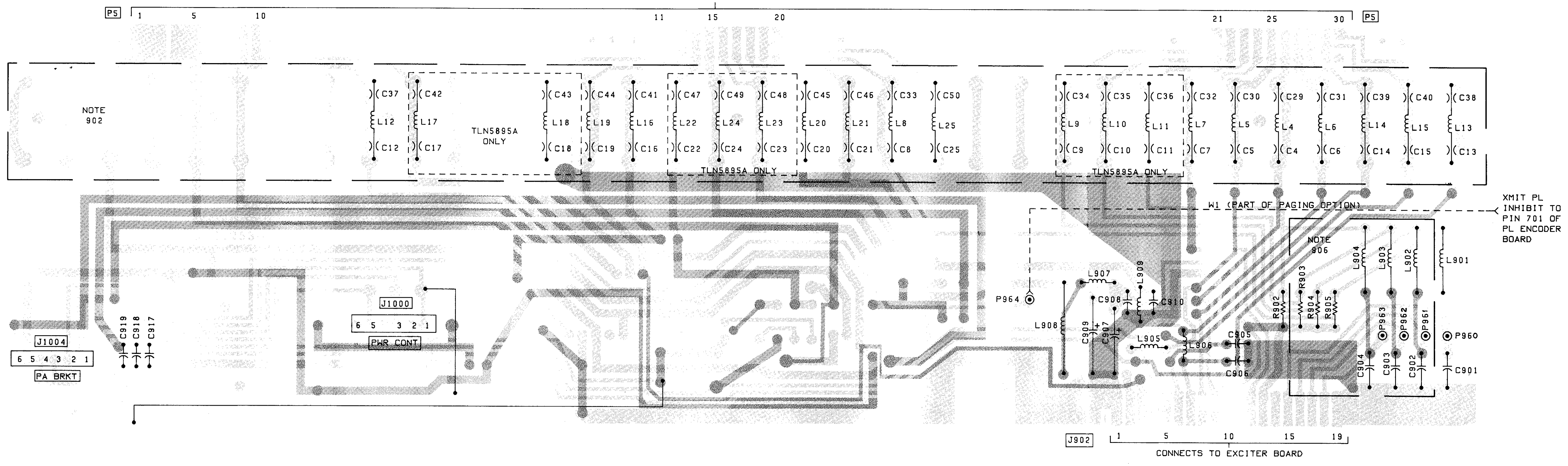
--Routes control functions from the unified chassis interconnect board to the transmitter.

--Repeater version includes unique transmitter filtering components.

--Includes partial control stage circuitry used to govern PA power output

--Includes current limiter stage (base stations only) which is electrically functional with antenna network.

CONNECTS TO UNIFIED CHASSIS INTERCONNECT BOARD



SHOWN FROM SOLDER SIDE

COMPONENT SIDE ® BD-EEPS-22691-O
SOLDER SIDE BD-EEPS-22690-O
OL-EEPS-22692-A

TRANSMITTER INTERCONNECT BOARD

68P81033E78-B
8/23/78-NPC

Model	Frequency
TLD5802B	132-150.8 MHz
TLD5803B	150.8-74 MHz

Technical Characteristics

	Model TLD5802B	Model TLD5803B
Frequency	132-150.8 MHz	150.8-174 MHz
Number of Channels	1 to 4	
Maximum Frequency Separation	±750 kHz	
Oscillator Frequency	11-14.5 MHz	
Freq3uency Multiplication	12 times	
Output Power	400 milliwatts	
Output Impedance	50 ohms	
Modulator Type	Direct FM	
Deviation	±5 kHz, adjustable instantaneous deviation limiting (clear mode)	
Audio Response	6 dB/octave pre-emphasis 300 to 3000 Hz	
Audio Sensitivity	165 millivolts for ±3.0 kHz deviation	
Audio Distortion	Less than 3% at ±3.0 kHz from 300 to 3000 Hz	
Power Requirements	Regulated +9.6 volts dc @ 150 mA +13.6 volts dc @ 100 mA	
Construction Metering	Fully solid-state. Five test points critical to operation and alignment are accessible at a metering receptacle which permits testing with an optional built-in station meter, Motorola portable test set, or 0-50 uA microammeter with 2,000 ohms series resistance.	

1. DESCRIPTION

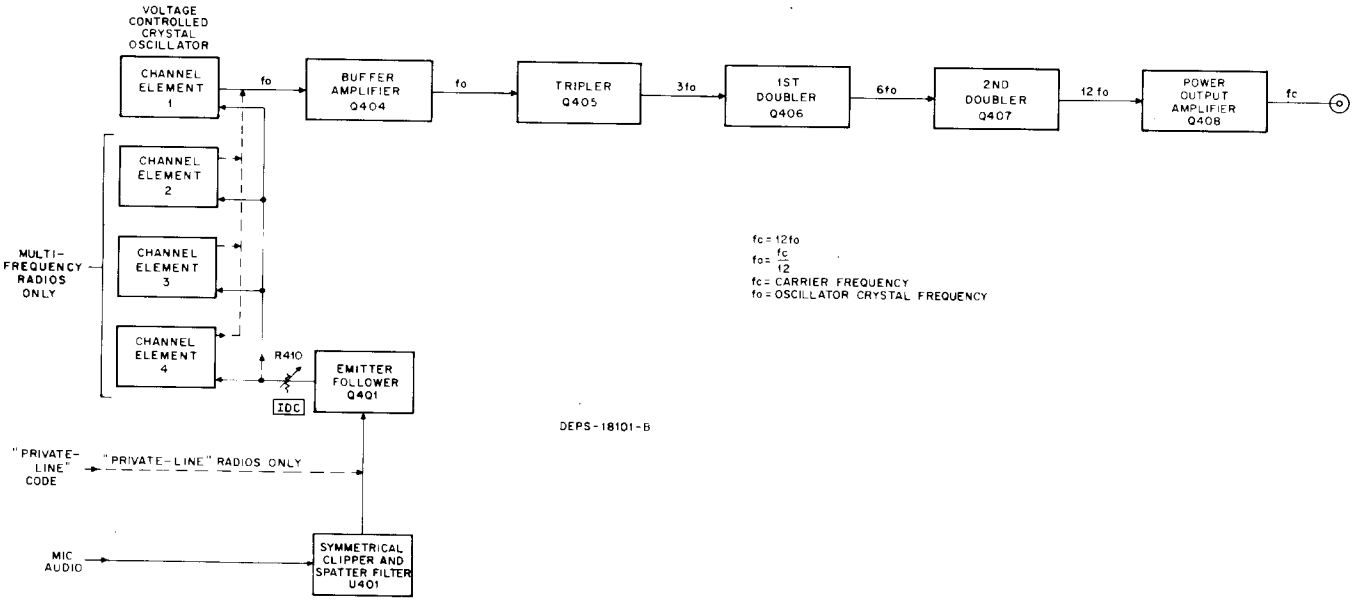
1.1 Models TLD5802B and TLD5803B Exciter provides the low power excitation for an FM transmitter. Up to four plug-in channel elements, one for each transmitter operating frequency, are used to develop a direct FM carrier signal of at least 400 milliwatts.

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

1.3 When the exciter is used in *Private-Line* stations, a *Private-Line* encoder circuit board is plugged directly into the mating pins of the exciter; and one jumper (JU402) is removed from the exciter; no interconnecting wires are used. The exciter board also includes additional pins that permit the board to be used with certain types of optional equipment. These pins are designated P403 on the exciter schematic diagram.

2. FUNCTIONAL OPERATION

Refer to the exciter block diagram and the exciter schematic diagram included in this section.



Exciter Block Diagram

2.1 DEVIATION LIMITING CIRCUIT

2.1.1 Microphone output audio is applied to the symmetrical clipper and splatter filter. This circuit, together with amplifier U401, provides pre-emphasis, amplification, and limiting of the microphone audio. Microphone audio is then applied to emitter follower Q401 (together with PL code) through IDC control to the channel elements.

2.1.2 The output of the emitter follower is developed across IDC potentiometer R410. This audio signal can be monitored at pin 1 of the exciter metering receptacle. The potentiometer adjusts the maximum level of audio coupled to the oscillator-modulator, thus setting the amount of deviation.

2.1.3 In *Private-Line* radios, a low amplitude *Private-Line* code is continuously injected into the oscillator-modulator from the *Private-Line* encoder. This code range will produce 0.5 to 1.0 kHz deviation.

2.2 MODULATOR-OSCILLATOR STAGE (CHANNEL ELEMENT)

2.2.1 The combination modulator-oscillator stage (channel element) produces a low-power crystal frequency signal modulated at an audio rate. This signal is multiplied twelve times and amplified in following stages to produce the carrier signal. The channel element consists of a parallel combination varactor and warping capacitor connected in series with a crystal. A change in capacitance seen at the crystal terminals will cause the crystal to vary its resonant frequency in proportion to the capacitance change. The audio voltage from the audio and IDC circuitry is applied to the varactor to cause a change in capacitance; this variation in turn causes the frequency to change at the same audio rate.

2.2.2 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 (-22°F to +140°F). A variable warp capacitor in the base of each channel element is accessible through a hole in the exciter circuit board for fine frequency adjustment. Each channel element is a factory sealed, plug-in module which provides a train of stable frequency positive pulses.

2.2.3 The exciter accepts up to four channel elements—one channel element is required for each frequency. Only one frequency may be selected at a time, but transmission is possible on as many as four separate frequencies. A power input of +9.6 volts is applied to the channel element(s) continuously while the station is turned ON. Channel element output is developed only when a switched ground generated by the local or remote control unit is present. In single-frequency receivers, this switched ground is applied to a specific channel element as determined by the frequency selector switch associated with the station. An indication of the channel element output is available at pin 2 of the metering socket. This allows channel element operation to be easily checked with optional built-in station metering or with a Motorola Portable test set.

NOTE

If the station is equipped with a time-out timer module and the timer times out, keyed A- is removed from the modulator-oscillator(s) and the entire transmitter is shut down.

2.3 BUFFER AMPLIFIER

The buffer amplifier, Q404, is biased to operate as a Class A amplifier and provides reserve gain to isolate the modulator-oscillator from the succeeding stages.

2.4 MULTIPLIERS AND EXCITER POWER AMPLIFIER

2.4.1 The multipliers develop an output signal that is 12 times the channel element frequency and a final power amplifier gives power gain and matches the output impedance to 50 ohms.

2.4.2 The buffer amplifier output is developed across two parallel resonant tank circuits at the channel element frequency. Tripler Q405 operates as a Class C amplifier with its parallel resonant output tuned to the third harmonic of its input. Thus the output of the tripler is three times the channel element frequency. A meter connected at pin 3 of the metering receptacle measures the average dc base current which is proportional to input signal strength.

2.4.3 The first doubler circuit operates very similar to the tripler except its output is tuned to the second harmonic of its input and its drive is metered at pin 4. The output of the doubler is six times the channel element frequency.

2.4.4 The second doubler circuit also operates similar to the tripler with its output tuned to the second harmonic of its input. The drive to the second doubler is metered on pin 5 of the metering receptacle. The output signal is 12 times the channel element frequency and is the carrier frequency of the transmitter.

2.4.5 The exciter power amplifier also operates as a Class C amplifier. The amplifier provides at least 400 milliwatts of frequency modulated signal at the carrier frequency to the power amplifier section of the transmitter.

3. MAINTENANCE

This section of the manual provides the maintenance shop type procedures for the transmitter exciter circuits in the station. These bench tests include measurements with a built-in station meter or Motorola portable test set, and procedures for testing and troubleshooting; including integrated circuit check-out.

NOTE

The exciter board must be installed in the transmitter for testing to provide the necessary power, ground, control and signal connections. The circuit board should always be secured in place with all mounting screws for operation and testing to provide good rf ground to all stages of the exciter.

3.1 METERING

3.1.1 The exciter is equipped with a metering receptacle which allows five major test points to be measured. The output of the exciter is measured on meter position 5. With the portable test set connected to the metering receptacles, or by using the built-in station metering kit (if so equipped), readings may be made at each of the major test points in the circuit. A failure in almost any portion of the exciter will produce a low or zero meter reading for one or more of the test points. Improper alignment will also cause improper meter readings.

3.1.1.1 USING BUILT-IN STATION METERING

Step 1. The output of the exciter must be terminated into its normal point, the first bandpass filter. The output of the station, through the antenna network, must be terminated in a 50-ohm dummy load or an antenna.

Step 2. Plug the metering plug into the exciter metering recptacle.

Step 3. Turn the station ON.

Step 4. Set the selector switch on the built-in station metering kit to position 1. Key the transmitter and whistle into the microphone long enough to observe the meter reading.

Step 5. Set the selector switch to positions 2, 3, 4 and 5 respectively, keying the transmitter and observing the meter reading for each position (whistling not required). On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the "Performance Tests" paragraph.

3.1.1.2 USING THE PORTABLE TEST SET

To make the measurements using a portable test set, the portable test set must be connected to the station as listed in the following procedure.

Step 1. Connect the 20-pin plug of the test set adapter cable to the test set. When the test set is not in use, disconnect the 20-pin plug to conserve battery life. The plug acts as an on-off switch completing the battery circuit.

Typical Exciter Meter Readings

Selector Switch Position	Reference Switch Position (Test Set Only)	Reading	Circuit Metered	If Low, The Defective Circuit Is
1	A	2 (no mod) 10 (1 rms @ 1 kHz mic input)	Audio output of IDC circuit	IDC circuit
2	A	20	Channel element output.	Channel element
3	A	20	Tripler input	Modulator or Tripler
4	A	15	1st doubler input	Tripler or 1st doubler
5	A	15	2nd doubler input	1st doubler or 2nd doubler

Step 2. Connect the red "control" plug of the adapter cable to the control receptacle on the unified chassis interconnect board. Connect the white "metering" plug of the adapter cable to the metering receptacle on the exciter circuit board.

Step 3. Set the function selector switch of the portable test set to the XMTR position.

Step 4. Set the oscillator and meter reversing switch of the test set to the OFF position.

Step 5. Set the 1 V-100 mV switch on the adapter cable to the 100 mV position (TEK-37). On the later version adapter cable (TEK-37A), the switch is omitted and the unit operates at 100 mV sensitivity.

Step 6. Set the REF A-B switch on the adapter cable to position A.

Step 7. The output of the exciter must be terminated into its normal point, the first bandpass filter. The output of the station, thru the antenna network, must be terminated in a 50-ohm dummy load or an antenna.

Step 8. Turn the station ON.

Step 9. Connect a microphone to the microphone receptacle on the portable test set or to the unified chassis interconnect board.

Step 10. Set the selector switch of the test set to position 1. Using the push-to-talk switch on the microphone, key the transmitter and whistle into the microphone long enough to observe the meter reading.

Step 11. Set the selector switch to positions 2, 3, 4 and 5 respectively, keying the transmitter with the XMTR ON pushbutton on the test set or the push-to-talk switch on the microphone and observing the meter reading for each position. On multi-frequency stations, repeat the readings for each exciter frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows in the "Performance Tests" paragraph.

Step 12. Move the "metering" plug to the power amplifier metering receptacle and observe the meter readings for selector switch position 1. The reference A-B switch must be set to the B position and the meter reversing switch to METER REV.

3.1.2 Each time maintenance is performed on the exciter, the readings should be compared with the previous set of readings. Any degradation of performance will quickly be noted. Often, a lower reading may indicate an impending failure and corrective action may be taken before the circuit fails entirely. The minimum values given in the table may be used if no previous readings are available. However, these readings are an absolute minimum for normal operation and are no substitute for a log of meter readings. A typical exciter may have much higher readings and should not be allowed to drop to these minimum values before corrective action is taken. If a log is maintained, even small drops in meter readings will be noticed. This condition should be interpreted as abnormal operation and corrective action taken (such as realignment) to assure continued peak performance.

3.2 PERFORMANCE TESTS

The performance tests may be used for troubleshooting to isolate the point of abnormal performance. They may also be used after repair and alignment to assure that the exciter meets all specifications before it is returned to service.

3.2.1 Power Output Test

3.2.1.1 SPECIFICATIONS

Step 1. The exciter shall provide at least 400 milliwatts rf output at the assigned frequency.

Step 2. On multi-frequency stations with frequency separation of less than ±750 kHz, at least 400 milliwatts output shall be provided on each channel.

3.2.1.2 PROCEDURE

Step 1. Connect the equipment as connected for Metering, except connect the test set "metering" plug to the exciter metering receptacle.

Step 2. Set the selector switch to position 5. This checks the input to the output of the exciter. A meter reading of at least 20 uA equals an rf signal level of 400 milliwatts.

Step 3. On multi-frequency stations, repeat the test for each exciter frequency. Select the frequency to be tested by the frequency selector switch associated with the station. The test set meter 2 should indicate at least 20 uA for each frequency.

3.2.2 Frequency Test

3.2.2.1 SPECIFICATIONS

The carrier frequency output of the exciter shall be within .0005§ of the assigned frequency for each channel of operation.

3.2.2.2 PROCEDURE

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

Step 2. Key the transmitter to produce an unmodulated carrier signal. Encode††Decode stations require the *DVP* Control to be set at "OFF". In tone-coded *Private-Line* stations disable the *Private-Line* encoder by unplugging the Vibrasender resonant reed. To perform coded modulation tests set *DVP* control to "ON".

NOTE

Do not use the push-to-talk switch on the microphone. Background noise will modulate the signal.

Step 3. Read the transmitter output frequency. On multi-frequency stations, repeat the test for each frequency.

Step 4. If adjustment is required, set the "warp" capacitor on the associated channel element for the assigned frequency output. For best accuracy, the radio set should be brought to room temperature (+70° to 75°F) and the test equipment throughly warmed up. This brings the channel element to the center of its temperature compensation range. Once calibrated at this temperature, it can most accurately compensate for future temperature changes.

3.2.3 Deviation Test

3.2.3.1 SPECIFICATIONS

- The exciter output shall deviate ±5 kHz with a clear audio input of 1 volt @ 1000 Hz.
- Coded voice deviation shall be a constant ±4 kHz regardless of the content of any voice modulation applied to the encoding circuits.
- In *Private-Line* stations, the exciter output shall deviate 0.5 to 1 kHz with *Private-Line* modulation applied.

3.2.3.2 PROCEDURE FOR ENCODE/DECODE STATONS

Step 1. Terminate the station output in an antenna and measure the radiated signal with a deviation meter.

Step 2. In *Private-Line* stations, re-enable PL that was disabled in the previous test. Key the transmitter with only *Private-Line* tone modulation. The deviation meter should indicate 0.5 to 1 kHz.

Step 3. Connect an audio oscillator output to pins 12 and 19 on the Exciter Board. Adjust the audio oscillator to 1000 Hz and 1 volt as measured on an ac voltmeter. The deviation meter should indicate ±5 kHz deviation.

Step 4. 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.

3.2.3.3 PROCEDURE FOR TRANSPARENT STATIONS

Since no local source of coded modulation is available, it is suggested that the coded deviation be checked after the station has been installed, and all audio and control terminations are complete. The station must then be keyed from the console site. Coded data can then be transmitted allowing the deviation to be checked.

3.2.4 Audio Sensitivity Test

3.2.4.1 SPECIFICATION

An audio input of 120 millivolts at 1000 Hz shall produce approximately ±3.0 kHz deviation.

3.2.4.2 PROCEDURE

Step 1. After completion of the Deviation Test, reduce the output of the audio oscillator to 120 millivolts at 1000 Hz.

Step 2. The deviation meter should indicate approximately ±3.0 kHz. Meter position 1 may be noted at this time for future reference. Future audio sensitivity checks may then be made by comparing the meter 1 reading with the reference value.

3.3 TROUBLESHOOTING

3.3.1 Check Input Voltages

3.3.1.1 If there are no test set indications at one or more of the metered points, check the dc input voltages to the exciter circuit board.

P902-11 & 13	+9.6 volts with respect to chassis.
P902-6	Keyed A- (approximately -13.6 volts in respect at A+, pin 7) when keyed.

3.3.1.2 If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

NOTE

In *Private-Line* stations, the transmitter cannot be keyed if the PL encoder is removed unless a jumper (JU401) is connected from pin 8 to pin 10 of the exciter to complete the keying circuit. This jumper is permanently connected in exciters for non- *Private-Line* operation.

NOTE (Cont'd.)

3.3.2 Alignment as a Troubleshooting Technique

Low test set readings, low power output, and subnormal performance are very often corrected by realignment. Therefore, alignment should be the first troubleshooting step performed for these symptoms. Many technicians prefer to use alignment as the first troubleshooting step in all cases. During the alignment procedure, any trouble caused by a defective component will be discovered and corrected before alignment can be completed.

3.3.3 Isolating Defective Components

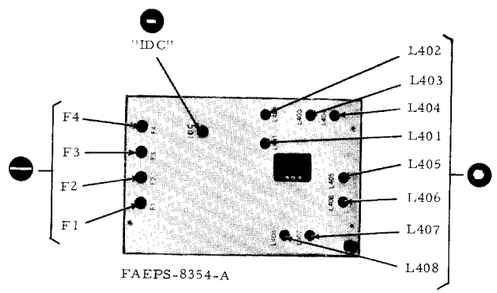
If test set readings are abnormal or tests indicated subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The meter readings and results of performance tests usually localize the malfunction to one or two specific stages. A zero meter reading indicates either (1) no drive from the preceding stages, or (2) a defective component in the metering circuit which includes the base-emitter junction of the following transistor which operates as a rectifier. The accompanying troubleshooting chart summarizes these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component. Note that the final amplifier stage of the exciter is powered by A+ and keyed A- and voltages should be checked in respect to keyed A- instead of chassis ground.

ALIGNMENT PROCEDURE

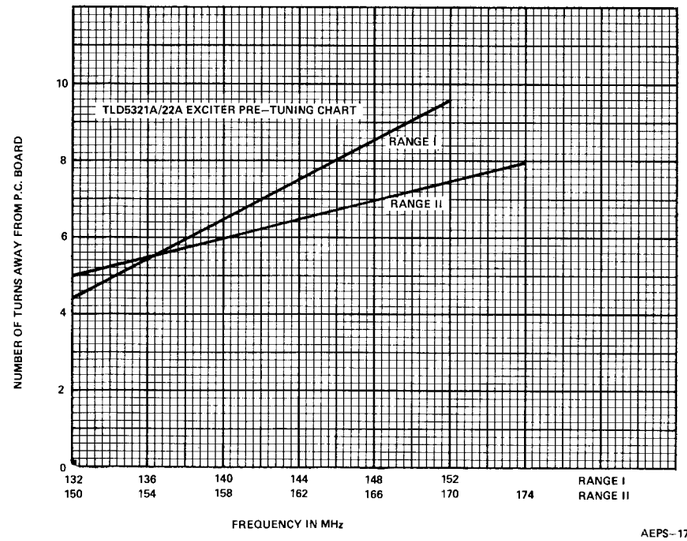
STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	METER REV. SWITCH AND REF A-B SWITCH (SEE NOTE)	STAGE AND PROCEDURE
1					SET UP - Key the transmitter with the XMTR ON pushubtton on the portable test set.
2	POWER SET				OUTPUT - Turn the POWER SET control fully counterclockwise. Unkey the transmitter.
3	FRE-QUENCY SWITCH	EXCITER	2	OFF REF A	CHANNEL ELEMENT - Select the desired frequency on multi-frequency stations. Key the transmitter. The test set meter 2 should indicate at least 10 uA.
4	ALL EXCITER COILS	EXCITER	5	OFF REF A	PRE-ALIGNMENT - If the exciter is completely untuned and shows no meter 5 readings, set cores of tuning coils L401 to L406 to the top of their coil forms (away from circuit board). Set cores of L407 and L408 per the exciter pre-tuning chart. If a meter 5 reading is available proceed to step 7.
5	L401	EXCITER	2	OFF REF A	BUFFER OUTPUT - Tune L401 for minimum meter reading.
6	L401, L402	EXCITER	3	OFF REF A	BUFFER OUTPUT - Tune L402 and then L401 for peak meter reading.
7	L403	EXCITER	3	OFF REF A	TRIPLER OUTPUT - Tune L403 for minimum meter reading.
8	L403, L404	EXCITER	4	OFF REF A	TRIPLER OUTPUT - Tune L404 and then L403 for peak meter reading.
9	L405	EXCITER	4	OFF REF A	FIRST DOUBLER OUTPUT - Tune L405 for minimum meter reading.
10	L405, L406	EXCITER	5	OFF REF A	SECOND DOUBLER OUTPUT - Tune L406, and then L405 for peak meter reading.
11	L407 L408	EXCITER	5	OFF REF A	EXCITER OUTPUT - Tune L407 then L408 for peak meter reading.
12	L407, L408	PA	1	METER REV REF A	EXCITER OUTPUT - Move the metering plug to the PA. Tune L408 and then L407 for peak meter reading.
13					Repeat steps 6, 8 and 10.
14					Align the power amplifier.

METERING NOTE

Alignment may be performed using a Motorola S1056B thru S1059B Portable Test Set or optional built-in station metering. The OSC. & METER REV. SWITCH column refers to portable test set usage -- polarity is automatically reversed as required when built-in station metering is used. All meter readings are based on a two-thousand ohm (2000_{Ω}) equivalent series resistance in the meter. Therefore, meters not having a two-thousand ohm series resistance must have their readings corrected.



FAEPS-8354-A



AEPS-17626-O

OSCILLATOR FREQUENCY ADJUSTMENT

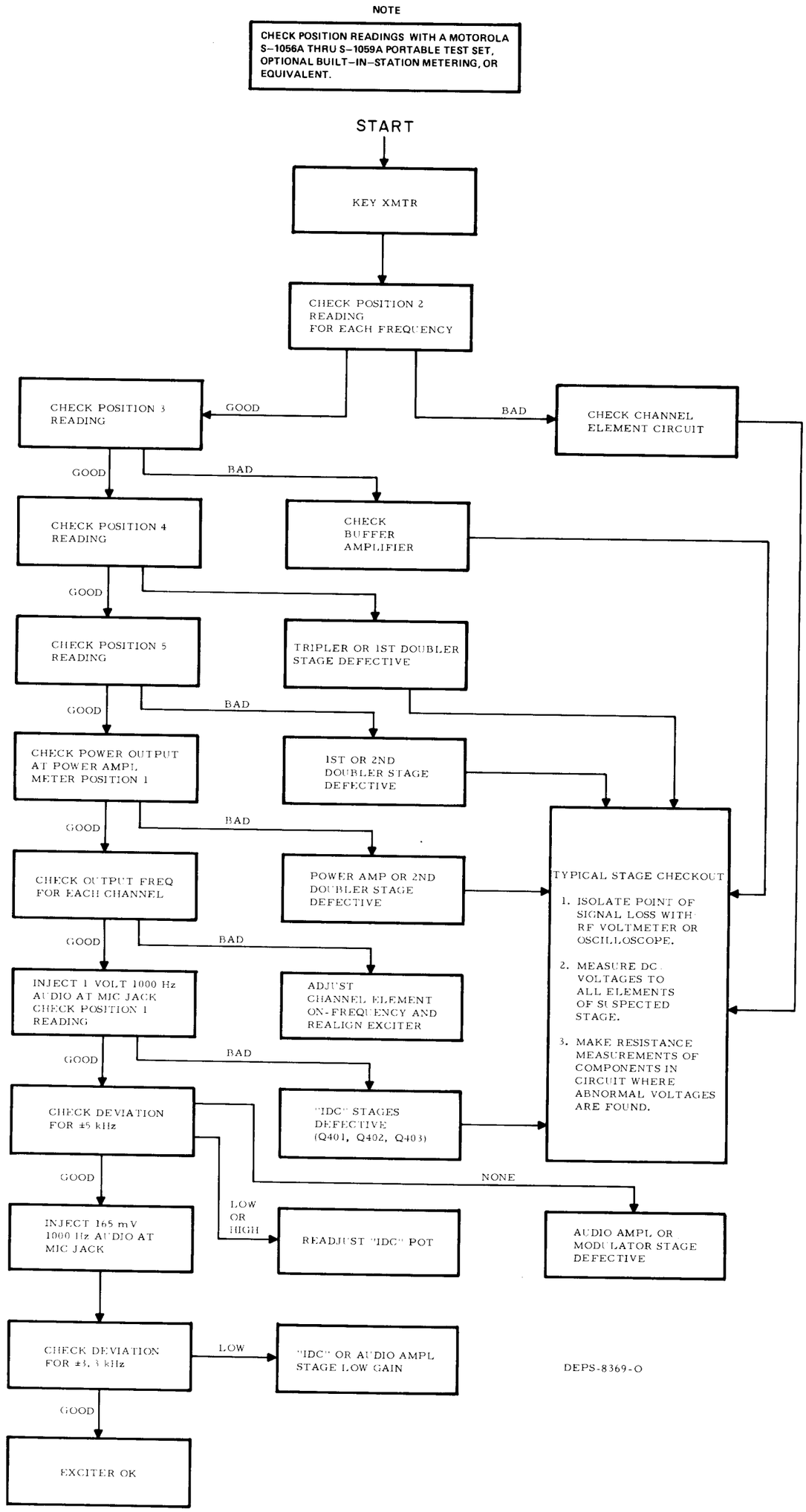
1. Key the transmitter with no modulation (key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the microphone). On "Private-Line" stations, unplug the "Vibrasender" resonant reed from the PL tone generator. On "Digital Private-Line" stations short together the code disable pins on the "Digital Private-Line" encoder board.
2. Adjust the channel element warp capacitor for the selected channel to the exact desired frequency. On single-frequency models, adjust the F1 channel element warp capacitor. On multi-frequency models, adjust the warp capacitor which corresponds to the frequency selector switch setting; repeat for each frequency.

