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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.

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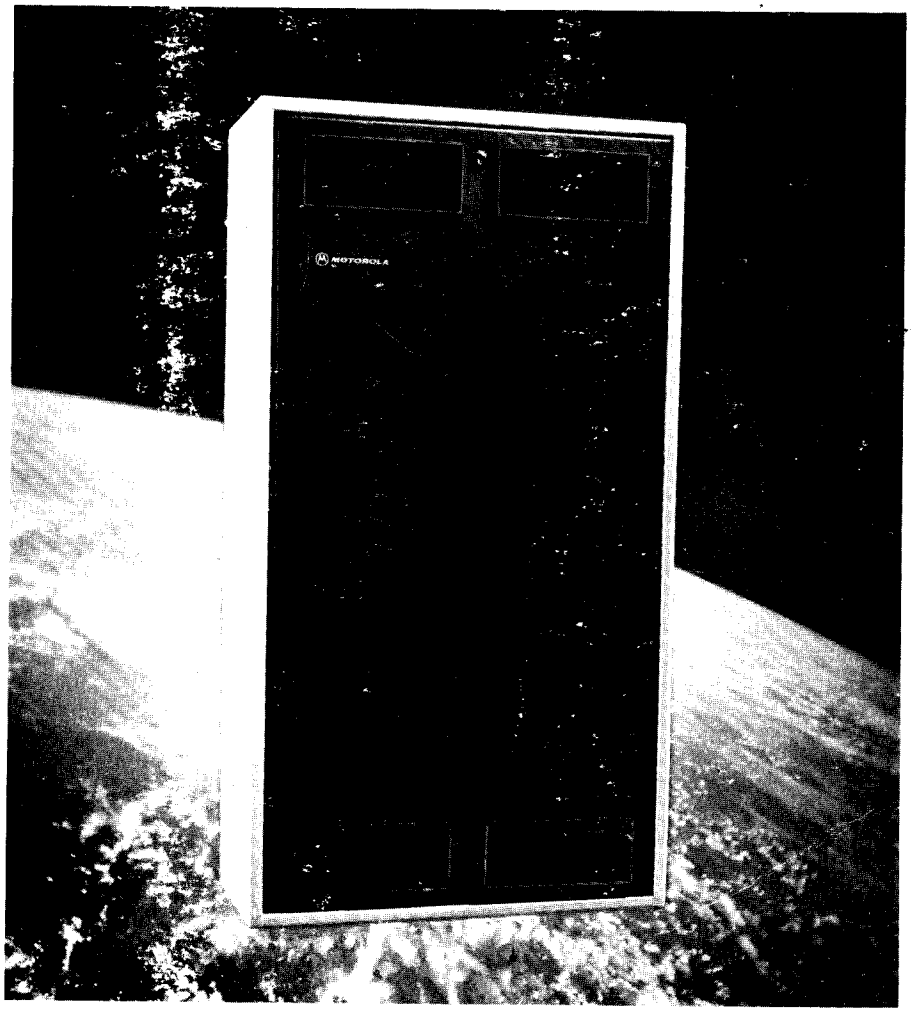
SECURENET™
DIGITAL VOICE PROTECTION™ SYSTEMS
MICOR® BASE AND REPEATER STATIONS
132-174 MHz

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

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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

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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.

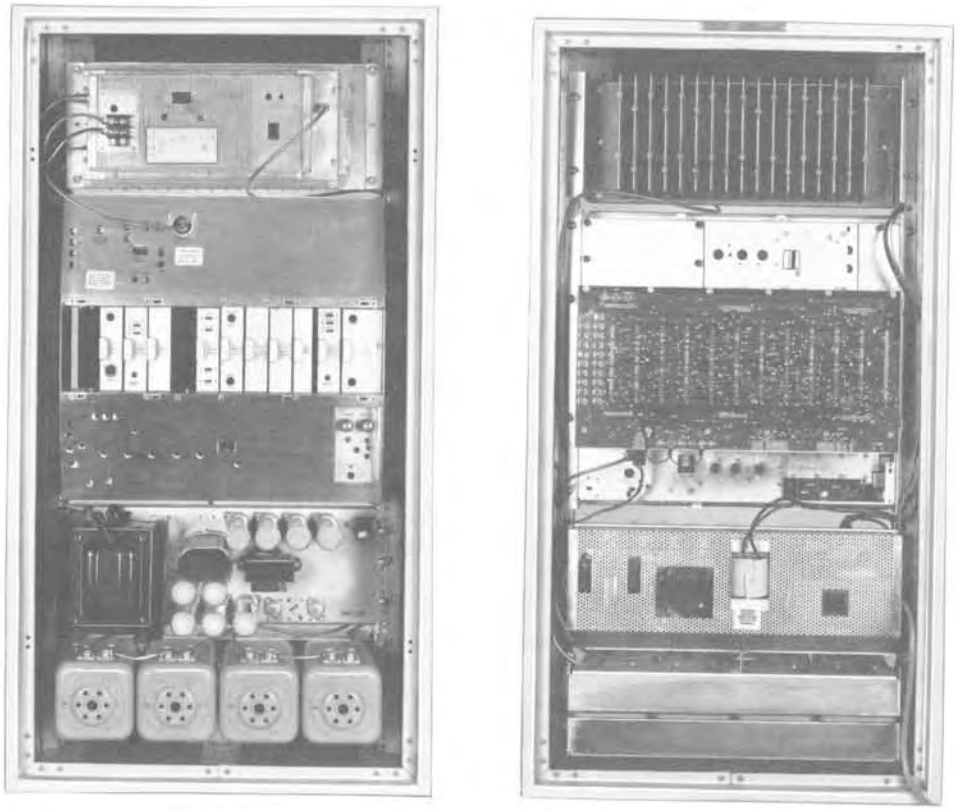
MODEL	DESCRIPTION	UNIT	DESCRIPTION																	
	EXCITER-FILTER																			
TLD2172A	(132-150.8 MHz)	TLD5802A	EXCITER BOARD (132-150.8 MHz)	X		X														
TLD2173A	(150.8-174 MHz)	TLD5803B	EXCITER BOARD (150.8-174 MHz)		X		X													
	UNIFIED CONTROL CHASSIS	TFD6111A	EXCITER FILTER (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.

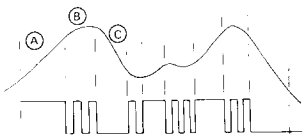


Figure 2. Typical CVSD Output

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.

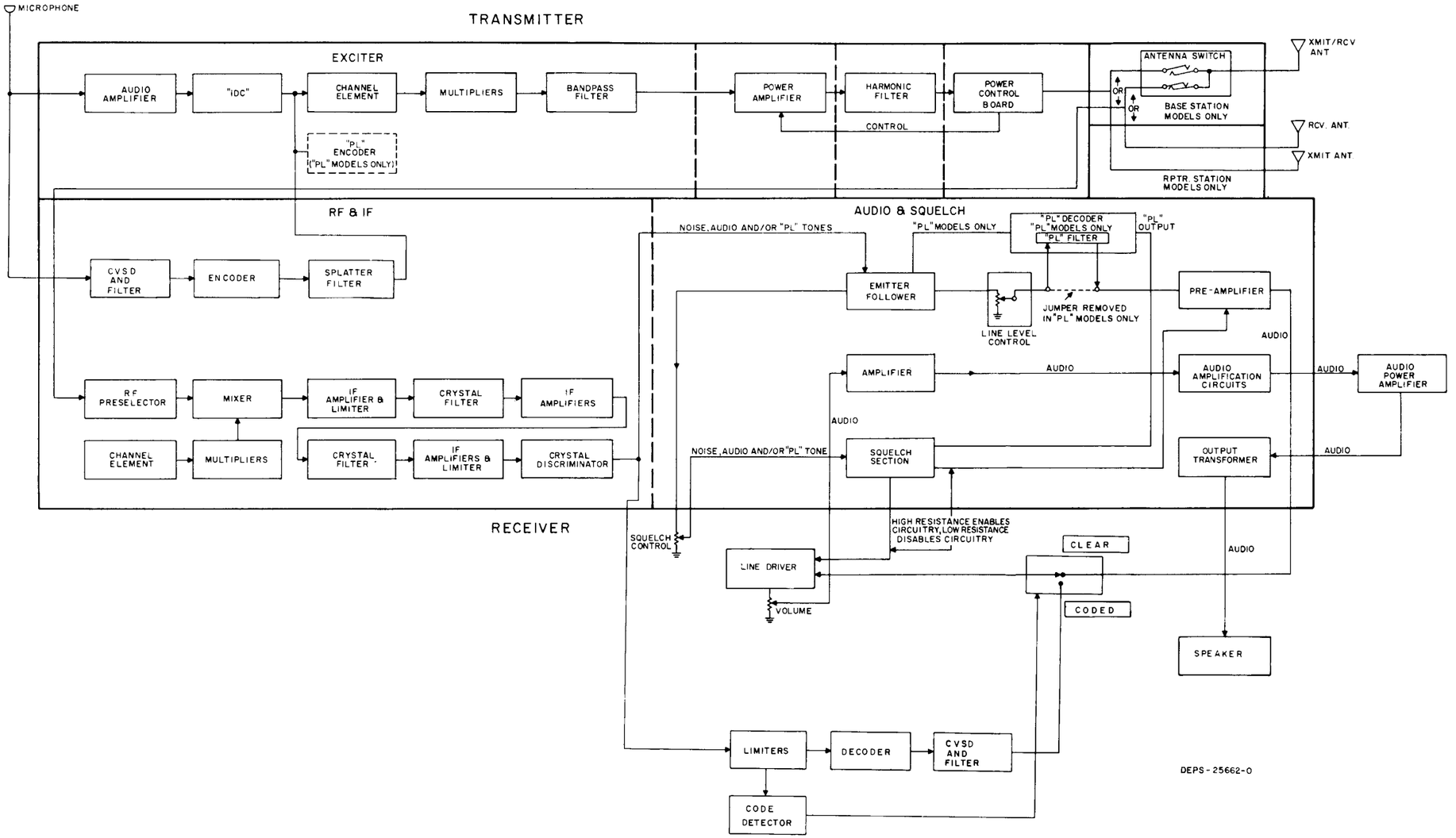


*Figure 3. **DVP** Station Block Diagram*

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.

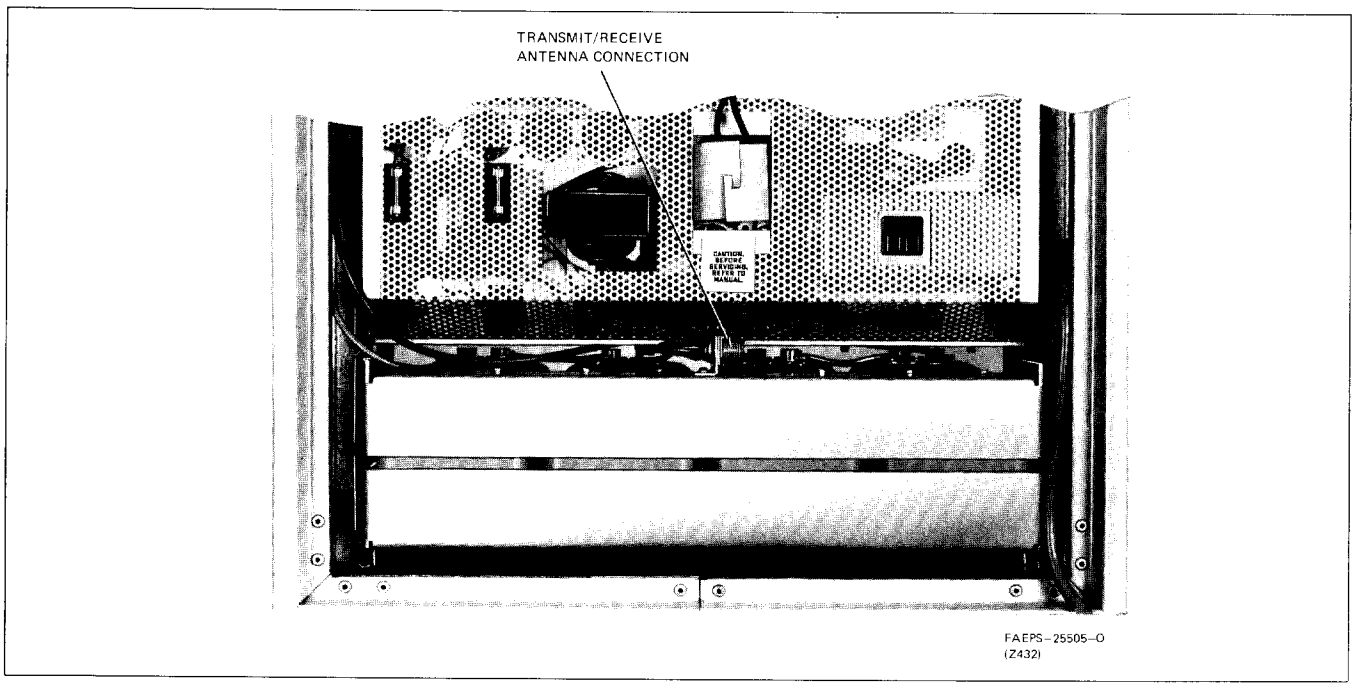


Figure 1. Antenna Connection Locations

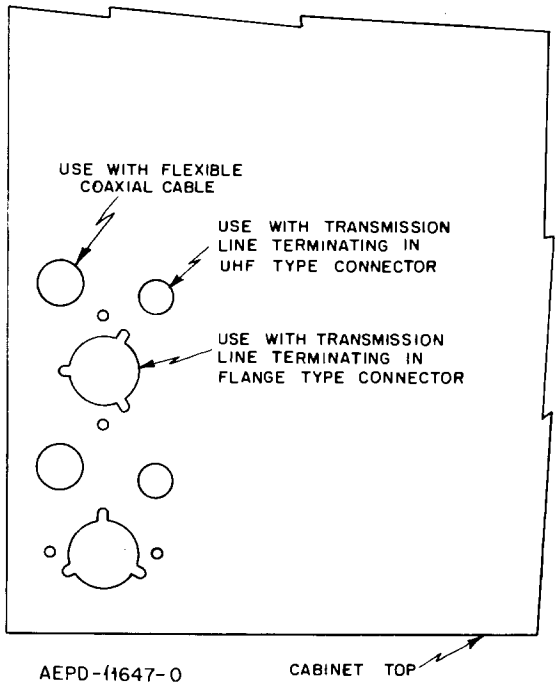


Figure 2. Cabinet Knockout Detail

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.

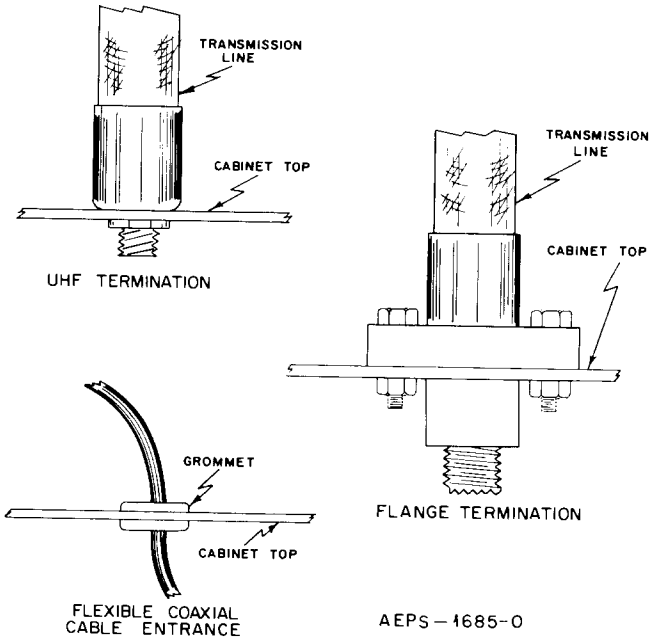


Figure 3. Indoor Cabinet Antenna Cable Installation

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.

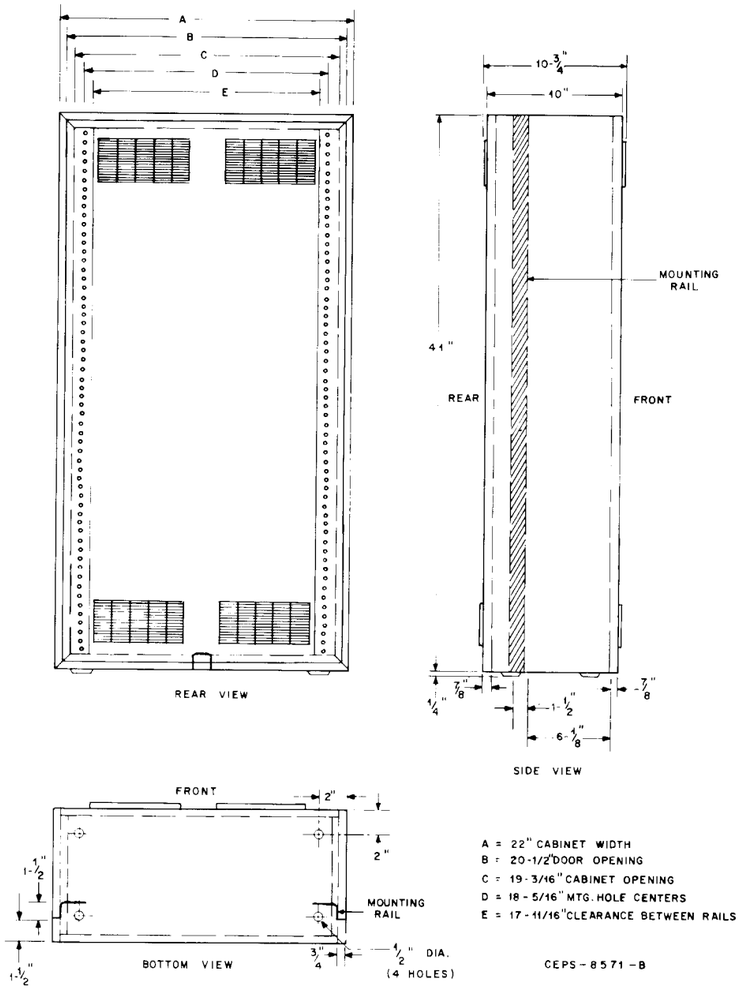
Step 8. Apply a 1000 uV carrier signal to the receiver antenna terminal from an FM signal generator. Modulate the carrier signal with a 1000 Hz tone at ±5 kHz deviation.