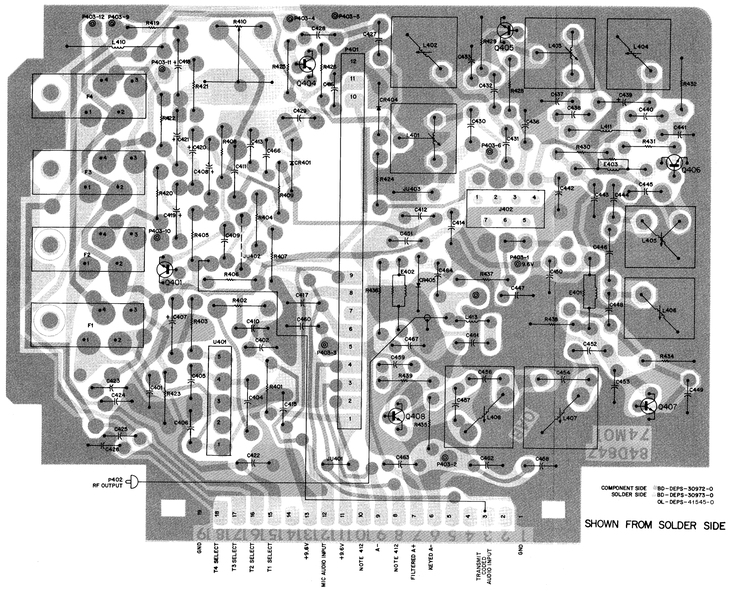
"IDC" ADJUSTMENT PROCEDURES

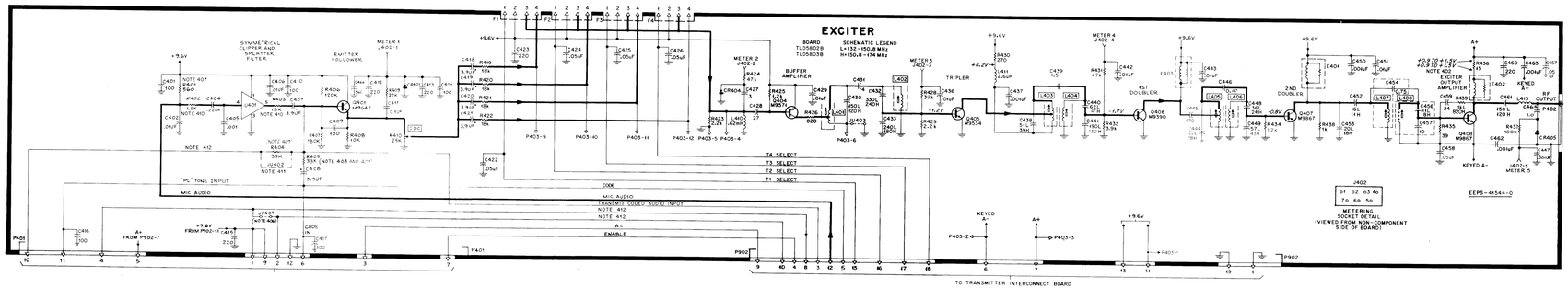
NOTE

For "Digital Private-Line" stations, deviation must be measured with a Motorola R1200 Service Monitor with RTC4000A Deviation Meter Plug-In Module that has been modified for frequency response of less than 1 Hz, or equivalent.

1. Each channel element must be "warped" on frequency before setting "IDC". Connect the audio oscillator to the exciter input (pins 1, gnd. and 12, audio high).
2. Set the audio oscillator to 1000 Hz and 1 volt. On tone "Private-Line" models, replace the "Vibrasender" resonant reed. On "Digital Private-Line" models, remove the short from the code disable pins.
3. Key the transmitter and adjust the IDC control for ±5 kHz deviation.
4. Reduce the tone oscillator output to .25 volt. Essentially full deviation should still be indicated. Less than full deviation may indicate a weak audio stage.


NOTE
CHECK POSITION READINGS WITH A MOTOROLA S-1056A THRU S-1059A PORTABLE TEST SET, OPTIONAL BUILT-IN-STATION METERING, OR EQUIVALENT.
START
KEY XMTR
CHECK POSITION 2 READING FOR EACH FREQUENCY
GOOD
BAD
CHECK POSITION 3 READING
CHECK CHANNEL ELEMENT CIRCUIT
GOOD
BAD
CHECK POSITION 4 READING
CHECK BUFFER AMPLIFIER
GOOD
CHECK POSITION 5 READING
TRIPLER OR 1ST DOUBLER STAGE DEFECTIVE
GOOD
BAD
CHECK POWER OUTPUT AT POWER AMPL METER POSITION 1
1ST OR 2ND DOUBLER STAGE DEFECTIVE
GOOD
BAD
CHECK OUTPUT FREQ FOR EACH CHANNEL
POWER AMP OR 2ND DOUBLER STAGE DEFECTIVE
GOOD
BAD
INJECT 1 VOLT 1000 Hz AUDIO AT MIC JACK CHECK POSITION 1 READING
ADJUST CHANNEL ELEMENT ON-FREQUENCY AND REALIGN EXCITER
GOOD
BAD
CHECK DEVIATION FOR ±5 kHz
"IDC" STAGES DEFECTIVE (Q401, Q402, Q403)
TYPICAL STAGE CHECKOUT
1. ISOLATE POINT OF SIGNAL LOSS WITH RF VOLTMETER OR OSCILLOSCOPE.
2. MEASURE DC VOLTAGES TO ALL ELEMENTS OF SUSPECTED STAGE.
3. MAKE RESISTANCE MEASUREMENTS OF COMPONENTS IN CIRCUIT WHERE ABNORMAL VOLTAGES ARE FOUND.
GOOD
LOW OR HIGH
NONE
INJECT 165 mV 1000 Hz AUDIO AT MIC JACK
READJUST "IDC" POT
AUDIO AMPL OR MODULATOR STAGE DEFECTIVE
CHECK DEVIATION FOR ±3.3 kHz
LOW
"IDC" OR AUDIO AMPL STAGE LOW GAIN
GOOD
EXCITER OK
DEPS-8369-O





NOTES:

401. Transmitter Frequency Calculation:

$$fo = \frac{fc}{12} \qquad fc = fo\ 12$$

Where:
fo = Channel Element Frequency
fc = Carrier Frequency

402. Voltage measured across R436.

403. High impedance transistorized voltmeters (11 megohm) not recommended.

404. Unless otherwise stated, voltages measured in respect to chassis ground.

405. Unless otherwise stated, capacitor values are in picofarads.

406. JU401 removed in *Private-Line* and *PURC* paging radios.

407. R401 removed in remote control stations.

408. R405 is removed unless code inputs are applied via P401-6 or P902-5.

409. R404 and R405 are factory selected so that *Private-Line* deviation falls between 500 Hz and 1000 Hz limits.

410. R402 and R403 removed only in flat audio stations.

411. JU402 is added when flat audio board is used.

412.

With PL Squelch Signal Name	With Flat Audio Option Signal Name
P401-10 Code Input	IDC Limited Flat Audio
P401-4, 902-8 Delayed Keyed A +	Flat Audio
P401-2, 902-10 Keyed A +	Flat Audio Control

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLD5800B Series Exciter
Schematic Diagram and Circuit Board Detail
Motorola No. ***PEPS-25498-B***
5/30/85- ***UP***

parts list

TLD5802B Exciter (132-150.8 MHz) = L
TLD5803B Exciter (150.8-174 MHz) = H

PL-9626-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
This parts list covers two models of the high band Exciter Board. Where differences exist a letter suffix L or H is added to the reference symbol to show the applicable unit.		
		capacitor, fixed: pF ±5%; 500 V unless otherwise stated
C401	21-831125	100 ±10%; 300 V
C402	21-83596E21	.01 uF +80-20%; 200 V
C403		NOT USED
C404	8-82905G11	.22 uF ±10%; 50 V
C405	21-83596E13	.001 uF ±10%; 100 V
C406	21-83596E21	.01 uF +80-20%; 200 V
C407, 408	23-84762H08	3.9 uF ±20%; 15 V
C409, 410	21-831125	100 ±10%; 300 V
C411	21-82372C03	0.1 uF +80-20%; 25 V
C412, 413, 415	21-83596E10	220 ±20%
C414, 416, 417	21-831125	100 ±10%; 300 V
C418 thru 421	23-84762H08	3.9 uF ±20%; 15 V
C422	21-82372C10	.05 uF +80-20%; 25 V
C423	21-83596E10	220 ±10%
C424, 425, 426	21-82872C10	.05 uF +80-20%; 25 V
C427	21-83406D51	3 ±0.25 pF
C428	21-83406D68	27; 500 V
C429	21-83596E21	.01 uF +80-20%; 200 V
C430L	21-84494B07	150
C430H	21-84494B06	120
C431	21-83406D54	4 ±0.25 pF
C432L	21-84494B16	330
C432H	21-84494B13	240
C433L	21-84494B13	240
C433H	21-84494B46	180 ±3%
C434, 435		NOT USED
C436	21-83596E21	.01 uF +80-20%; 200 V
C437	21-83596E13	.001 uF ±10%; 100 V
C438L	21-84494B01	51
C438H	21-84494B24	39
C439	21-861453	1.5 ±10%
C440L	21-852322	62
C440H	21-868681	47
C441L	21-84494B10	190
C441H	21-861601	130
C442, 443	21-83596E21	.01 uF +80-20%; 200 V
C444L	21-84493B26	22
C444H	21-83406D55	18
C445	21-82187B45	470 ±10%
C446	21-82450B37	0.47
C447	21-83596E13	.001 uF ±10%; 100 V
C448L	21-83406D92	36
C448H	21-83406D56	24
C449L	21-84493B31	57; 200 V
C449H	21-84494B28	43
C450	21-83596E13	.001 uF ±10%; 100 V
C451	21-83596E21	.01 uF +80-20%; 200 V
C452L	21-83406D93	16
C452H	21-83406D90	11
C453L	21-83406D81	20
C453H	21-83406D55	18
C454	21-82450B06	0.75 ±10%
C455		NOT USED
C456L	21-83406D90	11
C456H	21-83406D70	8 ±0.5 pF
C457	21-83406D89	10 ±0.5 pF
C458	21-82372C10	.05 ±20%; 25 V
C459	21-840365	24; NP0
C460	21-83596E10	220 ±20%
C461L	21-84494B07	150
C461H	21-84494B06	120
C462, 463	21-83596E13	.001 uF ±10%; 100 V
C464	21-82355B62	1.0
C465		NOT USED
C466	21-82187B06	560
C467	21-82372C10	.05 ±20%; 25 V
		diode: (see note)
CR401	48-863030	germanium
CR402, 403		NOT USED
CR404, 405	48-82139G01	germanium
		coil, rf:
E401	24-84392B06	40 turns on 820 ohm resistor
E402L	24-84392B13	15 turns on 560 ohm resistor
E402H	24-84392B05	9 turns on 560 ohm resistor
E403L	24-84392G18	40 turns on 10k ohm resistor
E403H	24-82835G08	2.7 uH coded RED-BLU-GLD
		connector, receptacle:
J401		NOT USED
J402	9-84207B01	7 contacts
		coil, rf:
L401	24-84389B02	18-2/3 turns; coded BLK
L402	24-84389B01	18-1/2 turns; coded YEL
L403	24-84389B06	8-2/3 turns; coded GRN
L404	24-84389B05	8-1/2 turns; coded RED
L405	24-84972A33	6-1/2 turns; coded RED
L406	24-84972A09	6-1/2 turns; coded YEL
L407, 408	24-84972A11	3-1/2 turns; coded GRN
L409		NOT USED
L410	24-80900A61	0.62 mH
L411	24-82835G08	2.6 uH; coded RED-BLU-GLD
L412		NOT USED
L413H	24-84923C01	1-1/2 turns
L413L	24-84923C04	2-1/2 turns
		connector, plug:
P401		part of printed circuit board
P402	28-84282D01	phono
P403, 902		part of printed circuit board
		transistor: (see note)
Q401	48-869642	NPN; type M9642
Q402, 403		NOT USED
Q404	48-869571	PNP; type M9571
Q405	48-869534	NPN; type M9534
Q406	48-869390	NPN; type M9390
Q407, 408	48-869867	NPN; type M9867
		resistor, fixed: ±5%; 1/4 W unless otherwise stated
R401	6-124A43	560
R402	6-124A53	1.5k
R403	6-124A79	18k
R404	6-124A87 or 6-124A89	39k 47k (factory selected for DPL models only)
R405	6-124A85 or 6-124A89	33k 47k (factory selected for PL models only)
R406	6-124A99	120k
R407	6-124B04	180k
R408	6-124A73	10k
R409	6-124A83	27k
R410	18-83083G24	variable: 25k ±30%
R411 thru 418		NOT USED
R419	6-124A79	18k%
R423	6-124A57	2.2k
R424	6-124A85	33k
R425	6-124A51	1.2k
R426	6-124A47	820
R427		NOT USED
R428	6-124A87	39k
R429	6-124A57	2.2k
R430	6-124A35	270
R431	6-124A89	47k
R432	6-124A63	3.9k
R433		NOT USED
R434	6-124A51	1.2k
R435	6-124A15	39
R436	6-125C05	15 ±10%; 1/2 W
R437	6-124A97	100k
R438	6-124A49	1k
R439L	6-124A49	1k
R439H	6-124A47	820
		symmetrical clipper and splatter filter:
U401	1-80726D74	potted unit
		non-referenced items
	14-861196	INSULATOR, transistor; 2 req'd. (used with Q407 & Q408)
	26-83379H01	HEAT SINK (used with Q408)
	26-84598A01	SHIELD, coil; 2 req'd. (used with L405, L406)
	26-84598A02	SHIELD, coil; 4 req'd. (used with L401 thru L404)
	26-84250B14	SHIELD, coil; 2 re'd. (used with L407, L408)
	42-84284B01	RETAINER: 4 req'd.
	3-139506	HEX LOCK; 4-40 x 5/8"; 4 req'd. (used for mounting Retainers)
	55-84300B01	HANDLE
	30-83794C01	CABLE, coaxial; 6" req'd. (used with P402)
	29-84028H01	TERMINAL, pin; 19 req'd.
	29-84028H02	TERMINAL, pin; 12 req'd.
	29-855943	TERMINAL, pin; 16 req'd.
	39-10184A10	CONTACT, terminal; 10 req'd.

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

90/100/110 W POWER AMPLIFIER

MODEL CHART

TLD1682B	132-150.8 MHz	INTERMITTENT DUTY
TLD1683C	150.8-162 MHz	
TLD1684C	162-174 MHz	
TLD1692D	132-150.8 MHz	CONTINUOUS DUTY
TLD1693E	150.8-162 MHz	
TLD1694E	162-174 MHz	

TECHNICAL CHARACTERISTICS*

RF Power In	400 mW
Input Impedance	50 ohms
RF Power Out	90 W Continuous & Intermittent
	100 W Continuous
	110 W Intermittent
Output Impedance	50 ohms
Power Requirements	12.8 volts @20.5 amps

*All values are typical

1. DESCRIPTION

Motorola's "Micor" power amplifiers provide the following features:

-A minimum of 110 W (intermittent duty) or 100 W (continuous duty) rf output.

-All circuitry except power transistors (and control stage transistor in continuous duty stations) contained on one double-sided circuit board.

-Power transistors mounted directly to (but electrically isolated from) the heat sink.

-RF connections made through two coaxial connections which plug directly into the input and output filter assemblies located below the heat sink shelf.

-DC power supplied via two feed-through capacitors that also provide filtering.

-Input, output and most other interstage matching (with the exception of a single fixed-tuned matching network between the controlled amplifier stage and the pre-driver stage) is accomplished by the use of rf transformers wound around ferrite cores. Only two tuning adjustments are required due to the relatively broadband matching characteristics of the ferrite transformers and the low inductance leads of the silicon opposed emitter transistors.

-One metering socket, which is accessible from the component side of the circuit board allows four major test points to be monitored and permits measurement of the dc current drawn by the final amplifier stage.

MOTOROLA INC.
Communications Division

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

-Due to the heat sink mounting requirements for this board, servicing is accomplished from the component side of the board.

-Diode protection against reverse polarity voltage (board mounted diode).

-Output protection provided by a control stage transistor driven by power control circuit. (Controls gain of the first stage). In intermittent duty stations, a single-wire connection provides interconnection between power control and PA circuitry. In continuous duty stations three wire connections provide the interconnection.

2. FUNCTIONAL OPERATION

Refer to the block diagram, Figure 1, and the schematic diagram. This series of power amplifiers requires a 400 mW rf input from the exciter board. This input is passed through a bandpass filter assembly and a ferrite step-down transformer (to match the input impedance to the first stage) to the gain-controlled amplifier stage. The external power control circuit which drives the control stage transistor determines the gain of this stage. The power control circuit monitors the output of the final stages of the power amplifier, the load condition and the heat sink temperature.

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

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

3. MAINTENANCE

a. General

NOTE

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

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

CAUTION

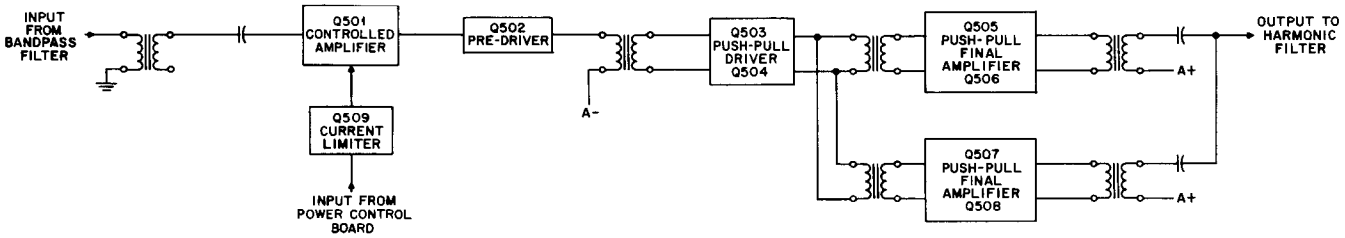
The PA board must be installed in the transmitter for testing to provide the necessary power, ground, control, heat sinking and signal connections.

b. Recommended Test Equipment

The following test equipment is the minimum required for troubleshooting and adjusting the PA. All such equipment is battery operated which permits testing to be performed in the field where no commercial power is available for bench type test equipment. Option built-in station metering when incorporated takes the place of the portable test set.

(1) Motorola S1056B through S1059B Portable Test Set and Model TEK-37 or TEK-37A Adapter Cable. The portable test set is required for checking each stage for proper operation.

(2) A Motorola Solid-State DC Multimeter or a 20,000 ohm-per-volt multimeter should be used, however a low impedance multimeter is acceptable for dc voltage measurements only.



69D84008E43-A

Figure 1. Block Diagram

(3) Motorola T1013A RF Load Resistor (dummy load) or equivalent.

c. Test Set Metering

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

(1) Using the Optional Built-In Station Meter

This procedure is valid only with intermittent duty station. Continuous duty stations with built-in station metering measure only exciter output (PA input), PA current, and PA voltage.

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

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

--The antenna load.

--A dummy load such as Motorola's T1013A RF Load Resistor.

--An RF Wattmeter.

NOTE

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

c. Turn the station ON.

d. With the meter selector switch set to position 1, key the transmitter and observe the meter. Unkey the transmitter.

Set the selector switch to position 2, 3, and 4 keying the transmitter and observing the meter reading for each. On multi-frequency stations, repeat the readings for each frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows the "Using the Portable Test Set" paragraphs.

(2) Using the Portable Test Set

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

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

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

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

d. Connect the red "control" plug of the adapter cable to the control receptacle on the local or remote control board. Connect the white "metering" plug of the adapter cable to the receptacle on the PA circuit board.

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

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

--The antenna load.

--A dummy load such as Motorola's T1013A RF Load Resistor.

--An RF Wattmeter.

NOTE

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

g. Turn the station ON.

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

i. Set the selector switch to positions 2, 3, & 4; then switch to reference position B and meter position 5 respectively, keying the transmitter and observing the meter reading for

each. On multi-frequency stations, repeat the readings for each frequency. An analysis of the meter readings for determining whether each circuit is good or bad follows.

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

d. Performance Tests

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

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

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

(2) Key the transmitter and observe power out, which should be 90, 100, or 110 watts, depending upon licensing.

MINIMUM PA METER READINGS

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION PORTABLE TEST SET ONLY	MINIMUM METER READINGS	CIRCUIT METERED	IF LOW, DEFECTIVE CIRCUIT IS: (SEE TROUBLESHOOTING CHARTS)
1	A	15 uA	Exciter Output (input to Controlled Amplifier Q501)	Exciter output, input circuitry of controlled amplifier stage Q501
2	A	5 uA	Input of Predriver Stage (Q502)	Output of controlled amplifier stage input circuitry of predriver stage
3	A	12 uA (100 W/ 110 W) 10 uA (90 W)	Input of Final Amplifier Stage Q505, Q506	Input of Q505, Q506 stages, output of driver stage (Q502, Q503), output of predriver stage Q502
4	A	12 uA (100 W/ 110 W) 10 uA (90 W)	Input of Final Amplifier Stage Q507, Q508	Input of Q507, Q508 stage output of driver stage Q502, Q503. Output of predriver stage Q502
5 (or 2 SEE NOTE)	B	21 uA min. / 27 uA max. — 90 W 23 uA min. / 37 uA max. — 100 W / 110 W	Total Current in Final Amplifier Stages Q505, Q506, Q507, Q508	Output of final amplifier stages Q505-Q508, power control board antenna switch, antenna.
6 (or 3 SEE NOTE)	B	12 V (0-30 V scale)	Final Amplifier Stage	Final amplifier stage A+ or A- input

NOTE

When optional built-in station metering is used in continuous duty stations, only exciter output (PA input), final PA current, and final PA voltage may be checked. Selector switch position functions change to:

SELECTOR SWITCH POSITION	FUNCTION METERED
1	PA input
2	PA current
3	PA voltage
4	Forward power monitor
5	Reflected power monitor
6	Control voltage

(3) If necessary, adjust POWER SET control for rated power output.

CAUTION

The PA shield must always be in place during operation of the radio set and should be kept in place as much as possible while testing and trouble-shooting. The circuit board must always be secured in place with all mounting screws. The transistors (including the control stage transistor) must be secured in place to provide proper heat sinking, and the feedthrough connectors must be soldered in place to provide dc power and good rf grounding.

4. TROUBLESHOOTING

If a problem has been localized to the PA decks, several checks can be made prior to extensive troubleshooting.

a. Visual

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

b. Voltage Checks

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

c. Troubleshooting

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

CAUTION

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

The schematic diagram of the PA board contains the voltage readings required for troubleshooting. The readings are typical for normal operating conditions at rated power output for the radio. Refer to the troubleshooting chart, and the schematic when a defect is suspected in the PA board.

5. PA REPAIR NOTES

a. Resistance Measurement of Transistors in Push-Pull Pairs

Due to the fact that transistors in push-pull pairs are dc connected at both base and emitter,

BOTH devices should be measured when a defect in the pair is suspected.

b. Transistor Removal Procedure

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

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

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

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

c. Transistor Installation Procedure

(1) Pre-tin underside of each transistor lead.

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

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

(4) Screw down the two mounting screws securely.

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

d. Procedures for Resistance Measurements of Transistors

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

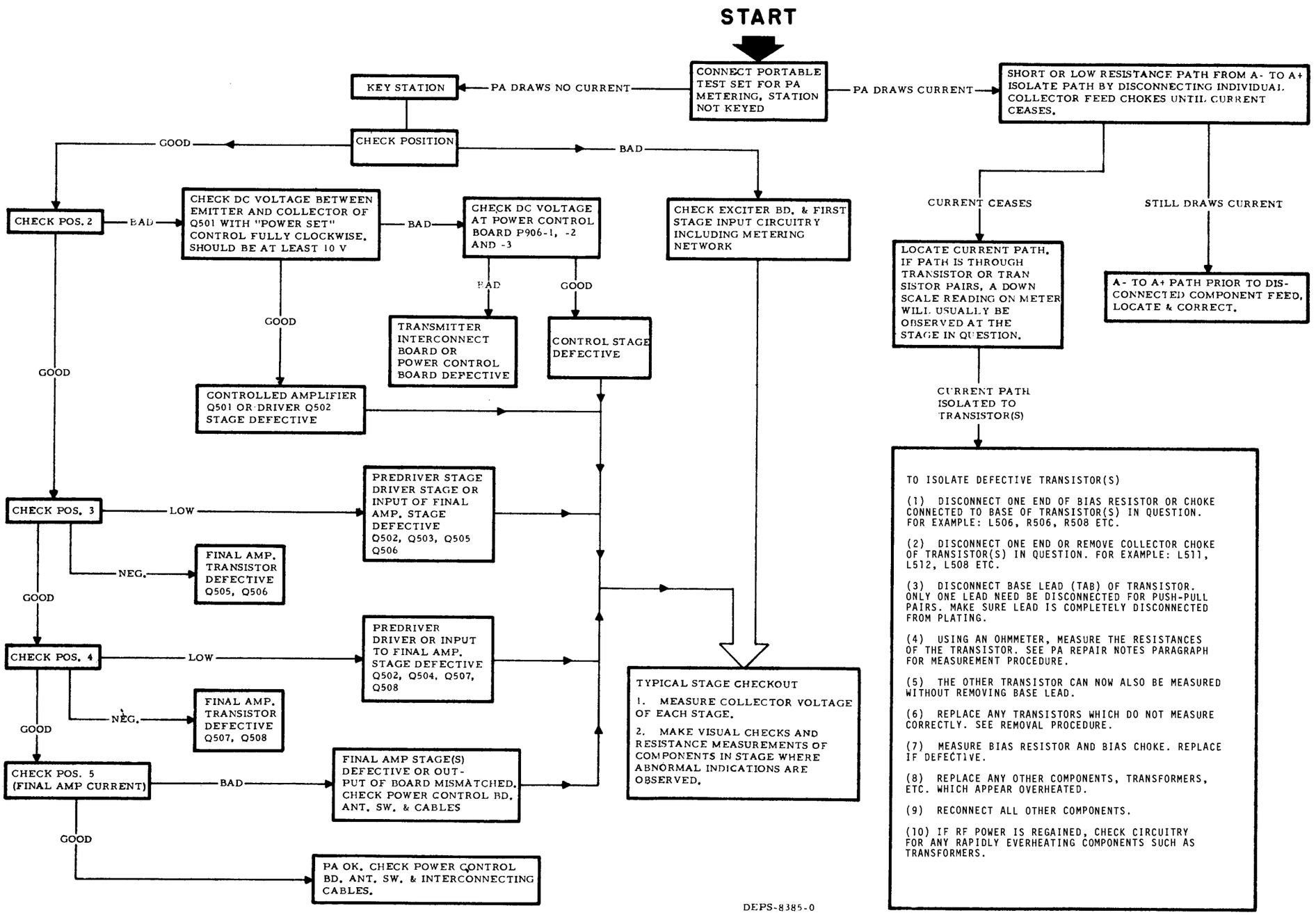
(2) Measure the resistance from lead to lead as described:

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

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

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

Should any indication be observed in measurements (a) or (c), the transistor is defective and should be replaced.


START
CONNECT PORTABLE TEST SET FOR PA METERING, STATION NOT KEYED
PA DRAWS NO CURRENT
KEY STATION
PA DRAWS CURRENT
SHORT OR LOW RESISTANCE PATH FROM A- TO A+ ISOLATE PATH BY DISCONNECTING INDIVIDUAL COLLECTOR FEED CHOKES UNTIL CURRENT CEASES.
CHECK POSITION
GOOD
BAD
CHECK POS. 2
BAD
CHECK DC VOLTAGE BETWEEN EMITTER AND COLLECTOR OF Q501 WITH "POWER SET" CONTROL FULLY CLOCKWISE. SHOULD BE AT LEAST 10 V
BAD
CHECK DC VOLTAGE AT POWER CONTROL BOARD P906-1, -2 AND -3
CHECK EXCITER BD. & FIRST STAGE INPUT CIRCUITRY INCLUDING METERING NETWORK
CURRENT CEASES
STILL DRAWS CURRENT
LOCATE CURRENT PATH. IF PATH IS THROUGH TRANSISTOR OR TRAN SISTOR PAIRS, A DOWN SCALE READING ON METER WILL USUALLY BE OBSERVED AT THE STAGE IN QUESTION.
A- TO A+ PATH PRIOR TO DISCONNECTED COMPONENT FEED, LOCATE & CORRECT.
GOOD
BAD
GOOD
TRANSMITTER INTERCONNECT BOARD OR POWER CONTROL BOARD DEFECTIVE
CONTROL STAGE DEFECTIVE
GOOD
CONTROLLED AMPLIFIER Q501 OR DRIVER Q502 STAGE DEFECTIVE
CURRENT PATH ISOLATED TO TRANSISTOR(S)
GOOD
CHECK POS. 3
LOW
PREDRIVER STAGE DRIVER STAGE OR INPUT OF FINAL AMP. STAGE DEFECTIVE Q502, Q503, Q505 Q506
NEG.
FINAL AMP. TRANSISTOR DEFECTIVE Q505, Q506
GOOD
CHECK POS. 4
LOW
PREDRIVER DRIVER OR INPUT TO FINAL AMP. STAGE DEFECTIVE Q502, Q504, Q507, Q508
NEG.
FINAL AMP. TRANSISTOR DEFECTIVE Q507, Q508
GOOD
CHECK POS. 5 (FINAL AMP CURRENT)
BAD
FINAL AMP STAGE(S) DEFECTIVE OR OUT-PUT OF BOARD MISMATCHED. CHECK POWER CONTROL BD. ANT. SW. & CABLES
GOOD
PA OK. CHECK POWER CONTROL BD. ANT. SW. & INTERCONNECTING CABLES.
TYPICAL STAGE CHECKOUT
1. MEASURE COLLECTOR VOLTAGE OF EACH STAGE.
2. MAKE VISUAL CHECKS AND RESISTANCE MEASUREMENTS OF COMPONENTS IN STAGE WHERE ABNORMAL INDICATIONS ARE OBSERVED.
TO ISOLATE DEFECTIVE TRANSISTOR(S)
(1) DISCONNECT ONE END OF BIAS RESISTOR OR CHOKE CONNECTED TO BASE OF TRANSISTOR(S) IN QUESTION. FOR EXAMPLE: L506, R506, R508 ETC.
(2) DISCONNECT ONE END OR REMOVE COLLECTOR CHOKE OF TRANSISTOR(S) IN QUESTION. FOR EXAMPLE: L511, L512, L508 ETC.
(3) DISCONNECT BASE LEAD (TAB) OF TRANSISTOR. ONLY ONE LEAD NEED BE DISCONNECTED FOR PUSH-PULL PAIRS. MAKE SURE LEAD IS COMPLETELY DISCONNECTED FROM PLATING.
(4) USING AN OHMMETER, MEASURE THE RESISTANCES OF THE TRANSISTOR. SEE PA REPAIR NOTES PARAGRAPH FOR MEASUREMENT PROCEDURE.
(5) THE OTHER TRANSISTOR CAN NOW ALSO BE MEASURED WITHOUT REMOVING BASE LEAD.
(6) REPLACE ANY TRANSISTORS WHICH DO NOT MEASURE CORRECTLY. SEE REMOVAL PROCEDURE.
(7) MEASURE BIAS RESISTOR AND BIAS CHOKE. REPLACE IF DEFECTIVE.
(8) REPLACE ANY OTHER COMPONENTS, TRANSFORMERS, ETC. WHICH APPEAR OVERHEATED.
(9) RECONNECT ALL OTHER COMPONENTS.
(10) IF RF POWER IS REGAINED, CHECK CIRCUITRY FOR ANY RAPIDLY EVERHEATING COMPONENTS SUCH AS TRANSFORMERS.