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

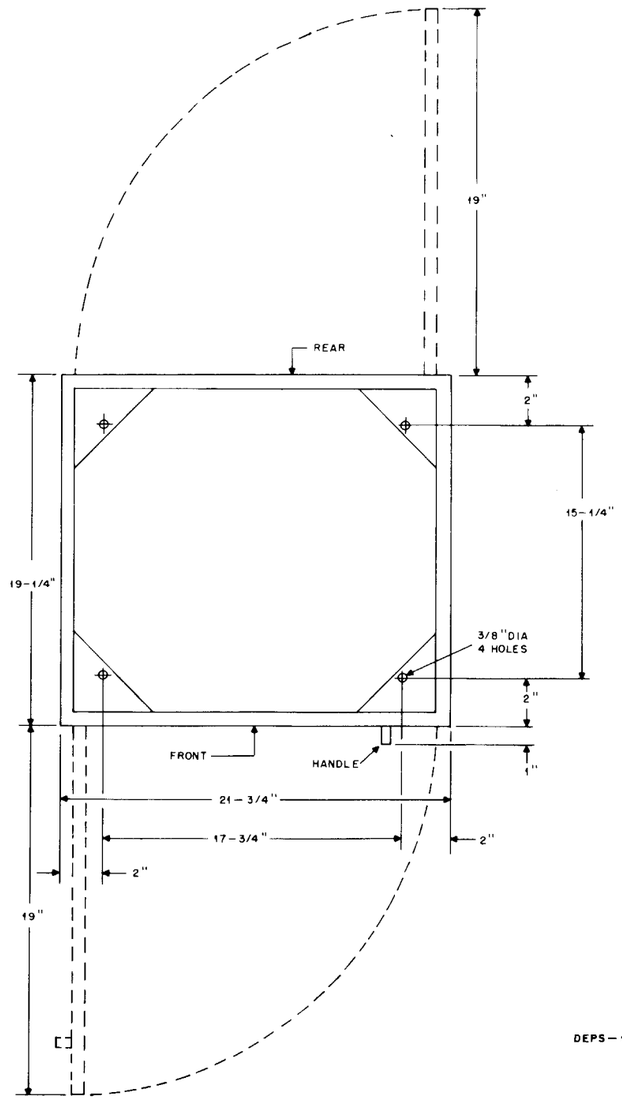
THN6142A Cabinet Kit (41-Inch) PL-1790-C

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

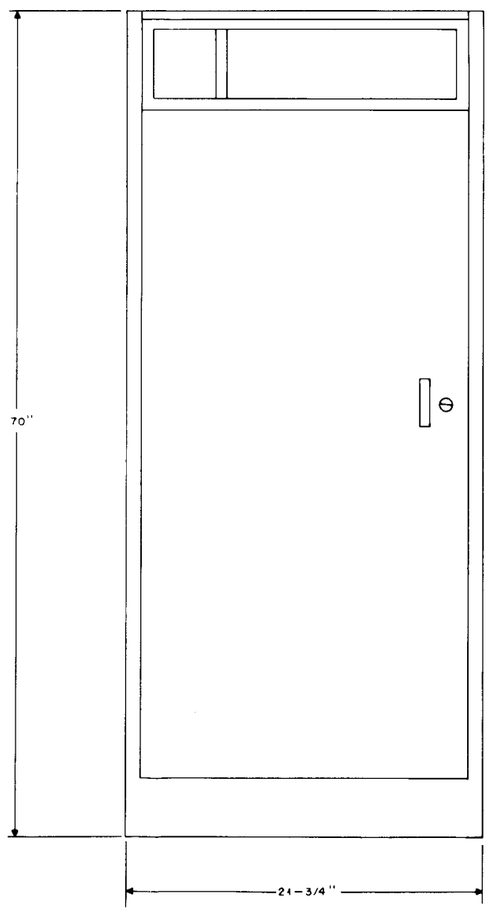
UPRIGHT INDOOR CABINET
OPTION C40 (FOR *COMPA-STATION* BASE RADIOS)

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

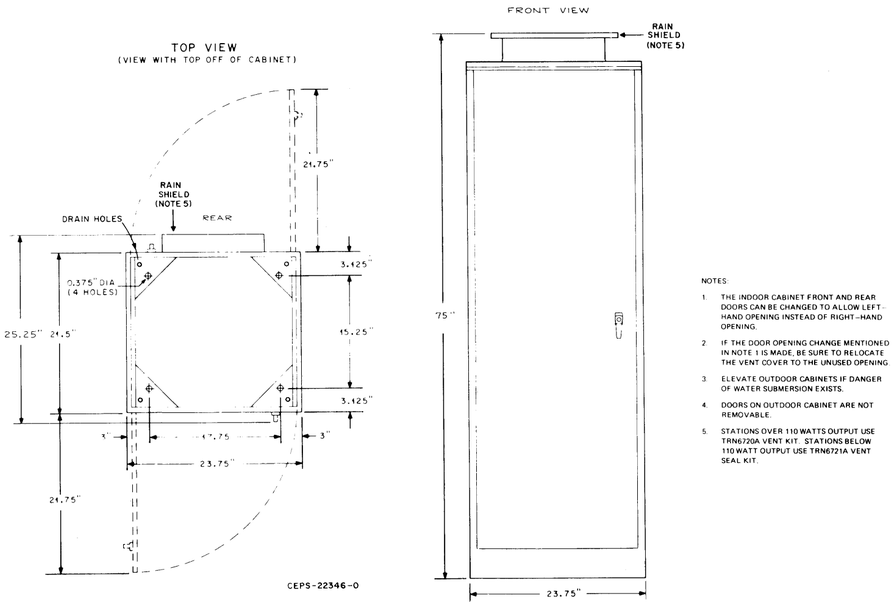
-- Use a paint scraper or putty knife to remove all loose paint and paint blisters from the cabinet. Use a wire brush or steel wool to remove remaining rust from the area. The surface must be cleaned to bare metal and free of all rust.
-- Wipe cleared surface with a clean cloth
-- Apply a thin even coat 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

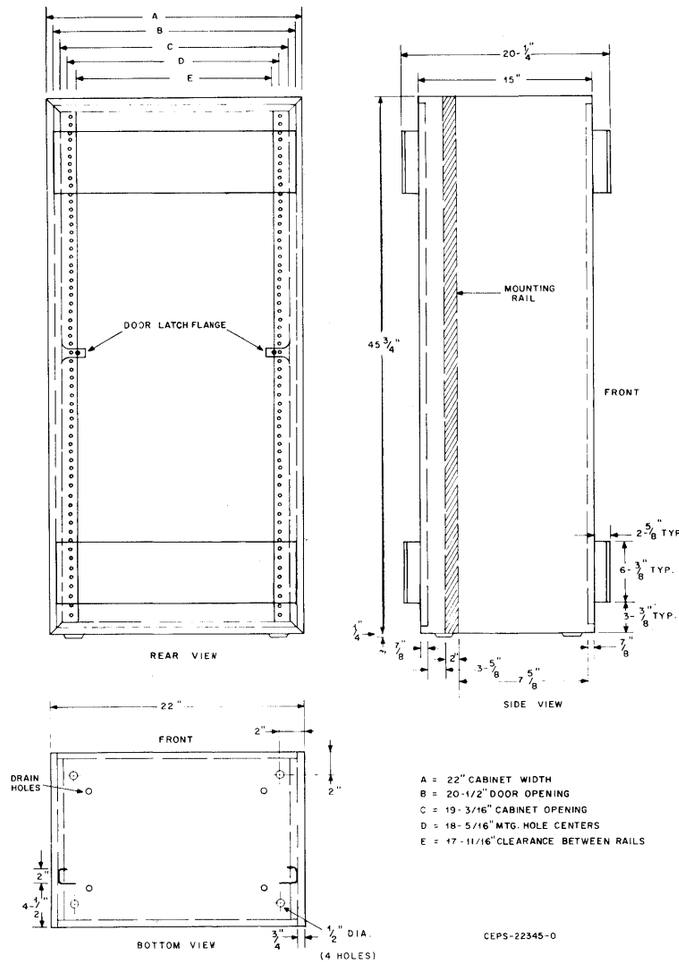
--Water drainange holes
--Rust resistant equipment mounting rails
--Thick door gaskets
--Screw and flange type door latches
--Vent seal for intermittent duty stations
--Vent kit for continuous duty stations
--Sealed cabinet corner joints

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.)

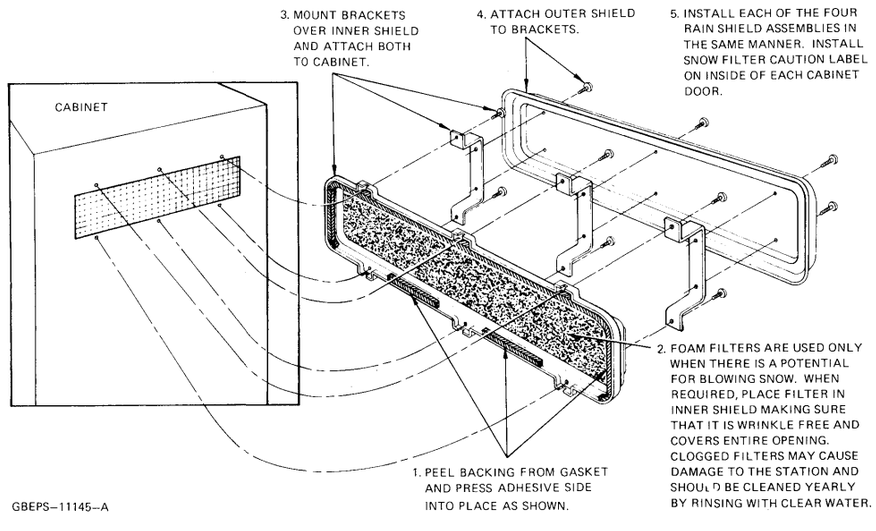
THN6143A Vented 46-Inch Cabinet
(For Continuous Duty Stations) — PL-5104-O

	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

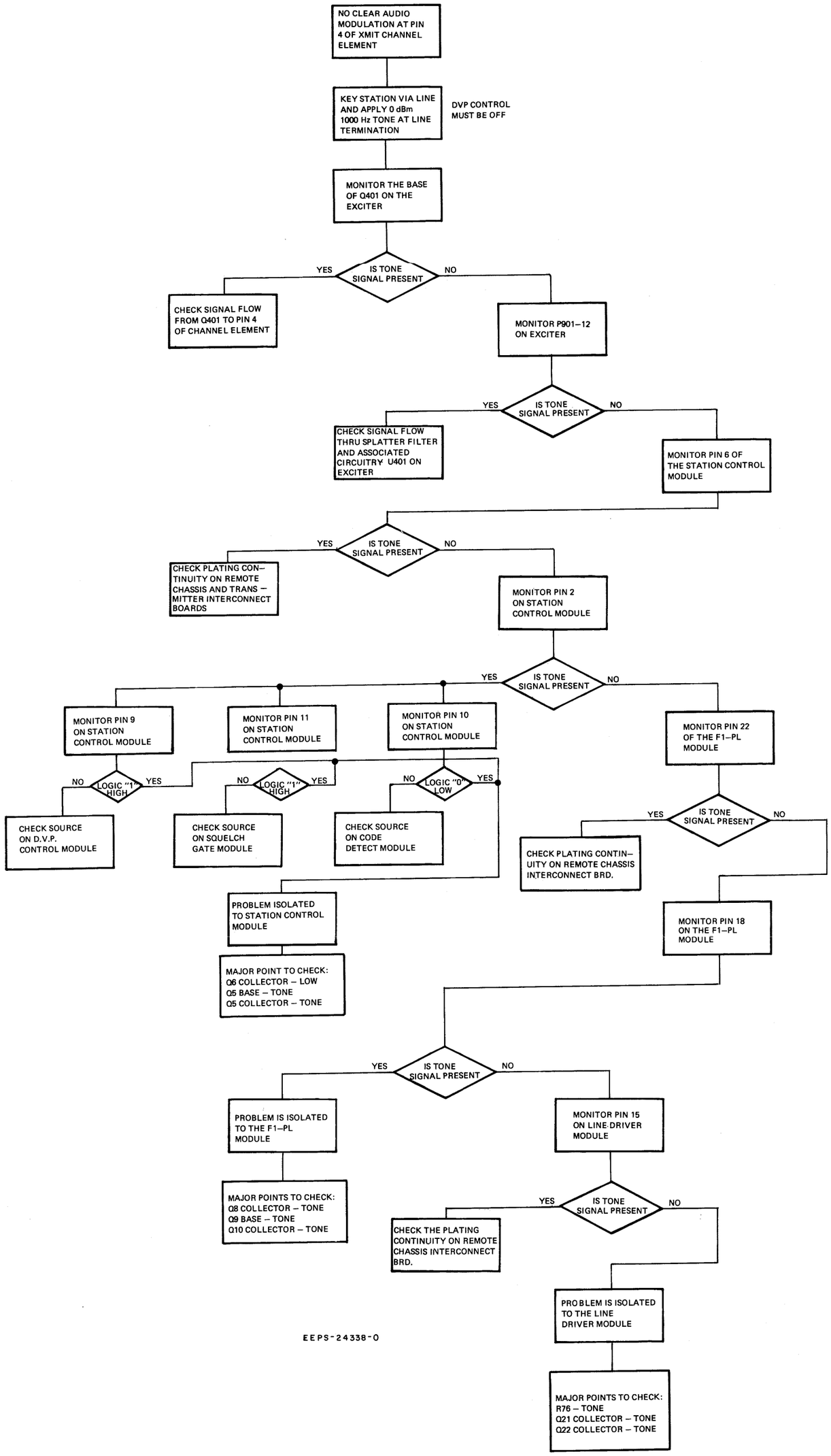
5. TABLE OF RECOMMENDED TEST EQUIPMENT (Cont'd.)

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

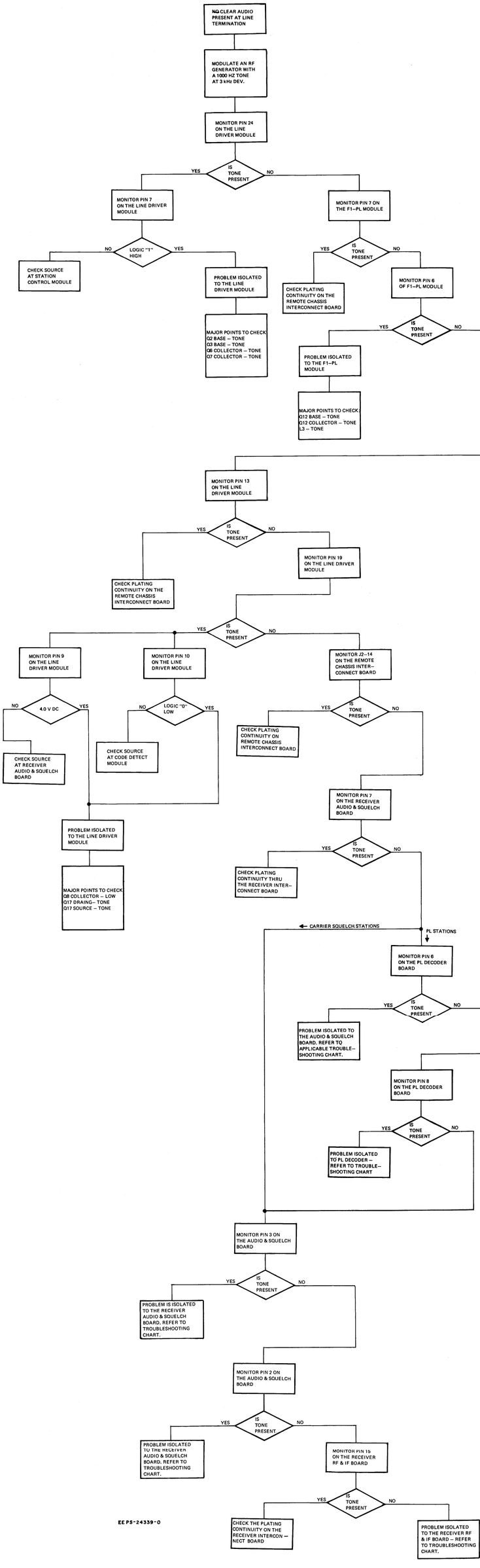
The following troubleshooting charts may be helpful in isolating a problem to a specific module. Once the faulty module is determined, several points to check are given. When troubleshooting a module, consult the schematic diagrams for voltages and proper operating conditions.