DEPS-8385-0

NOTE

Alignment may be performed using a Motorola S1056B thru S1059B Portable Test Set or optional built-in station metering. The OSC. & METER REV. SWITCH column refers to portable test set usage - - polarity is automatically reversed as required when built-in station metering is used.

EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

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.
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:

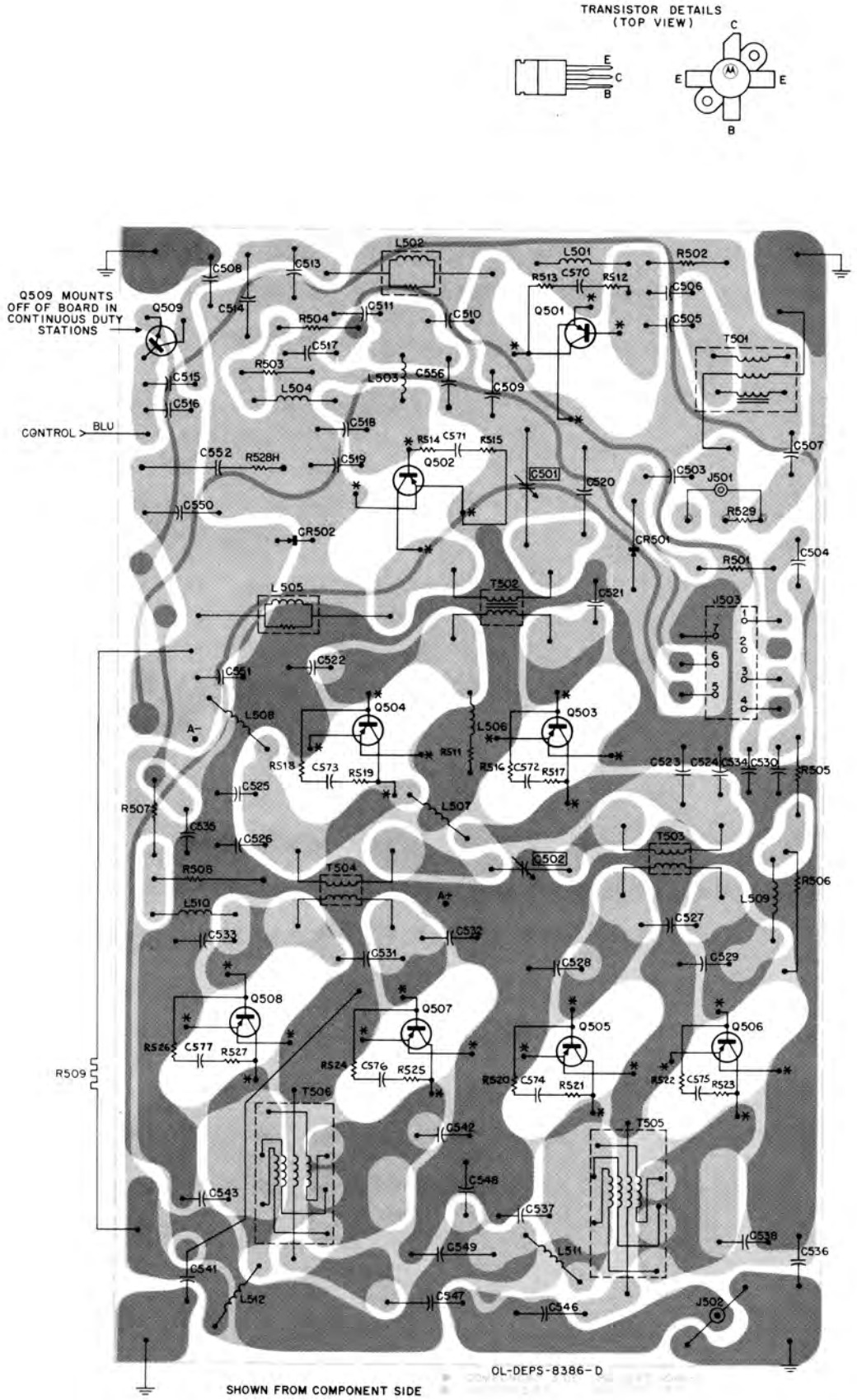
   a. When it is initially installed.
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

POWER AMPLIFIER ALIGNMENT PROCEDURE

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	METER REV. & ADAPTER CABLE REF. SWITCHES (SEE NOTE)	STAGE AND PROCEDURE
1					Align the exciter.
2					For complete power amplifier tune-up, proceed with step 3. To check alignment move metering plug to power control board and go to step 6.
3	C501, C502				PA PRE-ALIGNMENT - Set C501 fully clockwise and C502 to maximum capacity (plate fully meshed).
4	POWER SET	POWER CONTROL BOARD	Wattmeter or 1 AND METER REV. REF B	METER REV. REF A	OUTPUT-Move the metering plug to the power control board. Without exceeding rated power output of 90, 100, or 110 watts on the wattmeter or calibration label value on meter 1, adjust the POWER SET control for rated power or until no further increase in power output is observed. If meter 5 reads 15-25 uA, go to step 5. If meter 5 reads above 25 uA, then adjust the POWER SET control counterclockwise until meter 5 is between 15-25 uA.

POWER AMPLIFIER ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	METER REV. & ADAPTER CABLE REF. SWITCHES (SEE NOTE)	STAGE AND PROCEDURE
5	C501, C502	POWER CONTROL BOARD	5	METER REV. REF B	PA DRIVER OUTPUT - Tune C501, then C502 for a minimum meter 5 reading.
6	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV. REF A	OUTPUT - Adjust the POWER SET control for rated power output and perform step 5. (If rated power cannot be attained, repeat steps 4 and 5.)
			5	METER REV. REF B	Check meter 5 reading, it must not exceed 50 uA.
7		PA	5	METER REV. REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (I_c). I_c in amperes is the meter 5 reading (0-50) x 1/2.
8		PA	6	METER REV. REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (V_c). V_c is the meter 6 reading (0-30 volt scale).
9					Determine final input power (P_{in}). P_{in} equals $V_c \times I_c$. P_{in} should be less than: 180 watts for 90-watt models; 200 watts for 100-watt continuous duty models and 110-watt intermittent duty models.

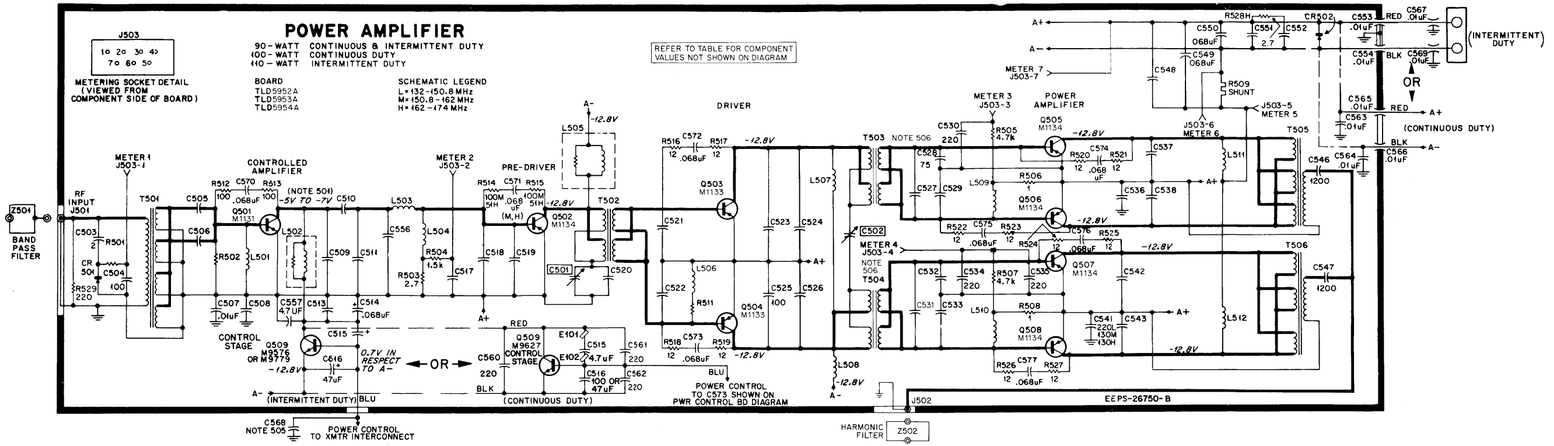


90/100/110 W Power Amplifier
Circuit Board Detail
Motorola No. PEPS-18126-B
7/3/85 - UP

PA COMPONENT VALUES

REF	136-150.8 MHz	150.8-162 MHz	162-174 MHz
C501	4-40	1.5-18	1.5-18
C502	2.4-27	2-19.3	2-19.3
C505	62	49	62
C506	62	51	34
C508	160	130	130
C509	15	15	10
C510	175	51	39
C511	62	51	39
C513	160	130	130
C515	-	4.7 uF	3.3 uF
C518	49	60	49
C519	49	60	43
C520	30	25	20
C521	62	43	43
C522	56	39	51
C523	80	100	120
C524	-	.01 uF	.05 uF
C526	-	.01 uF	.05 uF
C527	43	30	24
C528	75	75	80
C529	60	51	51
C531	43	30	24
C532	75	75	80
C533	62	60	68
C536	220	390	-
C537	130	150	100
C538	130	150	120
C541	220	130	130
C542	130	150	100
C543	120	130	100
C546	1200	1200	1200
C547	1200	1200	1200
C548	160	130	130
C551	160	130	130
C552	15 uF	100 uF	100 uF
C556	30	10	6
C557	-	-	4.7 uF
C571	-	.068 uF	.068 uF
C516	47 uF	100 uF	47 uF
L503	7-84400B03	1-1/2 turns	1-1/2 turns
L504	1 turn	1 turn	85
L506	.039 uH	.039 uH	290 nH
L507	2-1/2 turns	4-1/2 turns	4-1/2 turns
L508	2-1/2 turns	4-1/2 turns	4-1/2 turns
L509	0.29 uH	.039 uH	290 nH
L510	0.29 uH	.039 uH	290 nH
L511	4-1/2 turns	4-1/2 turns	0.29 uH
L512	4-1/2 turns	4-1/2 turns	0.29 uH
R501	100k	150k	150k
R502	10	10	49
R511	2.7	2.7	-
R514	-	100	51
R515	-	100	51
R528	-	-	2.7
T503	25-84859L01	25-84854L02	24-82060L01
T504	25-84859L02	25-84854L02	24-82060L01
T505	25-84860L01	25-84860L01	25-84861L01
T506	25-84860L01	25-84860L01	25-84861L01

EPS-26749-A



POWER AMPLIFIERS

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.
504. THE CONTROL STAGE TRANSISTOR IS BOARD-MOUNTED FOR INTERMITTENT DUTY OPERATION AND CHASSIS-MOUNTED FOR CONTINUOUS DUTY OPERATION.
505. C568 IS PART OF TRANSMITTER CHASSIS & HARDWARE KIT.
506. FOR FREQUENCY RANGE 162-174 MHz AIR-CORE TRANSFORMERS.

EPS-8362-A

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

90/100/110 W Power Amplifier
Schematic Diagram
Motorola No. PEPS-26753-A
7/3/85- UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN5605A Xmtr. Chassis & Heat Sink
(Intermittent Duty) (part of TLD1680 Series) PL-6097-O

		CAPACITOR, fixed:
C553, 554	21-84211B01	.01 uF +100-0%; 250 V
C555	23-83210A08	100 uF +150-10%; 25 V
C567	21-84211B01	.01 uF +100-0%; 250 V
C568	21-82880E19	500 pF ±10%; 500 V
C569	21-84211B01	.01 uF +100-0%; 250 V
		TRANSISTOR: (SEE NOTE)
Q501	48-84411L31	PNP; type M1131
Q502	48-84411L32	PNP; type M1132
Q503, 504	48-84411L33	PNP; type M1133
Q505 thru 508	48-84411L34	PNP; type M1134
Q509	48-869576 or 48-869779	NPN; type M9576 NPN; type M9779

NOTE: Additional electrical components for TLN5605A are listed in the Transmitter Interconnect section; hardware is listed in the Transmitter Hardware Kits section.

TLN5604A PA Hardware Kit
(Continuous Duty) (part of TLD1690 Series) PL-6098-O

		TRANSISTOR: PNP; (SEE NOTE)
Q501	48-84411L31	type M1131
Q502	48-84411L32	type M1132
Q503, 504	48-84411L33	type M1133
Q505 thru 508	48-84411L34	type M1134

NOTE: Additional electrical components for TLN5604A are listed in the Power Control section; hardware is listed in the Transmitter Hardware Kits section.

TLN4780A PA Casting & Hardware Kit
(Gontinuous Duty) (part of TLD1690 Series) PL-1719-B

C563, 564	21-84211B02	CAPACITOR, fixed: .01 uF +100-0%; 250 V

NOTE: Hardware for TLN4780A is listed in the Transmitter Hardware Kits section.

Exciter Output Filter PL-1721-O

		FILTER, RF: bandpass;
Z501L	TFD6111A	132-150.8 MHz
Z501M, 501H	TFD6112A	150.8-174 MHz

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TRN8012A Cable & Bracket Kit
(Continuous Duty) (part of TLD1690 Series) PL-6099-O

C560, 561, 562	21-410115	CAPACITOR, fixed: 220 pF ±20%;
C565, 566	21-84463D01	.001 uF ±20%; 500 V
		TRANSISTOR: (SEE NOTE)
Q509	48-869627	NPN; type M9627

NOTE: Cable assemblies for TRN8012A are listed in the RF Cables section; additional electrical components are listed in the Transmitter Interconnect section; hardware is listed in the Transmitter Hardware Kits section.

POWER AMPLIFIER (INTERMITTENT DUTY)

TLD1682B (132-150.8 MHz)
TLD1683C (150.8-162 MHz)
TLD1684C (162-174 MHz)

POWER AMPLIFIER (CONTINUOUS DUTY)

TLD1692D (132-150.8 MHz)
TLD1693E (150.8-162 MHz)
TLD1694E (162-174 MHz)

parts list

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

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

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

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

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

		CAPACITOR, fixed:
C570, 572 thru 577	8-83813H05	.068 uF ±10%; 100 V
C571L		Not Used
C571M, 571H	8-83813H05	.068 uF ±10%; 100 V
		RESISTOR, fixed:
R512, 513	6-125C25	100 ±10%; 1/2 W
R514L, 515L		Not Used
R514M, 515M	6-125C25	100 ±10%; 1/2 W
R514H, 515H	6-125A18	51 ±5%; 1/2 W
R516 thru 527	6-125C03	12 ±10%; 1/2 W
R529	6-126C33	220 ±10%; 1/4 W

PA Output (Harmonic) Filter PL-1722-O

		FILTER, RF: low pass;
Z502L	TFD6101A	132-150.8 MHz
Z502M, 502H	TFD6102A	150.8-174 MHz

TLN5074A Terminal Bracket Kit
(Intermittent Duty) PL-1856-O

		CAPACITOR, fixed:
C567, 569	21-84211B01	.01 uF +100-0%; 250 V

NOTE: Hardware for TLN5074A is listed in the Transmitter Hardware Kits section.

60 W POWER AMPLIFIER

MODEL TABLE

MODEL	FREQUENCY RANGE	APPLICATION
TLD1673A	150.8-162 MHz	Intermittent Duty
TLD1674A	162-174 MHz	
TLD1703B/C	150.8-162 MHz	Continuous Duty
TLD1704B/C	162-174 MHz	

TECHNICAL CHARACTERISTICS*

RF Power In	400 mW
Input Impedance	50 ohms
RF Power Out	60 watts (50 watts optional)
Output Impedance	50 ohms
Power Requirements	13.0 volts @11 amps

*All values are typical

1. DESCRIPTION

Motorola's TLD1670A and TLD1700B/C Series Power Amplifiers provide the following features:

- A minimum of 60 W rf output (50 W optional).

- All circuitry contained on one double-sided circuit board.

- Power transistors (and control stage transistor in continuous duty stations) mounted directly to (but electrically isolated from) the heat sink.

- RF connections made through two coaxial connections which plug directly into the input and output.

- DC power supplied via two feedthrough capacitors that also provide filtering.

- Input, output, and most other critical interstage matching is accomplished by the use of rf transformers wound around ferrite cores. Only one tuning adjustment is required dur to the relatively broadband matching characteristics of the ferrite transformers and the low inductance leads of the silicon opposed emitter transistors.

MOTOROLA INC.
Communications Division

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

- One metering socket which is accessible from the component side of the circuit board allows four major test points to be monitored and permits measurement of the dc current drawn by the final amplifier stage.

- Due to the heat sink mounting requirements for this board, servicing is accomplished from the component side of the board.

- Diode protection against reverse polarity voltage (board mounted diode).

- Output protection provided by a control stage transistor driven by the power control circuit (Controls gain of the first stage). In intermittent duty stations, a single-wire provides interconnection between power control and PA circuitry. In continuous duty stations, three wires provide this interconnection.

2. FUNCTIONAL OPERATION

Refer to the block diagram, Figure 1, and the schematic diagram. This series of power amplifiers requires a 400 mW rf input from the exciter board. This input is passed through a bandpass filter assembly and a ferrite step-down transformer (to match the input impedance to the first stage) to the gain-controlled amplifier stage. The external power control circuit which drives the control stage transistor determines the gain of this stage. The power control circuit monitors the output of the final stages of the power amplifier, the load condition and the heat sink temperature.

The output of the gain-controlled amplifier is passed through a fixed-tuned broadband, matching network and applied to the pre-driver stage. A parallel capacitor network couples the output of the pre-driver to the base of the driver stage. The output of the driver stage is split by a transformer to drive the push-pull final power amplifier stage. The output from the final stage is stepped up in impedance by a ferrite transformer to provide the 50-ohm output impedance to match the input impedance of the harmonic filter.

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

3. MAINTENANCE

a. General

NOTE

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

This section of the manual provides the maintenance shop procedures for the PA board.

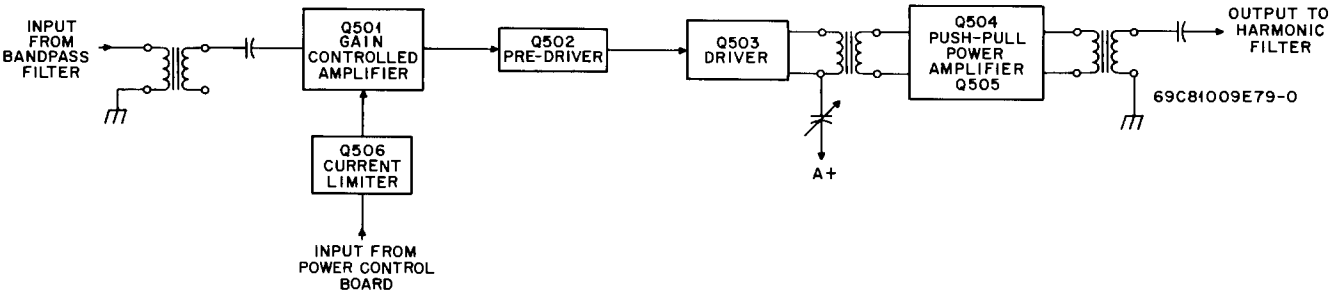


Figure 1. Block Diagram

It assumes that preliminary tests have already localized the trouble to the PA board. These procedures include measurements with optional built-in station metering or a Motorola Portable Test Set, a vom, a complete set of performance tests, and extensive troubleshooting procedures.

CAUTION

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

b. Recommended Test Equipment

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

(1) Motorola S1056B through S1059B Portable Test Set and Model TEK-37 or TEK-37A Adapter Cable. The portable test set is required for checking each stage for proper operation. Optional built-in station metering, when incorporated, takes the place of the portable test set.

(2) A Motorola Solid-State DC Multimeter or a 20,000 ohm-per-volt multimeter should be used, however, a low impedance meter is acceptable for dc voltage measurements only.

(3) Motorola T1013A RF Load Resistor (dummy load) or equivalent.

c. Metering

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

(1) Using the Optional Built-In Station Meter

This procedure applies to intermittent duty stations. Continuous duty stations with built-in station metering are similar, except these stations measure only exciter output (PA input), PA current and PA voltage of the final devices.

(a) The entire transmitter is necessary for testing PA boards including the power board for proper control.

(b) The output of the station must be terminated in one of three types of loads:

-- The antenna load.

-- A dummy load such as Motorola's T1013A RF Load Resistor.

-- An RF Wattmeter.

NOTE

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

(c) Turn the station ON.

(d) With the meter panel selector switch set to the XMIT position and the transmitter chassis selector switch set to position 1, key the transmitter and observe the meter. Unkey the transmitter. Set the transmitter chassis selector switch to positions 2, 3, and 4, keying the transmitter and observing the meter reading for each position. On multi-frequency stations, repeat the readings for each frequency. An analysis of the meter readings for determining whether each circuit is good or bad is given in the MINIMUM PA METER READINGS table.

(2) Using the Portable Test Set

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

(a) Set the function selector switch of the portable test set to the XMTR position.

(b) Set the meter reversing switch of the test set to the METER REV position.

(c) Set the selector switch of the test set to position 1 and reference position A.

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

(e) Connect the red "control" plug of the adapter cable to the control receptacle on the

local or remote control chassis circuit board. Connect the white "metering" plug of the adapter cable to the receptacle on the PA circuit board.

(f) The entire transmitter is necessary for testing PA boards including the power control board for proper control.

(g) The output of the station must be terminated in one of three types of loads:

-- The antenna load.

-- A dummy load such as Motorola's T1013A RF Load Resistor.

-- An RF Wattmeter.

NOTE

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

(h) Turn the station ON.

(i) Key the transmitter with the XMTR ON button on the test set. Observe the meter. Unkey the transmitter.

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

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

d. Performance Tests

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

(a) The exciter board should be known to be functioning normally.

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

(c) Antenna switch should be known to be operating normally (base stations only).

(2) Key the transmitter and observe power out, which should be 60 watts.

(3) If necessary, adjust POWER SET control for rated power output.

CAUTION

The PA shield must always be in place during operation of the station and should be kept in place as much as possible while testing and troubleshooting. The circuit board must always be secured in place with all mounting screws. The transistors (including the control stage transistor mounted on the inner wall) must be secured in place to provide proper heat sinking, and the feedthrough connectors must be soldered in place to provide dc power and good rf grounding.

4. TROUBLESHOOTING

If a problem has been localized to the PA deck, several checks can be made prior to extensive troubleshooting.

a. Visually

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

b. Voltage Checks

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

c. Troubleshooting

If test set readings are abnormal or tests indicate subnormal performance, a logical

MINIMUM PA METER READINGS

SELECTOR SWITCH POSITION (See Metering Note)	REFERENCE SWITCH POSITION (Portable Test Set Usage Only)	MINIMUM METER READING	CIRCUIT METERED	IF LOW, THE DEFECTIVE CIRCUIT IS
1	A	15 uA	RF output of exciter and collector voltage of controlled amplifier (PA input)	Exciter, controlled amplifier, or current limiter
2	A	5 uA	Controlled amplifier output	Controlled amplifier or pre-driver
3	A	10 uA	Pre-driver output	Pre-driver or driver
4	A	13 uA	Driver output and power amplifier input	Driver or power amplifier
5	B	25 uA min. 40 uA max.	Final amplifier output current	Final amplifier
6	B	12 V (0-30 V scale)	Final amplifier voltage	Final amplifier A+ or A- input

METERING NOTE

When optional built-in station metering is used in continuous duty stations, only exciter output (PA input), final PA current, and final PA voltage power amplifier functions may be checked. Selector switch position functions change to:

PA CHASSIS SELECTOR SWITCH POSITION	FUNCTION METERED	METER READING
1	PA input	15 uA min.
2	Final PA current	25 uA min, 40 uA max.
3	Final PA voltage	12 V normal
4	Forward power monitor	22-45 uA normal
5	Reflected power monitor	3-8 uA normal
6	Control voltage	3-35 uA normal

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

CAUTION

Due to the voltage requirements of PNP transistors, all "rf ground" plating is A+ and is "hot" with respect to chassis ground in negative ground applications. Because of this, caution should be used to prevent connection to "ground" plating on the PA board to chassis ground, either directly or by the use of test equipment ground leads. If ac

CAUTION (CONT)
operated test equipment is used, the ground lead must not be electrically connected to ac line ground.

5. PA REPAIR NOTES

a. Resistance Measurement of Transistors in Push-Pull Pairs

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

b. Transistor Removal Procedure

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

(2) Remove excess solder from around transistor tabs with a vacuum bulb type desoldering device.

(3) Gently lift each tab, one at a time while applying heat.

(4) When all four tabs are loose from the board carefully lift out the transistor.

c. Transistor Installation Procedure

(1) Pre-tin underside of each transistor lead.

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

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

(4) Screw down the two mounting screws securely.

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

d. Procedures for Resistance Measurements of Transistors

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

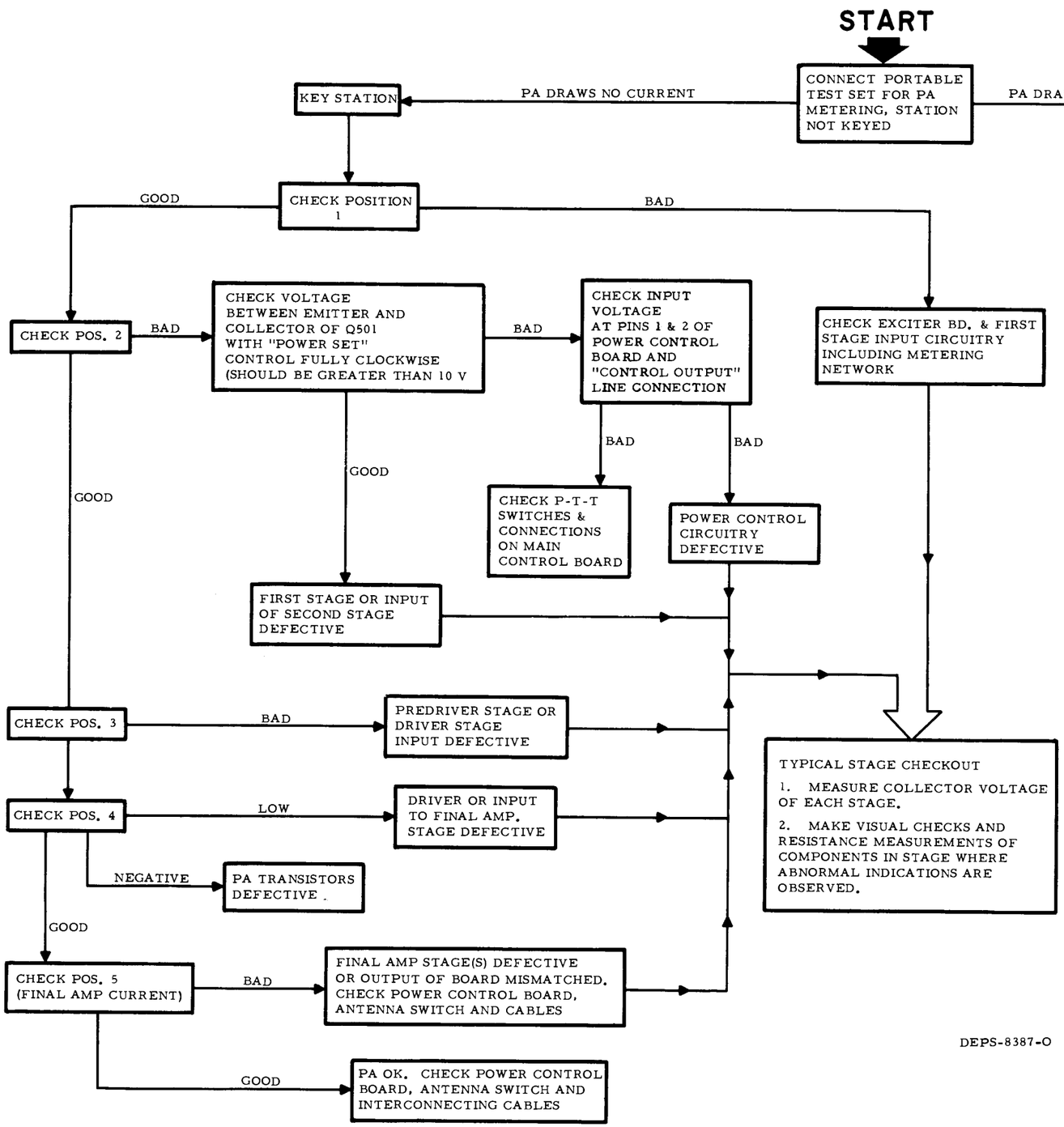
(2) Measure the resistance from lead to lead as described:

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

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

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

Should any indication be observed in measurements (a) or (c), the transistor is defective and should be replaced.



TO ISOLATE DEFECTIVE TRANSISTOR(S)

(1) DISCONNECT ONE END OF BIAS RESISTOR OR CHOKE CONNECTED TO BASE OF TRANSISTOR(S) IN QUESTION. FOR EXAMPLE: L504, L506, L508.

(2) DISCONNECT ONE END OR REMOVE COLLECTOR CHOKE OF TRANSISTOR(S) IN QUESTION. FOR EXAMPLE: L505, L507, L509.

(3) FOR PUSH-PULL PAIRS DISCONNECT BASE LEAD (TAB) OF ONE TRANSISTOR. ONLY ONE LEAD NEED BE DISCONNECTED. MAKE SURE LEAD IS COMPLETELY DISCONNECTED FROM PLATING.

(4) USING AN OHMMETER, MEASURE THE RESISTANCES OF THE TRANSISTOR. SEE PA REPAIR NOTES PARAGRAPH FOR MEASUREMENT PROCEDURE.

(5) THE OTHER TRANSISTOR CAN NOW ALSO BE MEASURED (WITHOUT REMOVING BASE LEAD).

(6) REPLACE ANY TRANSISTORS WHICH DO NOT MEASURE CORRECTLY. SEE REMOVAL PROCEDURE.

(7) MEASURE BIAS RESISTOR AND BIAS CHOKE. REPLACE IF DEFECTIVE.

(8) REPLACE ANY OTHER COMPONENTS. TRANSFORMERS, ETC. WHICH APPEAR OVERHEATED.