BASE STATION CLEAR MODE TRANSMIT TROUBLESHOOTING CHART

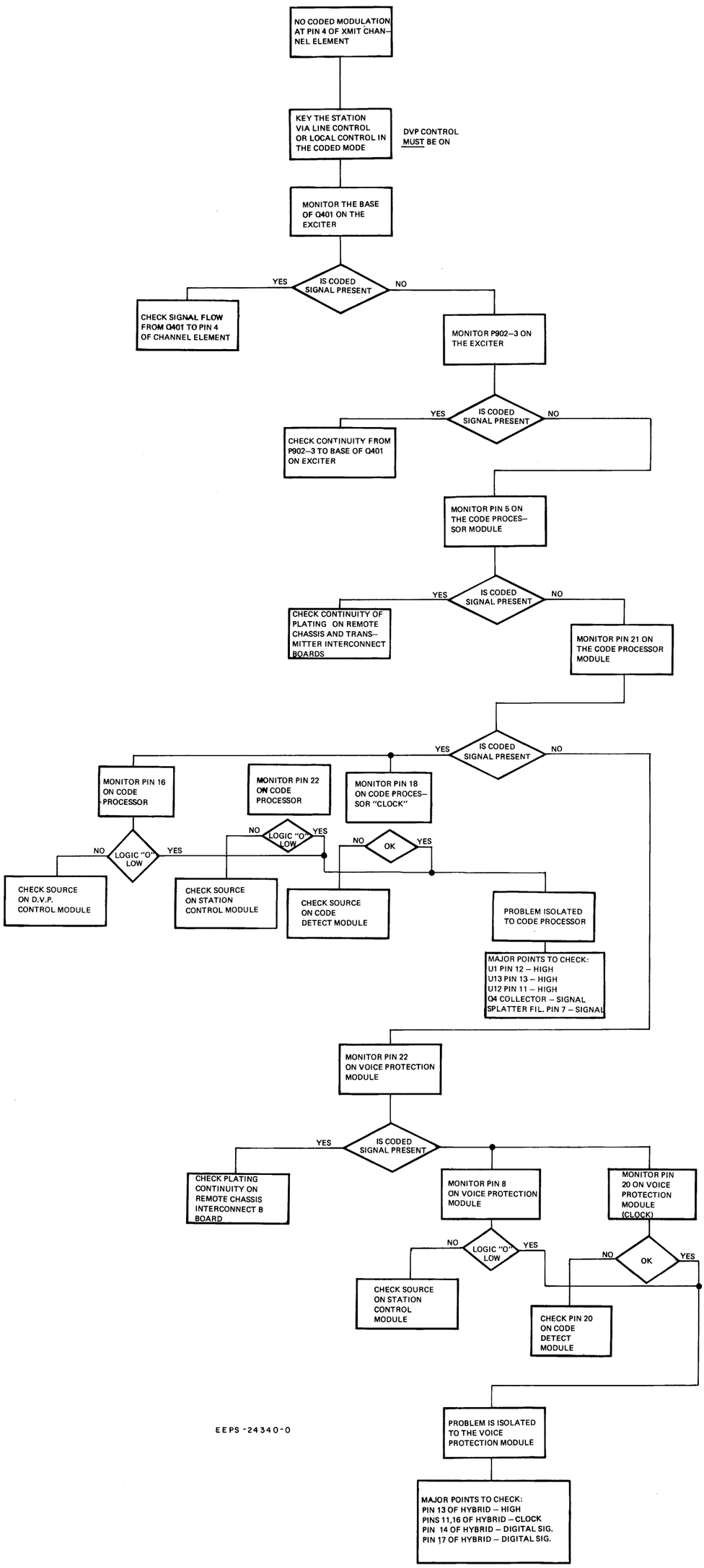


EEPS-24338-O

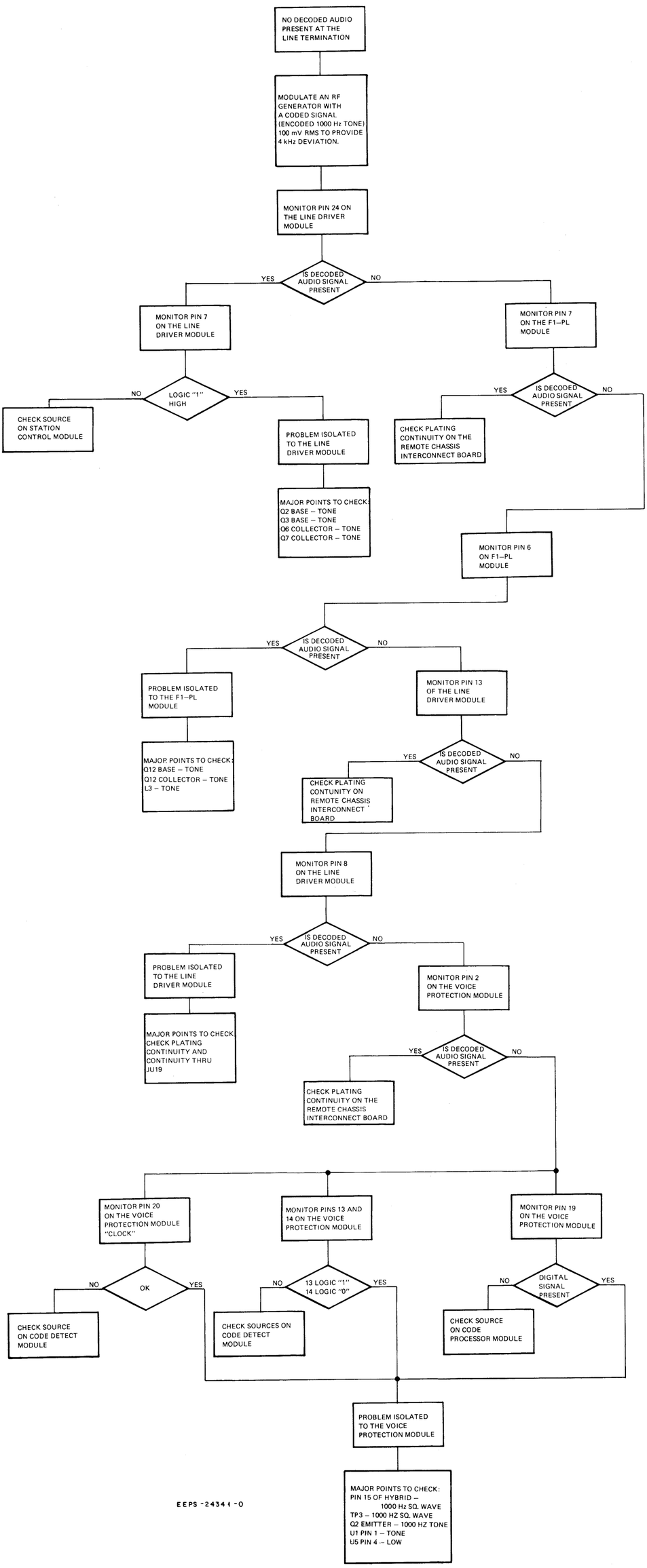
BASE STATION CLEAR MODE RECEIVE TROUBLESHOOTING CHART



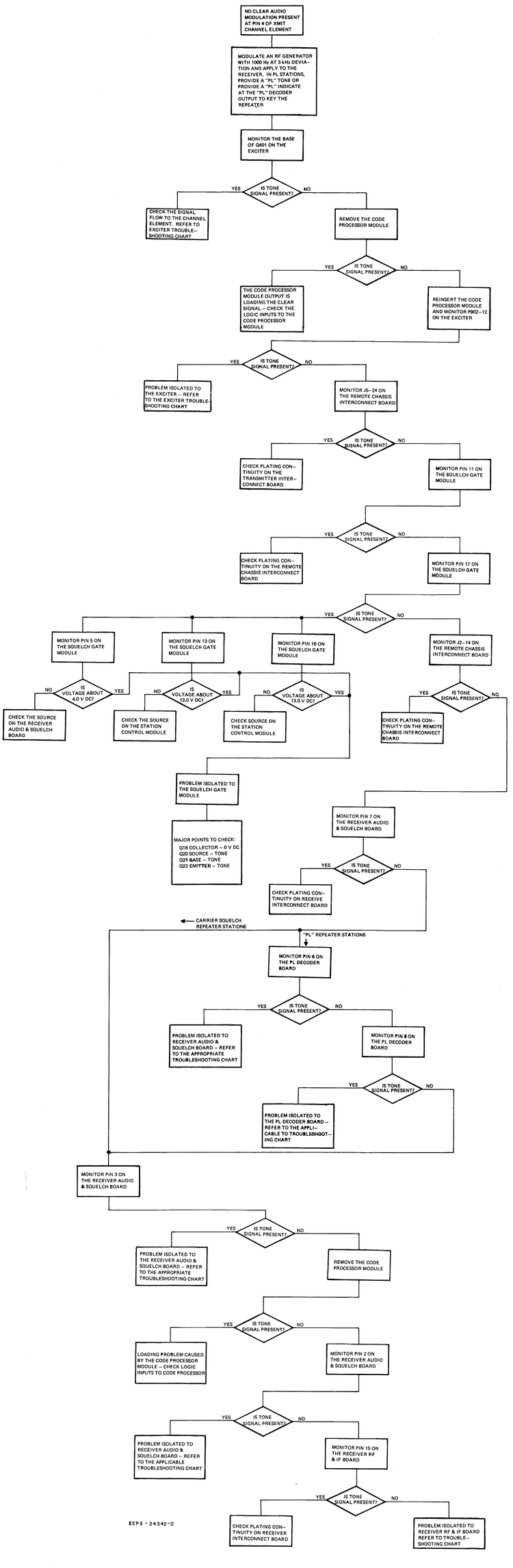
BASE STATION CODED MODE TRANSMIT TROUBLESHOOTING CHART



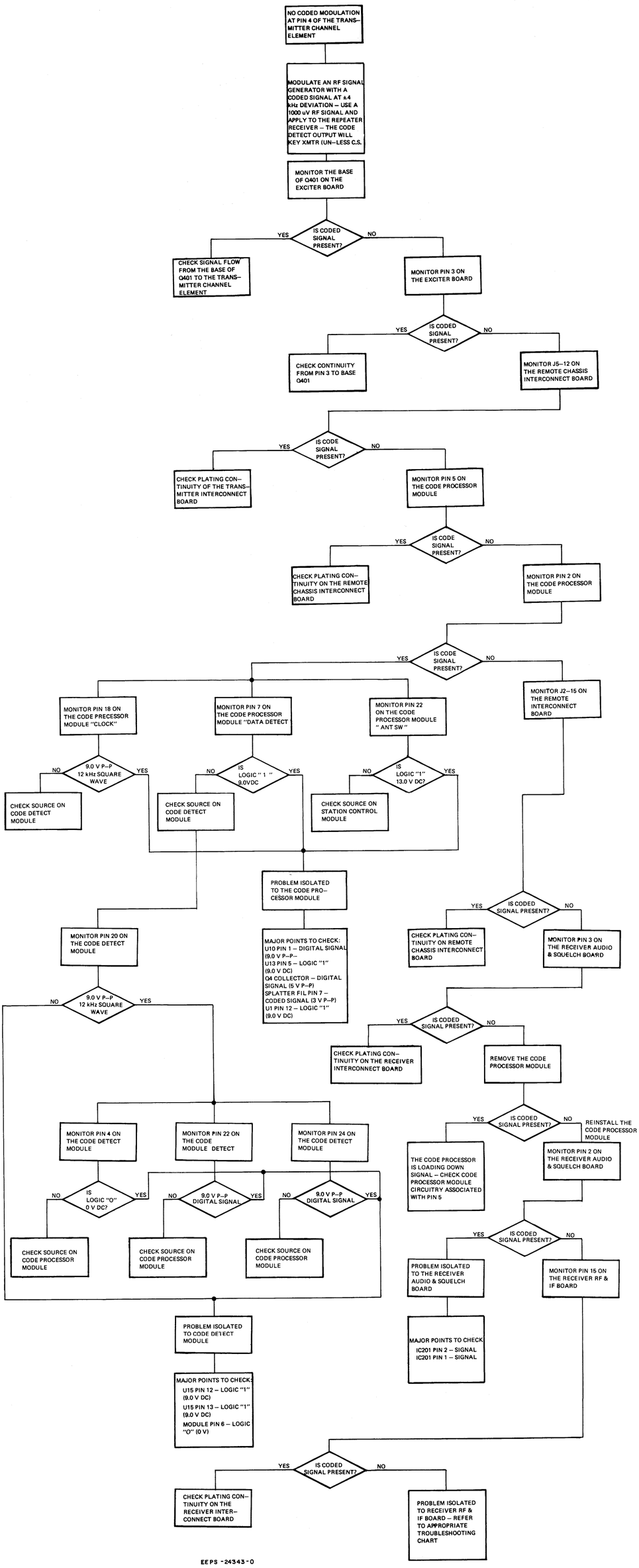
BASE STATION CODED MODE RECEIVE TROUBLESHOOTING CHART



REPEATER STATION CLEAR MODE TROUBLESHOOTING CHART

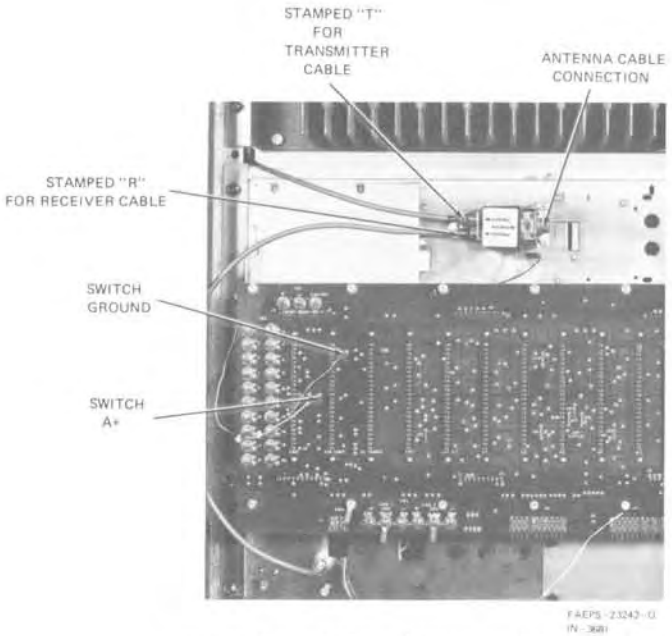


REPEATER STATION CODED MODE TROUBLESHOOTING CHART

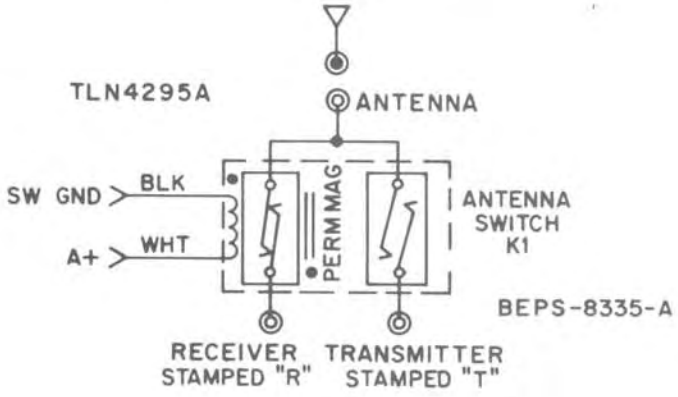


EEPS -24343-0

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

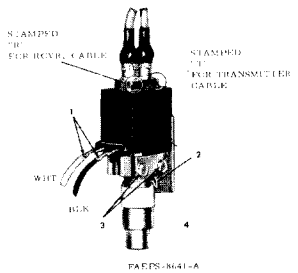
USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

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)

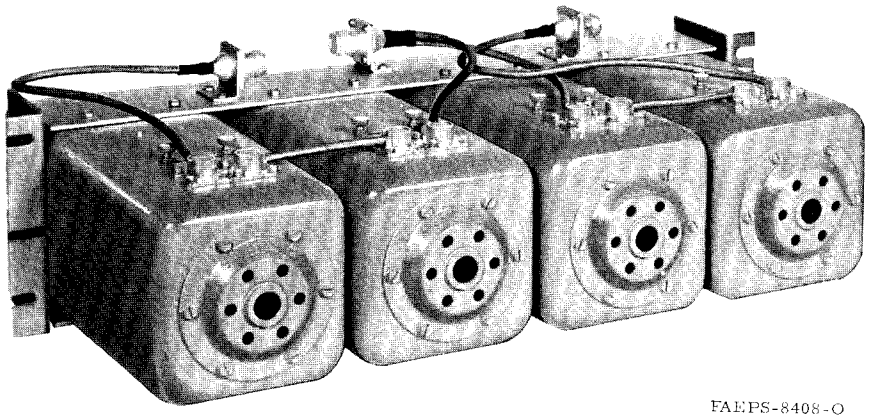
1	29-82010D01	TERMINAL, female
2	3-131965	LOCKSCREW: tapping, 8-32 x 3/8" pln hex
3	3-135841	LOCKSCREW: tapping, 6-32 x 1" pln hex
4	7-84266D01	BRACKET



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.

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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

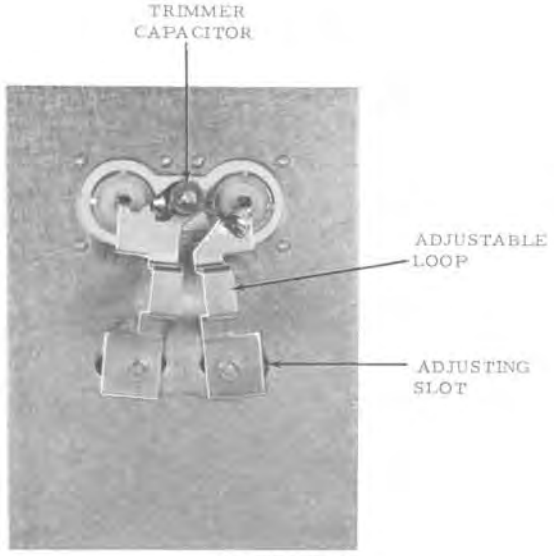
The cable shields are soldered to the connector portion of the loops. These shields must first be unsoldered before the loops can be removed. The shields cannot be unsoldered while the connectors are attached to the cavity body because the cavity body acts as a heat sink.

(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.

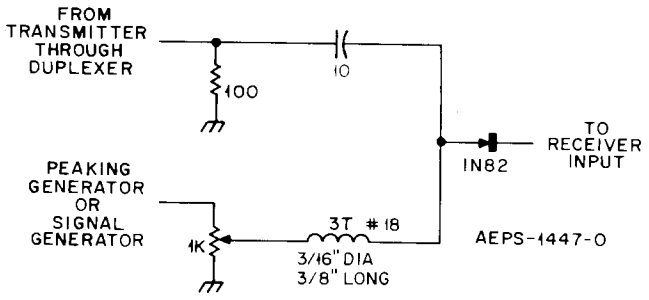


Figure 2.
Mixer Circuit

(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.

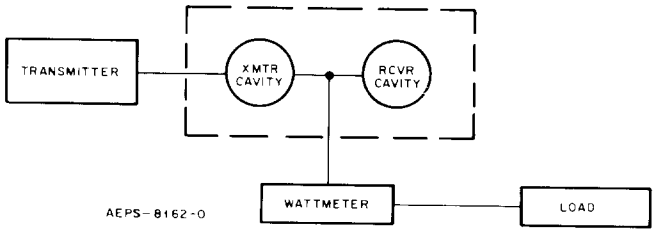


Figure 3.
Method 2 Transmitter Branch
Pass Test Set-Up

(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.

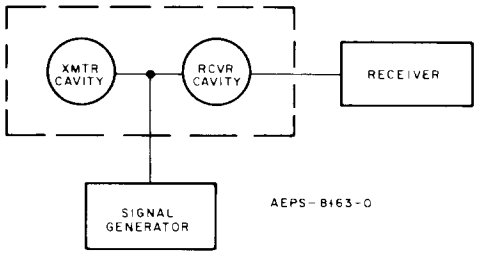


Figure 4.
Method 2 Receiver Branch
Pass Test Set-Up

(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.

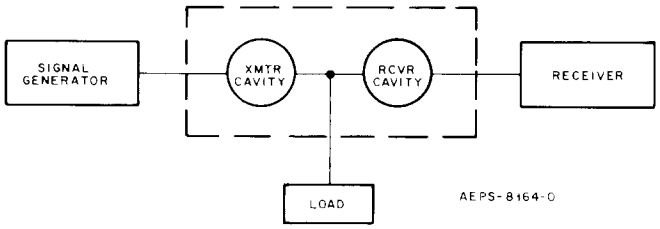


Figure 5.
Method 2 Transmitter Branch
Reject Test Set-Up

(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.

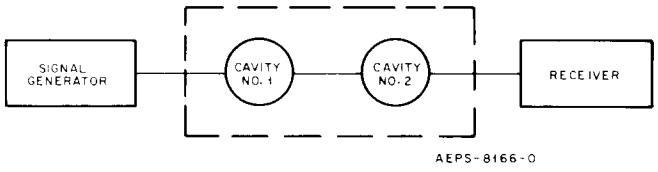


Figure 7.
Model T1482A Test Set-Up

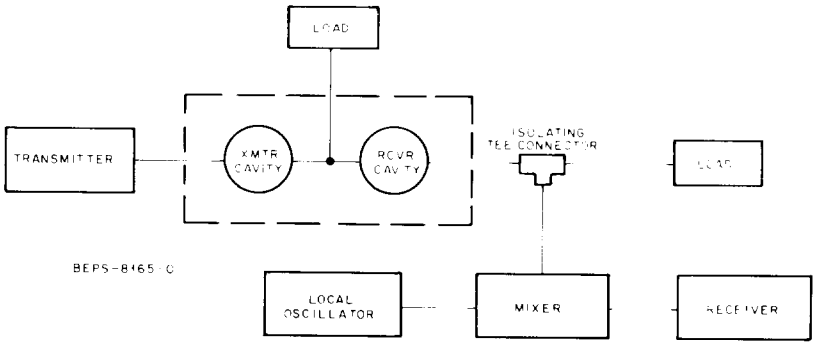


Figure 6.
Method 2 Receiver Branch Reject Test Set-Up

(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

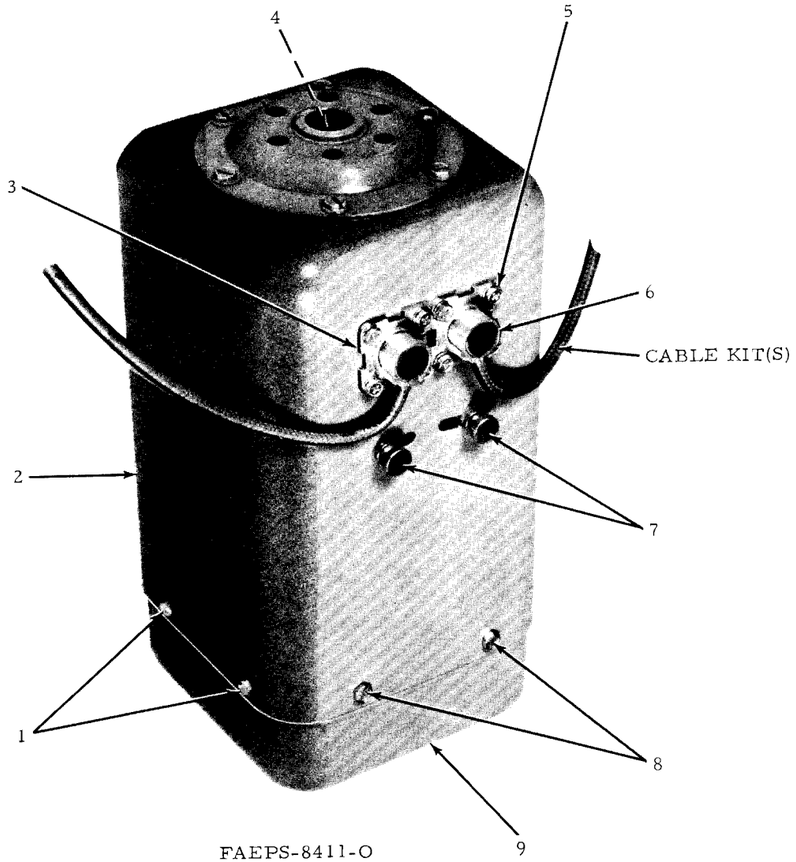
MODEL NUMBER	T1481A	T1482A
INSERTION LOSS	0.6 dB	1.3 dB
MAXIMUM POWER INPUT	125 W	125 W
MINIMUM PASS-REJECT SEPARATION	1.5 MHz	±1.5 MHz
MINIMUM REJECT ATTENUATION	35 dB @ 1.5 MHz	42 dB @ 1.5 MHz
TEMPERATURE RANGE	-30°C to +60°C	-30°C to +60°C
SIZE	6" x 5" x 8-1/2"	19" x 5-1/2" x 8-1/2"
TERMINATION	N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

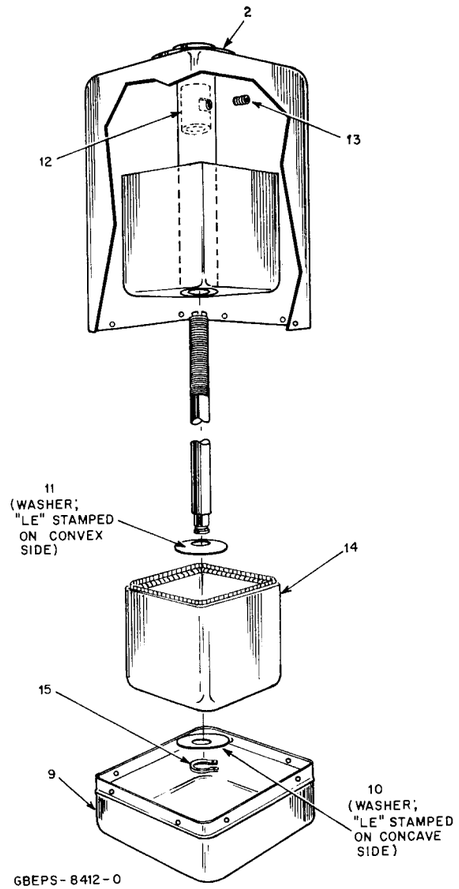


FAEPS-8411-O

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

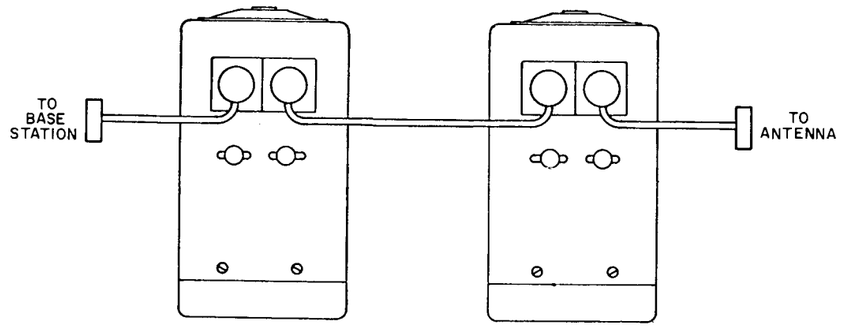
CODE	MOTOROLA PART NO.	DESCRIPTION
	7-84395D01	BRACKET, cavity mtg
8	3-3398	SCREW, tapping: 6-20 x 3/8" plain hex head (4 req'd)
	3-1209	SCREW, machine: 10-32 x 1/2" slotted binder head (4 req'd)
	3-7658	LOCKWASHER: No. 10 internal (4 req'd)
	2-7048	NUT, machine: 10-32 x 5/16" hex (4 req'd)
	3-136716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