(9) RECONNECT ALL OTHER COMPONENTS.

(10) IF RF POWER IS REGAINED, CHECK CIRCUITRY FOR ANY RAPIDLY OVERHEATING COMPONENTS SUCH AS TRANSFORMERS. IF SO, REPLACE.

EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

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.

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:

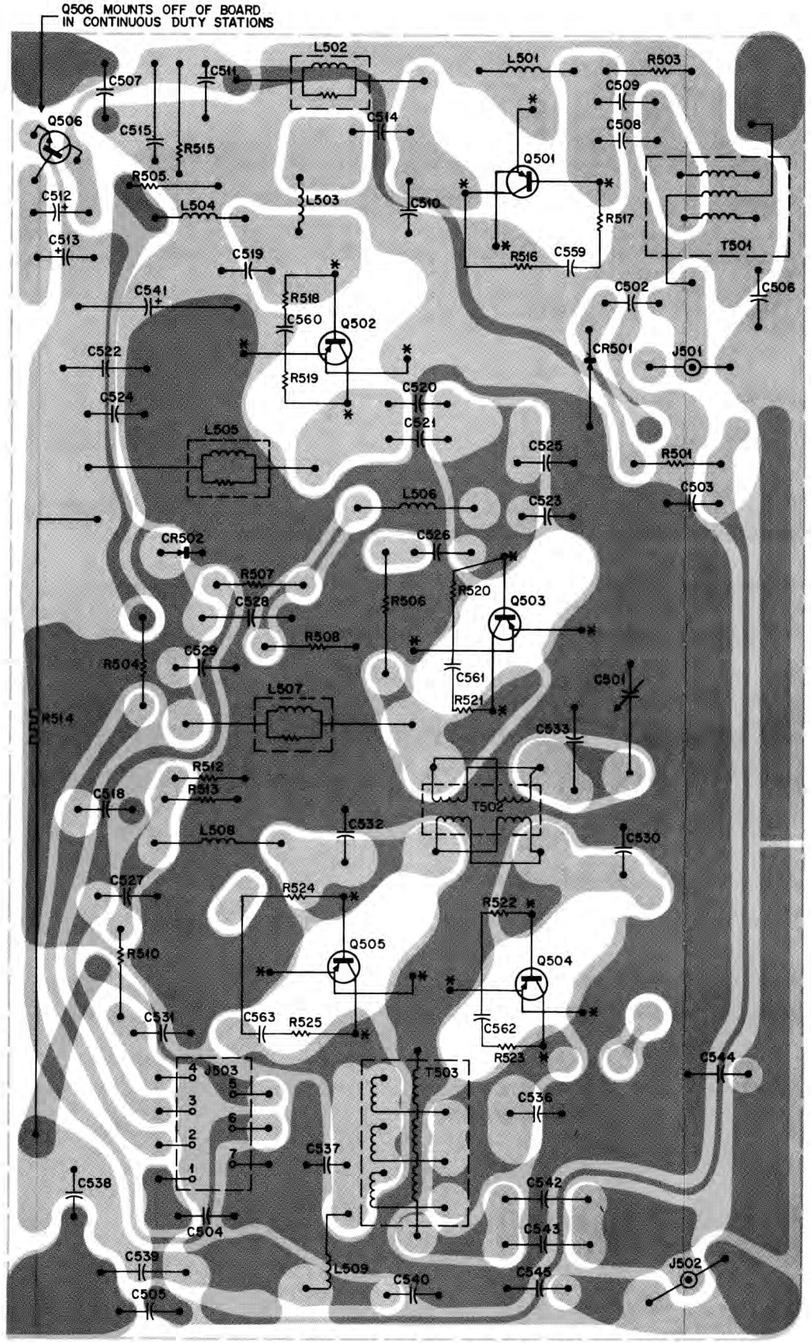
   a. When the transmitter is initially installed.
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.

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.

ALIGNMENT PROCEDURE

	PORTABLE TEST SET			OPTIONAL BUILT-IN METER SWITCHES POSITION						
STEP	METERING PLUG LOCATION	TEST SET SWITCH POSITION	ADAPTER CABLE SWITCH POSITION	METER CHASSIS SELECTOR SWITCH: INTERMITTENT DUTY MODELS	METER CHASSIS SELECTOR SWITCH: CONTINUOUS DUTY MODELS	TRANSMITTER SELECTOR SWITCH (INTERMITTENT DUTY ONLY)	EXCITER SELECTOR SWITCH (CONTINUOUS DUTY ONLY)	POWER AMPLIFIER SELECTOR SWITCH (CONTINUOUS DUTY ONLY)	ADJUST	STAGE AND PROCEDURE
1	--	--	--	--	--	--	--	--	--	Align the exciter.
2	--	--	--	--	--	--	--	--	--	For complete power amplifier tune-up, proceed to step 3. To check alignment, go to step 7.
3	--	--	--	--	--	--	--	--	C501	PA PRE-ALIGNMENT - Set C501 fully clockwise.
4	POWER CONTROL BOARD	5	METER REV. REF B	XMIT	PA	PWR CONT 5	5	4	POWER SET C501	OUTPUT - Gradually rotate the POWER SET control until an initial meter 5 reading is observed. Do not readjust POWER SET control. If this indication is less than 50 uA, proceed with step 5. If greater than 50 uA, tune C501 for an on-scale reading.
5	POWER CONTROL BOARD	Wattmeter or 1&5	METER REV. REFA	XMIT	PA	PWR CONT 1	5	2	POWER SET	OUTPUT - Without exceeding rated power output of 60 watts on wattmeter or calibration label value on meter 1, adjust the POWER SET control for rated power or until no further increase in power output is observed. If PA Meter 5 is greater than 25 uA, adjust POWER SET counterclockwise (if less than 15 uA, adjust POWER SET clockwise) until meter reading is between 15 and 25 uA.
6	POWER CONTROL BOARD	5	METER REV. REF B	XMIT	PA	PWR CONT 5	5	4	C501	PA DRIVER OUTPUT - Tune C501 for minimum meter 5 reading.
7	POWER CONTROL BOARD	Wattmeter or 1 5	METER REV. REF A METER REV. REF B	XMIT XMIT	PA PA	PWR CONT 1 PWR CONT 5	5 5	2 4	POWER SET	OUTPUT - Adjust the POWER SET control for rated power output and repeat step 6 (if rated power cannot be attained, repeat steps 5 and 6). Check meter reading, it must not exceed 50 uA.
8	PA	5	METER REV. REF B	XMIT	PA	PA5	5	5	--	FINAL COLLECTOR CURRENT - The relationship between the meter reading and the actual current being measured is 50 uA = 10A. Therefore, to measure the final collector current (I_C) in amperes, take 1/5 the meter reading.
9	PA	6	METER REV. REF B	XMIT	PA	PA6	5	6	--	FINAL COLLECTOR VOLTAGE - The relationship between the meter reading and the actual voltage being measured is 50 uA = 50 V. Therefore, to measure the final collector voltage (V_C) in volts, read the meter directly.
10	--	--	--	--	--	--	--	--	--	FINAL INPUT POWER - (Pin) - Pin = $V_C I_C$ and should be less than 120 watts.

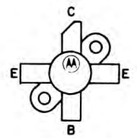


SHOWN FROM COMPONENT SIDE

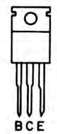
OL-DEPS-8388-A

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

TRANSISTOR DETAILS

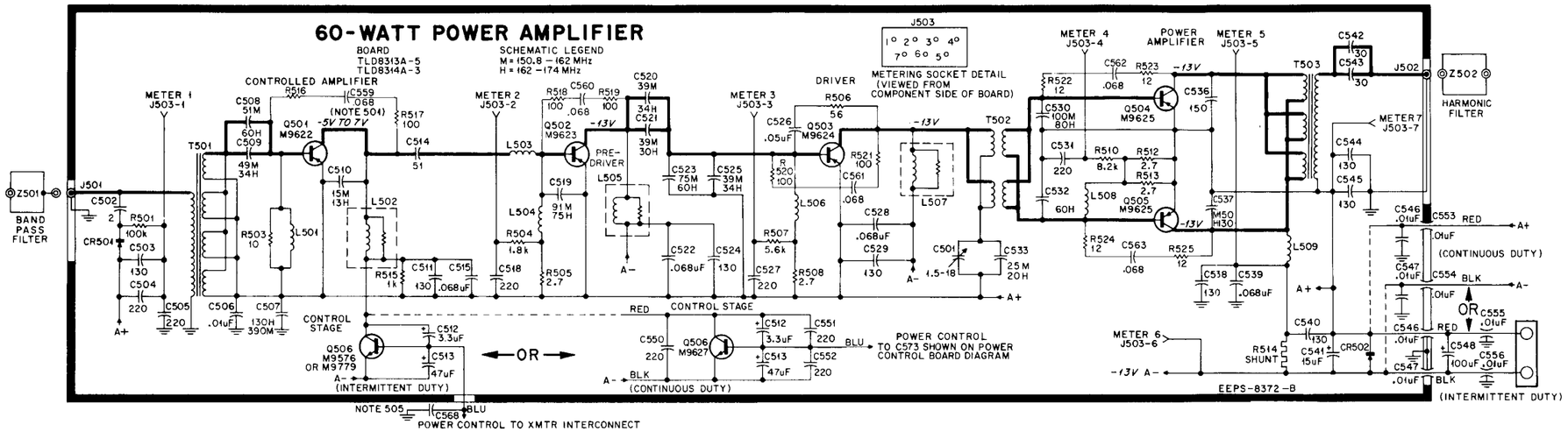


TOP VIEW



FRONT VIEW

60-Watt Power Amplifier
Circuit Board Detail
Motorola No. PEPS-8639-A
2/15/78-NPC



POWER AMPLIFIERS

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.
504. THE CONTROL STAGE TRANSISTOR IS BOARD-MOUNTED FOR INTERMITTENT DUTY OPERATION AND CHASSIS-MOUNTED FOR CONTINUOUS DUTY OPERATION.
505. C568 IS PART OF TRANSMITTER CHASSIS & HARDWARE KIT.
506. FOR FREQUENCY RANGE 162-174 MHz AIR-CORE TRANSFORMERS.

EPS-8362-A

60-WATT POWER AMPLIFEIR

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

60-Watt Power Amplifier
Schematic Diagram
Motorola No. 63P81015E13-C
6/20/80-PHI

REVISIONS

PEPS-8640-A

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN4781A	Q506	ADDED ALTERNATE TRANSISTOR 48R869779, TYPE M9779	PARTS LIST	NOT AFFECTED

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN6444A R-C Regen Suppressor Kit
(P/O TLD1670 Series & TLD1700 Series) PL-3530-O

		CAPACITOR
C559-563	8D83813H05	.068 uF ±10%; 100 V
		RESISTOR: fixed: ±10%; 1/2 W
R516-519	6S125C25	100
R520, 521	6S125C11	27
R522-525	6S125C03	12

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

LEGEND:
H = (150.8-162 MHz)
HH = (162-174 MHz)

TLD8313A PA Board (150.8-162 MHz)
TLD8314A PA Board (162-174 MHz)

PL-1736-A

		CAPACITOR, fixed; pF; ±5% 500 V; unless otherwise stated
C501	20C83201B07	variable: 1.5-18; 100 V
C502	21D83406D52	2 ±0.25 pF; NP0
C503	21D84494B26	130
C504	21D83596E10	220 ±20%
C505	21D83596E10	220 ±20%
C506	21D82428B59	.01 uF +80-20%; 200 V
C507HH	21D84494B26	130 pF
C507H	21D84494B18	390 pF
C508H	21D84494B01	51
C508HH	21D84494B35	60
C509H	21D84494B25	49
C509HH	21D84494B30	34
C510H	21D84494B38	15
C510HH	21D84494B36	13
C511H	21D84494B26	130
C511HH		NOT USED
C512	23D83214C17	3.3 uF ±20%; 25 V
C513	23D83214C10	47 uF ±20%; 25 V
C514	21D84494B01	51 pF
C515	8D83813H05	.068 uF ±10%; 100 V
C518	21D83596E10	220 ±20%
C519H	21D84494B52	91 pF
C519HH	21D84494B31	75
C520H	21D84494B24	39
C520HH	21D84494B30	34
C521H	21D84494B24	39
C521HH	21D84494B33	30
C522	8D83813H05	.068 uF ±10%; 100 V
C523H	21D84494B31	75
C523HH	21D84494B35	60
C524	21D84494B26	130
C525H	21D84494B24	39
C525HH	21D84494B30	34
C526	21C82372C04	.05 uF +80-20%; 25 V
C527	21D83596E10	220 ±20%
C528	8D83813H05	.068 uF ±10%; 100 V
C529	21D84494B26	130
C530	21D84395B03	80 pF; 250 V
C531	21D83596E10	220 ±20%
C532H	21D84395B03	80 pF; 250 V
C532HH	21D84395B07	60; 250 V
C533H	21D84936A04	25 pF, 2000 V, P120
C533HH	21D84936A07	15; 2000 V; P120
C536	21D84395B06	150; 250 V
C537H	21D84395B06	150; 250 V
C537HH	21D84395B05	130; 250 V
C538	21D84494B26	130
C539	8D83813H05	.068 uF ±10%; 100 V
C540	21D84494B26	130
C541	23D83210A21	15 uF +150-10%; 25 V
C542	21D84936A06	30 ±1.5 pF; 2000 V; P120
C543	21D84936A06	30 ±1.5 pF; 2000 V; P120
C544	21D84494B26	130
C545	21D84494B26	130
		SEMICONDUCTOR DEVICE, diode; (SEE NOTE)
CR501	48C82139G01	germainium
CR502	48C82525G01	silicon

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle:
J501	28C84227B01	male; coaxial; miniature type
J502	28C84227B01	male; coaxial; miniature type
J503	9C84207B01	female; 7-contact
		COIL, RF:
L501	24C83961B01	choke; consists of a ferrite core with a 3-turn winding
L502H	24C84392B03	choke; consists of a resistor (82 Ohms ±10%; 1 Watt) covered with a 6-turn winding
L502HH	24C84392B01	choke; consists of a resistor (120 Ohms ±10%; 1 Watt) covered with a 6-turn winding
L503	24C83884G03	choke; 1-1/2 turns, molded
L504	24C83961B01	choke; consists of a ferrite core with a 3-turn winding
L505	24C84392B02	choke; consists of a resistor (39 Ohms ±10%; 2 Watt) covered with a 4-turn winding
L506H	24D82723H04	choke; 0.29 uH
L506HH	24B83977B01	choke; 1-1/2 turns on ferrite body
L507	24C84392B04	choke; consists of a resistor (100 Ohms ±10%; 2 Watt) covered with a 4-turn winding
L508	24B83977B01	choke; 1-1/2 turns on ferrite body
L509	24B84393B02	choke; 5-1/2 turns
		RESISTOR, fixed: ±10%; 1/4 W; unless otherwise stated
R501	6S124C97	100k
R503	6S124A01	10 ±5%
R504	6S124C55	1.8k
R505	6S124B55	2.7 ±5%
R506	6S125C19	56; 1/2 W
R507	6S124C67	5.6k
R508	6S124B55	2.7 ±5%
R510	6S124C71	8.2k
R512	6S124B55	2.7 ±5%
R513	6S124B55	2.7 ±5%
R514	6C84232B02	(meter shunt)
R515	6S124C49	1k
		TRANSFORMER, RF:
T501	25C84396B01	pri: 5 turns sec: 4 windings, 1 turn each
T502	25C84818B01	pri: 2 windings, 1-3/4 turns each; sec: 2 windings; 1-3/4 turns each
T503	25B84012C01	pri: 3 windings, 1-1/2 turns each; sec: 4 turns

TLN4742A PA Hardware Kit (continuous duty)
(p/o TLD1703A & TLD1704A) PL-1737-A

		TRANSISTOR: (SEE NOTE)
Q501	48R869622	P-N-P; type M9622
Q502	48R869623	P-N-P; type M9623
Q503	48R869624	P-N-P; type M9624
Q504, 505	48R869625	P-N-P; type M9625

NOTE:

Additional electrical components for TLN4742A are listed in the Power Control and Transmitter Interconnect sections; hardware is listed in the Transmitter Hardware Kits section.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN4780A PA Heat Sink Kit (continuous duty)
(p/o TLD1703A & TLD1704A) PL-1738-O

		CAPACITOR, fixed:
C546, 547	21C84211B02	.01 uF +100-0%; 250 V

NOTE:

Hardware for TLN4780A is listed in the Transmitter Hardware Kits section.

TLN5922A Input Bracket and Cable PL-5090-O

		CAPACITOR, fixed:
C560, 561, 562	21-410115	220 pF ±20%; 500 V
C565, 566	21-84211B01	.001 uF; 250 V
		TRANSISTOR: (SEE NOTE)
Q509	48-869627	NPN; type M9627

NOTE: Cable assemblies are listed in the RF Cables section; additional electrical components are listed in the Transmitter Interconnect section; hardware is listed in the Transmitter Hardware Kits section.

TLN4781A Xmtr. Chassis & Heat Sink (intermittent duty)
(p/o TLD1673A & TLD1674A) PL-1740-B

		CAPACITOR, fixed:
C548	23D83210A08	100 uF +150-10%; 25 V
C555 thru 558	21C84211B01	.01 uF +100-0%; 250 V
C568	21-82880E19	500 pF ±10%; 1000 V
		TRANSISTOR: (SEE NOTE)
Q501	48R869622	P-N-P; type M9622
Q502	48R869623	P-N-P; type M9623
Q503	48R869624	P-N-P; type M9624
Q504, 505	48R869625	P-N-P; type M9625
Q506	48R869576 or 48R869779	N-P-N; type M9576 N-P-N; type M9779

NOTE:

Additional electrical components for TLN4781A are listed in the Transmitter Interconnect section; hardware is listed in the Transmitter Hardware Kits section.

TLN5074A Terminal Bracket Kit PL-1831-O

		CAPACITOR, fixed:
C555, 556	21-84211B01	.01 uF +100-0%; 250 V

NOTE:

Hardware for TLN5074A is listed in the Transmitter Hardware Kits section.

Exciter Output Filter PL-1741-O

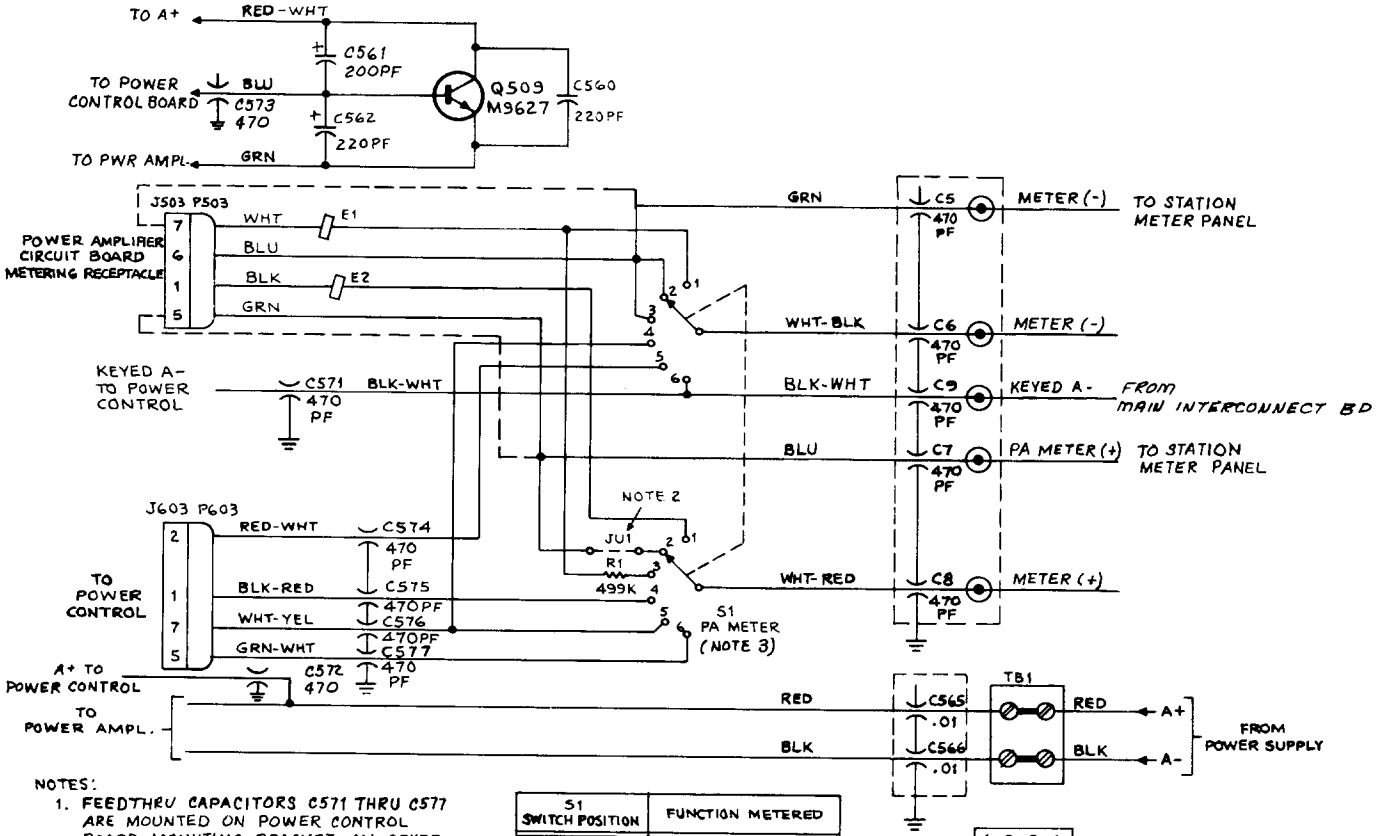
		FILTER, RF: bandpass; 150.8-174 MHz
Z501	TFD6112A	

PA Output (Harmonic) Filter PL-1742-O

		FILTER, RF: low-pass 150.8-174 MHz
Z502	TFD6102A	

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



NOTES:

1. FEEDTHRU CAPACITORS C571 THRU C577 ARE MOUNTED ON POWER CONTROL BOARD MOUNTING BRACKET, ALL OTHER COMPONENTS ARE MOUNTED ON PA INPUT BRACKET
2. JU1 IS REMOVED WHEN A SECOND METER IS USED TO MEASURE PA CURRENT.
3. PA METER SWITCH S1 AND ASSOCIATED COMPONENTS (P503, P603, E1, E2, AND R1) ARE PART OF THE V VERSION AMPLIFIER MODELS AND ARE SHOWN HERE FOR REFERENCE ONLY TO PROVIDE INTERCONNECTION DATA. CONNECTIONS SHOWN IN DASHED LINES ARE USED ON UNIFIED CHASSIS MODELS.

S1 SWITCH POSITION	FUNCTION METERED
1	PA INPUT
2	FINAL PA CURRENT
3	FINAL PA VOLTAGE
4	FORWARD POWER
5	REFLECTED POWER
6	CONTROL VOLTAGE

CEPS-22932-A

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN5922A Input Bracket and Cable Assembly
Schematic Diagram
Motorola No. 63P81033E29-A
2/15/78-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

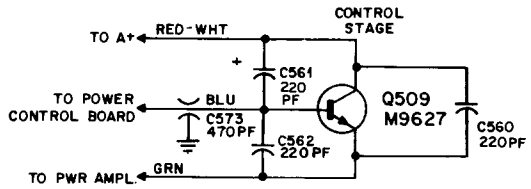
TLN5922A Input Bracket & Cable Kit PL-5180-O

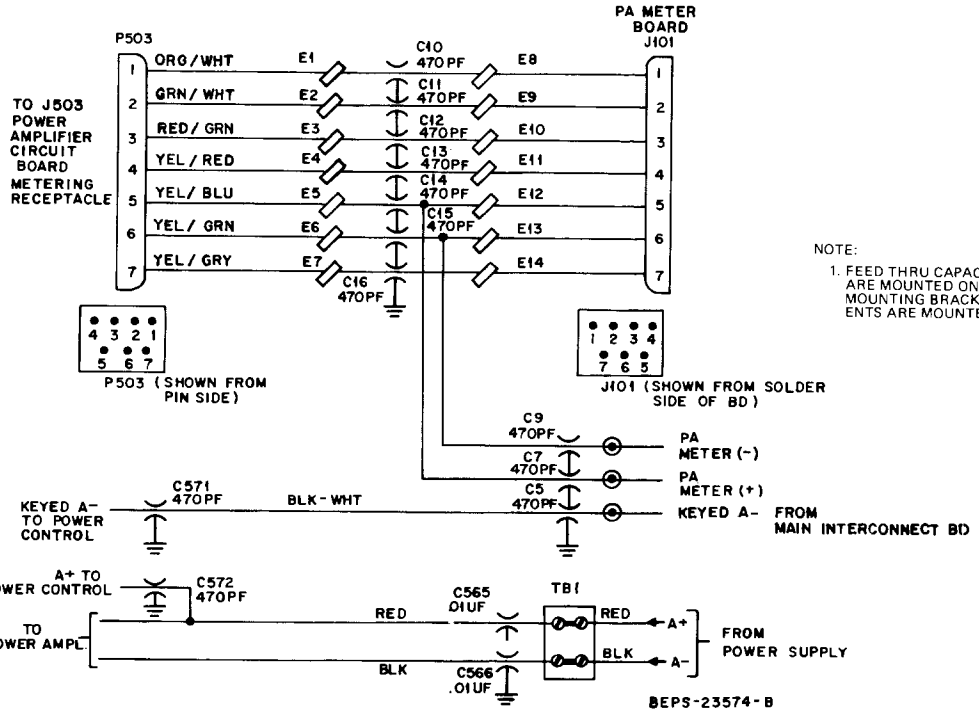
		CAPACITOR, fixed:
C5 thru 9	21-821474	470 pF ±20%; 500 V
C560, 561, 562	21-410115	220 pF ±20%; 500 V
C565, 566	21-84211B01	.01 uF; 250 V
		TRANSISTOR: (SEE NOTE I)
Q509	48-869627	NPN; type M9627
		TERMINAL BOARD:
TB1	31-50378	2-terminal
	NON-REFERENCED ITEMS	
	1-80793B63	BRACKET ASSEMBLY includes:
	7-82961L01	BRACKET, input
	9-84935D01	SOCEKT, transistor (for Q509)
		CAPACITORS C5 thru C9
	2-115968	NUT, hex: 1/4-28 x 3/8 x 1/8"; 2 used
	3-3360	SCREW, tapping: 6-20 x 1/2"; 2 used
	3-8153	SCREW, tapping: 8-15 x 3/4"; 2 used
	4-7557	WASHER, flat: .172 x .375 x .033; 2 used
	4-7678	WASHER, lock: #1/4 (external tooth); 2 used
	14-865875	INSULATOR, transistor
	29-5223	LUG, soldering: #8L; 2 used

NOTE:

I For optimum performance, replacement diodes and transistors must be ordered by Motorola part numbers.

II Cable assemblies for TLN5922A are listed in the RF Intercabling Section.





NOTE:

1. FEED THRU CAPACITORS C571 THRU C573 ARE MOUNTED ON POWER CONTROL BOARD MOUNTING BRACKET. ALL OTHER COMPONENTS ARE MOUNTED ON PA INPUT BRACKET.

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TRN8012A Input Bracket and Cable Assembly Schematic Diagram
Motorola No. 63P81034E78-B
2/15/78-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TRN8012A Input Bracket & Cable Assembly
(High Band) PL-5338-A

		CAPACITOR, fixed:
C5, 7, 9 thru 16	21-821474	470 pF ±20%; 500 V
C560, 561, 562	21-410115	220 pF ±20%; 500 V
C565, 566	21-84211B01	.01 uF; 250 V
		FERRITE BEAD:
E1 thru 14	76-84069B02	.138 OD x .118" lg.
		CONNECTOR, receptacle:
J101	9-84207B01	7-pin
		CONNECTOR, plug:
P503	28-84208B01	7-pin
		TRANSISTOR: (SEE NOTE I)
Q509	48-869627	NPN; type M9627
		TERMINAL BOARD:
TB1	31-50378	2-terminal
	NON-REFERENCED ITEMS	
	1-80798B16	BRACKET ASSEMBLY includes:
	7-84234L01	BRACKET, mounting
	9-84935D01	SOCKET, transistor
	43-82253C07	BUSHING, threaded: 2 used
		CAPACITORS C5, C6, C9-C16, C571 & C573
	1-80792B71	CIRCUIT BOARD ASSEMBLY includes:
	1-80792B83	CIRCUIT BOARD SUBASSEMBLY includes:
	39-10184A10	CONTACT, male: 7 used
		CONNECTOR J101
	2-115968	NUT, hex: 1/4-28 x 3/8 x 1/8"; 2 used
	3-3360	SCREW, tapping: 6-20 x 1/2"; 2 used
	3-139905	SCREW, tapping: 8-18 x 3/4"; 2 used
	3-134184	SCREW, tapping: 4-40 x 5/16"; 2 used
	4-7557	WASHER, flat: .172 x .375 x .033"; 2 used
	4-7678	WASHER, lock: #1/4 (external tooth); 2 used
	14-865875	INSULATOR, transistor
	29-5223	LUG, soldering: #8L; 2 used
	42-84834G01	COVER, plug

NOTES:
I For optimum performance, replacement transistors must be ordered by Motorola part numbers.
II RF Cable assemblies for TRN8012A are listed in the RF Intercabling Section.

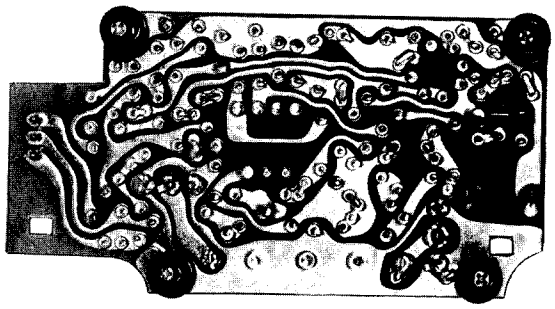
TLN4741A Hardware Kit (100 W)
TLN4742A Hardware Kit (60 W) PL-5344-O

		CAPACITOR, fixed:
C571, 572, 573	21-821474	470 pF ±20%; 500 V

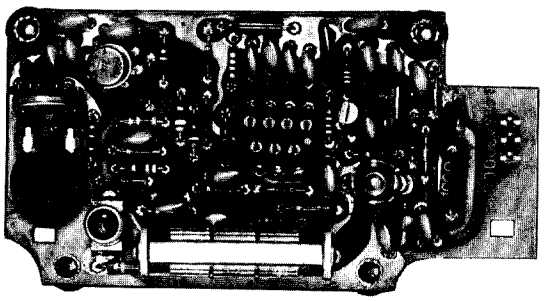
NOTE:
Additional electrical components for TLN4741A & TLN4742A are listed in the 60- & 100-Watt Power Amplifier Board sections; hardware is listed in the Transmitter hardware kits section.