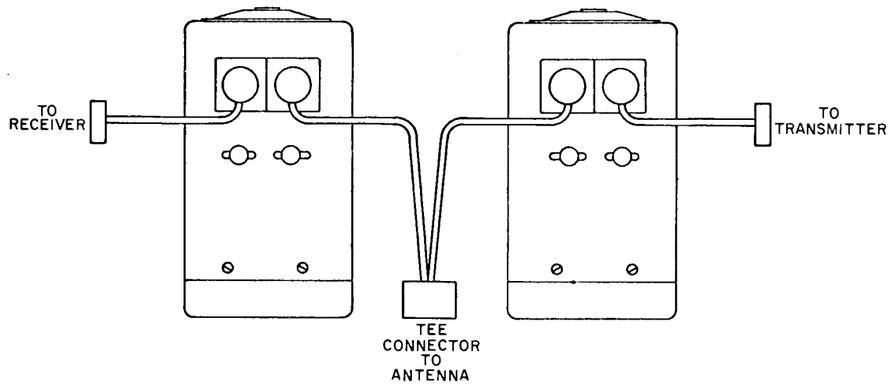
CODE	MOTOROLA PART NO.	DESCRIPTION
	64-84003D01	PANEL, cavity mtg (top)
	64-84004D01	PANEL, cavity mtg (bottom)
8	3-3398	SCREW, tapping: 6-20 x 3/8" plain hex head (16 req'd)
	3-128109	SCREW: 6-32 x 1/4" slotted round head; external lockwasher (6 req'd)
	3-135038	SCREW, tapping: No. 14 x 3/4" Phillips 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

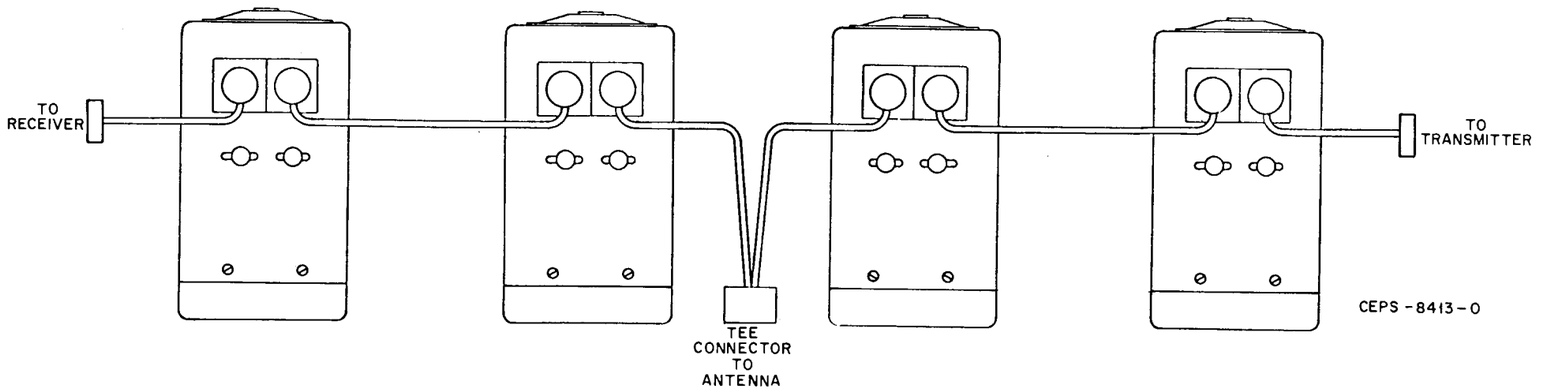
MODEL T1482A



MODEL T1485A

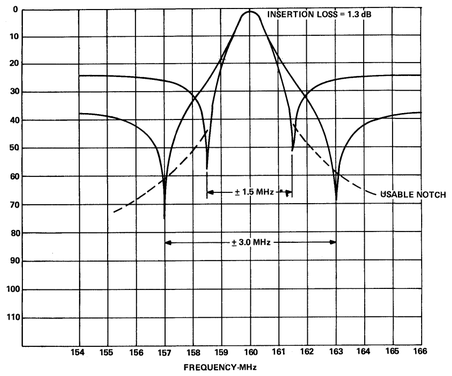


MODEL T1487A



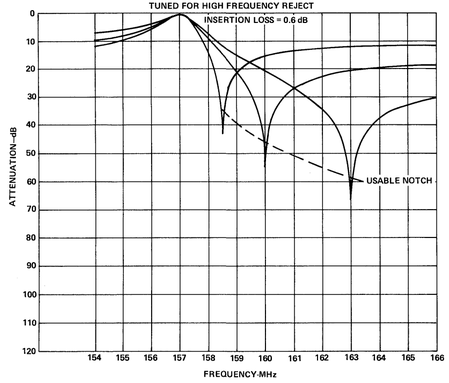
Duplex Cabling Detail
Motorola No. CEPS-8413-O
2/15/78 UP

T1482A DUAL-REJECT FILTER



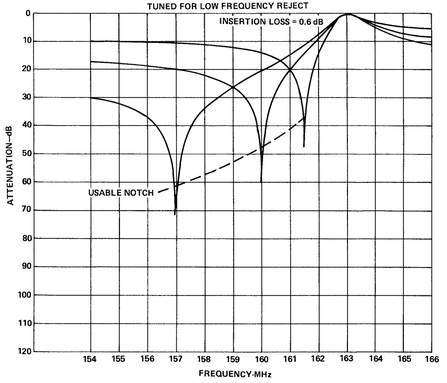
T1481A PASS-REJECT FILTER

TUNED FOR HIGH FREQUENCY REJECT



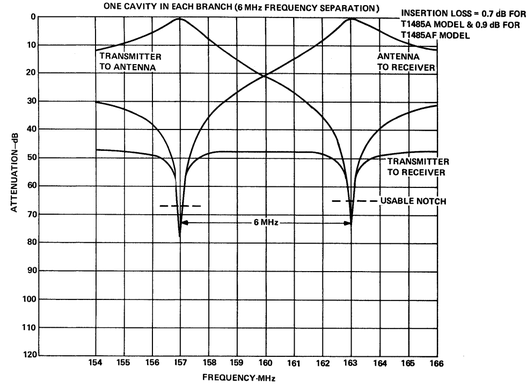
T1481A PASS-REJECT FILTER

TUNED FOR LOW FREQUENCY REJECT



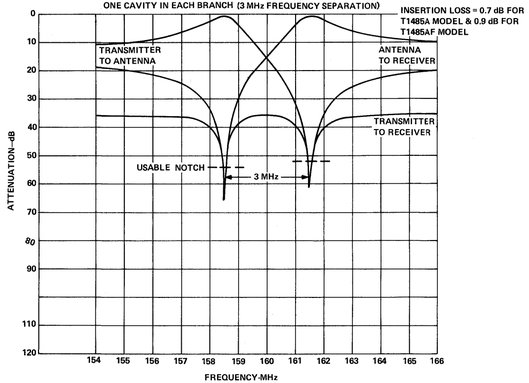
T1485A, AF PASS-REJECT DUPLEXER

ONE CAVITY IN EACH BRANCH (6 MHz FREQUENCY SEPARATION)



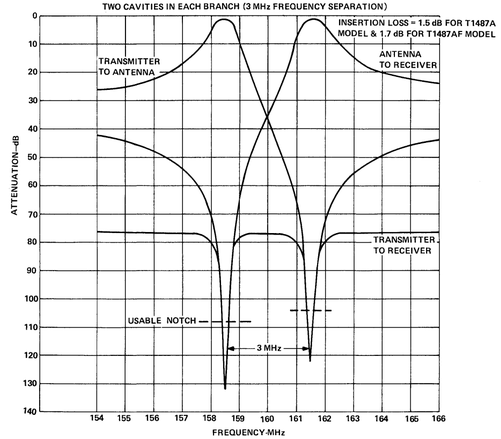
T1485A, AF PASS-REJECT DUPLEXER

ONE CAVITY IN EACH BRANCH (3 MHz FREQUENCY SEPARATION)



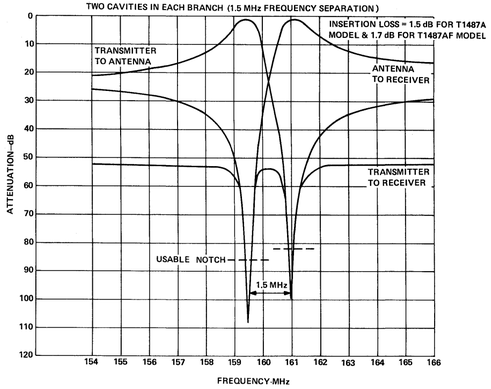
T1487A, AF PASS-REJECT DUPLEXER

TWO CAVITIES IN EACH BRANCH (3 MHz FREQUENCY SEPARATION)



T1487A, AF PASS-REJECT DUPLEXER

TWO CAVITIES IN EACH BRANCH (1.5 MHz FREQUENCY SEPARATION)



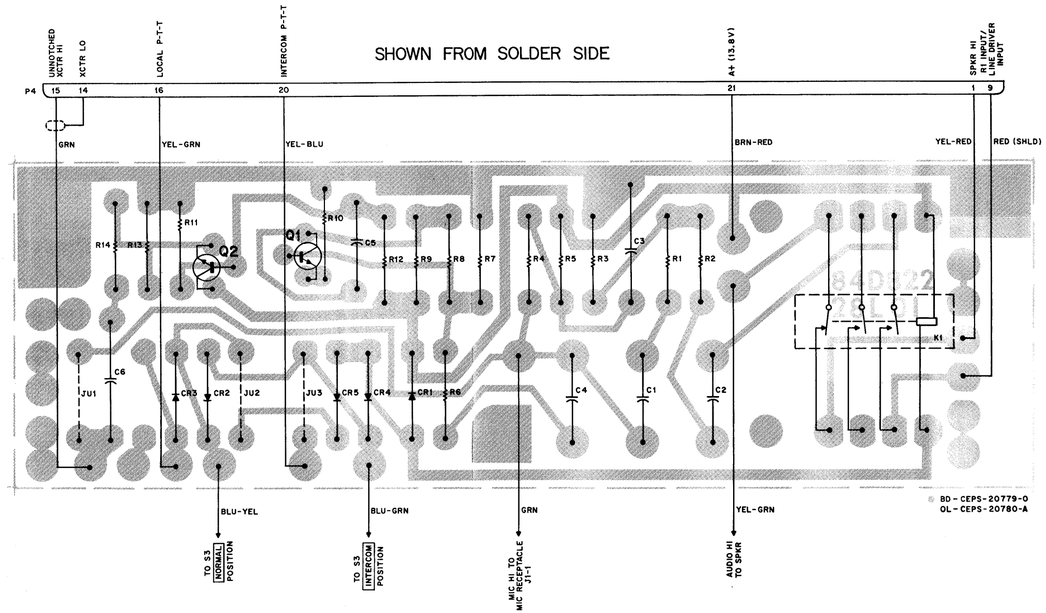
EEPS-8176-O

parts list

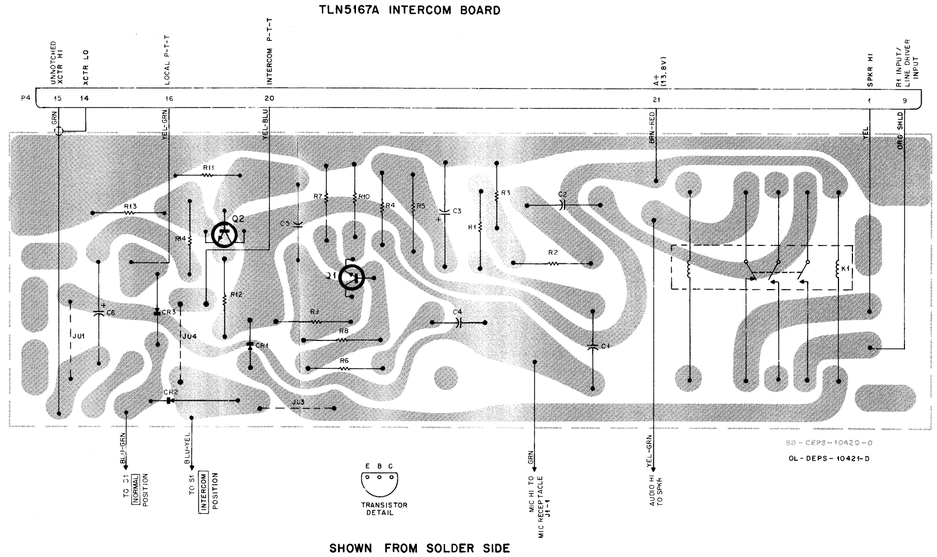
TLN5167A Intercom Board — PL-5076-D

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

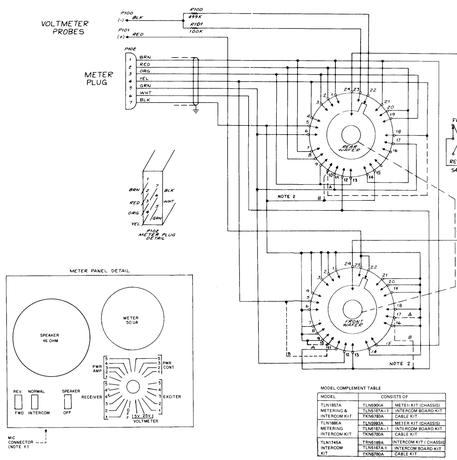
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

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

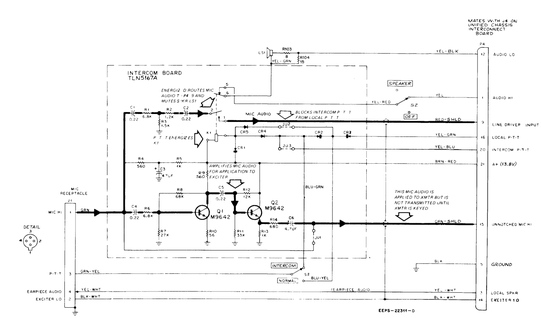
Step 1. Connect a test microphone to the microphone receptacle on the meter & intercom chassis.

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

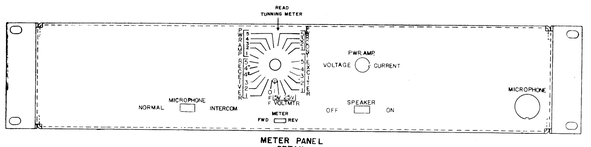
FUNCTION

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

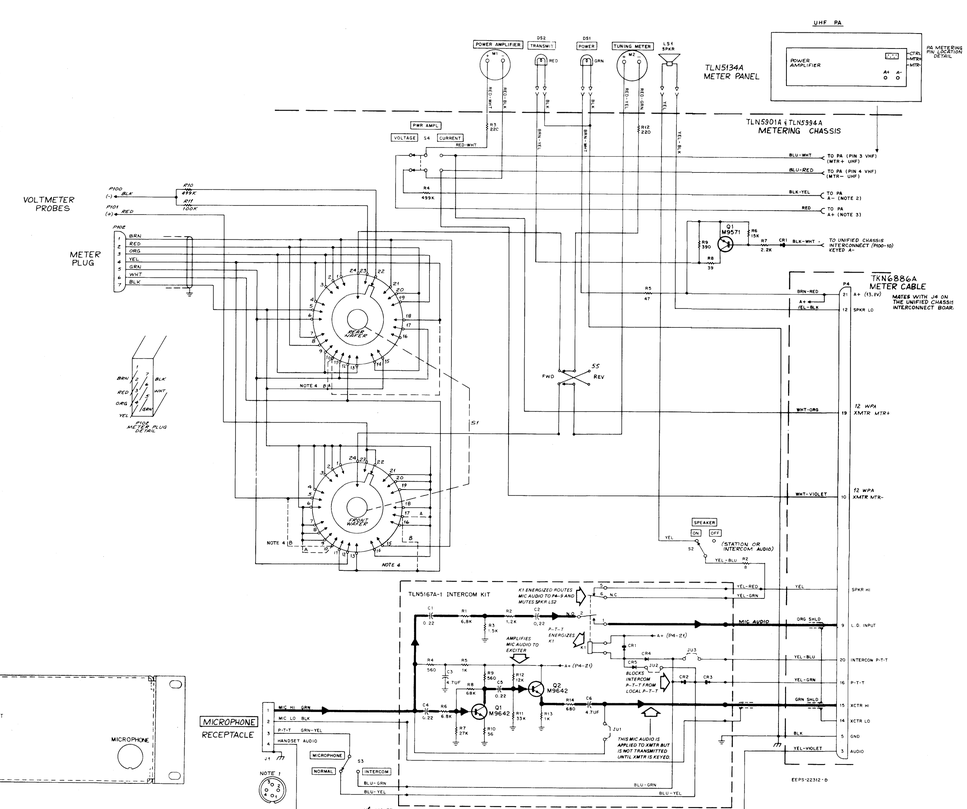
P102 METER PLUG CONNECTED TO	METER SELECTOR SWITCH		LOW BAND–MID BAND TLN1886A/TLN1887A		HIGH BAND TLN1857/TLN1858A		800 MHz/UHF TLN1857A/TLN1858A	
	MTR. NO.	POS.	POL.	FUNCTION METERED	POL.	FUNCTION METERED	POL.	FUNCTION METERED
RCVR AND IF BOARD	RCVR	1	REV	EXTENDED CHANNEL ELEMENT	REV	–	FWD	CHANNEL 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

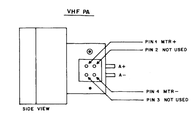
EPS-23014-A



METER PANEL DETAIL

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





MODEL COMPLEMENT TABLE

MODEL	CONSISTS OF:	
TLN1859A	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 TMN6021A 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 A+1 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	- 9-841513B03 1-84536D02	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

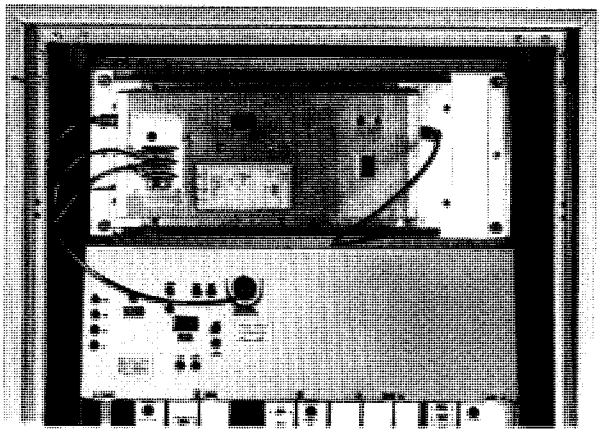
TLN5134A Meter Panel PL-2233-A

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

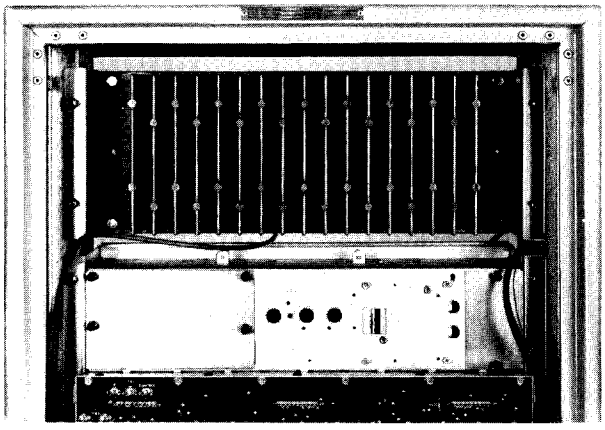
4. MONITORING

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

PARTS LIST

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

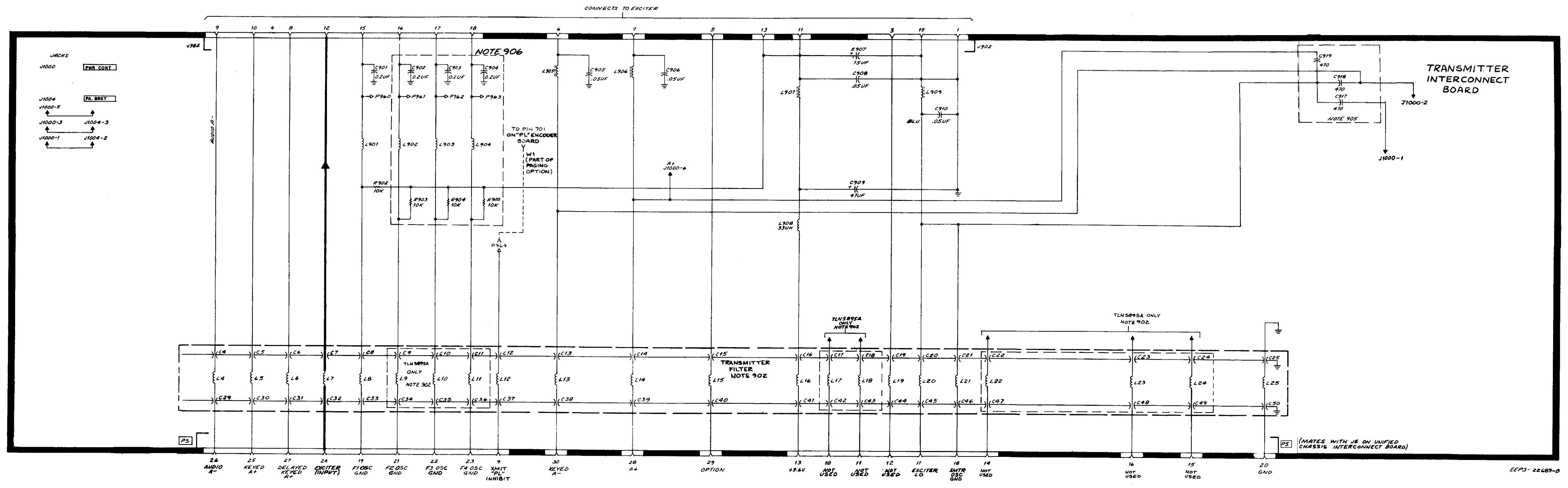
NOTE

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

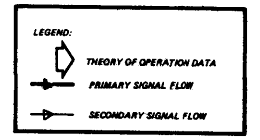
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF +100-0% 500 V: unless otherwise stated
C1, 2, 3		NOT USED
C4 thru 8	21-861219	1000 (TLN5894A & TLN5895A)
C9, 10, 11	21-861219	1000 (TLN5895A)
C12 thru 16	21-861219	1000 (TLN5894A & TLN5895A)
C17, 18	21-861219	1000 (TLN5895A)
C19	21-82812H01	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--R906 NOT USED ON TLN5894A (REPEATER) MODEL.



TRANSMITTER INTERCONNECT BOARD

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

FUNCTION -

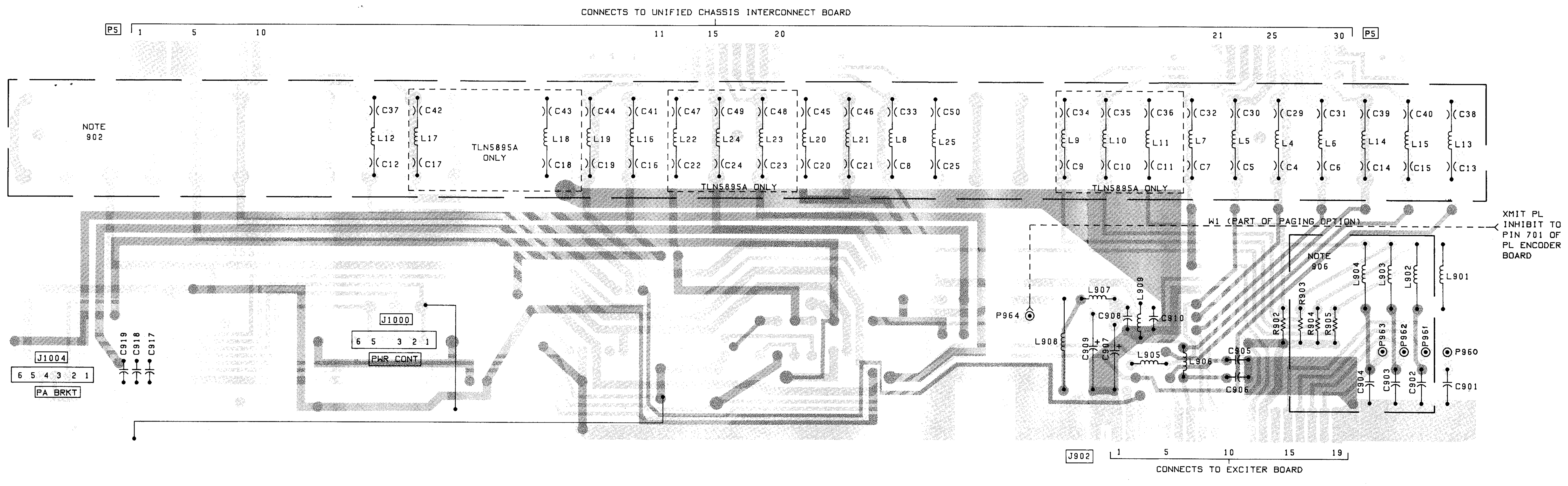
--Interconnects most transmitter circuit boards to each other (except PA).

--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.



SHOWN FROM SOLDER SIDE

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

TRANSMITTER INTERCONNECT BOARD

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

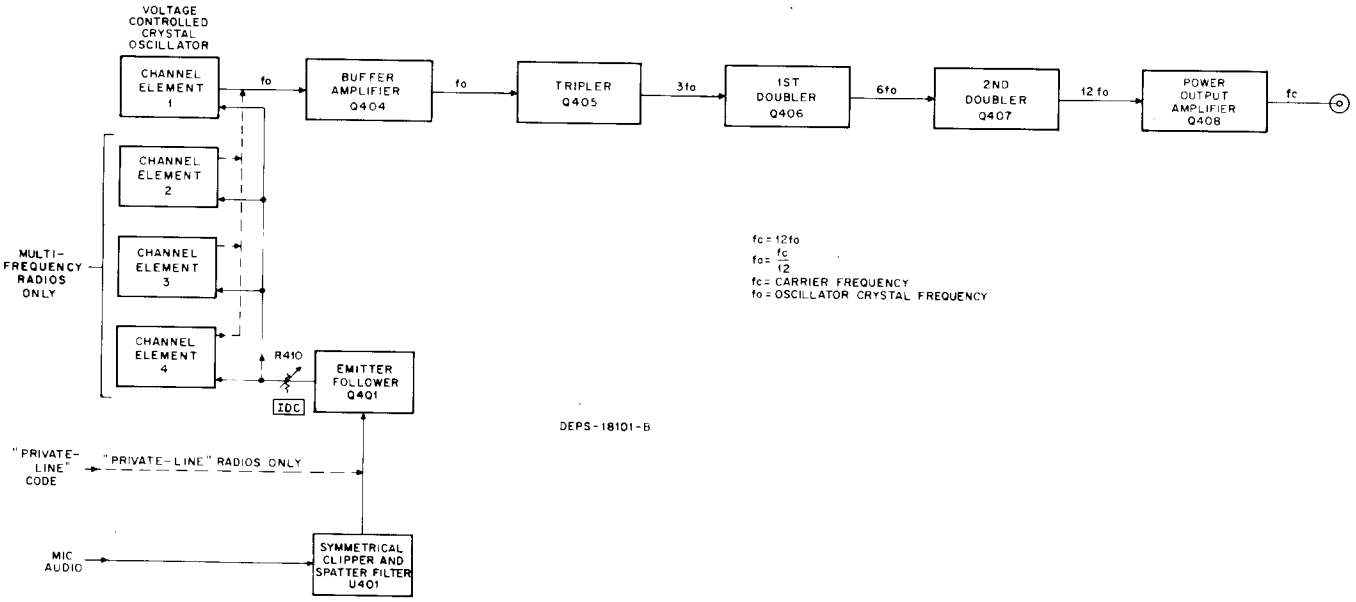
1.1 Models TLD5802B and TLD5803B Exciter provides the low power excitation for an FM transmitter. Up to four plug-in channel elements, one for each transmitter operating frequency, are used to develop a direct FM carrier signal of at least 400 milliwatts.

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

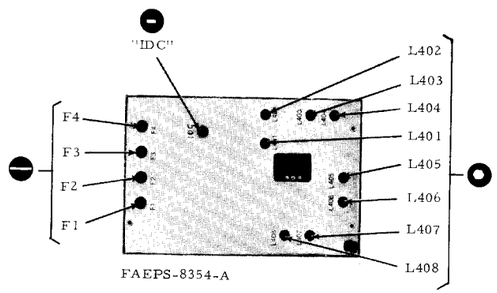
If test set readings are abnormal or tests indicated subnormal performance, a logical troubleshooting procedure is required to isolate the defective component efficiently. The meter readings and results of performance tests usually localize the malfunction to one or two specific stages. A zero meter 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.



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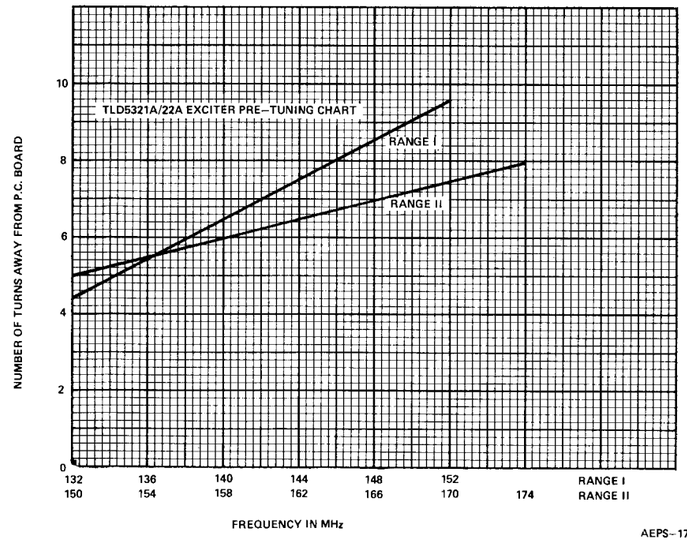

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OSCILLATOR FREQUENCY ADJUSTMENT

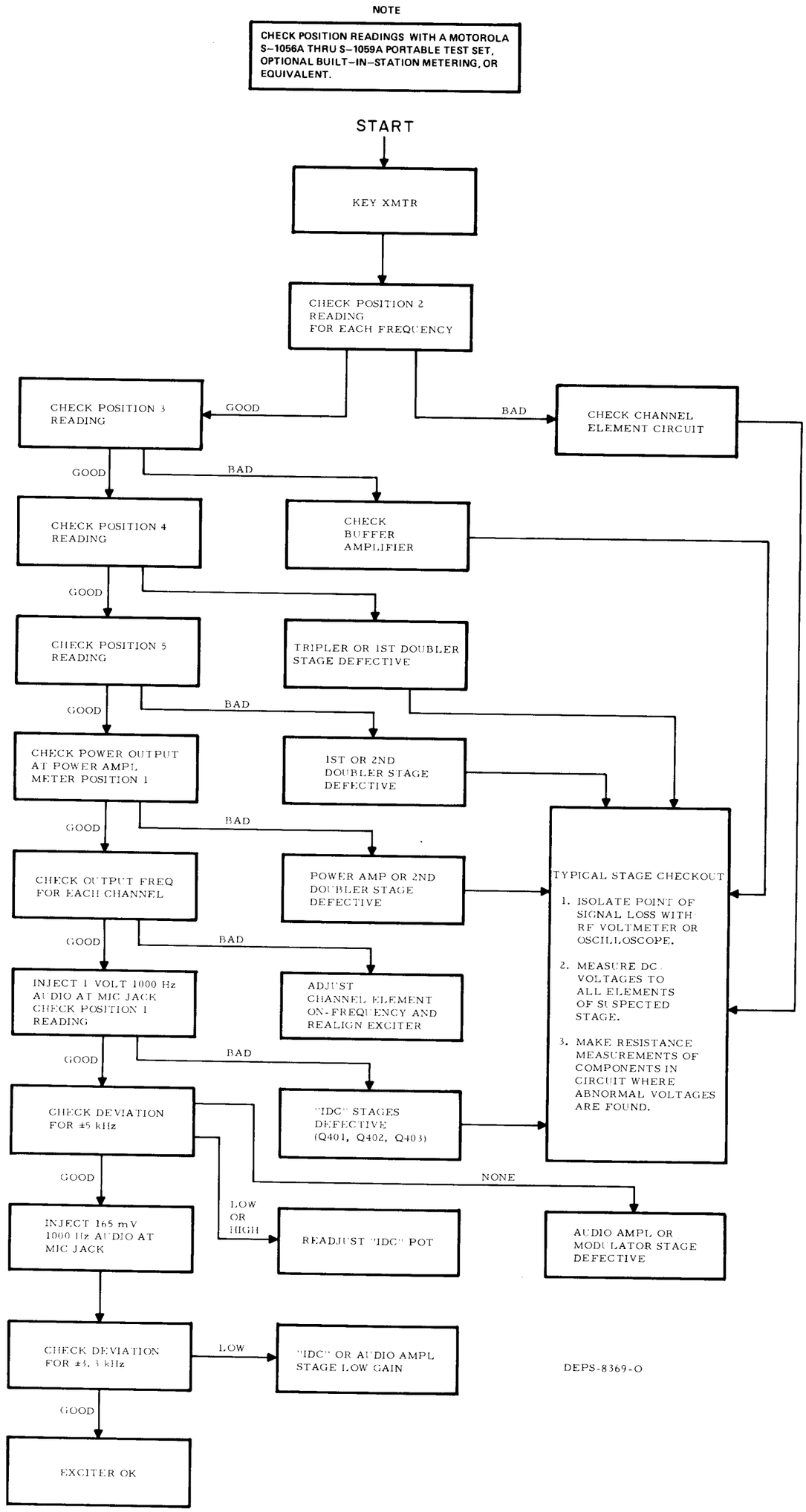
1. Key the transmitter with no modulation (key the transmitter with the XMTR ON pushbutton on the portable test set rather than with the microphone). On "Private-Line" stations, unplug the "Vibrasender" resonant reed from the PL tone generator. On "Digital Private-Line" stations short together the code 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.

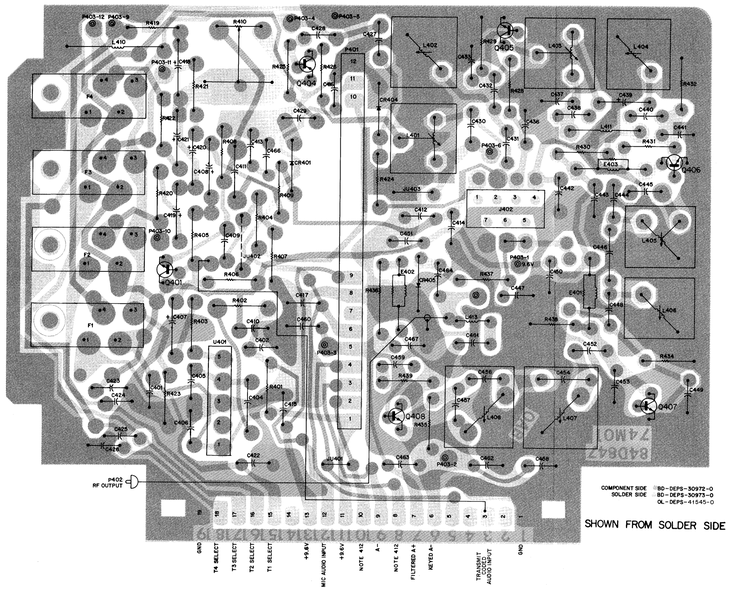
"IDC" ADJUSTMENT PROCEDURES

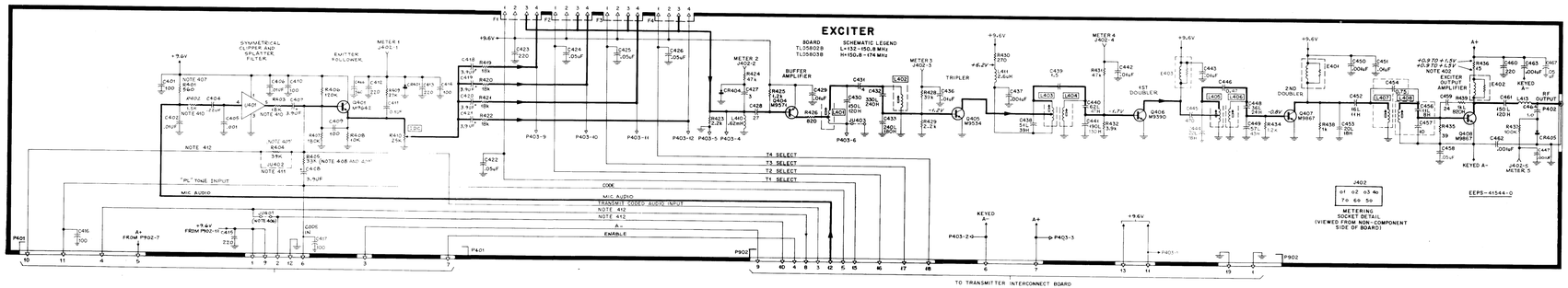
NOTE

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.

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Communications Division

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-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.

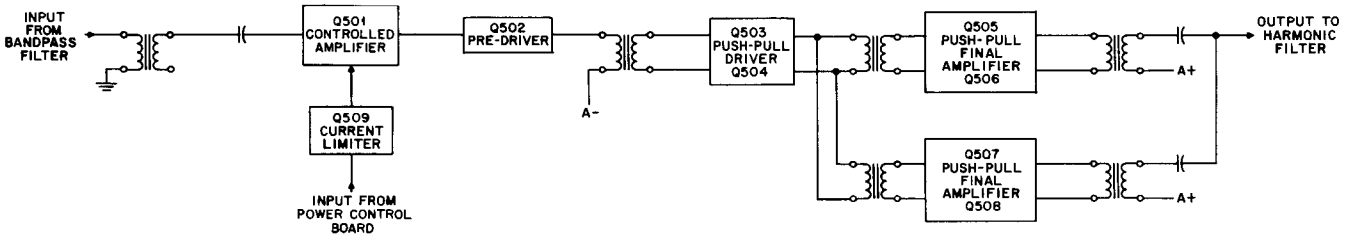

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Figure 1. Block Diagram

(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).

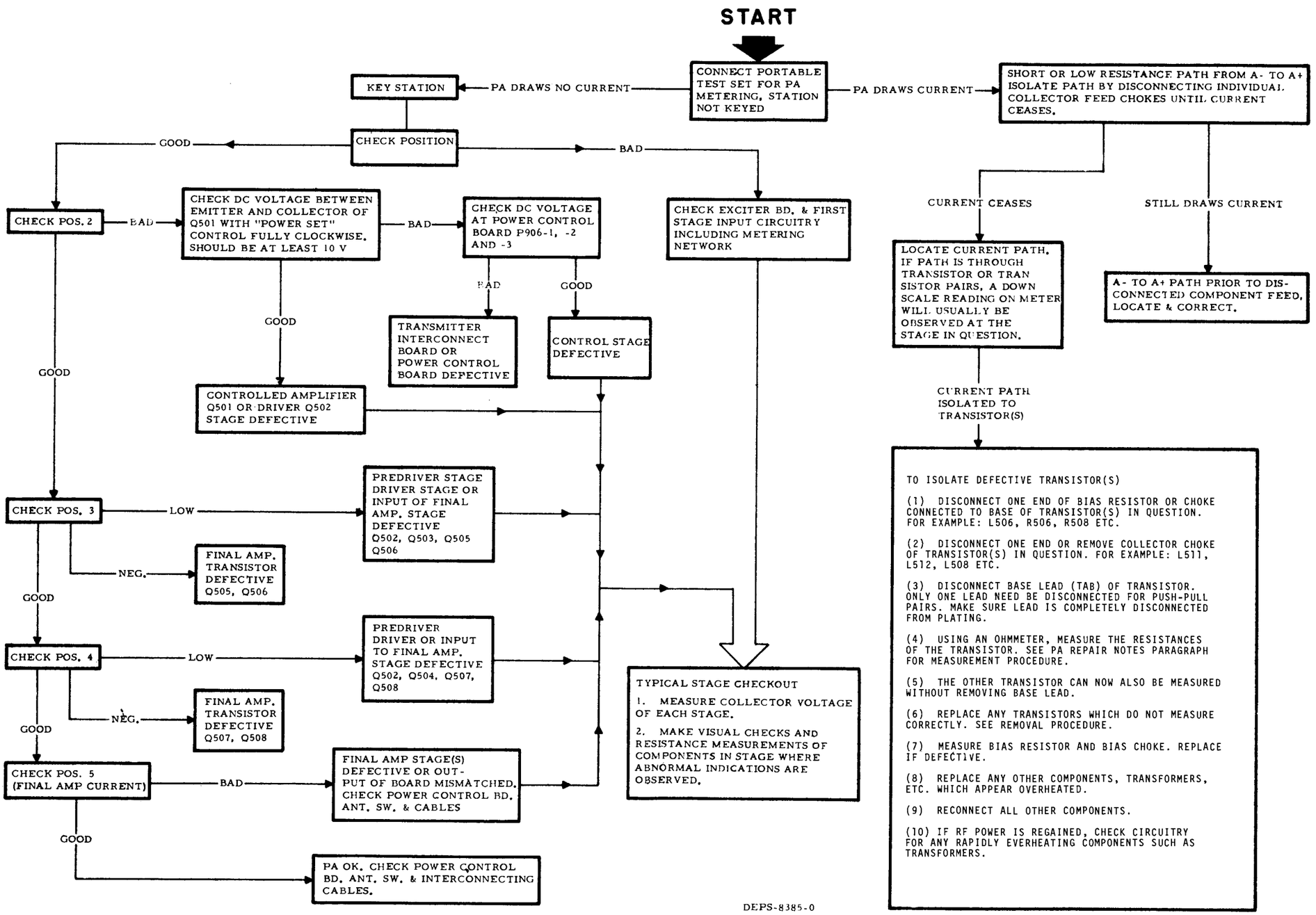
(2) Measure the resistance from lead to lead as described:

(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.