POWER CONTROL BOARD

MODELS TLD8610A & TLD8620A
TLD8610AV & TLD8620AV
& TLD5960A



TOP VIEW



BOTTOM VIEW

FAEPS-6127-A

MODEL TABLE

MODEL	POWER RANGE
TLD8610A & TLD8610AV	60 W
TLD8620A & TLD8620AV	90/110 W Intermittent
TLD5960A	100 W Continuous

1. DESCRIPTION

The solid-state power control board provides regulation and protection for the rf transistors. One model is used with all 60-watt stations--the other model is used with 100-watt continuous duty stations and 90 or 110-watt intermittent duty stations. The following four functions are provided by the circuitry.

--Power Leveling - The board permits the adjustment of the output of the power amplifier to the proper level and then maintains that level of output regardless of power or supply voltage fluctuations as long as the gain of the power amplifier is equal to, or above, the preset level.

--VSWR Protection - A voltage standing wave ratio (VSWR) detector operates during transmitting periods to prevent over-dissipation of the final amplifier transistors should a fault occur in the antenna circuit. The circuitry compares power reflected from the antenna circuit to forward (output) power. When this ratio exceeds a predetermined amount, the output of the circuit lowers the power output of the power amplifier.

--Temperature Protection (Intermittent Only) -- A portion of the circuitry continually monitors heat sink temperature. When a temperature of approximately 80°C is reached, the power control board begins to reduce the power amplifier output to prevent damage to the final stage

MOTOROLA INC.
Communications Division

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

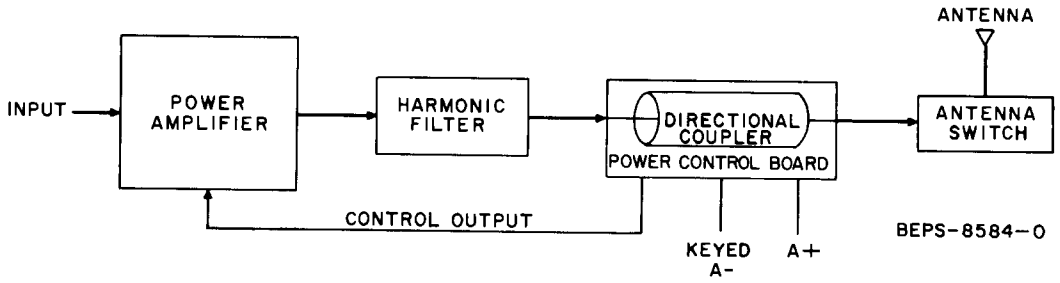


Figure 1.
Loop Block Diagram

power transistors. Any further increase in heat sink temperature will cause a correspondingly greater decrease in power output. A reduced power output level will be maintained until the heat sink temperature drops below 80°C. Thermal protection is not needed on the continuous duty version due to the large heat exchanger used.

--Forward and Reverse Power Metering- Metering points on the board provide a means of monitoring the amount of forward (output) and reflected (reverse) power in the load system.

The power control board is constructed on a single circuit board which is easily removed and replaced. All external connections are made by two coaxial connectors (input and output for the dual directional coupler) and three pins which plug into the control board. All metering points and the single adjustment point are accessible from the plating side of the board.

2. FUNCTIONAL OPERATION

Refer to the loop block diagram, Figure 1. 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.

Refer to the block diagram, Figure 2. The output of the integrated circuit differential amplifier, amplified by the dc amplifier is the controlling input to the power amplifier board.

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.

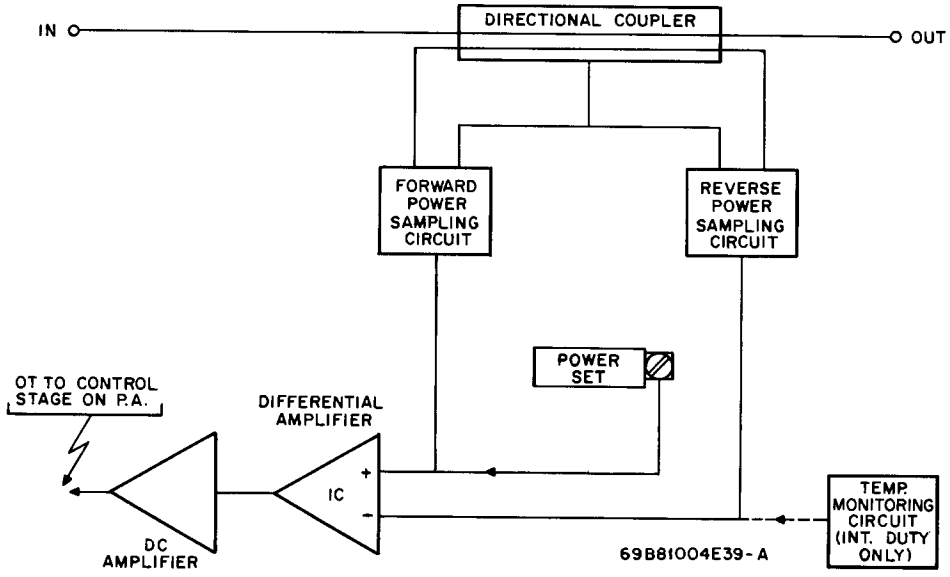


Figure 2.
Power Control Board Block Diagram

When the impedances of the antenna circuitry (load) and the power amplifier are matched (a VSWR of 1:1), and the heat sink temperature is below 80°C (for intermittent duty stations), a bias voltage produced by the dc reference bias circuitry is placed on the inverting input (also called the "reference input") of the differential amplifier (see Figure 5).

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

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 negative current to flow, which, in turn, decreases the potential on the reference input of the differential amplifier. Therefore, increasing levels of reflected power will cause the transmitter power output to be decreased to a safe level.

On intermittent duty stations, 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.

3. CIRCUIT DESCRIPTION

a. Bias Circuitry

Since the power control board has the capability to regulate the output of the transmitter power amplifier from a completely cut-off state to above the rated output power, a definite controlled output level is necessary whenever the transmitter is keyed. The desired controlled output level is determined by bias voltages present on the inverting and non-inverting inputs of the differential amplifier IC601 (see Figure 3.). Under

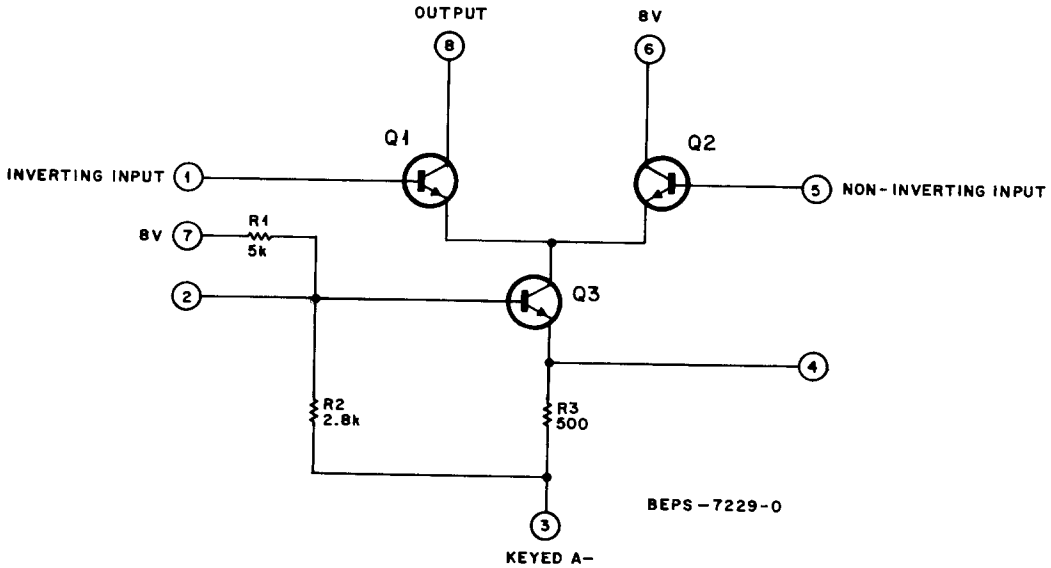


Figure 3.
IC601 Schematic Diagram

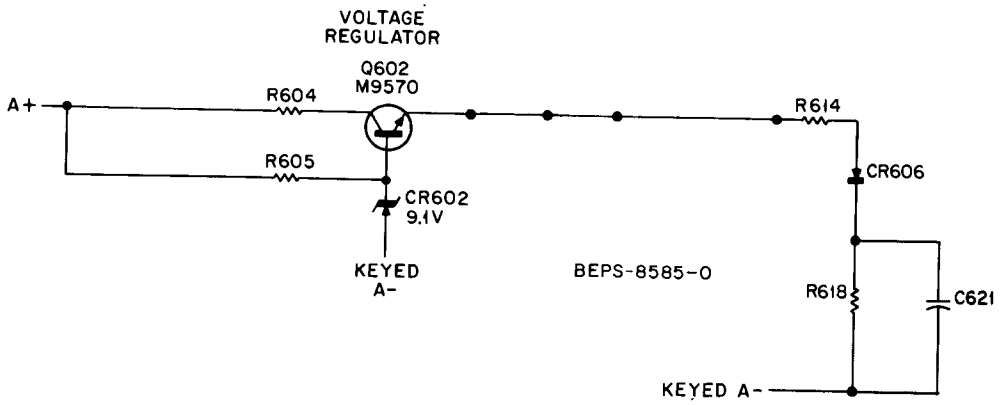


Figure 4.
Voltage Regulator and Main Divider Line

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

(1) Voltage Regulator and Main Divider Line

Refer to Figure 4. The A+ supply to the board is regulated by a series regulator circuit providing a nominal voltage of 8.0 volts. The Zener diode holds the base of the series pass transistor at a fixed potential. The series pass transistor operates as a variable resistor to hold the input to the reference circuitry constant. The divider consisting of the two resistors and the diode provides the proper voltage tap points for the secondary voltage divider networks. All 220 pF capacitors in the board are used as rf bypasses.

(2) Reference Bias Circuit

Refer to Figure 5. The reference bias is developed (with a 1:1 VSWR and normal heat sink temperature on intermittent duty stations) by the voltage divider made up of two resistors and a diode between the regulated supply voltage and the switched A- source. Since A+ is applied to the board continuously and A- is only applied when the transmitter is keyed by the push-to-talk

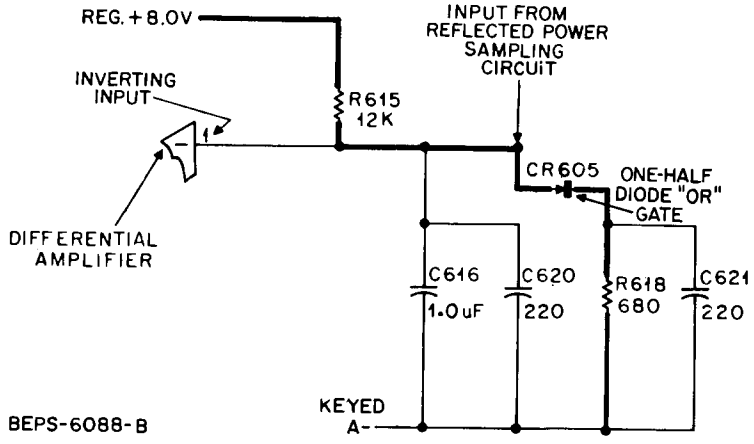


Figure 5.
Reference Power Bias Circuit

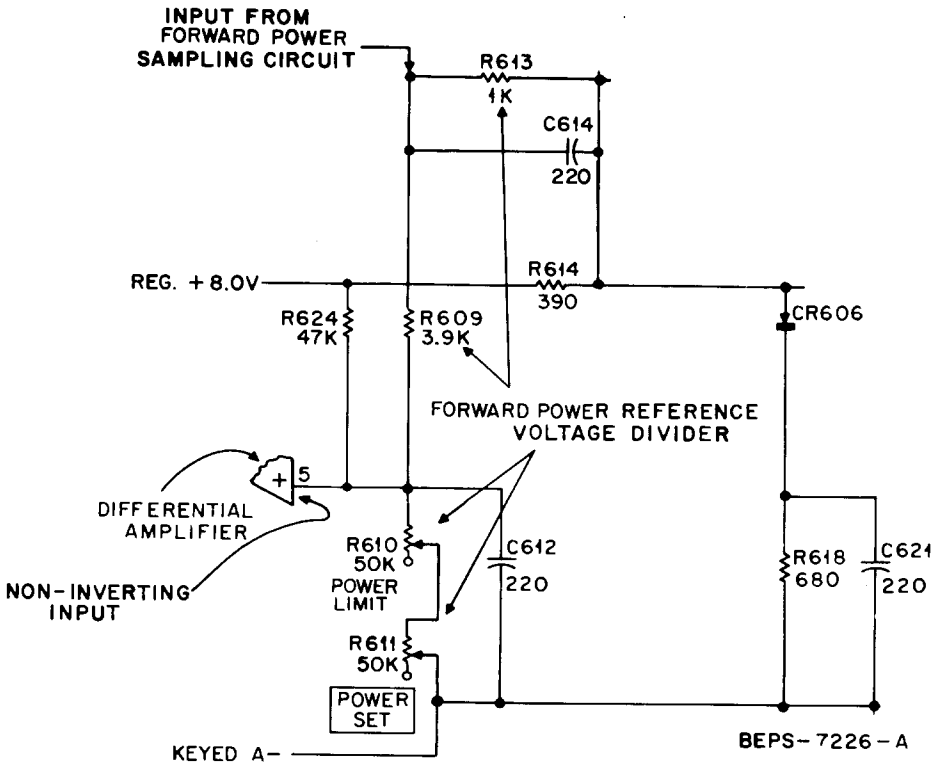


Figure 6.
Forward Power Bias Circuit

switch, the larger capacitor connected between the inverting input and keyed A- provides a time constant which allows the inverting input bias to build up slowly when power is first applied. This prevents full power output from occurring until the leveling circuitry can react and reach a quiescent level.

b. Directional Coupler

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

c. Protection Circuitry

(1) Forward Power Bias and Detection Circuit

Refer to Figure 6. The forward power reference voltage divider comprised of two resistors and two potentiometers provides a stable potential that supplies a dc bias to the non-inverting input of the differential amplifier. With an approximately correct power output from the final stages of the power amplifier, a dc level proportional to that power is produced by the forward power detector circuit, which, in combination with the voltage developed by the voltage divider, produces a bias on the non-inverting input that can be adjusted by the POWER SET potentiometer. The POWER LIMIT control is pre-set to prevent over-dissipation if the POWER SET control should be set to maximum. (Refer to the CAUTION preceding maintenance information in this section.) The dc bias value will be determined by the power amplifier output and, with no reflected power (VSWR 1:1), balanced against the reference bias present on the inverting input of the differential amplifier. Once the bias has been set, and change in power output will change the bias on the non-inverting input causing the differential amplifier to compensate for the deviation. The forward power detector circuit (refer to Figure 7) detects rf power flowing through the directional coupler when the transmitter is keyed, and causes a small proportional current flow in the forward power sampling circuit. The diode converts the rf sample into a pulsating dc voltage and the dc filter removes the ripple. This is the dc voltage which is added to the dc bias already applied to the non-inverting

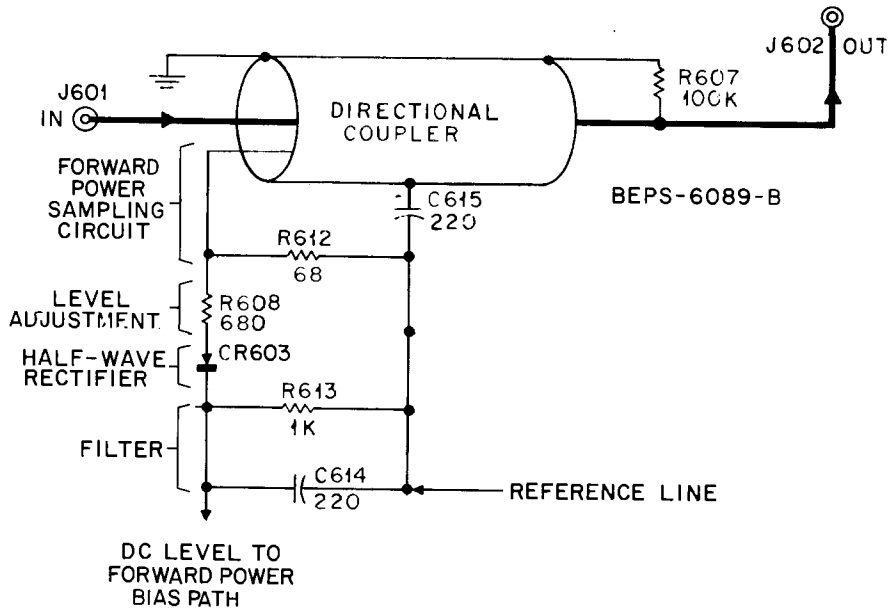


Figure 7.
Forward Power Detector Circuit

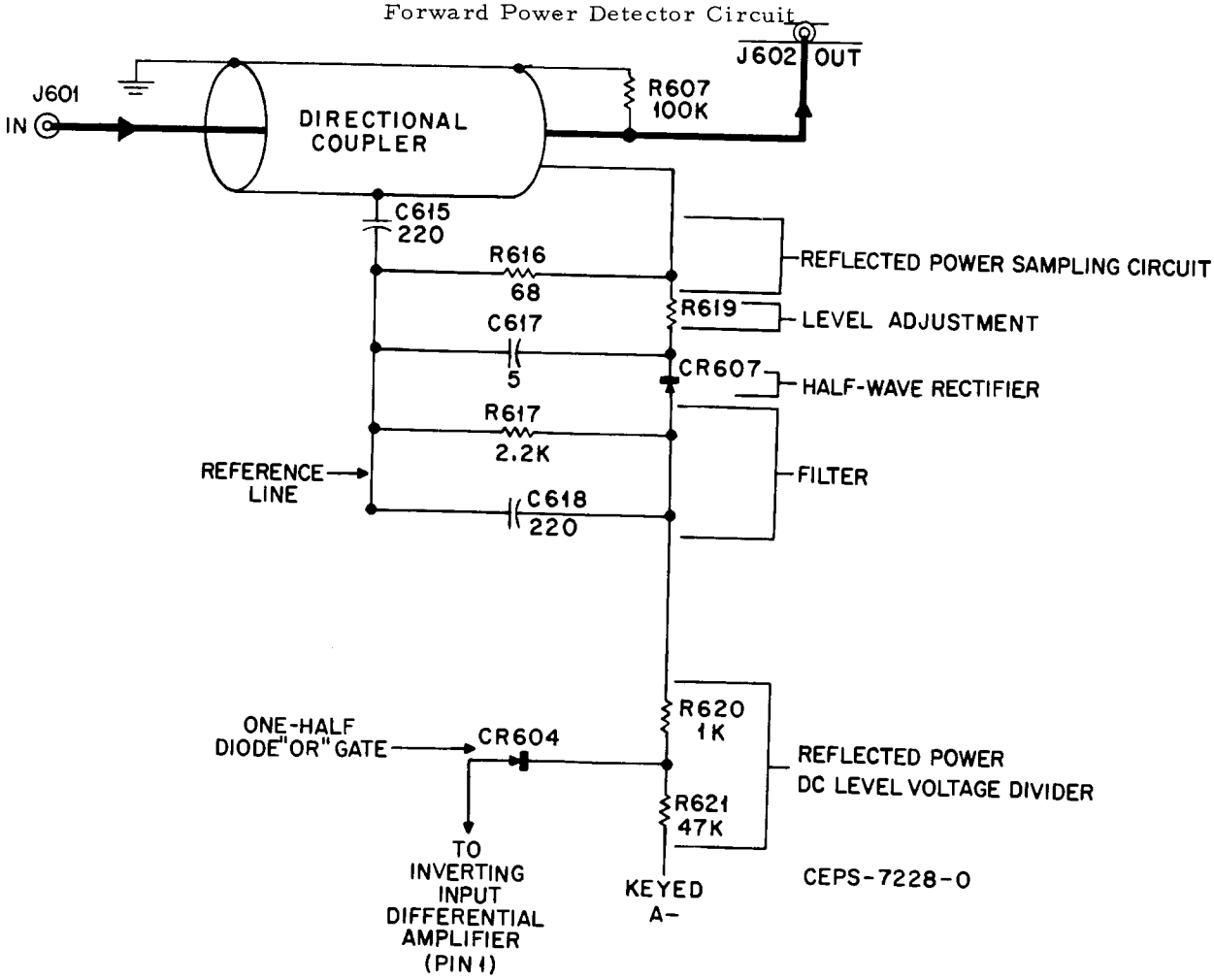


Figure 8.
Reverse Power Detector Circuit

input of the differential amplifier from the secondary divider circuitry.

(2) VSWR - Reverse Power Detection Circuit

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

Refer to Figure 8. The components of the reverse power detector circuit function the same as those in the forward power detector. The voltage divider develops a bias voltage that isn't quite enough to forward bias the diode that makes up one-half of a diode "OR" gate. When reflected power is detected, the resultant negative-going dc level lowers the dc bias level and the combination of the two forward bias the diode. The negative-going dc level on the inverting input increases the output voltage of the differential amplifier, decreasing the dc control output to protect the final stages of the power amplifier.

(3) Temperature Protection Circuit

Refer to Figure 9. 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.

Thermistor RT601 is omitted on continuous duty stations. Temperature protection is not needed due to the large exchanger used.

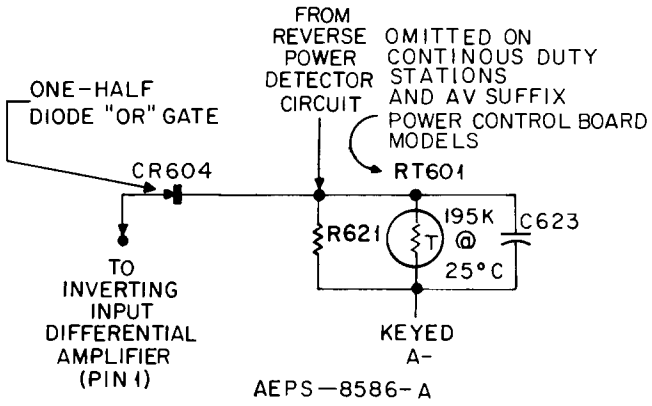


Figure 9.
Temperature Protection Circuit

(4) DC Level Output Amplification

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

4. MAINTENANCE

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, load variation, and device variations. In order for the circuitry to operate properly and provide protection it is necessary to set the power output control (POWER SET) in accordance with the station alignment procedure.

a. General

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

● Replace the defective circuit board with a spare and return the defective board to a maintenance shop for repair.

If necessary, a power control board from a "Micor" mobile radio may be used as a replacement. In continuous duty stations, remove thermistor RT601 before installing the board.

CAUTION

If the power control board is removed from a continuous duty station, be sure Thermistor RT601 is replaced before using the board in a mobile radio or intermittent duty station.

● Isolate and repair the trouble on the spot. This approach must be used if spares are not available.

Regardless of the maintenance approach used, a few simple tests on the overall radio set will localize the trouble to the power control board if it is defective. These procedures are given elsewhere in the manual. This section of the manual provides the maintenance shop level

procedures for the power control circuitry. It assumes that preliminary tests have already localized the trouble to the power control board. These bench test type procedures include measurements with a Motorola portable test set, a simple set of performance tests, and complete troubleshooting procedures including step-by-step circuit check-out.

NOTE

The power control board must be installed in the station for testing to provide the necessary power, ground, control, and signal connections. For bench testing of a board that has been removed from the station and replaced by a spare, another station or Motorola "Micor"® mobile FM two-way radio is required as a test fixture for troubleshooting.

b. Recommended Test Equipment

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

(1) Optional built-in station metering or Motorola S1056B through S1059B Portable Test Set and Model TEK-37 or TEK-37A Adapter Cable. (The meter or portable test set is necessary to monitor forward and reverse power detectors.)

(2) Motorola Solid-State DC Multimeter or equivalent. A 20,000 ohm-per-volt multimeter may be used but a low impedance volt-ohm meter may not be used. This meter is used for measuring dc voltages and resistance.

(3) Motorola T1013A RF Load Resistor (Dummy Load) or equivalent.

c. Metering

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

When optional built-in station metering is used in continuous duty stations, only exciter output (PA input), final PA current, and final PA voltage may be checked. Refer to the alignment procedure for selector switch position functions.

(1) Using Built-In Station Metering

(a) The output of the power control board must be terminated in one of three types of loads.

--The antenna load

--A dummy load such as Motorola's T1013A RF Load Resistor.

--An RF wattmeter.

NOTE

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

(b) Turn the station ON.

(c) Set the selector switch of the built-in station meter to position 1 and key the transmitter. Observe the wattmeter, or the meter reading if a dummy load is used or if the antenna is used. Unkey the transmitter. Under normal conditions at rated power out, meter 1 should read between 22 uA and 40 uA typically.

(2) Using Portable Test Set

(a) Set the function selector switch of the portable test set to the XMTR position.

(b) Set the meter reversing switch of the test set to the METER REV position.

(c) Set the REF switch to position A or B.

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

(e) Connect the red "control" plug of the adapter cable to the control receptacle on the local or remote control circuit board. Connect the white "metering" plug of the adapter cable to the receptacle on the power control board.

(f) The output of the power control board must be terminated in one of three types of loads.

--The antenna load.

--A dummy load such as Motorola's T1013A RF Load Resistor.

--An RF wattmeter.

NOTE

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

(g) Turn the station ON.

(h) Set the selector switch of the test set to position 1 and key the transmitter with the XMTR ON button on the test set. Observe the wattmeter, or the meter reading if a dummy load is used or if the antenna is used. Unkey the transmitter. Under normal conditions at rated power out, meter 1 should read between 22 uA and 40 uA typically.

d. Performance Test, Power Set Control

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

CAUTION

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

Refer to the power amplifier tune-up procedure.

(a) Key the transmitter.

(b) Adjust the POWER SET control until the rated power output is reached.

(c) Unkey the transmitter.

e. Troubleshooting

(1) Isolating Defective Components

If built-in station meter or test set readings are abnormal or tests indicate subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The accompanying troubleshooting charts summarize these results in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component. Note that all circuits powered by A+ and A- are not referenced to chassis ground, but to A-. This feature allows operation from positive or negative ground power sources.

(2) Troubleshooting Integrated Circuits

Integrated circuits (IC's) are very reliable components and should not be replaced until all checks have proven definitely that the IC is the defective component. Removal of an IC is time consuming and often ruins the part. Therefore, a few extra checks before that task is attempted are worthwhile. Before replacing a bad IC, make sure that the external components in the circuit are normal. Otherwise, the conditions which caused the IC to fail initially may still be present and destroy the new IC.

A defective IC on the power control board may be located by dc voltage measurements. Measure the dc voltages at the pins of the IC, as shown in the troubleshooting charts. Refer to the troubleshooting charts or the IC601 Schematic Diagram (Figure 3.), to locate and isolate any defective component on the board.

If the IC is to be replaced, use a "desoldering" iron with a vacuum bulb to remove solder.

f. Troubleshooting Notes

The schematic diagram of the power control board contains the voltages necessary for troubleshooting. These voltages are typical for normal operating conditions at rated power out for the station. Refer to the troubleshooting charts and the schematic when troubleshooting and a defect is suspected on the power control board.

NOTES

(1) Slight variations in meter readings or power out may occur during measurements. This is normal and does not necessarily indicate any problem.

(2) With 0 reflected power (1:1 VSWR), meter 2 will read between -10 uA and -18 uA on Model TLD8610A, and between -3 uA and -8 uA on Model TLD8620A. Again, this is normal and does not indicate a defect. The meter reversing switch on the portable test set must be placed in the OFF position for upscale readings of meter 2. Built-in station metering polarity switch mube be set to FWD when metering the power control board.

g. Complete Power Amplifier Alignment

A complete realignment of the power amplifier tuning controls and power control board adjustments may be necessary under the following conditions:

(1) Major changes, repairs (such as transistor replacement) or complete replacement of the power amplifier board.

(2) Repair or replacement of the power control board.

(3) A change in transmitter frequency greater than approximately ±1 MHz.

A complete alignment procedure is at the end of this section.

IMPORTANT

The complete alignment procedure differs from the standard tune-up procedure in that a factory set control which has been adjusted for full power amplifier protection under tune-up conditions must be readjusted. This complete alignment procedure is not required and should not be performed when an alignment check is required or if frequency has been changed less than ±1 MHz.

COMPLETE POWER AMPLIFIER ALIGNMENT PROCEDURE

NOTE

If the transmitter frequency is to be changed, first realign the exciter board per the exciter alignment procedure.

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV. SWITCH POSITION (SEE NOTE)	STAGE AND PROCEDURE
1					If the power amplifier is to be re-aligned greater than ±1 MHz from the original frequency, proceed with step 2. If the power amplifier is to be re-aligned less than ±1 MHz from the original frequency, remove the power control board shield, move the metering plug to the power control board and proceed to step 6.
2	C501 C502 R610				PRE-ALIGNMENT - Set capacitor C501 fully clockwise. For 90-, 100-, and 110-watt radio sets, also set capacitor C502 to maximum capacity (plates fully meshed). Remove the power control board shield and move the metering plug to the power control board. Use tuning tool #66A82846D01, or equivalent, to pre-align R610 located on the component side of the board. Access to this control is provided by a small slot located approximately 3/4-inch from the POWER SET access hole. The tuning tool is used to rotate the outer edge of a serrated knob. Adjust the POWER LIMIT control to the end of its travel by rotating the edge of the knob toward the bottom of the station.
3	POWER SET	POWER CONTROL BOARD			TRANSMITTER OUTPUT - Adjust the POWER SET control to the maximum clockwise position.
4	C501	POWER CONTROL BOARD	5	METER REV REF B	PA DRIVER OUTPUT - Observe meter 5. If this indication is LESS than 50 uA (full scale), proceed with step 5. If this indication is GREATER than 50 uA, tune C501 for an on-scale reading.

ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV SWITCH POSITION (SEE NOTE)	STAGE AND PROCEDURE
5	R610	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust R610 toward the top of the station until either rated output is attained or no further increase in power output is observed. In either case, adjust the POWER LIMIT control for an approximate 5- to 10-watt reduction.
6	C501 C502	POWER CONTROL BOARD	5	METER REV REF B	PA DRIVER OUTPUT - Tune C501 for a minimum meter 5 reading. If a dip is not present, minimum meter 5 should occur at maximum capacitance. On 90/100/110-watt models tune C501, then C502 for a minimum meter 5 reading.
7	R610	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust R610 for the following power output: 60-watt models approximately 65 W, 90/100/110-watt models approximately 115 W. Repeat step 6. NOTE: If the required output cannot be obtained, repeat steps 5 and 6.
8	R610	POWER CONTROL BOARD	5	METER REV REF B	Replace the power control board shield. If meter 5 exceeds 50 uA when the shield is replaced, remove the shield and adjust R610 slightly (turn knob toward the bottom of the station) until an on-scale reading--50 uA or less--is obtained with the shield replaced. The power output should be at least that specified in step 7.
9	POWER SET	POWER CONTROL BOARD	Wattmeter or 1	METER REV REF A	TRANSMITTER OUTPUT - Adjust the POWER SET control for rated power out and repeat step 6.
10		PA	5	METER REV REF B	FINAL COLLECTOR CURRENT - Move the metering plug to the PA. Measure the final collector current (I_c). I_c, in amperes, is the meter 5 reading, (0-50) x 1/5 for 60-watt models; meter 5 reading (0-50) x 1/2 for 90/100/110-watt models.

ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUST	METERING PLUG LOCATION	SELECTOR SWITCH POSITION	OSC & METER REV SWITCH POSITION (SEE NOTE)	STAGE AND PROCEDURE
11		PA	6	METER REV. REF B	FINAL COLLECTOR VOLTAGE - Measure the final collector voltage (V_c). V_c is the meter 6 reading (0-30 V scale).
12					Determine the final input power (P_{in}). P_{in} equals $V_c \times I_c$. P_{in} should be less than: 120 W for 60 W models 180 W for 90 W models 200 W for 100 W and 110 W models

POWER CONTROL BOARD METERING

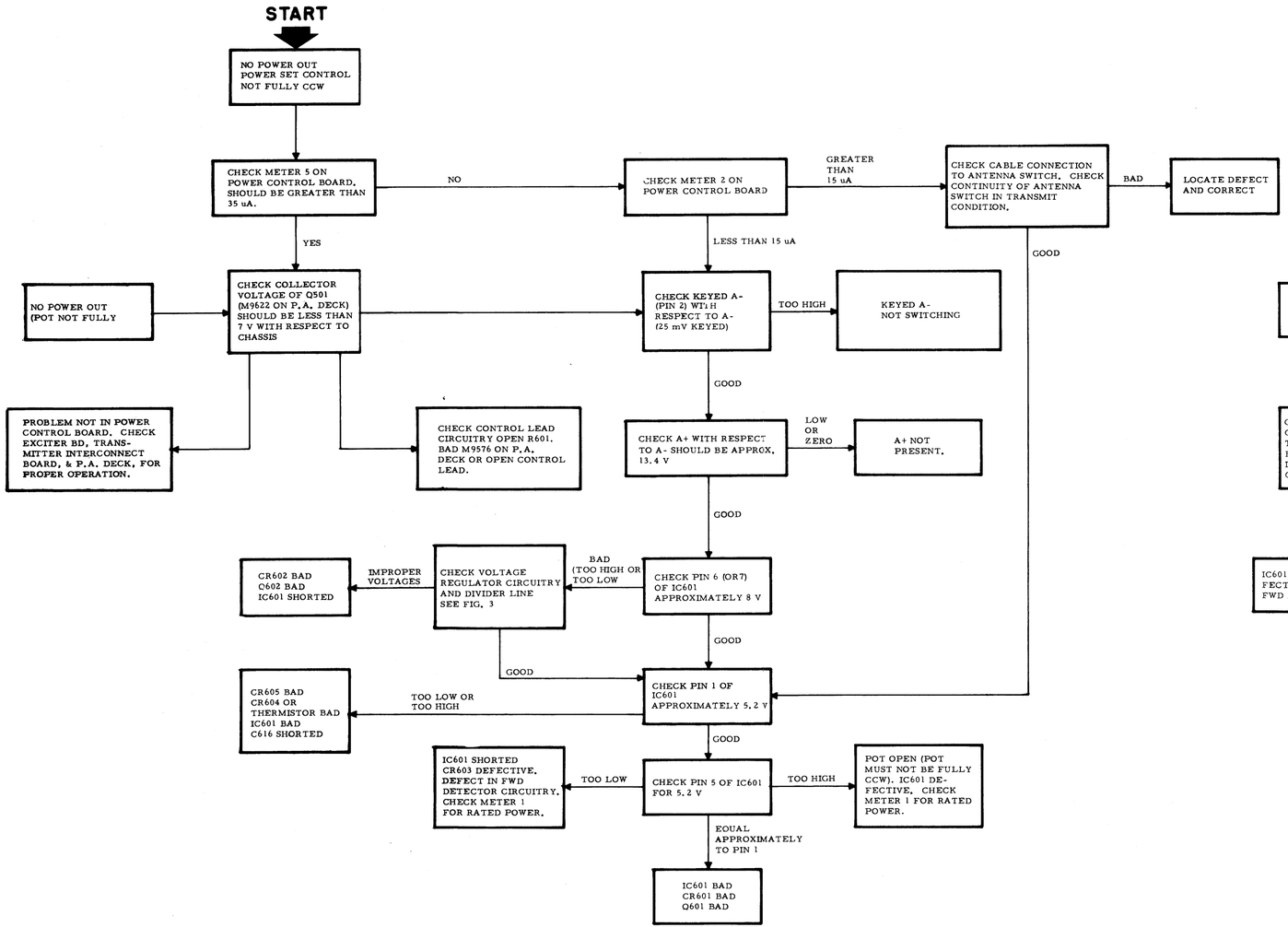
NOTE

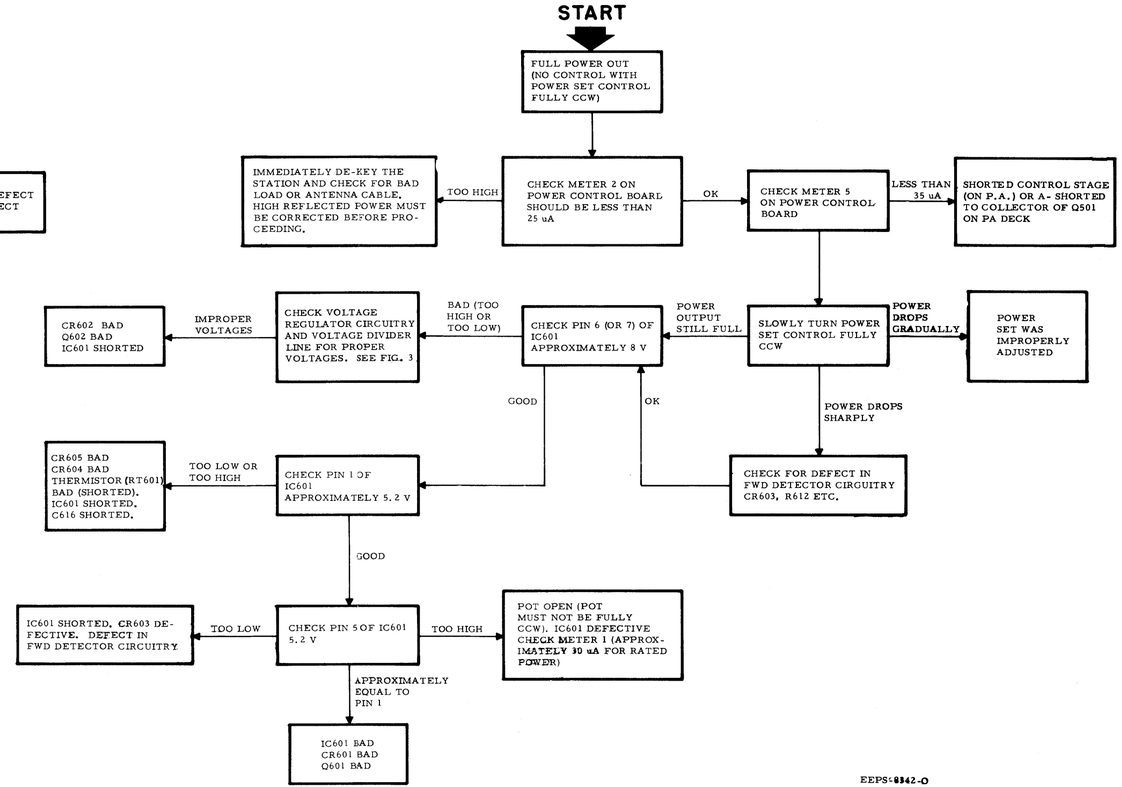
Radio operating at rated power into proper 50 ohm load.

SELECTOR SWITCH POSITION	REFERENCE SWITCH POSITION (SEE NOTE)	NORMAL METER READINGS	FUNCTION
1	A (Meter Reverse On)	22-45 uA	Indicates forward power output per calibration label on PA shield.
2	A	3-8 uA (60 W models) 10-18 uA (90/100/110 W models)	A meter reading higher than the normal range indicates reflected power caused by a defective antenna, antenna switch, or cables.
5	B (Meter Reverse On)	3-35 uA	Indicates the relative level of drive sent to the PA on the blue control lead. A reading of greater than 35 uA indicates the power control board is set for a higher power than the radio is capable of supplying.

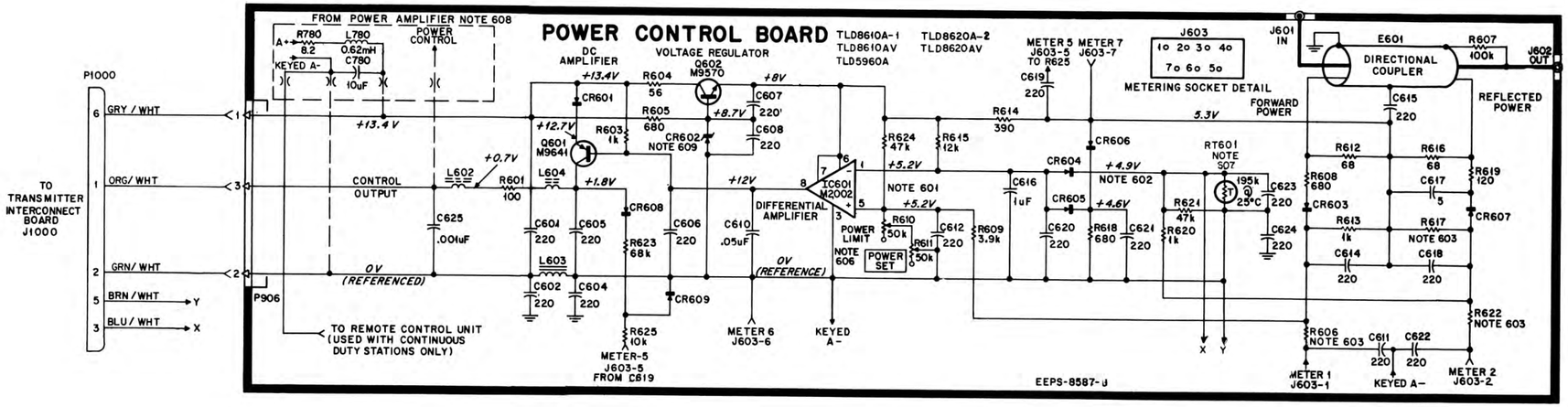
METERING NOTE

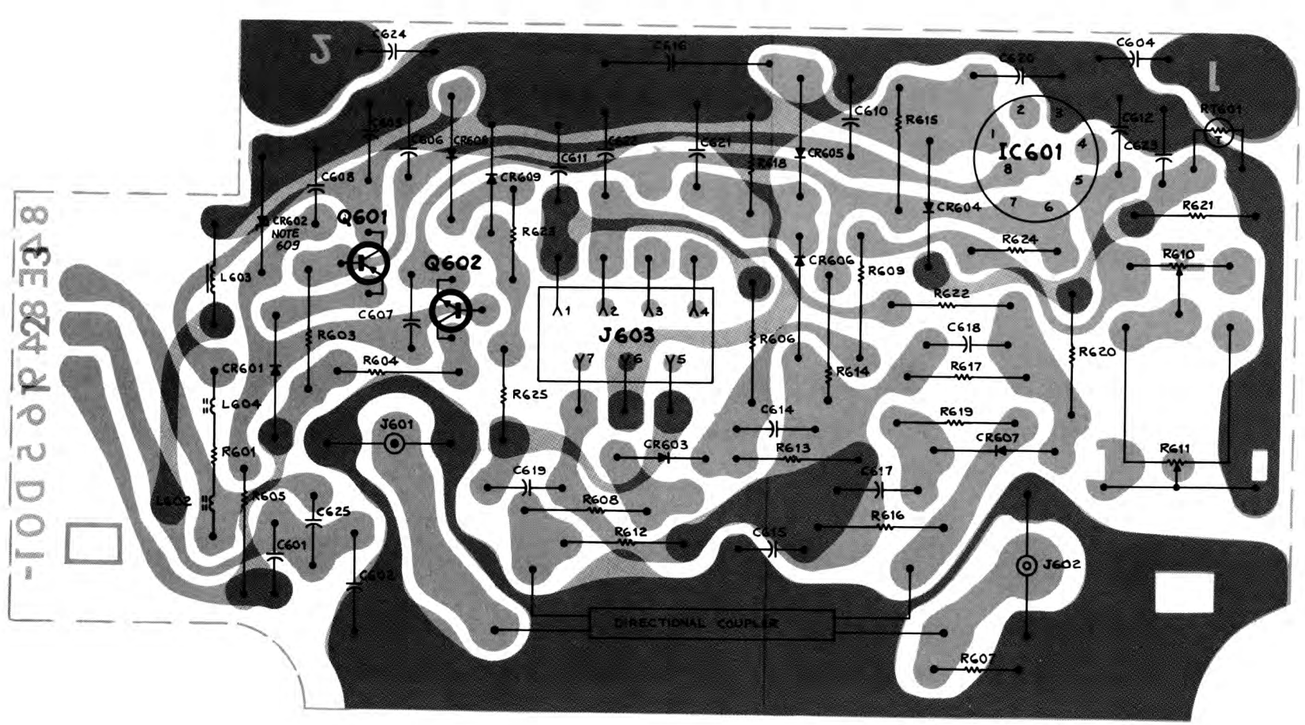
Alignment may be performed using a Motorola S1056B thru S1059B Portable Test Set or optional built-in station metering. The OSC. & METER REV. SWITCH column refers to portable test set usage. The optional built-in station metering is similar to the portable test set except PA voltage is measured with the two voltage probes. The built-in metering polarity switch is set to REV for PA metering and FWD for Power Control Board metering.


START
NO POWER OUT POWER SET CONTROL NOT FULLY CCW
CHECK METER 5 ON POWER CONTROL BOARD, SHOULD BE GREATER THAN 35 uA.
NO
CHECK METER 2 ON POWER CONTROL BOARD
GREATER THAN 15 uA
CHECK CABLE CONNECTION TO ANTENNA SWITCH. CHECK CONTINUITY OF ANTENNA SWITCH IN TRANSMIT CONDITION.
BAD
LOCATE DEFECT AND CORRECT
GOOD
YES
LESS THAN 15 uA
NO POWER OUT (POT NOT FULLY
CHECK COLLECTOR VOLTAGE OF Q501 (M9622 ON P.A. DECK) SHOULD BE LESS THAN 7 V WITH RESPECT TO CHASSIS
CHECK KEYED A- (PIN 2) WITH RESPECT TO A- (25 mV KEYED)
TOO HIGH
KEYED A- NOT SWITCHING
GOOD
PROBLEM NOT IN POWER CONTROL BOARD. CHECK EXCITER BD, TRANSMITTER INTERCONNECT BOARD, & P.A. DECK, FOR PROPER OPERATION.
CHECK CONTROL LEAD CIRCUITRY OPEN R601. BAD M9576 ON P.A. DECK OR OPEN CONTROL LEAD.
CHECK A+ WITH RESPECT TO A- SHOULD BE APPROX. 13.4 V
LOW OR ZERO
A+ NOT PRESENT.
GOOD
CR602 BAD C602 BAD IC601 SHORTED
IMPROPER VOLTAGES
CHECK VOLTAGE REGULATOR CIRCUITRY AND DIVIDER LINE SEE FIG. 3
BAD (TOO HIGH OR TOO LOW
CHECK PIN 6 (OR7) OF IC601 APPROXIMATELY 8 V
GOOD
GOOD
CR605 BAD CR604 OR THERMISTOR BAD IC601 BAD C616 SHORTED
TOO LOW OR TOO HIGH
CHECK PIN 1 OF IC601 APPROXIMATELY 5.2 V
GOOD
IC601 SHORTED CR603 DEFECTIVE. DEFECT IN FWD DETECTOR CIRCUITRY. CHECK METER 1 FOR RATED POWER.
TOO LOW
CHECK PIN 5 OF IC601 FOR 5.2 V
TOO HIGH
POT OPEN (POT MUST NOT BE FULLY CCW). IC601 DEFECTIVE. CHECK METER 1 FOR RATED POWER.
EOUAL APPROXIMATELY TO PIN 1
IC601 BAD CR601 BAD Q601 BAD


START
FULL POWER OUT (NO CONTROL WITH POWER SET CONTROL FULLY CCW)
IMMEDIATELY DE-KEY THE STATION AND CHECK FOR BAD LOAD OR ANTENNA CABLE. HIGH REFLECTED POWER MUST BE CORRECTED BEFORE PROCEEDING.
TOO HIGH
CHECK METER 2 ON POWER CONTROL BOARL SHOULD BE LESS THAN 25 uA
OK
CHECK METER 5 ON POWER CONTROL BOARD
LESS THAN 35 uA
SHORTED CONTROL STAGE (ON P.A.) OR A- SHORTED TO COLLECTOR OF Q501 ON PA DECK
CR602 BAD Q602 BAD IC601 SHORTED
IMPROPER VOLTAGES
CHECK VOLTAGE REGULATOR CIRCUITRY AND VOLTAGE DIVIDER LINE FOR PROPER VOLTAGES. SEE FIG. 3
BAD (TOO HIGH OR TOO LOW)
CHECK PIN 6 (OR 7) OF IC601 APPROXIMATELY 8 V
POWER OUTPUT STILL FULL
SLOWLY TURN POWER SET CONTROL FULLY CCW
POWER DROPS GRADUALLY
POWER SET WAS IMPROPERLY ADJUSTED
GOOD
OK
POWER DROPS SHARPLY
CR605 BAD CR604 BAD THERMISTOR (RT601) BAD (SHORTED). IC601 SHORTED. C616 SHORTED.
TOO LOW OR TOO HIGH
CHECK PIN 1 OF IC601 APPROXIMATELY 5.2 V
CHECK FOR DEFECT IN FWD DETECTOR CIRGUITRY CR603, R612 ETC.
GOOD
IC601 SHORTED. CR603 DEFECTIVE. DEFECT IN FWD DETECTOR CIRCUITRY
TOO LOW
CHECK PIN 5 OF IC601 5.2 V
TOO HIGH
POT OPEN (POT MUST NOT BE FULLY CCW). IC601 DEFECTIVE CHECK METER 1 (APPROXIMATELY 30 uA FOR RATED POWER)
APPROXIMATELY EQUAL TO PIN 1
IC601 BAD CR601 BAD Q601 BAD

EEPS-0342-O





SHOWN FROM SOLDER SIDE

POWER CONTROL BOARD

601. VOLTAGES AT PINS 1 AND 5 SHOULD DIFFER BY LESS THAN 50 mV.
602. VOLTAGES MEASURED AT 25 C.
603.

POWER	R606	R622	R617
60 W	15K	18K	1.8K
90/100/110 W	27K	47K	2.2K

604. TYPICAL VOLTAGES UNDER NORMAL OPERATING CONDITIONS.
605. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS.
606. FACTORY ADJUSTMENT.
607. RT601 OMITTED IN CONTINUOUS DUTY STATIONS AND FOR MODELS TLD8610AV & TLD8620AV.
608. USED ONLY IN CONTINUOUS DUTY STATIONS. NOT PART OF OR MOUNTED ON POWER CONTROL BOARD. PART OF MODEL TLN4780A P.A. HEAT SINK KIT.
609. ON MODEL TLD5960A CR602 IS A HYBRID ASSEMBLY.

EPS-8313-E

POWER CONTROL BOARD

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLD8610A-1 and TLD8620A-1
TLD8610AV, TLD8620AV and TLD5960A
Power Control Board
Schematic Diagram and Circuit Board Detail
Motorola No. 63P81015E08-K
8/23/78-NPC

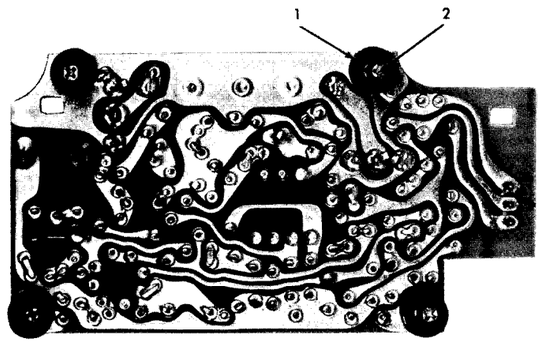
REVISIONS 63P81015E08-E

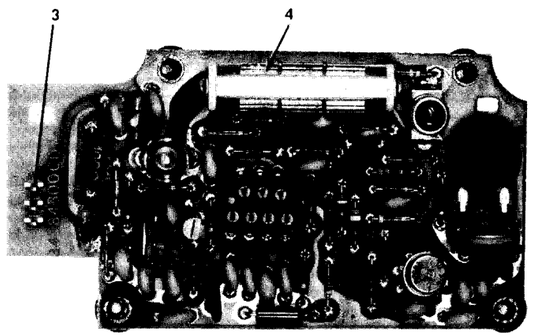
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4780A-1	C780	ADDED 23-83214C20, 10 uF	P. A. INPUT (A-), A-J
	L780	ADDED 24-80900A61, 0.62 MH	
	R780	ADDED 6-124B67, 8.2 OHMS	
TLD8610A-1 TLD8620A-1	R619	FROM 6-124A13, 33 TO 6-124A27, 120	PARTS LIST
	R606	FROM 6-129887, 12K TO 6-124A77, 15K (TLD8610A ONLY)	
	R617	FROM 6-128689, 2.2K TO 6-124A55, 1.8K (TLD8610A ONLY)	
	RT601	FROM 6-867628 TO 6-82462G03 CIRCUIT BOARD PLATING REVISED	
TLD8610AV TLD8620AV		NEW MODELS ADDED	
TLD5960A		ADD NEW MODEL	

parts list

Mechanical Parts List PL-854-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	42C84284B01	RETAINER; 4 used
2	3-138162	SCREW, tapping: 4-40 x 5/16"
3	29C84028H01	TERMINAL, male; 3 used
4	42B84678B01	CLIP, component
	NON-CODED ITEM	
	55B84300B04	HANDLE, plastic
	1-80797B34	CABLE ASSEMBLY (LD8610AV & TLD8620AV only) includes:
	42-10217A02	STRAP, tie





BEPS-6542-O

ELECTRICAL PARTS LIST

TLD5960A Power Control Board (High Power)
TLD8610A/AV Power Control Board (Low Power)
TLD8620A/AV Power Control Board (High Power) PL-1508-G

NOTE
This parts list covers more than one model. Where differences exist the model number of the applicable unit is given in the Description column.

		CAPACITOR, fixed:
C601	21-83596E10	220 pF ±20%; 500 V
C602	21-83596E10	220 pF ±20%; 500 V
C604 thru 608	21-83596E10	220 pF ±20%; 500 V
C610	21-82372C04	.05 uF +80-20%; 25 V
C611, 612	21-83596E10	220 pF ±20%; 500 V
C614, 615	21-83596E10	220 pF ±20%; 500 V
C616	23-83214C04	1.0 uF ±20%; 15 V
C617	21-82133G53	5 pF ±0.5 pF; 500 V; NP0
C618 thru 624	21-83596E10	220 pF ±20%; 500 V
C625	21-82187E14	.001 uF ±10%; 100 V
		SEMICONDUCTOR DEVICE, diode:
CR601	48-83654H01	silicon
CR602	48-83696E04 or 1-80709D68	Zener (9.1 V) hybrid assembly
CR603	48-84616A01	silicon
CR604	48-82392B11	silicon
CR605	48-82392B11	silicon
CR606	48-82392B11	silicon
CR607	48-84616A01	silicon
CR608	48-82392B03	silicon
CR609	48-82392B11	silicon
		COUPLER, line:
E601	58-84685B01	dual
		INTEGRATED CIRCUIT:
IC601	51-84320A02	M2002
		CONNECTOR, receptacle:
J601	28-84227B02	male; single contact
J602	9-84231B02	female; single contact
J603	9-84207B01	female; 7 contact
		COIL, RF:
L602	76-83960B01	ferrite bead
L603	24-83961B01	choke
L604	76-83960B01	ferrite bead
		CONNECTOR, plug:
P1000	—	consists of: (TLD8610AV & TLD8620AV only)
	15-83498F06	HOUSING, connector
	29-83499F01	CONTACT, terminal: 5 used
	46-84549F01	PLUG, polarizing
		TRANSISTOR:
Q601	48-869641	PNP; type M9641
Q602	48-869570	NPN; type M9570
		RESISTOR, fixed: ±10%; 1/4 W: unless otherwise stated
R601	17-82291B21	100 ±5%; 3 W
R603	6-124C49	1k
R604	6-124C19	56
R605	6-124A45	680 ±5%
R606	6-124A77	15k ±5% (TLD8610A only)
	or 6-124A83	27k ±5% (TLD8620A, TLD5960A)
R607	6-124C97	100k
R608	6-124A45	680 ±5%
R609	6-124A63	3.9k ±5%
R610	18-83083G26	variable; 50k
R611	18-83083G20	variable; 50k
R612	6-124A21	68 ±5%
R613	6-124A49	1k ±5%
R614	6-124A39	390 ±5%
R615	6-124C75	12k
R616	6-124A21	68 ±5%
R617	6-124A57	2.2k ±5% (TLD8620A, TLD5960A)
	or 6-124A55	1.8k ±5% (TLD8610A only)
R618	6-124A45	680 ±5%
R619	6-124A27	120 ±5%
R620	6-124C49	1k
R621	6-124A89	47k
R622	6-131526	18k ±5% (TLD8610A only)
	or 6-124A89	47k ~~±5%~~ (TLD8620A, TLD5960A)
R623	6-185A93	68k ±5%; 1/8 W
R624	6-185B99	47k; 1/8 W

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R625	6-185A73	10k ±5%; 1/8 W
RT601	6-82462G03	THERMISTOR: 195k @25°C (TLD8610A & TLD8620A only)

Power Amplifier Heatsink Kit (P/O TLN4780A) PL-2657-A

C780	23-83214C20	CAPACITOR, fixed: 10 uF ±20%; 20 V
L780	24-80900A61	COIL, RF: choke; 0.62 mH; coded BRN-ORG
R780	6-124B67	RESISTOR, fixed: 8.2 ±5%; 1/4 W

TONE "PRIVATE-LINE" ENCODER

MODEL TI N5731A

TECHNICAL CHARACTERISTICS

"PL" TONE FREQUENCY	Selected from 67-210 Hz range
FREQUENCY DETERMINING DEVICE	"Vibrasender" Resonant Reed
STABILITY	±0.15%
LEVEL (nominal)	350 mV rms
OUTPUT IMPEDANCE	4.7k ohms
POWER REQUIREMENTS	+9.6 V dc @15 mA

1. DESCRIPTION

The "Private-Line" (PL) encoder generates a low-frequency audio tone for continuous modulation of the transmitted rf signal in "Private-Line" operation.

2. FUNCTIONAL OPERATION

2.1 GENERAL

The encoder may be divided into three major sections.

Tone Oscillator -- The tone oscillator generates two equal-amplitude tone signals 180° out-of-phase whenever power is applied to the radio. A feedback amplifier provides negative feedback to limit the level of oscillation. The "Vibrasender" resonant reed determines the frequency of operation.

Reverse Burst Timing Generator -- The reverse burst timing generator provides a transmitter turn-off delay of approximately 150 milliseconds after the transmitter is unkeyed. During this period, a shifted phase tone (reverse burst) is developed in the tone output circuit which dampens the oscillations of the "Vibrasponder" resonant reed in listening receivers to eliminate the "squelch tail" noise burst at the end of the message.

Tone Output Circuit -- The tone output circuit provides a fixed level tone output to the modulator of the transmitter and shifts the phase of the tone during the reverse burst period to rapidly dampen the "Vibrasponder" resonant reeds in listening receivers.

2.2 TONE OSCILLATOR

The tone oscillator operates continuously while the station is "on". 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 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 provided 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.

2.3 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 PTT 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, filter A+ is applied through Q707 to turn on the transmitter.

--C708 charges from the filtered A+ line through Q706 base-emitter junction, CR730 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 PTT button is released, the keyed, filter 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.

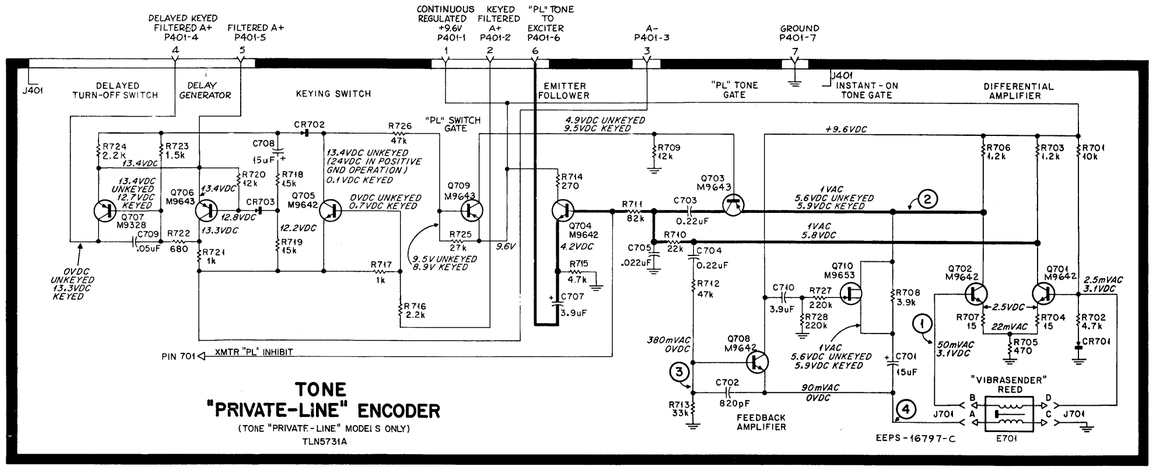
--After approximately 150 milliseconds, the voltage across C708 decreases to the point where Q706 turns on again and applies A+ across R721.