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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:

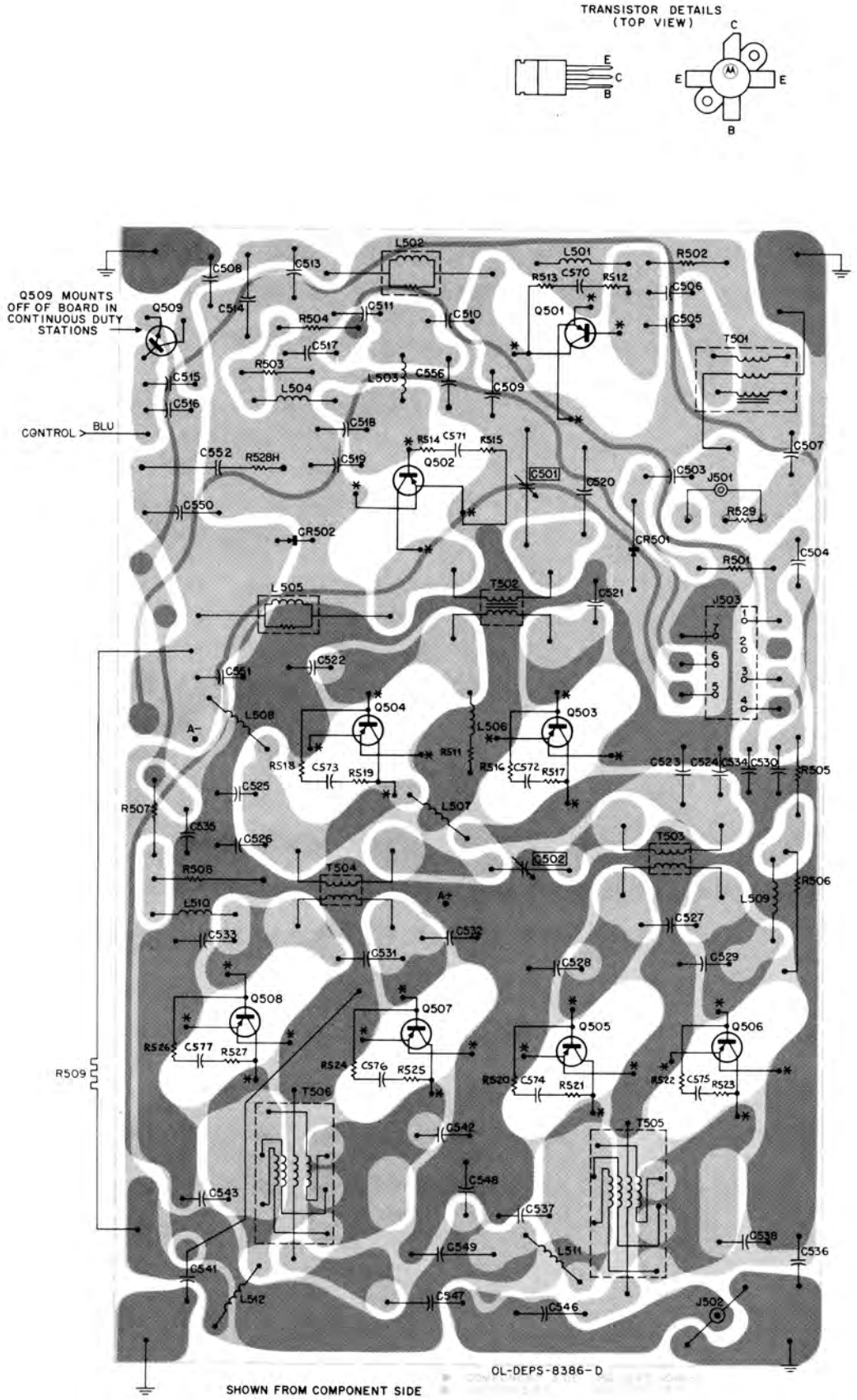
   a. When it is initially installed.
   b. When any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
   c. At intervals not to exceed one year.

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.

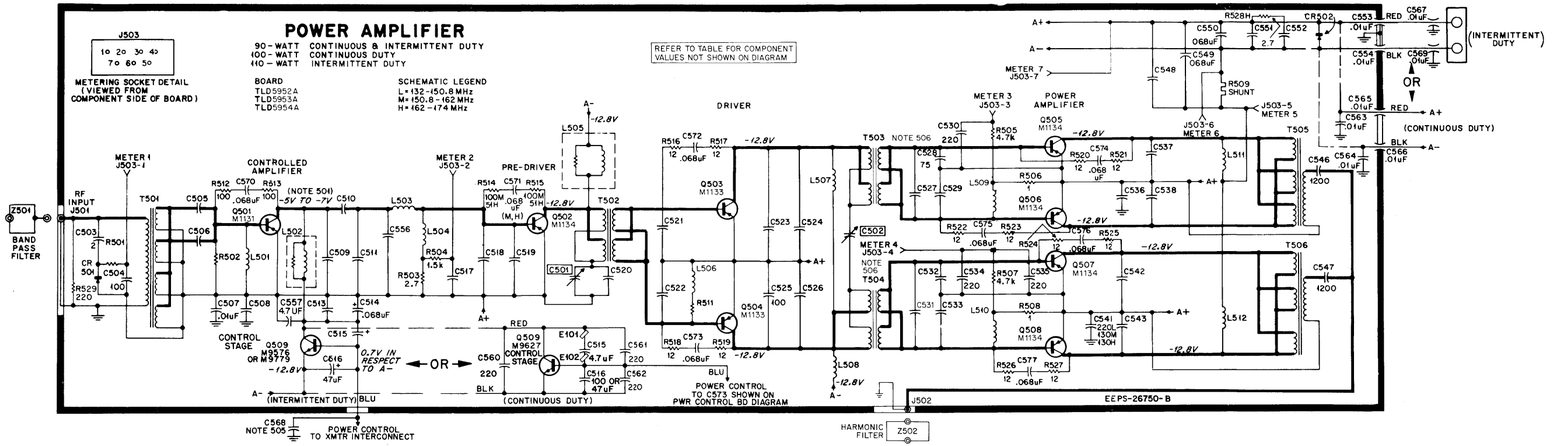


90/100/110 W Power Amplifier
Circuit Board Detail
Motorola No. PEPS-18126-B
7/3/85 - UP

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.

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- 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.

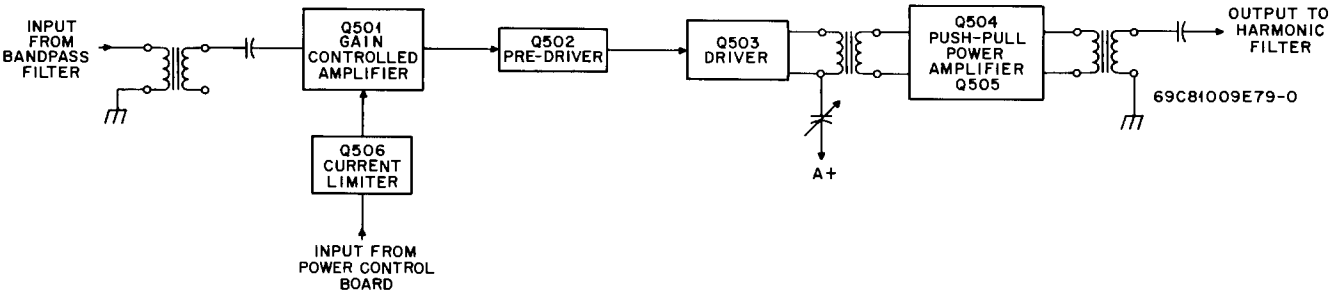


Figure 1. Block Diagram

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).

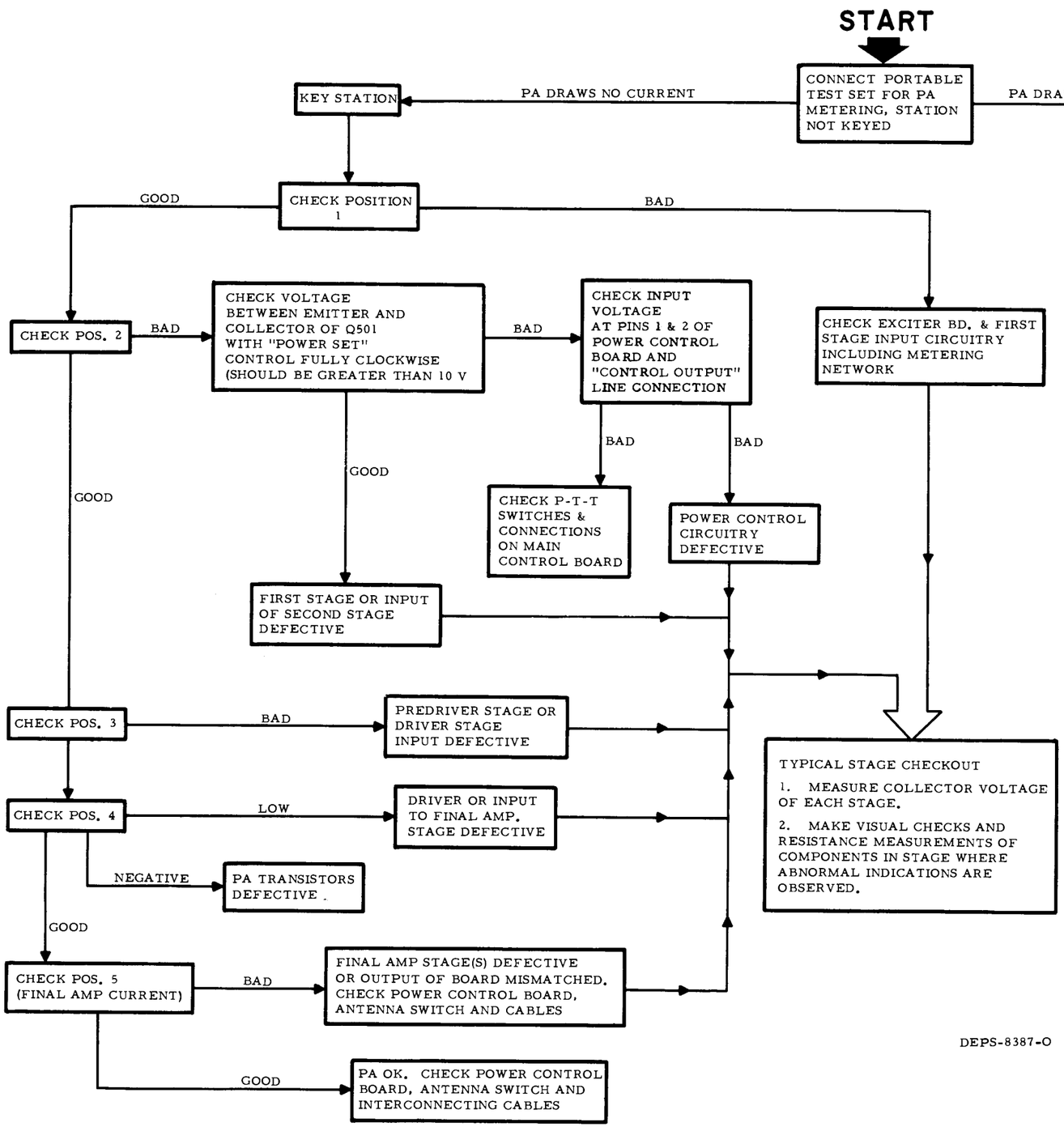
(2) Measure the resistance from lead to lead as described:

(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:

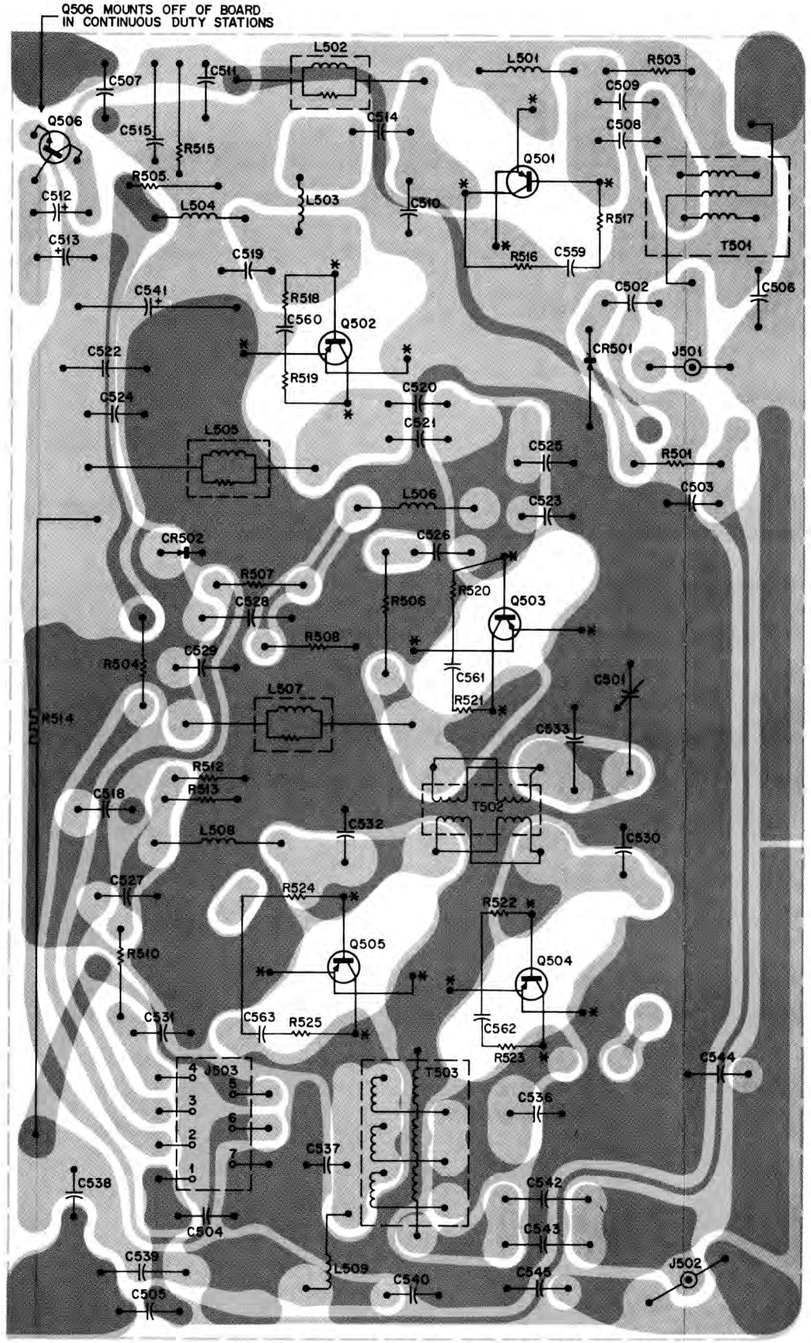
   a. When the transmitter is initially installed.
   b. When any change is made in the transmitter which may increase the power input.
   c. At intervals not to exceed one year.

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.

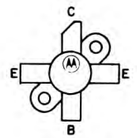


SHOWN FROM COMPONENT SIDE

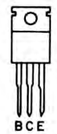
OL-DEPS-8388-A

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

TRANSISTOR DETAILS

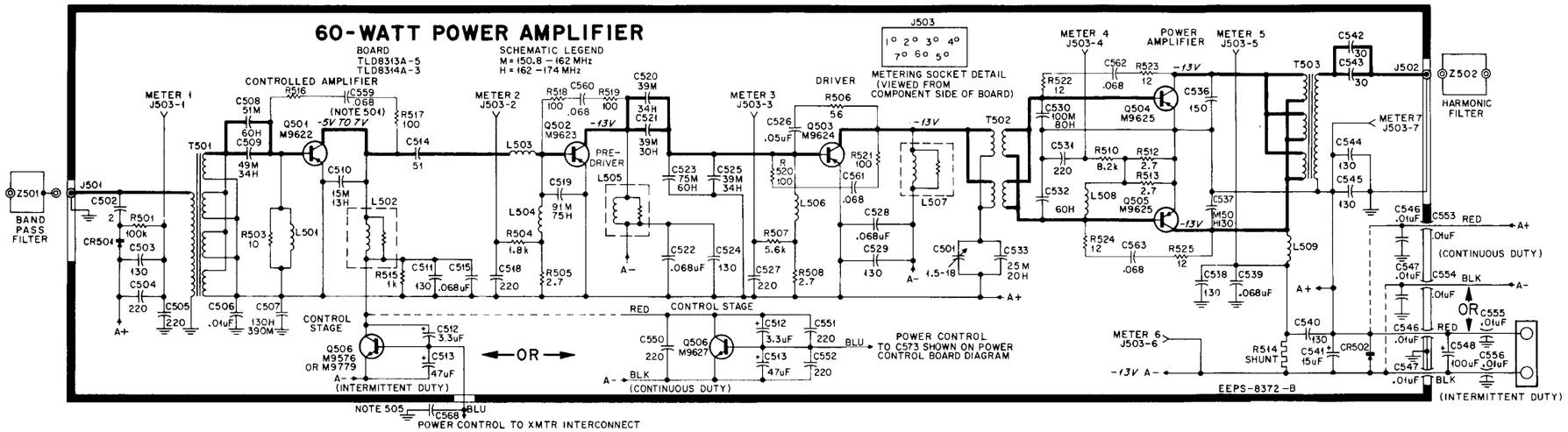


TOP VIEW



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

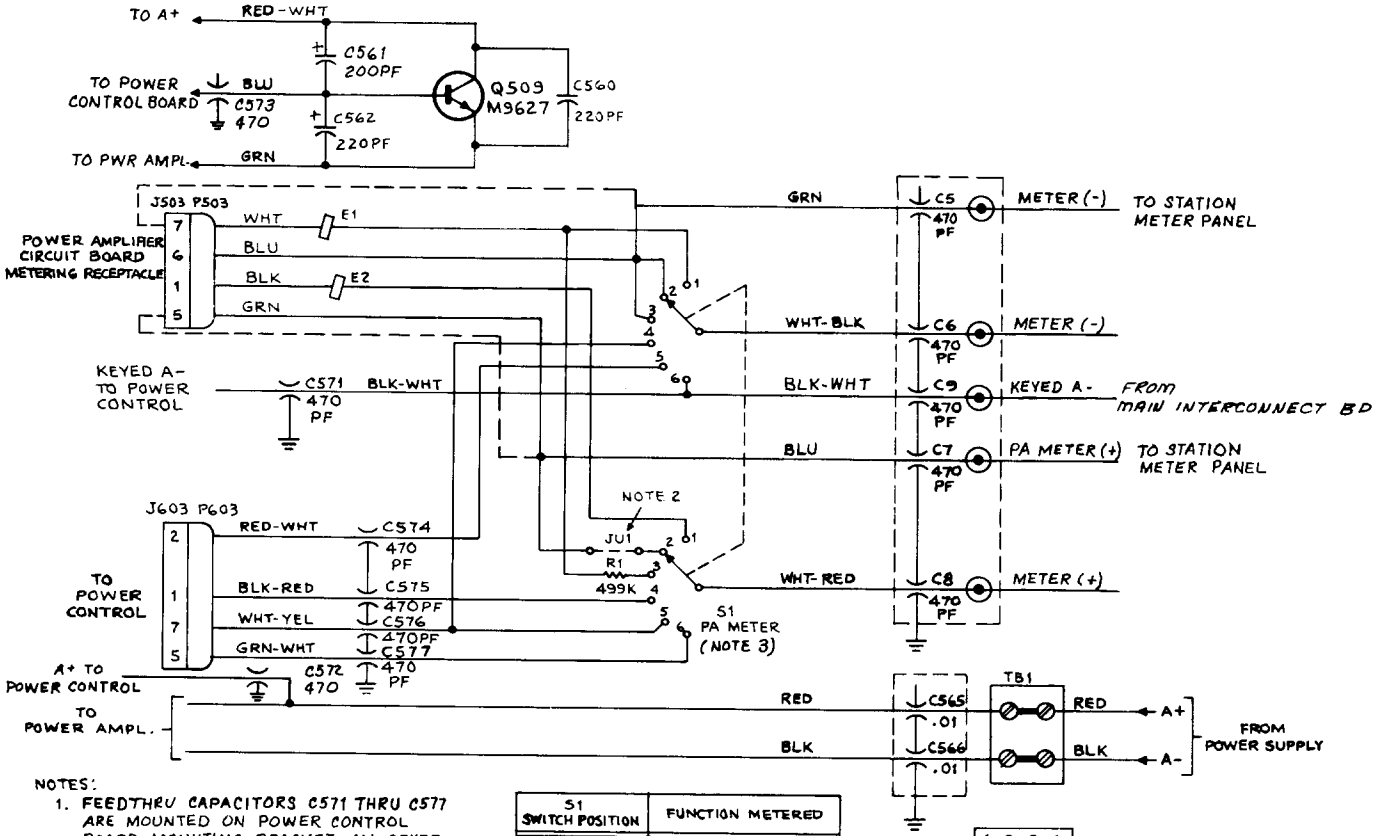
		FILTER, RF: bandpass; 150.8-174 MHz
Z501	TFD6112A	

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

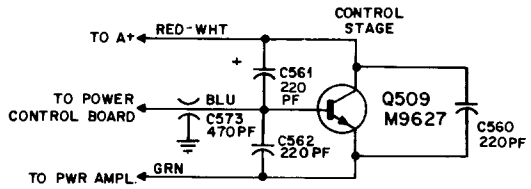
TLN5922A Input Bracket & Cable Kit PL-5180-O

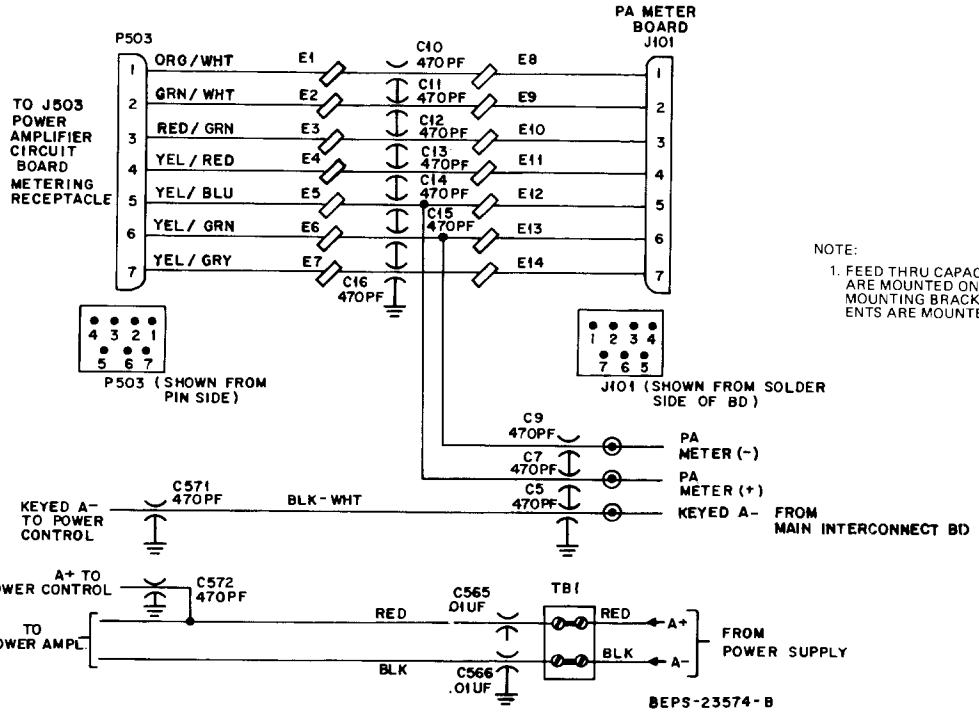
		CAPACITOR, fixed:
C5 thru 9	21-821474	470 pF ±20%; 500 V
C560, 561, 562	21-410115	220 pF ±20%; 500 V
C565, 566	21-84211B01	.01 uF; 250 V
		TRANSISTOR: (SEE NOTE I)
Q509	48-869627	NPN; type M9627
		TERMINAL BOARD:
TB1	31-50378	2-terminal
	NON-REFERENCED ITEMS	
	1-80793B63	BRACKET ASSEMBLY includes:
	7-82961L01	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.

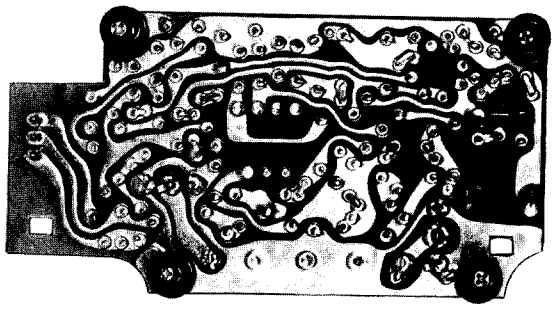
TLN4741A Hardware Kit (100 W)
TLN4742A Hardware Kit (60 W) PL-5344-O

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

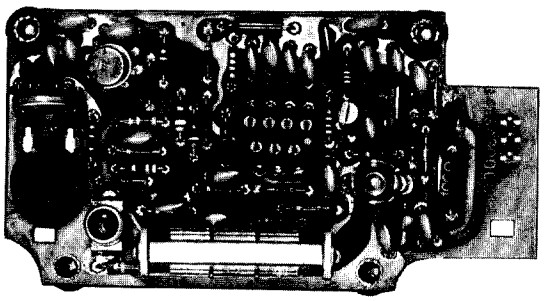
NOTE:
Additional electrical components for TLN4741A & TLN4742A are listed in the 60- & 100-Watt Power Amplifier Board sections; hardware is listed in the Transmitter hardware kits section.

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

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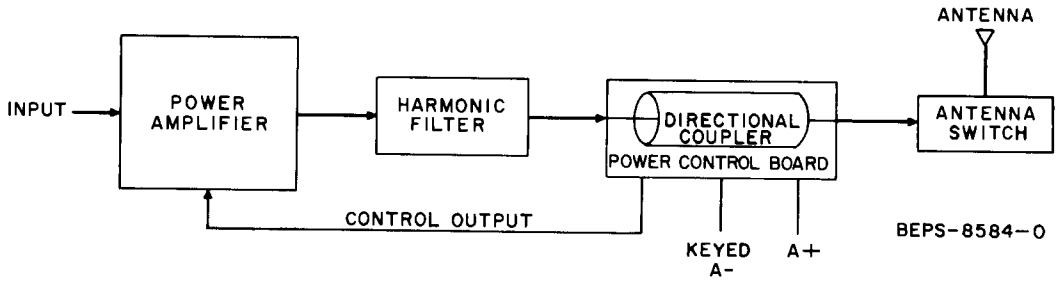


Figure 1.
Loop Block Diagram

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.

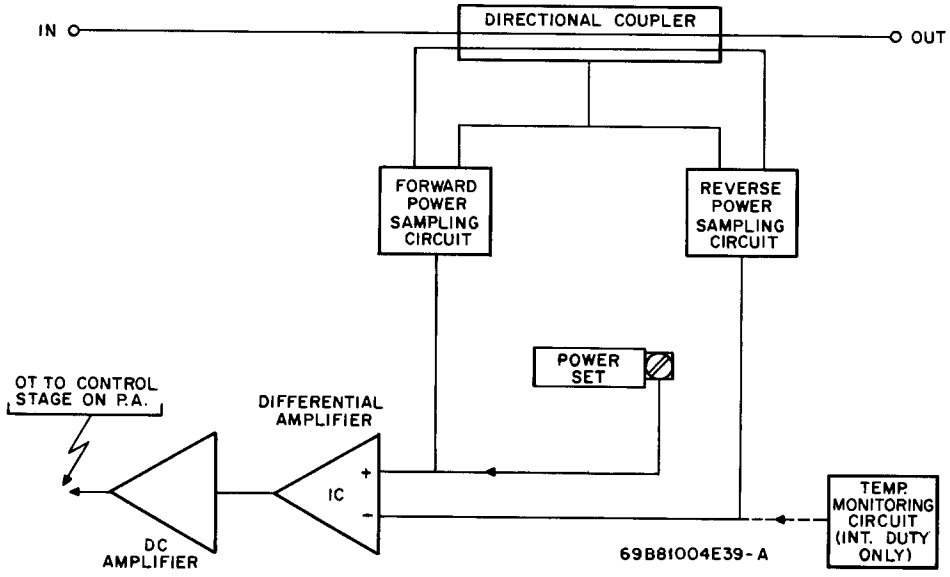


Figure 2.
Power Control Board Block Diagram

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

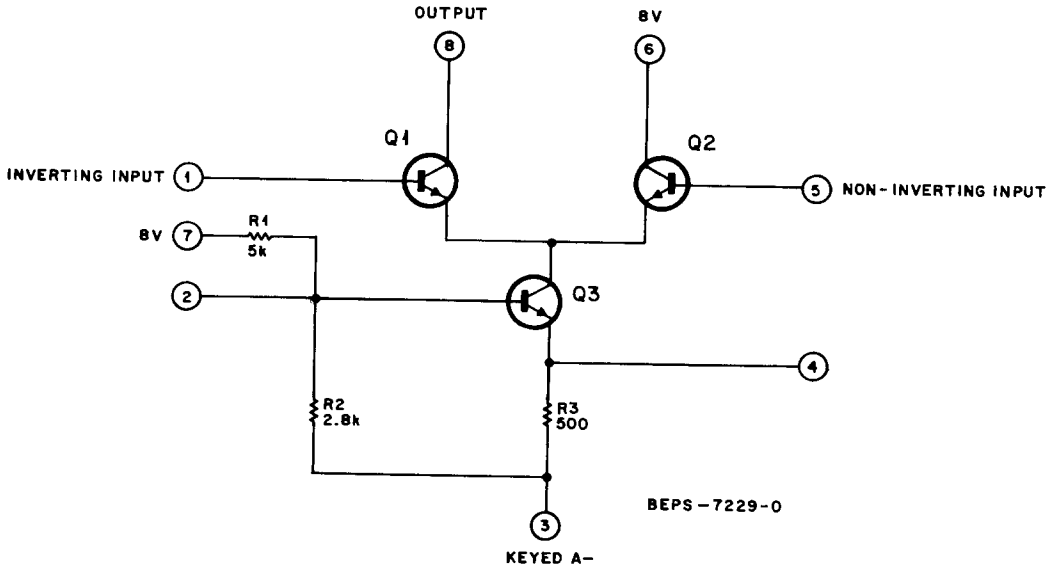


Figure 3.
IC601 Schematic Diagram

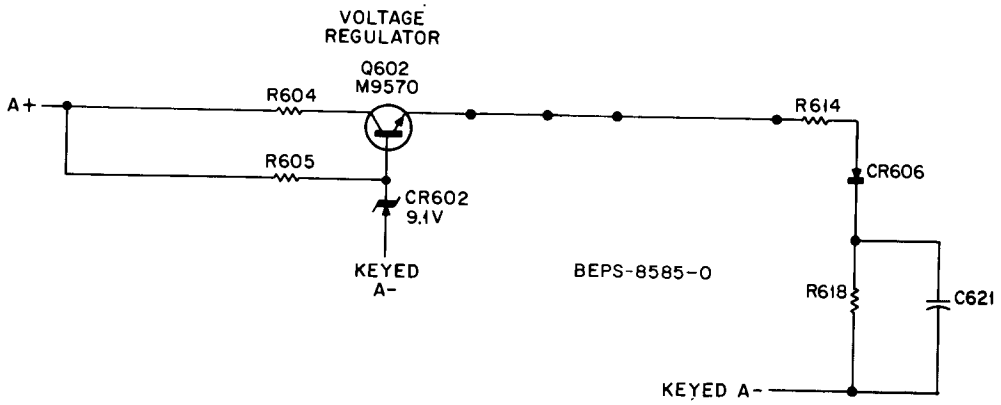


Figure 4.
Voltage Regulator and Main Divider Line

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

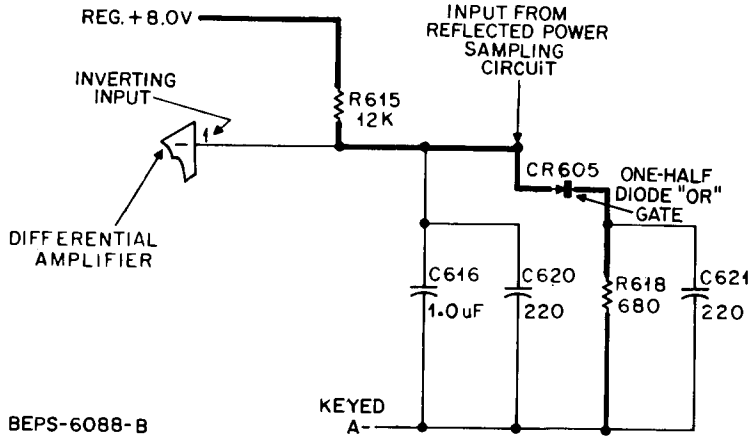


Figure 5.
Reference Power Bias Circuit

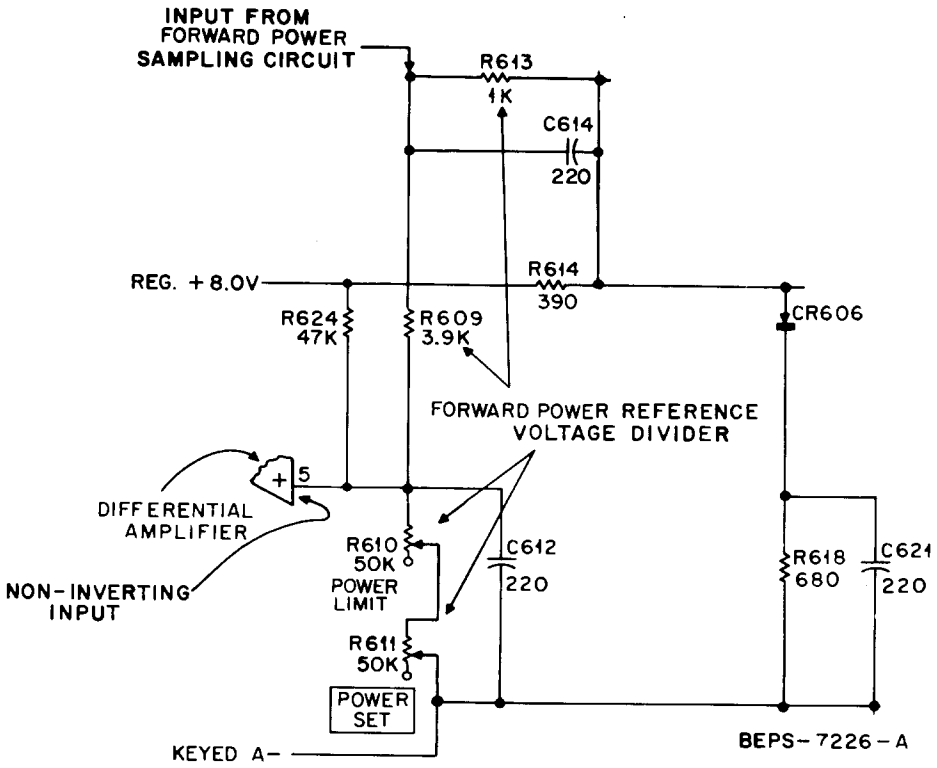


Figure 6.
Forward Power Bias Circuit

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

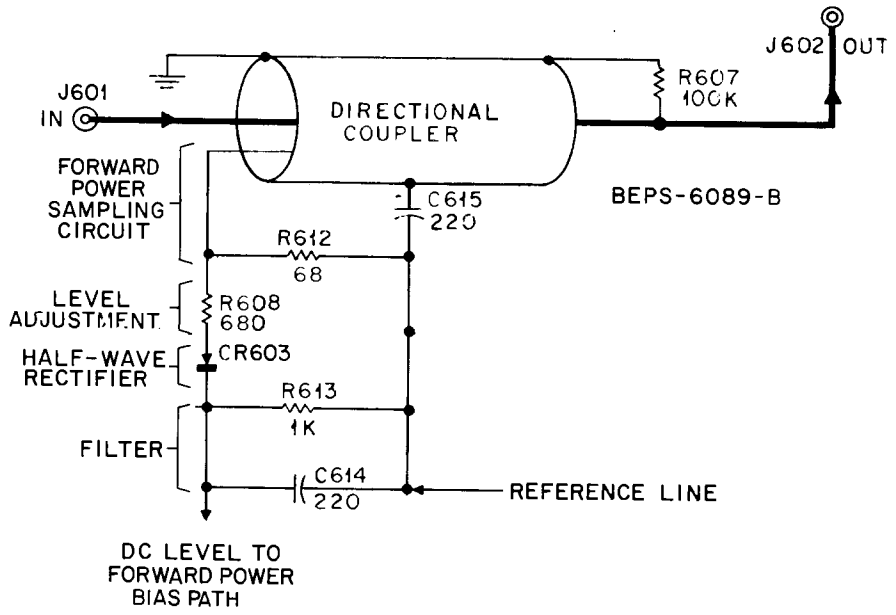


Figure 7.
Forward Power Detector Circuit

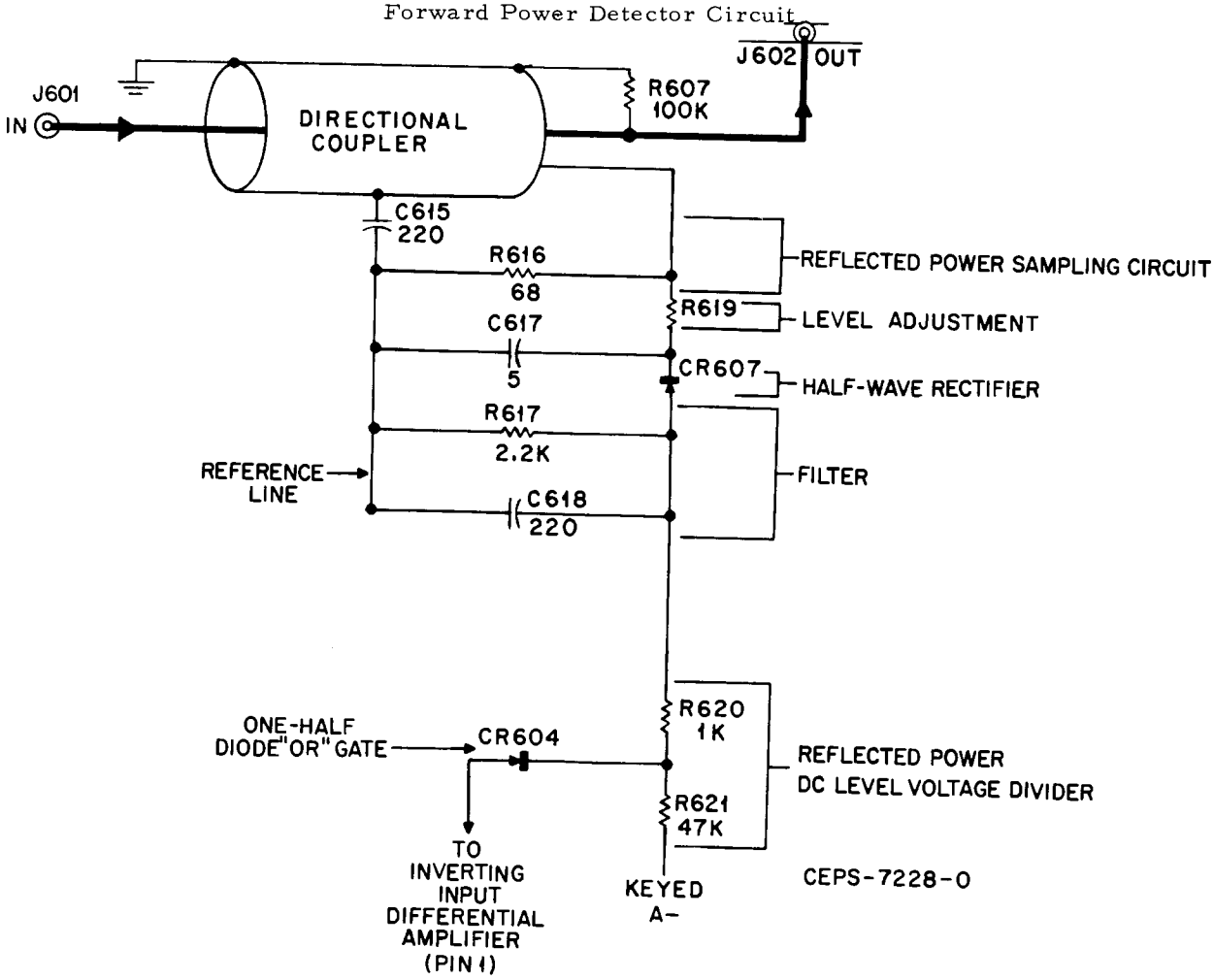


Figure 8.
Reverse Power Detector Circuit

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.