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

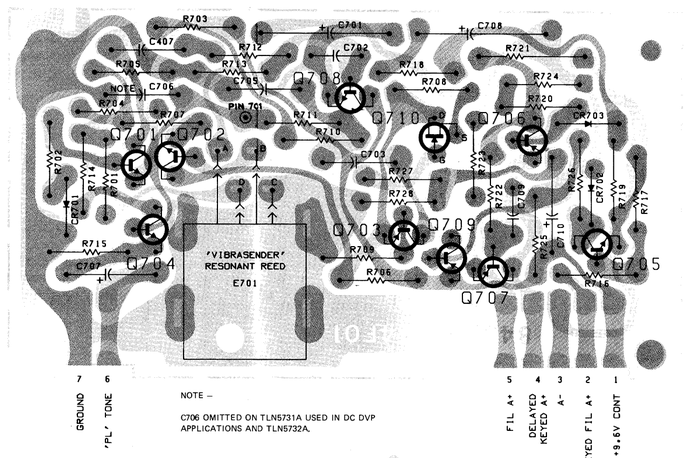
2.4 TONE OUTPUT CIRCUIT

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 ouput and isolates the tone oscillator from the external circuit to which the tone output is applied.

EPS-17757-B



SHOWN FROM SOLDER SIDE



"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 Q706, 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.

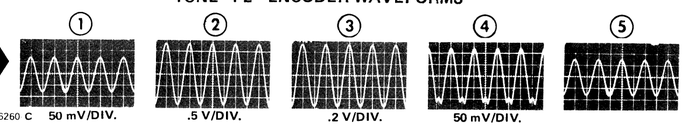
705. PINS J401-6 AND -7 ON THE PL ENCODER MATE WITH PINS P401-11 AND -12 ON THE EXCITER.

NEPS-7051-B

TONE "PL" ENCODER WAVEFORMS

OSCILLOSCOPE WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

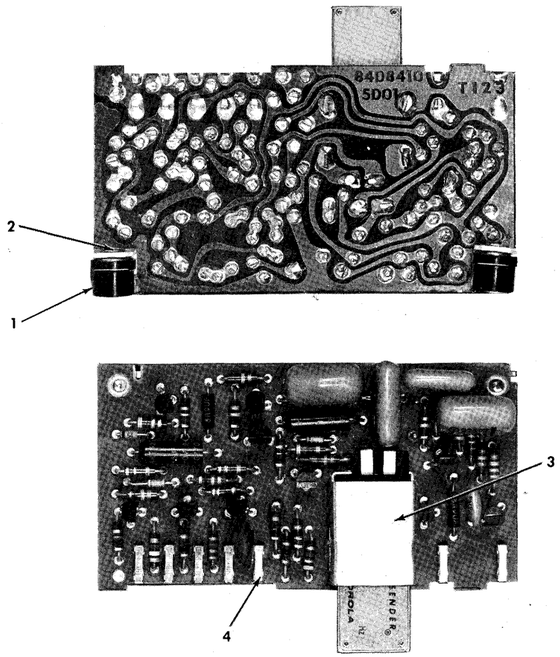
1. WAVEFORMS SHOWN USING 100 Hz "VIBRASENDER" RESONANT REED.
2. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
3. HORIZONTAL DEFLECTION = 5 msec/DIV.
4. ALL WAVEFORMS MEASURED IN RESPECT TO CHASSIS GROUND.



EPS-6260 C

TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A



AEPS-6945-O

MECHANICAL PARTS LIST

TLN5731A and TLN4293B
"Private-Line" Encoder

PL-1308-D

CODE	MOTOROLA PART NO.	DESCRIPTION
1	42-84284B01	RETAINER, screw: 2 req'd
2	3-138162	LOCKSCREW, tapping: No 4 x 3/8" Phillips hex head; 2 req'd
3	42-84116B02	SOCKET & BRACKET ASSEMBLY: for "Vibrasender" Resonant Reed
4	9-83011H01	TERMINAL, pin: female 7 req'd

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

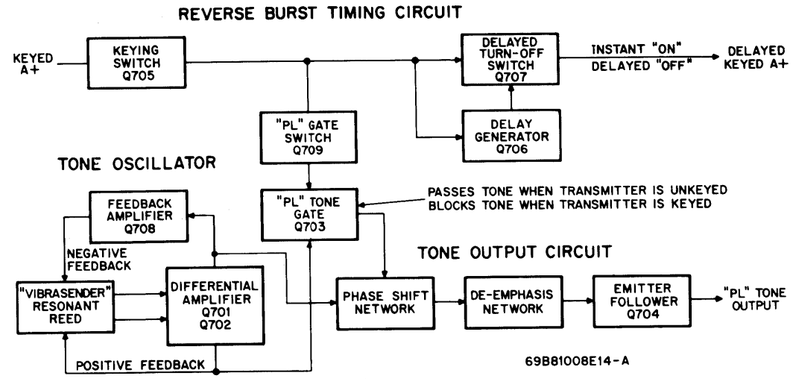
TLN5731A Tone "Private-Line" Encoder PL-3260-D

		CAPACITOR, fixed: uF; ±10%; 50 V; unless otherwise stated
C701	23-84762H09	15 ±20%; 20 V
C702	21-82187B23	820 pF; 500 V
C703, 704	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
		DIODE: (SEE NOTE I)
CR701, 702, 703	48-83654H01	silicon
		CONNECTOR, receptacle:
J401		consists of 7 female contact terminals (Part No. 9-83011H01) mounted on edge of circuit board
		"VIBRASENDER" RESONANT REED: (SEE NOTE II)
E701	KLN6210A	"plug-in" unit
		TRANSISTOR: (SEE NOTE I)
Q701, 702	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q703	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q704, 705	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q706	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q707	48-869328	PNP; type M9328
Q708	48-869570	NPN; type M9570
	or 48-869642	NPN; type M9642
Q709	48-869571	PNP; type M9571
	or 48-869643	PNP; type M9643
Q710	48-869653	FET; type M9653
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R701	6-124A73	10k
R702	6-124A65	4.7k
R703, 706	6-124A51	1.2k
R704	6-124A05	15
R705	6-124A41	470
R707	6-124A05	15
R708	6-124A63	3.9k
R709	6-124C75	12k ±10%
R710	6-124A81	22k
R711	6-124A95	82k
R712	6-124A89	47k
R713	6-124A85	33k
R714	6-124C35	270 ±10%
R715	6-124A65	4.7k
R716	6-124C57	2.2k ±10%
R717	6-124C49	1k ±10%
R718	6-124A53	1.5k
R719	6-124A77	15k
R720	6-124A75	12k
R721	6-125A49	1k;1/2 W
R722	6-124A45	680
R723	6-124A53	1.5k
R724	6-124C57	2.2k ±10%
R725	6-124C83	27k ±10%
R726	6-124C89	47k ±10%
R727, 728	6-124D06	220k ±10%

NOTES:

I. For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

II. The "Vibrasender" Resonant Reed (Model KLN6210A) is not a part of the encoder board. When ordering a complete board, the reed must be ordered separately.



MAINTENANCE

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 -- valuable for signal tracing and locating sources of distortion.

(4) Motorola Solid-State DC Multimeter -- used for dc voltage measurement.

(5) Motorola S1343 Series Frequency Counter or S1344 Series Frequency Counter/Deviation Meter -- used for measuring PL tone frequency.

b. Performance Test

Measure 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 any 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 is defective.

(f) If the reed is good, replace it in the encoder and make dc voltage measurement in the tone oscillator circuit to locate the defective components.

(2) If low deviation is measured, check ac signal voltages and compare them with the chart readings to find the source of trouble.

(3) If deviation is normal, but calls are not being received, check the frequency of the PL encoder tone. If 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 is 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.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4728A/TLN5605A
Xmtr. Chassis & Heat Sink PL-1838-A

	1-80728B50	CHASSIS ASSEMBLY: includes: 7-84221B01 BRACKET 26-84198B02 HEATSINK 27-84349D01 CHASSIS 1-80728B01 BRACKET ASSEMBLY: includes: BRACKET ref. items C902, C904, C907 & C909
	27-84350D01	CHASSIS
	7-84354D01	BRACKET
	41-84144C01	SPRING, retaining
	3-50378	TERMINAL STRIP
	14-84210A01	INSULATOR
	4-84152B01	WASHER, shoulder
	14-84290B01	INSULATOR, pa
	26-84588B01	SHIELD
	43-84219C01	SPACER
	55-84300B01	HANDLE

NOTE:

Electrical components for TLN4728A are listed in the Power Amplifier and Transmitter Interconnect sections.

TLN4730A Xmtr. Hardware Kit PL-1774-O

	1-80709B41	SHIELD ASSEMBLY
	1-80731B73	SHIELD ASSEMBLY, exciter
	3-84141D01	SCREW, captive; 4 req'd
	15-84352D01	COVER, rear; xmtr.
	15-84300B01	COVER, bottom, xmtr.
	55-84300B01	HANDLE, large
	55-84300B02	HANDLE, small

TLN4741A PA Hardware Kit PL-1834-O

	1-80727B91	BRACKET ASSEMBLY; includes: 7-84407D01 BRACKET ref items C571, C572 & C573
	9-84234E10	JACK, test; white; 3 req'd
	26-84402D01	SHIELD
	14-84290B02	INSULATOR

NOTE:

Electrical components for TLN4741A are listed in the Power Amplifier and Power Control sections.

TLN4742A Hardware Kit PL-1855-A

	1-80727B91	BRACKET ASSEMBLY; includes: 7-84407D01 BRACKET, mounting 4-83755H01 WASHER, solder; 7 req'd ref. items C571, C572 & C573
	9-84234E10	JACK, test; white; 3 req'd
	26-84911L02	SHIELD, power amplifier

NOTE:

Electrical components for TLN4742A are listed in the Power Amplifier and Power Control sections.

parts list

TLN5074A Terminal Bracket Kit PL-1857-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	7-84354D01	BRACKET, terminal board
	31-50378	TERMINAL BOARD, 2 terminal
	3-13424	SCREW, tapping: 4 x 40 x 5/16
	4-7569	WASHER, flat: 0.145 x 0.312 x .027

NOTE: Electrical components for TLN5074A are listed in the Power Amplifier section.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN4744A Exciter Hardware Kit PL-1829-O

	1-80727B99	FILTER ASSEMBLY: includes: 64-84014E01 PLATE, mounting 4-83755H01 WASHER, solder; 2 req'd ref. items C911 & C912
	1-80730B02	CHASSIS ASSEMBLY: includes: 27-84140D01 CHASSIS, exciter 1-80728B01 BRACKET ASSEMBLY includes: 7-84948D01 BRACKET 4-83755H01 WASHER, solder; 4 req'd ref. items C902, C904, C907 & C909
	7-84221B01	BRACKET
	15-84165D01	COVER, exciter
	15-84166D01	COVER, rear
	15-84301E01	COVER, front
	41-84144C01	SPRING, retaining

NOTE:

Electrical components for TLN4744A are listed in the Transmitter Interconnect section.

TLN4822A Cable & Bracket Kit PL-1828-O

	1-80727B94	BRACKET ASSEMBLY: includes: 7-84405D01 BRACKET 9-84935D01 SOCKET, transistor 4-83755H01 WASHER, solder; 3 req'd ref. items C565, C566 & C570
	14-865875	INSULATOR, mica

NOTE:

Cable assemblies for TLN4822A are listed in the rf cables section; electrical components are listed in the Power Amplifier and Transmitter Interconnect sections.

TLN4781A Xmtr. Chassis & Heat Sink Kit PL-1836-O

	1-80728B50	CHASSIS ASSEMBLY: includes: 1-80728B01 BRACKET ASSEMBLY: includes: 7-84948D01 BRACKET 4-83755H01 WASHER, solder; 4 req'd ref items C902, C904, C907 & C909 7-84221B01 BRACKET 26-84198B02 HEATSINK 27-84349D01 CHASSIS
	27-84350D01	CHASSIS
	7-84354D01	BRACKET
	41-84144C01	SPRING, retaining
	31-50378	TERMINAL BOARD, 2 terminal
	14-84210A01	INSULATOR
	4-84152B01	WASHER, shoulder
	14-84020C01	INSULATOR
	26-84588B01	SHIELD
	43-84219C01	SPACER
	55-84300B01	HANDLE
	4-83755H01	WASHER, solder, 2 req'd

NOTE:

Electrical components for TLN4781A are listed in the Power Amplifier and Transmitter Interconnect sections.

TRANSMITTER HARDWARE KITS

132-174 MHz

MODEL TABLE

MODEL	DESCRIPTION	TYPE OF STATION USED WITH			
		INTERMITTENT DUTY	CONTINUOUS DUTY	60 W	HI PWR
TLN4728A	CHASSIS & HEAT SINK	X			X
TLN4730A	XMTR HARDWARE KIT	X		X	X
TLN4741A	PA HARDWARE KIT		X		X
TLN4742A	PA HARDWARE KIT		X	X	
TLN4744A	XCTR HARDWARE KIT		X	X	X
TLN4780A	PA CASTING & HARDWARE KIT		X	X	X
TLN4781A	XMTR CHASSIS & HEAT SINK	X		X	
TLN4822A	INPUT BRACKET & CABLE		X	X	X
TLN5074A	TERMINAL BRACKET	X		X	X
TRN6188A	"PL" ENCODER HARDWARE KIT		X	X	X
TLN5902A	SHIELD, xmtr		X	X	X
TRN6974A	SHIELD, xmtr	X		X	X

TRN6188A Hardware Kit, "PL" Encoder PL-5094-A

	2-7019	NUT, hex; 4-40 x 1/4 x 3/32"; 2 used
	3-139495	SCREW, tapping: 6-20 x 5/16"; 2 used
	7-82310N01	BRACKET
	14-83809K01	INSULA TOR, board
	75-82303N01	PAD, rubber

TRN6974A Shield, Transmitter PL-5512-O

	1-80793B77	COVER ASSEMBLY includes:
	I-80793B78	COVER SUBASSEMBLY includes:
	64-82673L01	COVER
	3-138162	SCREW, tapping: 4-40 x 3/8"; 4 used
	42-84284B01	RETAINER: 4 used
	3-139495	SCREW, tapping: 6-20 x 5/16"; 5 used
	26-83146L01	SHIELD

TLN5902A/TLN5913A Shield, Transmitter PL-5095-O

	1-80793B77	COVER ASSEMBLY includes:
	1-80793B78	COVER SUBASSEMBLY includes:
	64-82673L01	COVER
	3-138162	SCREW, tapping: 4-40 x 3/8"; 4 used
	42-84284B01	RETAINER, screw; 4 used
	3-139495	SCREW, tapping: 6-20 x 5/16"; 5 used
	26-82676L01	SHIELD, xmtr (TLN5902A)
	26-82910L01	SHIELD, xmtr (TLN5913A)

MOTOROLA INC.
Communications Division

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

MOTOROLA INC.
Communications
Sector

PRIVATE-LINE INHIBIT CABLE KITS

MODEL TKN6631A (18")
MODEL TKN6808A (10.75")

DESCRIPTION

These single lead cable kits are used in system that inhibit the transmitted *Private-Line* code in certain modes of operation (such as paging). Cable interconnection is between the TLN5731A *Private-Line* Encoder pin 701 and the TLN4729B/TLN4743B Transmitter Interconnect Board pin 30 (TKN6631A), or the TLN5893A/94A TLN5895A Transmitter Interconnect Board pin P964 (TKN6808A).

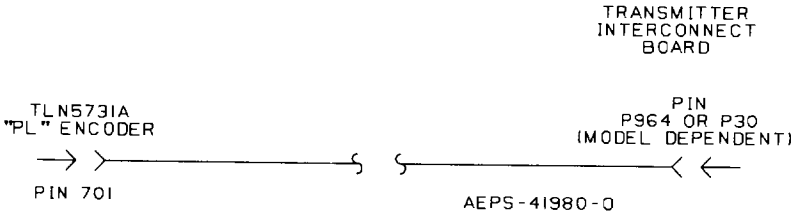


Figure 1. TKN6631A/TKN6808A Cable Kits

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

MOTOROLA INC.
Communications
Sector

UNIFIED CHASSIS RECEIVER INTERCONNECT BOARD

1. DESCRIPTION

The receiver interconnect board connects the receiver rf and i-f board and the receiver audio and squelch board to the station unified chassis interconnect board.

A number of jumpers are provided to allow use of the board in single and two-receiver stations, with *Digital Private-Line* operation and for modified squelch operations. Jumper connections for these modes of operation are shown in the jumper chart on the receiver interconnect board schematic diagram.

2. "AND SQUELCH" OPERATION

An optional mode of receiver operation, known as "AND SQUELCH", can be added when desired. This feature provides "variable PL sensitivity" (coded squelch plus adjustable noise-activated carrier squelch.)

In this mode, the receiver audio channel is activated when a PL tone is received and the carrier squelch threshold level is exceeded. Since the carrier (noise-activated) squelch circuit sensitivity is adjustable, and since it is one of the controlling factors in the squelching of receiver audio, the operation can be aptly described as "variable PL sensitivity". Thus, "AND SQUELCH" denotes both coded squelch and carrier squelch operating simultaneously.

Conversion of the receiver to the "AND SQUELCH" mode of operation requires the addition of certain components to the receiver interconnect board, and the omission of certain jumpers on both the receiver interconnect board and the audio & squelch board.

The parts required to convert the receiver to "AND SQUELCH" operation are listed with the receiver interconnect board schematic diagram.

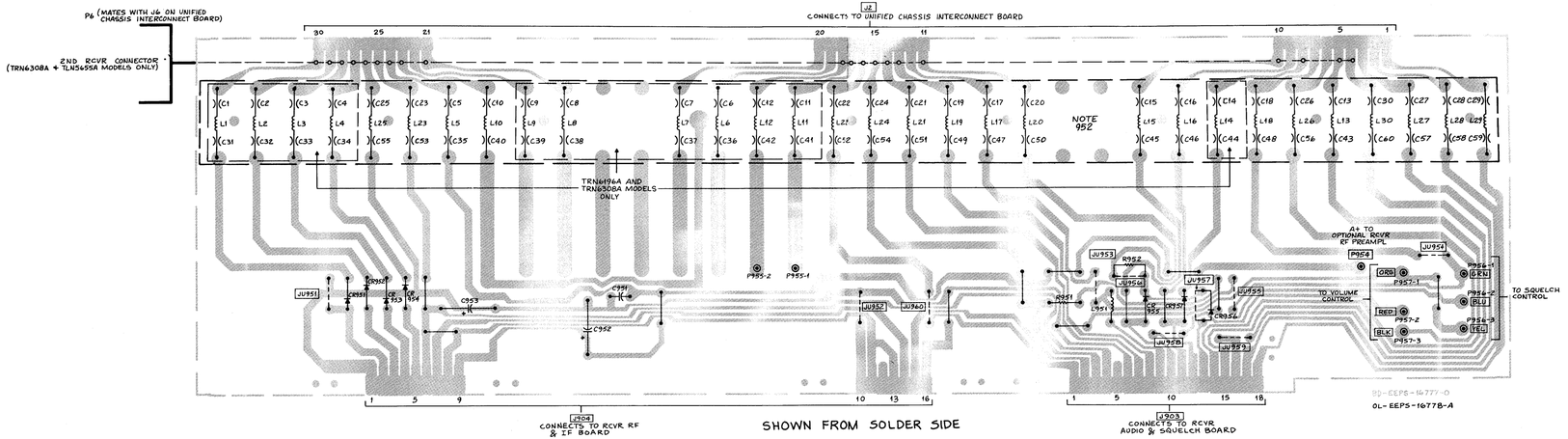
Refer to the Audio & Squelch Board section (PEPS-24477) of this manual for further details relating to "AND SQUELCH" operation.

5/30/85- UP

technical writing services
1301 E. Algonquin Road, Schaumburg, IL 60196

68P81034E07-E

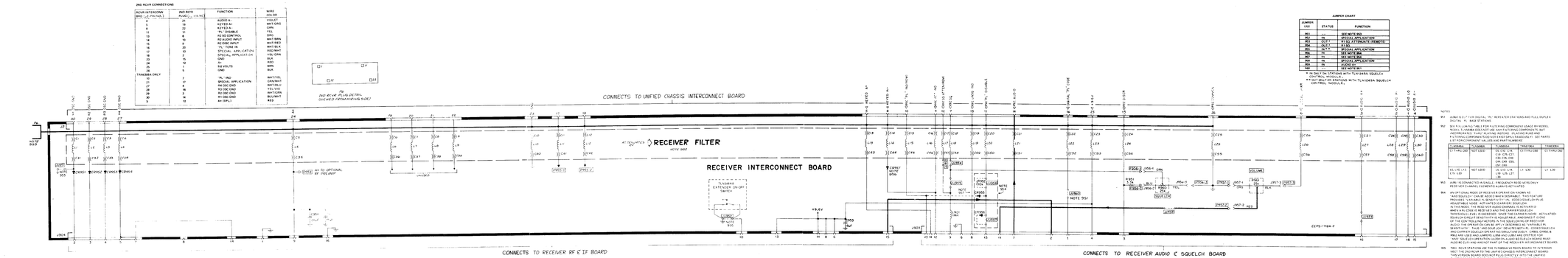
RECEIVER INTERCONNECT BOARD



FUNCTION

Interconnects various receiver circuit boards to the unified chassis interconnect board. Model differences are primarily rf filtering.

Model	Application
TLN5646A	With Repeater Stations
TLN5648A	With Base Stations (1st RCVR only)
LN5655A	With Base Stations (2nd RCVR only)
TRN6196A (optional)	In place of TLN5646A or TLN5648A (provides additional filtering)
TRN6308A (optional)	In place of TLN5655A (provides additional filtering)



PARTS LIST SHOWN ON BACK

Motorola No. PEPS-28297-A
5/30/85- UP

RECEIVER INTERCONNECT BOARD

parts list

NOTE

This parts list covers five models of the Receiver Interconnect Board. Where differences exist, the model number of the applicable unit is given in the Description column.

TLN5646A/TLN5648A/TLN5655A/TRN6196A/TRN6308A
Receiver Interconnect Board PL-3435-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1 thru 60	21-861219	1000 pF +100-0%; 500 V (TRN6196A & TRN6308A)
C951	21-82428B59	.01 uF +80-20%; 200 V
C952, 953	23-84762H09	15 uF ±20%; 20 V
		diode: (see note)
CR951 thru 954, 957	48-83654H01	silicon
		coil, rf:
L1 thru 4, 6 thru 9, 11, 12, 14, 15 thru 21, 24, 25, 26	24-83961B01	3 turns; coded brown
L5, 10, 13, 22, 23, 27 thru 30	24-83977B01	1-1/2 turns
L901	24-82549D03	1000 uH
		connector, plug:
P6	—	(TLN5655A) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle: 14 req'd.
P6	—	(TRN6308A) includes:
	14-84556B01	HOUSING, connector
	9-84151B03	CONTACT, receptacle: 20 req'd.
		resistor, fixed:
R951	6-124C61	3.3k ± 10%; 1/4 W
		non-referenced items
	7-82626K01	BRACKET, filter
	14-82621K01	INULATOR (TLN5648A & TLN5655)
	1-80775B75	COVER ASSEMBLY, filter (TLN5646A, TLN5655A, TRN6196A, & TRN6308A) includes:
	15-82173K01	COVER, filter
	3-138162	SCREW, tapping: 4-40 x 3/8"; 5 used (TLN5646A, TRN6196A & TRN6308A)
	3-139495	SCREW, tapping: 6-20 x 5/16"; 4 used (TLN5646A TLN5648A, TRN6196A & TRN6308A)
	42-84284B01	RETAINER, screw; 5 used (TLN5646A, TRN6196A & TRN6308A)
	3-139495	SCREW, tapping: 6-20 x 5/16"; 7 used (TLN5655A)
	42-82143C02	CLAMP, cable: 1/4" ID; 2 used (TLN5655A)
	42-82143C02	CLAMP, cable: 1/4" ID (TRN6308A)
	42-82143C03	CLAMP, cable: 1/8" ID (TLN5655A & TRN6308A)
	14-82613M02	INSULATOR
	2-410058B10	WASHER, flat; 2 used

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLN5912A Hardware Kit, 2nd Rcvr PL-5080-O

R960	18-82515B50	RESISTOR, variable: 25k ±30%; 1/4 W

NOTE:
Hardware for TLN5912A is listed in the Receiver Hardware Kits Section.

TLN5184A "Extender" On-Off Switch Kit PL-5081-O

S1	40-82085J03	SWITCH, toggle: spdt
NON-REFERENCED ITEMS		
	4-1725	WASHER, flat: .266 x .562 x .040; 2 used
	54-84861G01	LABEL: Extender On-Off

TLN5892A Chassis & Hardware Kit PL-5086-O

R951, 961	18-82515B50	RESISTOR, variable: 25k ±30%; 1/4 W (shown on Receiver Interconnect Board Schematic)

NOTE:
Hardware for TLN5892A is listed in the Control and Application Manual.

TLN5060A Optional "And Squelch" Parts PL-2573-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		semiconductor device, diode: (see note)
CR955, 956	48-8364H01	silicon
		resistor, fixed:
R952	6-124C73	10k ± 10%; 1/4 W

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

RECEIVER ALIGNMENT PROCEDURE

A. FREQUENCY CALCULATIONS

Where:

f_o = channel element frequency

f_c = carrier frequency

11.7 MHz IF Receivers 11.8 MHz IF Receivers

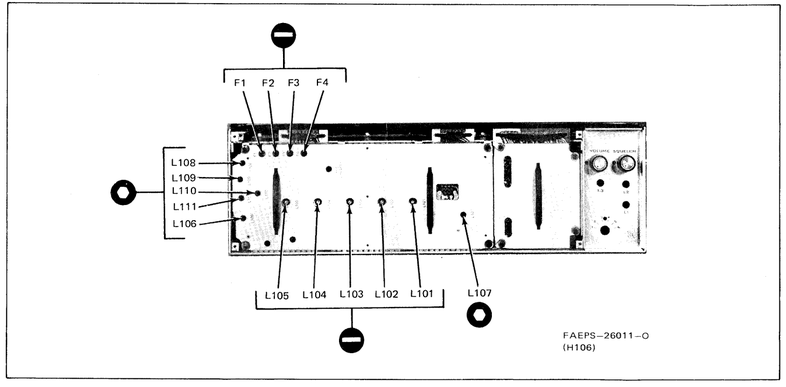
132-150.8 MHz

$$f_o = \frac{f_c + 11.7\ MHz}{9} \text{ or } \frac{f_c + 11.8\ MHz}{9}$$

150.8-174 MHz

$$f_o = \frac{f_c - 11.7\ MHz}{9} \text{ or } \frac{f_c - 11.8\ MHz}{9}$$

B. RECEIVER ADJUSTMENT LOCATIONS



C. TYPICAL RECEIVER METER READINGS
(NO INPUT SIGNAL APPLIED)

Test Set Selector Switch Position	Reading (uA)	Circuit Metered
3	15	Channel Element Output
4	0 ±2	Discriminator Output
5	1 or less (if unreadable, inject maximum on-channel signal at antenna receptacle; 20 uA, typical, should be obtained)	3rd IF Amplifier and Limiter

D. RF PREAMPLIFIER ALIGNMENT

Step	Adjust	Selector Switch Position	Osc.& Meter Rev. Switch	Stage And Procedure
1				If the station is equipped with an optional preamplifier, disconnect the bypass the preamplifier. Align the receiver then, reconnect the preamplifier.
2	L3, L2, L1	5	Meter Rev.	Adjust L3, L2, and L1 in that order for maximum test set meter indication. Repeat.
3				Tune L2 for maximum quieting.

E. RECEIVER ALIGNMENT

Step	Adjust	Selector Switch Position	Osc.& Meter Rev. Switch	Stage And Procedure
1	L108, L109	3	Meter Rev.	CHANNEL ELEMENT OUTPUT (3RD HARMONIC) - Adjust L108 and L109 for maximum meter indication. On multifrequency receivers make this adjustment with frequency selector switch in F1 position.
2	L107	4	A or B (Test Set must be equipped with 11.7 MHz crystal in corresponding socket) (and with an 11.8 MHz crystal in corresponding socket for some two-receiver stations)	DISCRIMINATOR - Unsquelch the receiver by turning the squelch control fully counterclockwise. *Private-Line* radios must also be PL disabled. Insert 11.7 MHz (or 11.8 MHz) injection probe of test set into L106 opening of receiver shield being careful not to contact circuit board. Insert probe into hole far enough to obtain a meter 5 indication of 15 uA (signal is "sprayed" into receiver). Adjust L107 for 0 center reading on top scale with selector switch of test set in position 4. Adjustment is critical and should be exactly on 0. Remove probe.
3	L110, L111	5	Meter Rev.	MULTIPLIER - Connect signal generator to antenna input and apply a carrier frequency signal. Adjust L110 and L111 for maximum meter indication. If two peaks are observed, use peak with slugs farthest from circuit board. If a meter 5 indication cannot be obtained, connect center conductor of signal generator cable directly to the mixer gate.
4	L101, L102, L103, L104, L105, L106	5	Meter Rev.	RF PRESELECTOR AND MIXER - Turn out L101 thru L105 slugs until tip of each tuning screw extends approx. 1/4-inch beyond spring (mechanical parts list code 8). Connect signal generator to antenna input and apply carrier frequency signal. Tune L101 thru L105 for peak on meter position 5. Turn L103, L104, and L105 slugs in one turn. Peak L106 thru L101, in that order, on meter position 5. Decrease signal generator output as necessary to maintain indication between 10 and 25 uA.
5	L108, L110, L111	5	Meter Ref.	Adjust signal generator output for 25 uA meter indication. Detune L108 until meter indication decreases to 15 uA. Repeak L110 and L111 for maximum meter indication. Repeat entire step.
6	L108, L109	3	Meter Rev.	Repeak L108 and L109 for maximum meter indication.
7	L101, L102, L103, L104, L105	5 6*	Meter Rev. OFF	Repeak L101 through L105 for maximum meter indication. Repeat. Peak L103 thru L105 for minimum indication on meter 6 (maximum quieting).
8	F1, F2, F3, F4	5	Meter Rev.	ON-FREQUENCY ADJUSTMENT - Disconnect signal generator and transmit carrier signal from transmitter normally received. If transmitter is known to be on frequency, test set meter position 5 should indicate rise when transmitter is keyed (if necessary connect antenna). Check test set position 4 reading with transmitter keyed. 0 indicates on-frequency condition. Adjust F1 warp capacitor for exact 0 reading. DO NOT READJUST L108 OR L109 AFTER THESE ADJUSTMENTS ARE MADE. If the receiver is equipped with AFC, short the AFC DISABLE contact while adjusting F1.
9	—	—	—	Perform 20 dB quieting sensitivity measurement as check of alignment.

* If the portable test set is used connect an ac voltmeter across pins 1 and 18 of the audio control module for this reading.

MICOR SENSITRON HIGH BAND RECEIVER RF & IF BOARD

TLD5780AV SERIES

Model Table

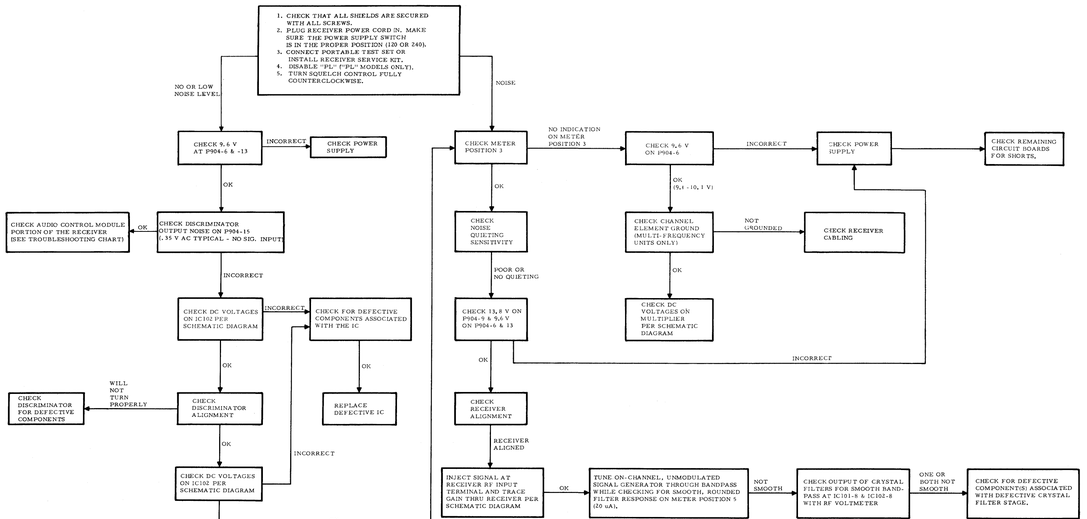
Model	Frequency Range (MHz)
TLD5781AV	132-142
TLD5782AV	142-150.8
TLD5783AV	150.8-162
TLD5784AV	162-174

Technical Characteristics

Input Impedance		50 ohms
RF Frequency Range		132-174 MHz
Cannel Element Frequency Range		15.455-18.055 MHz
Channel Spacing		30 kHz
Number Of Channels		1 (capable of up to 4 for special applications)
Selectivity EIA SINAD		-95 dB
Intermodulation EIA SINAD		-80 dB
Modulation Acceptance EIA		±7 kHz
Sensitivity (50 Ohms RF Input Impedance)	20 dB Quieting	less than 0.5 microvolt
	EIA Sinad	less than 0.35 microvolt
Oscillator (channel Element) Stability		±.0005% (±.0002% optional) from -30°C to +60°C ambient
Spurious & Image Rejection		-100 dB
Power Requirements		regulated 9.6 volts @ 70 mA 13.8 volts @ 20 mA
Construction		fully solid-state, two integrated circuits
Receiver Type		FM superhetrodyne single conversion
IF Frequency		11.7 MHz or 11.8 MHz
Crystal Filter Type		dual resonator, mode coupled, monolithic crystal
Discriminator Type		dual resonator, mode coupled, monolithic crystal
Metering		three test points critical to operation and alignment are accessible at a metering receptacle which permits testing with a Motorola portable test set, optional built-in metering, or any 50 microampere meter.

68P81037E72-B
5/30/85- UP

RECEIVER RF & IF CIRCUIT BOARD TROUBLESHOOTING CHART



1. DESCRIPTION

1.1 The fully solid-state receiver rf & i-f circuit board consists of an rf preselector, two integrated circuits, three transistors, two i-f crystal filters, plug-in channel elements, and a crystal discriminator. These components are used to develop a low-noise audio signal from a frequency modulated "on-channel" rf carrier in the 132-174 MHz range.

1.2 All circuits are constructed on a single plug-in circuit board which is easily removed and replaced. All external dc and audio connections are made at a single row of pins which eliminate interconnecting wires; rf input is provided by a single plug-in coaxial cable. Circuit board plating is on both sides of the board with all components mounted on the back side. All alignment points are accessible from the front of the station.

2. FUNCTIONAL OPERATION

This circuit board is a highly selective, crystal controlled, single conversion FM receiver (less audio amplifier, squelch circuitry, and speaker). Bandwidth and selectivity characteristics are determined by rf preselector coils and i-f crystal filters. Plug-in crystal oscillator modules (channel elements) provide stable frequency control. Integrated circuits are used for all amplification and limiting after the first crystal filter section which produce high i-f signal gain and exceptionally high reliability. A crystal discriminator is used to provide high audio recovery from the i-f signal. Refer to schematic diagram for more circuit details.

3. MAINTENANCE

3.1 GENERAL

This section of the manual provides the maintenance procedures for the receiver rf and i-f section of the receiver. These bench tests include metering measurements and procedures for testing and troubleshooting, including integrated circuit check-out.

NOTE

The receiver rf and i-f board must be installed in the receiver 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

NOTE (Cont'd)

and testing to provide a good rf ground to all stages of the receiver. The board may be installed in the station or a "Micor" mobile radio set for testing.

3.2 20 DB QUIETING SENSITIVITY TEST

This performance test may be used after repair and alignment to assure that the receiver meets all specifications before it is returned to service.

It may be performed using a Motorola S-1056B thru S-1059B Portable Test Set or optional built-in receiver metering. J101 can accommodate only the built-in metering set or the portable test set, but not both simultaneously. Plugging a portable test set in a receiver that has built-in metering will disconnect the built-in metering cable.

NOTE

The receiver shield must be in place while performing this test.

3.2.1 Using the Portable Test Set and an AC Voltmeter

Step 1. 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.

Step 2. Be sure the receiver shield is in place.

Step 3. Apply ac input power to the receiver.

Step 4. Using a TEK-37A Adapter Cable, connect a Motorola portable test set or meter panel to the station 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 7-pin white "metering" plug to the metering receptacle on the receiver rf and i-f board.

Step 5. 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.

Step 6. Refer to the meter reading table in paragraph 3.3.1. 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.

Step 7. Connect an ac voltmeter across pins 1 and 18 of the audio control module.

Step 8. (PL receivers only). Disable PL, using the switch on the PL module.

Step 9. Set the receiver squelch control fully counterclockwise (unsquelched).

Step 10. Adjust the LINE LEVEL control so the ac voltmeter reads 565 mV volts ac.

Step 11. 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.

Step 12. Slowly decrease the signal generator output level until the ac voltmeter reads 565 mV ac (20 dB down from 565 mV ac). Switch to a lower voltmeter scale if necessary. The generator output now indicates the 20 dB quieting sensitivity and should be 0.5 microvolt, or less (0.25 microvolt with preamplifier).

Step 13. Readjust the LINE LEVEL control as described in the MAINTENANCE section of the manual.

3.2.2 Using the Optional Built-In Receiver Metering

3.2.2.1 Unsquelch the receiver by turning the SQUELCH control fully counterclockwise. "Private-Line" receivers must also be PL disabled. Turn metering POWER switch on.

3.2.2.2 Set the meter selector switch to position 6 and the speaker switch to the OFF position. Adjust the receiver LINE LEVEL control for 50 uA as indicated on the meter.

3.2.2.3 Connect a signal generator to the station antenna receptacle and adjust it to the receiver frequency. Set the rf output to minimum.

3.2.2.4 Increase the signal generator output until the meter reading drops to 5 uA. The generator output level now indicates the 20 dB quieting sensitivity and should be 0.5 microvolt, or less (0.25 microvolt, or less, with preamplifier). Readjust the line level as described in the MAINTENANCE section in the front of the manual.

3.3 TROUBLESHOOTING

3.3.1 Circuit Measurements

3.3.1.1 General

A failure in almost any part of the rf and i-f section will produce an improper meter reading on one or more of the test points. Improper alignment will also cause improper meter readings.

A "0" meter reading in position 3 or 5 indicates either (1) insufficient drive from a preceding stage or (2) a defective component at the metering point.

3.3.1.2 Procedure Using Portable Test Set or Optional Built-In Receiver Metering

3.3.1.2.1 (Portable test set only). 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 test set battery life. The plug acts as an on-off switch completing the battery circuit.

3.3.1.2.2 (Portable test set only). Connect the white "metering" plug of the adapter cable to the metering receptacle on the receiver rf and i-f circuit board.

3.3.1.2.3 Compare the current readings in SELECTOR SWITCH positions 3, 4 and 5 with those in the following table. A low reading on meter position 3 indicates a defective channel element or multiplier circuit. An improper meter reading in position 4 or 5 readings indicate a malfunction elsewhere in the receiver, which can most rapidly be found by checking rf and i-f voltages, per the schematic diagram.

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

SELECTOR SWITCH POSITION	READING (MICROAMPS)	CIRCUIT METERED
3	15	Channel Element Output
4	0±2	Discriminator Output
5	1 or less (If unreadable, inject 1.0 V on-channel signal at antenna receptacle; 20 uA, typical, should be obtained.)	3rd i-f Amplifier and Limiter

3.3.2 Input Voltages

If there are no test set indications at one or more of the metered points, check the dc input voltages to the receiver rf and i-f circuit board.

P904-9	A+ (13.8 V dc with reference to chassis)
P904-6 P904-13	9.6 V dc (with reference to chassis) (±0.5 V)

If test set indications localize the trouble to a specific stage or two, measure the dc input voltages to the suspected stages. Refer to the schematic diagram for the normal voltages.

3.3.3 Alignment as a Troubleshooting Technique

Low test set readings, improper discriminator output, and otherwise abnormal performance are very often corrected by re-alignment. Therefore, alignment should be the first troubleshooting step performed for these symptoms. Many technicians prefer to use alignment as the first troubleshooting step in all cases.

3.3.4 Isolating Defective Components

If test set readings are abnormal or tests indicate sub-normal performance, a logical troubleshooting procedure is required to isolate the defective component. The accompanying troubleshooting chart summarizes troubleshooting in a logical sequence. A few voltage and resistance checks in the suspected circuit should readily isolate the defective component.

3.3.5 Troubleshooting Integrated Circuits

The IC's in the receiver rf and i-f section may be checked by dc voltage measurements. Proper voltages are shown on the schematic diagram.

3.3.6 Troubleshooting Crystals

A defective filter crystal can best be found by performing an i-f gain check per the schematic diagram. A defective crystal will show an abnormally high insertion loss. Before making the gain check, verify, using an ohmmeter, that the center pins of all four filter crystals are connected to the associated crystal case. The resistance between the center pin and the case should be less than 0.1 ohm. The loss of this ground may cause errors in gain measurements because of the loss of shielding effectiveness. If the filter is found to be defective because of high insertion loss or an ungrounded case, it should be replaced.

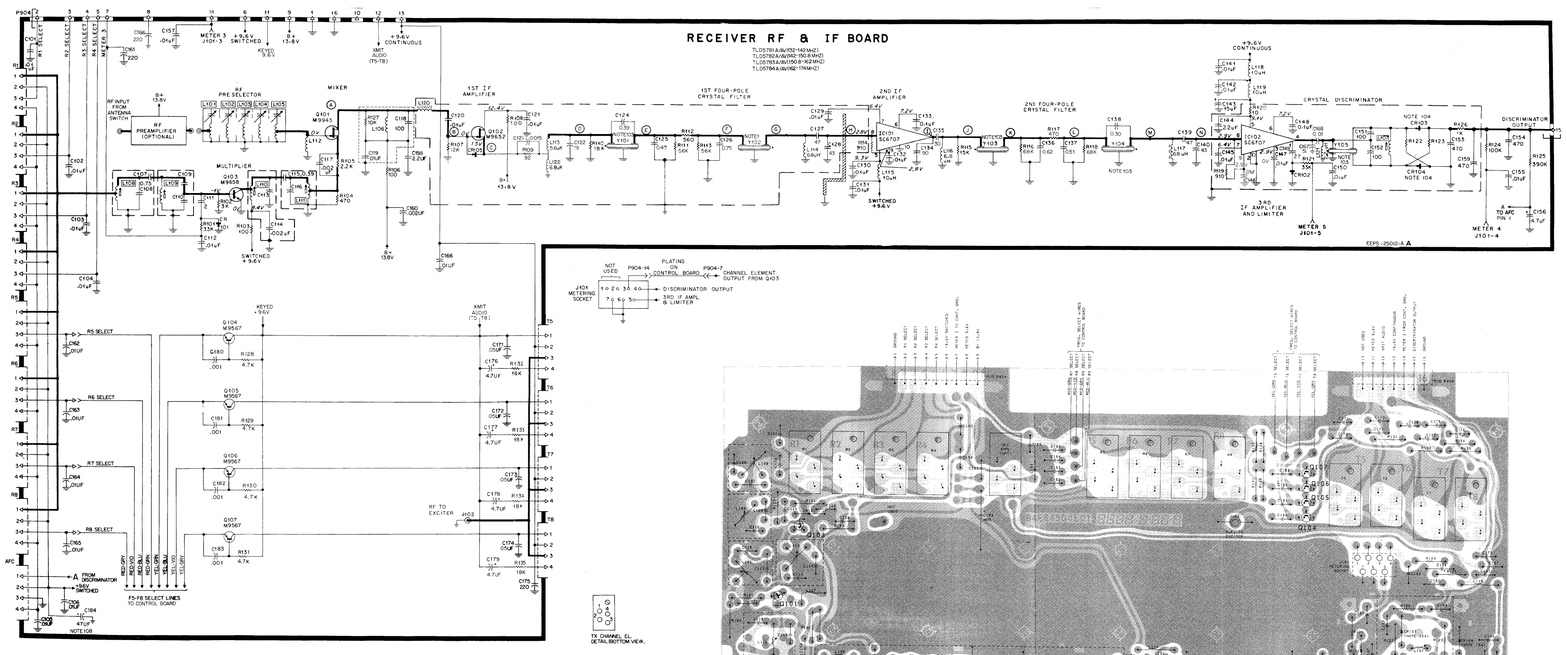
Before replacing the discriminator crystal, verify that all components associated with the discriminator circuitry are not defective. Also, verify, in a manner similar to that used for the filter crystals, that pin 2 is connected (less than 0.1 ohm) to the crystal case. The discriminator crystal should be replaced if found defective.

NOTE

If the discriminator crystal, Y105, is replaced, it must be physically oriented so that the index dot on the top of the filter can is toward IC102 on the circuit board. This crystal matches specific input and output impedance and will not perform satisfactorily if reversed. All other filter crystals, if replaced, may be oriented in either direction.

3.4 FIELD CONVERSION TO SHIFTED IF

A standard 11.7 MHz i-f receiver can easily be converted to operate at the shifted i-f of 11.8 MHz. Replace crystal filters Y101 through Y105 with the 11.8 MHz parts; refer to the parts list for the TLD8740A Shifted IF Crystal Kit for the part numbers. Finally, replace the channel element, using the 11.8 MHz i-f formula for calculating the crystal frequency.



NON-"EXTENDER" RECEIVER RF VOLTAGE TABLE

SET RF INPUT AT ANT. TO OBTAIN (NOTE 106)	AT TEST POINT	RF INPUT SHOULD BE (MAY VARY APPROX. 2 TO 5)
300 mV	A	13 mV
	B	13 mV
	C	9 mV
	D	3 mV
50mV	E	4 mV
	F	5 mV
	G	5 mV
	H	50 mV
	J	10 mV
	K	10 mV
	L	20 mV
	M	21 mV
	N	72 mV

DC VOLTAGE TABLE FOR IC'S

IC101		IC102	
PIN	VOLTAGE	PIN	VOLTAGE
1	2.8 V	1	2.8 V
2	9.3 V	2	0 V
3	7.2 V	3	2.8 V
4	6.4 V	4	0 V
5	2.8 V	5	9.3 V
6	2.8 V	6	7.2 V
7	0 V	7	6.4 V
		8	2.8 V
		9	2.8 V
		10	0 V

RECEIVER RF & IF BOARD

101. RECEIVER FREQUENCY CALCULATION:

132-150.8 MHz

$f_c - M_c - 11.7\ MHz = f_e - f_c + 11.7\ MHz = f_e$

150.8-174 MHz

$f_c - M_c - 11.7\ MHz = f_e - f_c - 11.7\ MHz = f_e$

WHERE: f_c = CARRIER FREQUENCY f_e = CHANNEL ELEMENT FREQUENCY

102. DASHED LINES REPRESENT SHIELDING.
103. INDEX DOT ON CRYSTAL CANS INDICATES PHYSICAL ORIENTATION REQUIRED.
104. DIODES CR103 AND CR106 ARE SHOWN FOR 150-174 MHz MODELS. REVERSE FOR 132-150.8 MHz MODELS. NOT USED IN 450-512 MHz MODELS.
105. RF VOLTAGES TAKEN WITH MOTOROLA SOLID-STATE DC MULTIMETER WITH PLUG-IN RF PROBE.
106. UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS. RESISTOR VALUES ARE IN OHMS.
107. UNLESS OTHERWISE STATED VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLT-METER IN RESPECT TO CHASSIS GROUND.
108. C184 IS USED ON TLD5781(w) SERIES ONLY.

RECEIVER RF & IF BOARD COMPONENT VALUES

REFERENCE SYMBOL	132 - 142 MHz	142 - 150.8 MHz	150.8 - 162 MHz	162 - 174 MHz
C108	22	18	24	18
C109	56	47	56	47
C110	100	80	100	80
C115	10	7.5	10	7.5
C116	10	7.5	10	7.5
R102	8.2K	8.2K	8.2K	8.2K
R123	8.2K	8.2K	6.8K	6.8K

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM
Receiver RF & IF Board
Schematic Diagram and Circuit Board Detail
Motorola No. PEPS-25507-B
8/23/78-NPC

RECEIVER RF & IF BOARD

LEGEND
L = 132-142 MHz
M = 142-150.8 MHz
H = 150.8-162 MHz
HH = 162-174 MHz

TLD5781AV Receiver Board RF & IF Board (132-142 MHz)
TLD5782AV Receiver Board RF & IF Board (142-150.8 MHz)
TLD5783AV Receiver Board RF & IF Board (150.8-162 MHz)
TLD5784AV Receiver Board RF & IF Board (162-174 MHz)

PL-5780-A

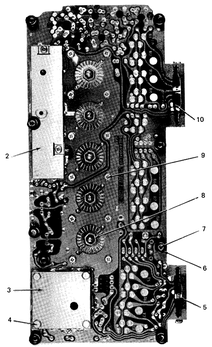
		CAPACITOR, fixed: pF, ±5%; 500 V unless otherwise stated
C101 thru 106	21-82428B62	.01 uF +80-20%; 200 V
C107	21-82450B06	0.7†
C108L	21-82610C22	20; NP0
C108M	21-82133G29	18; NP0
C108H	21-82133C44	24; NP0
C108HH	21-82133G29	18; NP0
C109L	21-83406D46	56; N150
C109M	21-82610C44	47; N080
C109H	21-83406D46	56; N150
C109HH	21-82610C44	47; N080
C110L	21-83798B01	100
C110M	21-84494B03	80
C110H	21-83798B01	100
C110HH	21-84494B03	80
C111	21-82133G37	2 ±0.25 pF; NP0
C112	21-82428B62	.01 uF +80-20%; 200 V
C113L	21-83406D36	10 ±0.25 pF; NP0
C113M	21-82133G14	7.5 ±0.25 pF; NP0
C113H	21-83406D36	10 ±0.25 pF; NP0
C113HH	21-82133G14	7.5 ±0.25 pF; NP0
C114	21-83596E14	.002 uF ±10%; 200 V; Y5F
C115	21-82450B07	0.39
C116L	21-83406D36	10 ±0.25 pF; NP0
C116M	21-82133G14	7.5 ±0.25 pF; NP0
C116H	21-83406D36	10 ±0.25 pF; NP0
C116HH	21-82133G14	7.5 ±0.25 pF; NP0
C117	21-83596E14	.002 uF ±10%; 200 V; Y5F
C118	21-82610C44	100; 100 V; N220
C119	21-82428B62	.01 uF +80-20%; 200 V
C120	21-82428B62	.01 uF +80-20%; 200 V
C121	21-82428B62	.01 uF +80-20%; 200 V
C122	21-83406D04	19; NP0
C123	21-82187B18	.0015
C124	21-82450B07	39; 500 V
C125	21-82450B24	.47
C126	21-82450B06	.75 ±10%; 500 V
C127	21-82610C57	47; N330
C128	21-82610C02	43; N220
C129	21-82428B62	.01 uF +80-20%; 200 V
C130	21-82428B62	.01 uF +80-20%; 200 V
C131	21-82428B62	.01 uF +80-20%; 200 V
C132	21-82428B62	.01 uF +80-20%; 200 V
C133	8-83813U06	0.1 uF ±10%
C134	21-00865941	90 ±2%; 300 V
C135	21-82610C99	30; NP0
C136	21-82450B16	62 ±10%; 500 V
C137	21-82450B29	51; 500 V
C138	21-82450B26	.30 ±10%; 500 V
C139	21-82610C57	47; N330
C140	21-82610C02	43; N220
C141	21-82428B62	.01 uF +80-20%; 200 V
C142	21-82428B62	.01 uF +80-20%; 200 V
C143	23-83214C02	15 uF ±20%; 25 V
C144	23-84762H04	2.2 uF ±20%; 25 V
C145	21-82428B62	.01 uF +80-20%; 200 V
C146	21-82428B62	.01 uF +80-20%; 200 V
C147	21-82428B62	.01 uF +80-20%; 200 V
C148	8-83293B01	0.1 uF ±10%
C149	21-82133G58	27; NP0
C150	21-82428B62	.01 uF +80-20%; 200 V
C151	21-83798B01	100; 200 V; NP0
C152	21-83798B01	100; 200 V; NP0
C153	21-82187B39	470 ±10%
C154	21-82187B39	470 ±10%
C155	21-82428B59	.01 uF +80-20%; 200 V
C156	23-84538G02	4.7 uF ±20%; 35 V
C157	21-82428B62	.01 uF +80-20%; 200 V
C158	23-84762H04	2.2 uF ±20%; 25 V
C159	21-82187B07	470 ±10%
C160	21-83596E14	.002 uF ±10%; 200 V
C161	21-83596E10	220 ±20%
C162 thru 165	21-82428B62	.01 uF +80-20%; 200 V
C166	21-83596E10	220 pF ±20%
C167	21-82610C07	51; NP0
C168	21-82428B62	.01
C169		NOT USED
C170		NOT USED
C171 thru 174	21-82372C07	.05 uF; 25 V
C175	21-83596E10	220 pF ±20%
C176 thru 179	23-84538G02	4.7 uF ±20%; 20 V
C180-183	21-83596E13	.001 uF ±10%; 100 V
C184	23-84538G06	47 uF
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101	48-82139G01	germanium
CR102	48-82139G01	germanium
CR103	48-84616A01	planar hot carrier
CR104	48-84616A01	planar hot carrier
CR105	48-84616A01	planar hot carrier
		INTEGRATED CIRCUIT: (SEE NOTE)
IC101, 102	51-84267A07	SC6707
		CONNECTOR, receptacle:
J101	9-84207B01	female; 7 contact
J102	9-84231B02	female; single contact; phono type
		COIL, RF: unless otherwise stated
L101L	24-84070C01	input
L101M	24-84070C01	input
L101H	24-84409B01	input
L101HH	24-84409B01	input
L102L	24-84070C03	center
L102M	24-84070C03	center
L102H	24-84409B03	center
L102HH	24-84409B03	center
L103L	24-84070C03	center
L103M	24-84070C03	center
L103H	24-84409B03	center
L103HH	24-84409B03	center
L104L	24-84070C03	center
L104M	24-84070C03	center
L104H	24-84409B03	center
L104HH	24-84409B03	center
L105L	1-80713B52	output
L105M	1-80713B52	output
L105H	1-80709B36	output
L105HH	1-80709B36	output
L106	24-83879G08	IF (GRN)
L107	24-83879G04	discriminator (YEL)
L108	24-84115B03	multiplier (ORG)
L109	24-84115B12	multiplier (BRN)
L110	24-83857G07	multiplier (YEL)
L111	24-83857G08	multiplier (VIO)
L112L	24-84411B02	choke; YEL
L112M	24-84411B02	choke; YEL
L112H	24-84411B02	choke; YEL
L112HH	24-84411B01	choke; WHT
L113	24-82459D50	choke; 5.6 uH (shielded)
L114	24-84250D02	choke; 6.8 uH (shielded)
L115	24-82723H07	choke; 10 uH (VIO)
L116	24-84250D02	choke; 6.8 uH (shielded)
L117	24-84250D02	choke; 6.8 uH (shielded)
L118	24-82723H07	choke; 10 uH (VIO)
L119	24-82723H07	choke; 10 uH (VIO)
L120	76-83960B01	choke; Ferrite Bead
L121	24-84250D03	choke; 2.2 uH (shielded)
L122	24-82450D02	choke; 6.8 uH (shielded)
		TRANSISTOR: (SEE NOTE)
Q101	48-869943	N-Channel; FET M9943
Q102	48-869652	N-Channel; FET M9652
Q103	48-869658	NPN; M9658
Q104	48-869567	NPN; M9567
Q105	48-869567	NPN; M9567
Q106	48-869567	NPN; M9567
Q107	48-869567	NPN; M9567
		RESISTOR, fixed: ±10%; 1/4 W: unless otherwise stated
R101	6-124C85	33k
R102	6-124A60	3k ±5%
R103	6-124C25	100
R104	6-124C41	470
R105	6-124C57	2.2k
R106	6-124C25	100
R107	6-124A75	12k ±5%
R108	6-124C25	100
R109	6-124A23	82 ±5%
R110	6-124A79	18k ±5%
R111	6-124A91	56k ±5%
R112	6-124A43	560 ±5%
R113	6-124A91	56k ±5%
R114	6-124A48	910 ±5%
R115	6-124A77	15k ±5%
R116	6-124A93	68k ±5%
R117	6-124A41	470 ±5%
R118	6-124A93	68k ±5%
R119	6-124A48	910 ±5%
R120	6-124C01	10
R121	6-124C85	33k
R122L, 122M	6-124A69	6.8k ±5%
R122H, 122HH	6-124A71	8.2k ±5%
R123L, 123M	6-124A69	6.8k ±5%
R123H, 123HH	6-124A71	8.2k ±5%
R124	6-124C97	100k
R125	6-124C12	390k
R126	6-124C49	1k
R127	6-124C73	10k
R128	6-124C65	4.7k
R129	6-124C65	4.7k
R130	6-124C65	4.7k
R131	6-124C65	4.7k
R132	6-124A79	18k ±5%
R133	6-124A79	18k ±5%
R134	6-124A79	18k ±5%
R135	6-124A79	18k ±5%
		CRYSTAL, quartz:
Y101	48-84755E08	11.700 kHz
Y102-104	48-84755E07	11.700 kHz (GRN dot)
Y105	48-84754E01	11.700 kHz

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

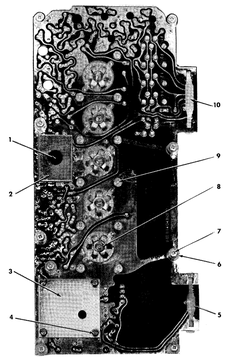
MECHANICAL PARTS LIST

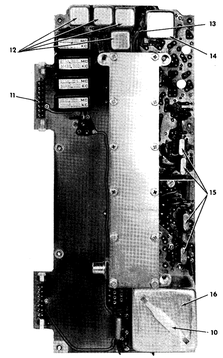
TLD5780A Series Receiver RF & IF Board PL-5781-A

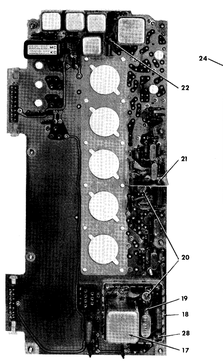
CODE	MOTOROLA PART NO.	DESCRIPTION
2	26-84641E01	SHIELD (IF)
3	26-84413B01	SHIELD (discriminator)
4	3-125913	SCREW, tapping: 6-18 x 1/2"; (4 req'd.)
5	55-84300B02	HANDLE (long) 2 req'd.
6	42-84284B01	RETAINER, screw: 9 req'd.
7,9	3-139506	LOCKSCREW: No. 4 x 5/16"; 21 req'd.
8	41-84410B03	SPRING, torque: 5 req'd.
:0	55-84300B03	HANDLE (short)
:1	29-84028H01	CONTACT, male: 16 req'd.
:2	26-84250B05	SHIELD, coil: 3 req'd.
:3	39-10184A24	CONTACT, female (under pre-selector output lead shield)
:4	26-84250B06	SHIELD, coil
:5	14-84540B01	INSULATOR (crystal) 4 req'd.
:6	26-84414B01	SHIELD, bottom
:7	24-84250B08	SHIELD, discriminator coil
:8	26-84415B01	SHIELD, spring
:9	14-84583B01	INSULATOR (crystal)
20	4-49854	WASHER, spacer: 2 req'd. IC MTG
21	26-84643B01	SHIELD, barrier
22	39-10184A10	CONTACT, 11 req'd.
23	29-855943	CONTACT, male; 52 req'd.
24	15-84408B01	COVER, RF deck
25	3-134169	LOCKSCREW: No. 4 x 1/4" 12 req'd.
26	15-84407B01	HOUSING, RF deck
27	3-136926	LOCKSCREW: No. 4-40 x 5/16" 10 req'd. (inside preselector)
28	5-84220B01	GROMMET, "Nylon"; 4 req'd.
29	26-84456D01	SHIELD, preselector output lead

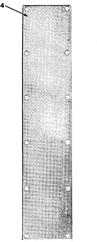


FEPS-29006-A
(9433,C433)









CEPS-6142-C