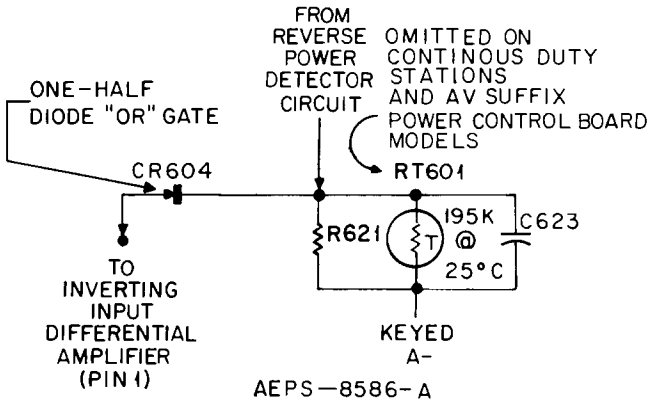


Figure 9.
Temperature Protection Circuit

(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

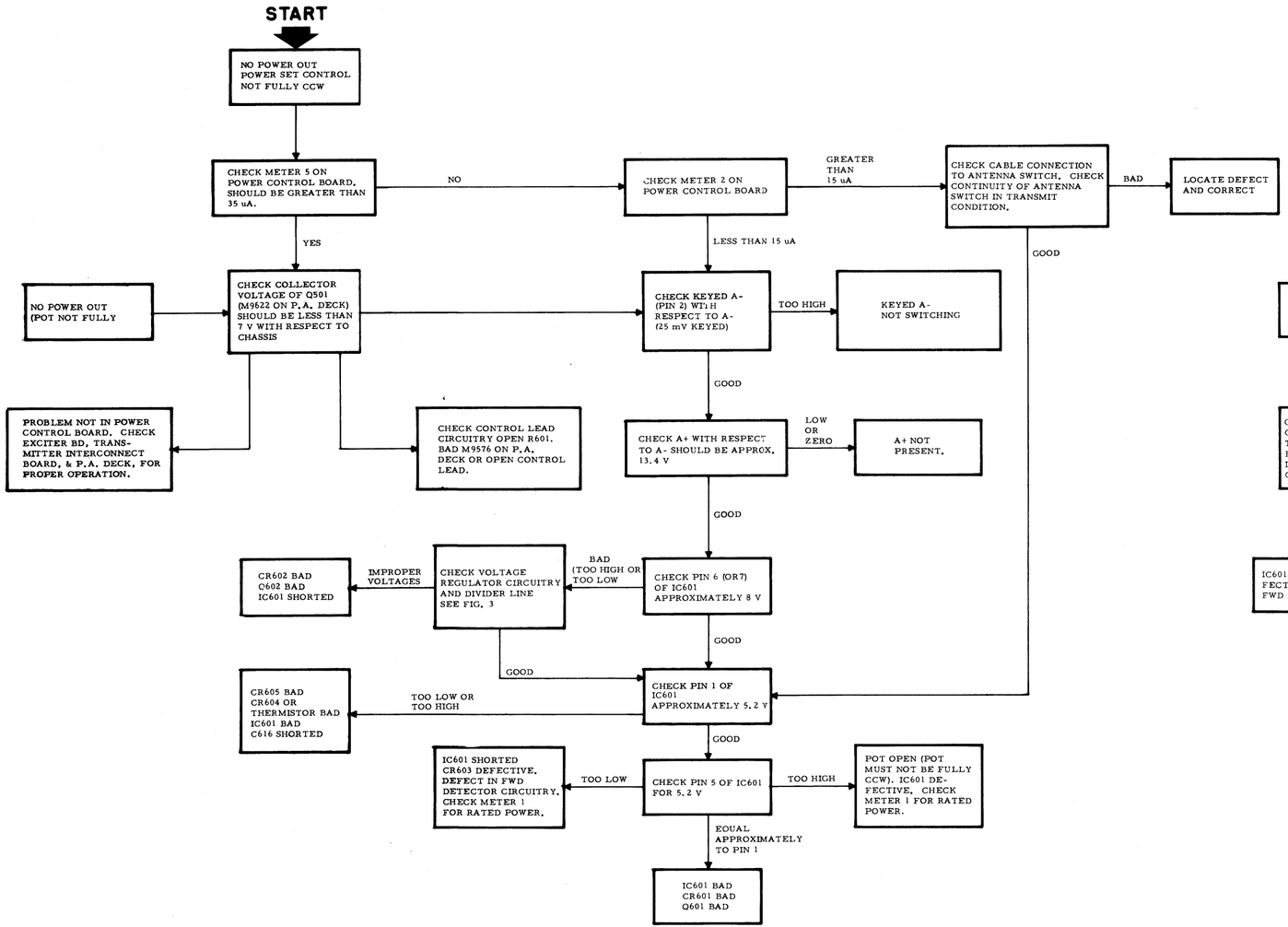
NOTE

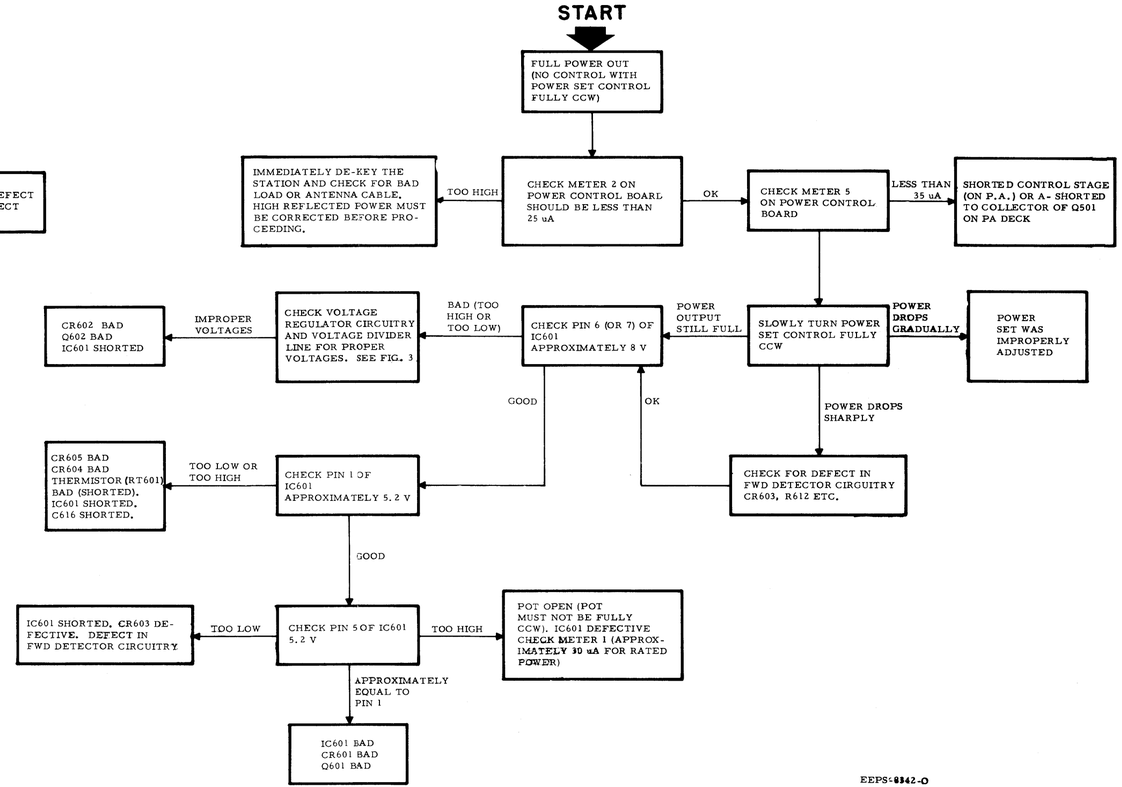
Radio operating at rated power into proper 50 ohm load.

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

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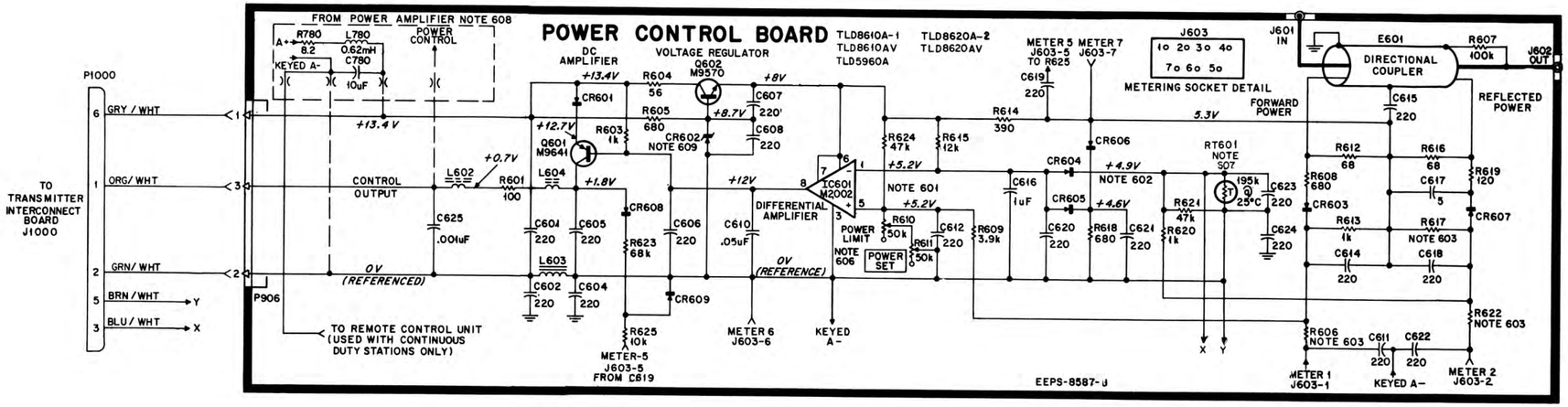

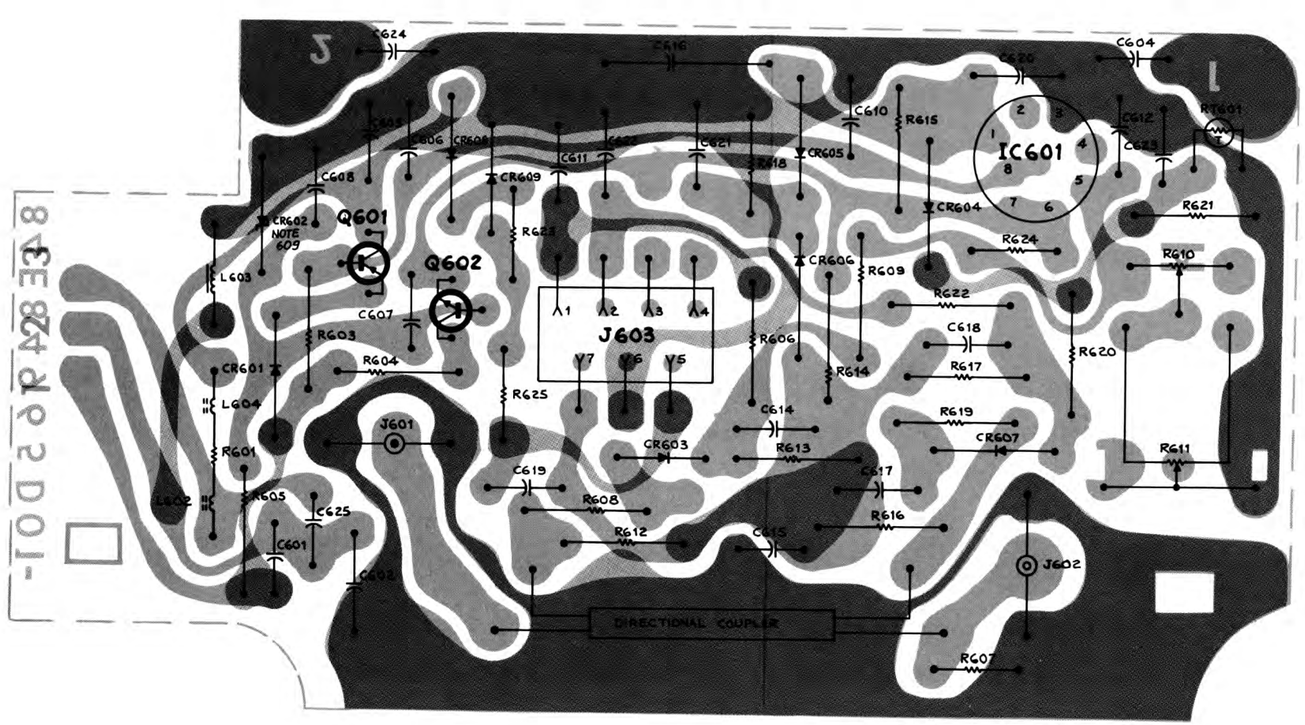

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POWER CONTROL BOARD

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.

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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

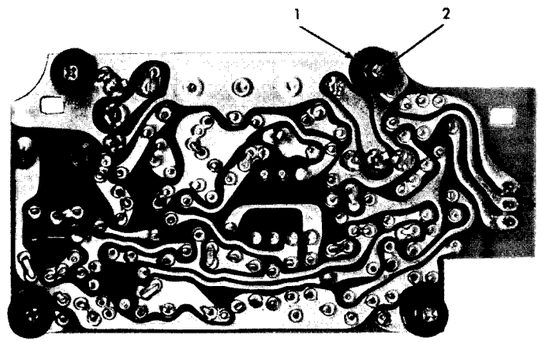
REVISIONS 63P81015E08-E

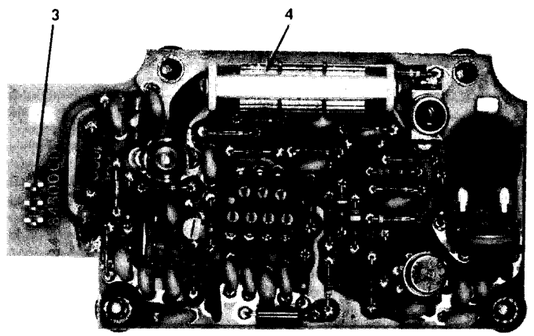
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4780A-1	C780	ADDED 23-83214C20, 10 uF	P. A. INPUT (A-), A-J
	L780	ADDED 24-80900A61, 0.62 MH	
	R780	ADDED 6-124B67, 8.2 OHMS	
TLD8610A-1 TLD8620A-1	R619	FROM 6-124A13, 33 TO 6-124A27, 120	PARTS LIST
	R606	FROM 6-129887, 12K TO 6-124A77, 15K (TLD8610A 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





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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.

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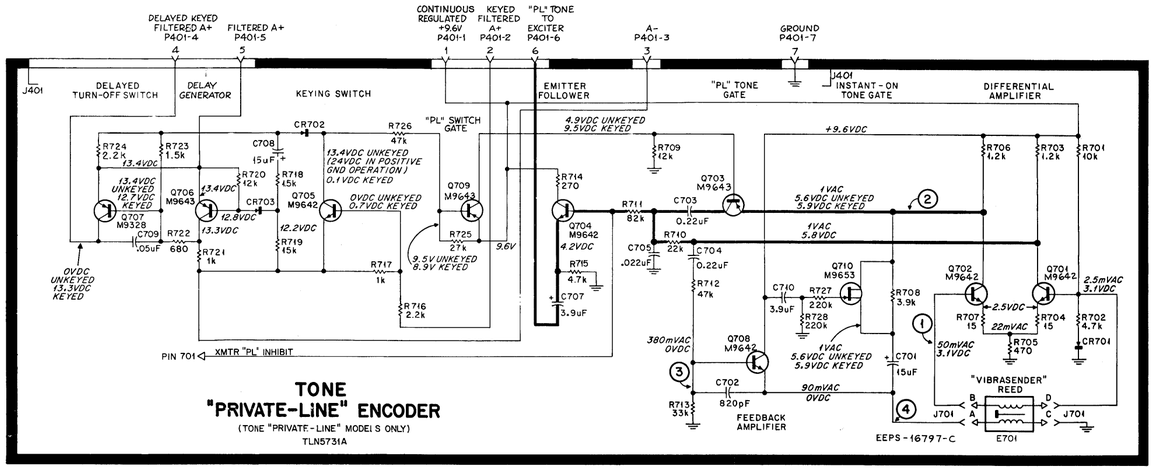

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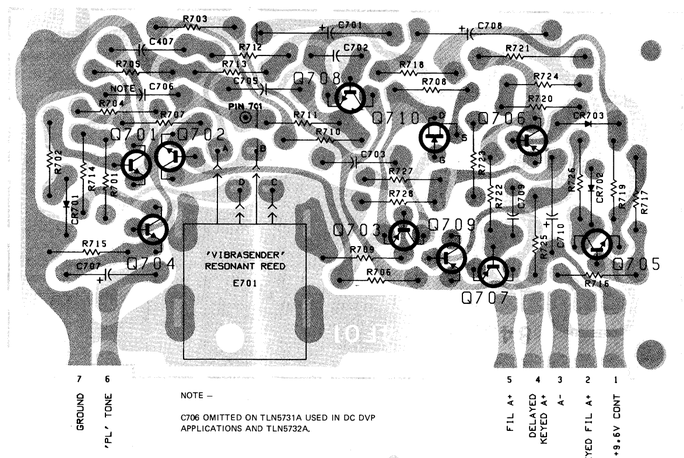

"PL" ENCODER

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.

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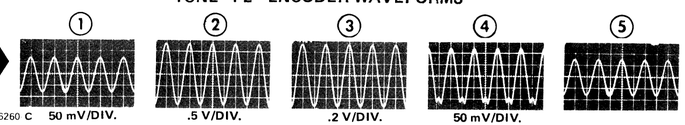
TONE "PL" ENCODER WAVEFORMS

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.



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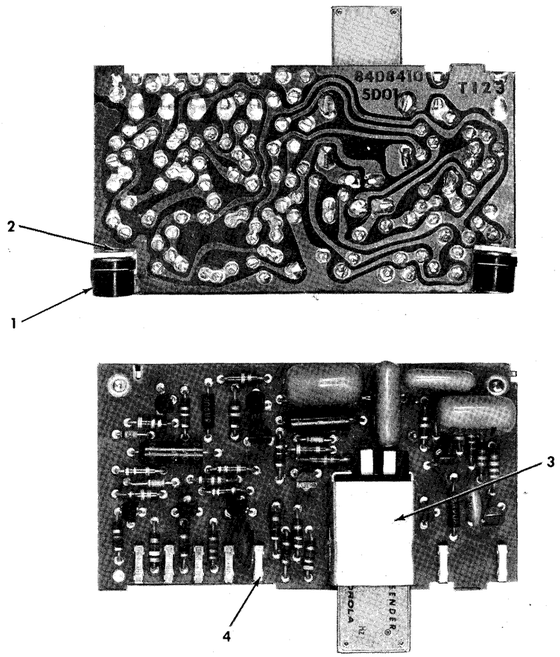
TONE "PRIVATE-LINE" ENCODER

MODEL TLN5731A



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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

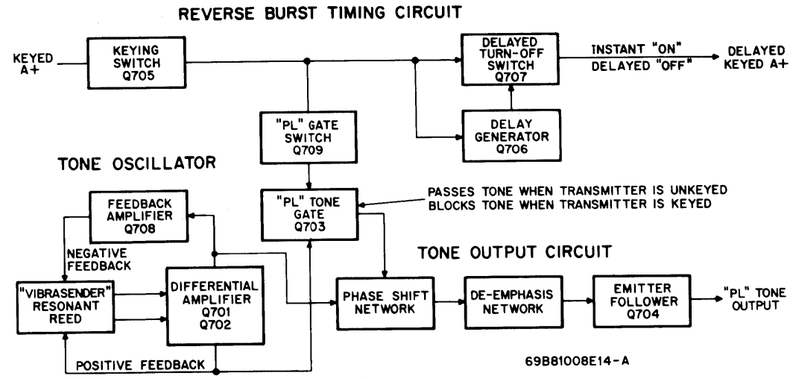
TLN5731A Tone "Private-Line" Encoder PL-3260-D

		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)

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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).

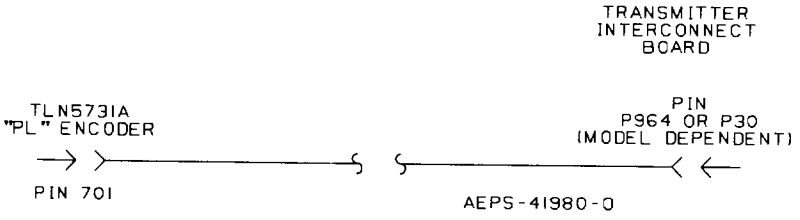

Figure 1. TKN6631A/TKN6808A Cable Kits

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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

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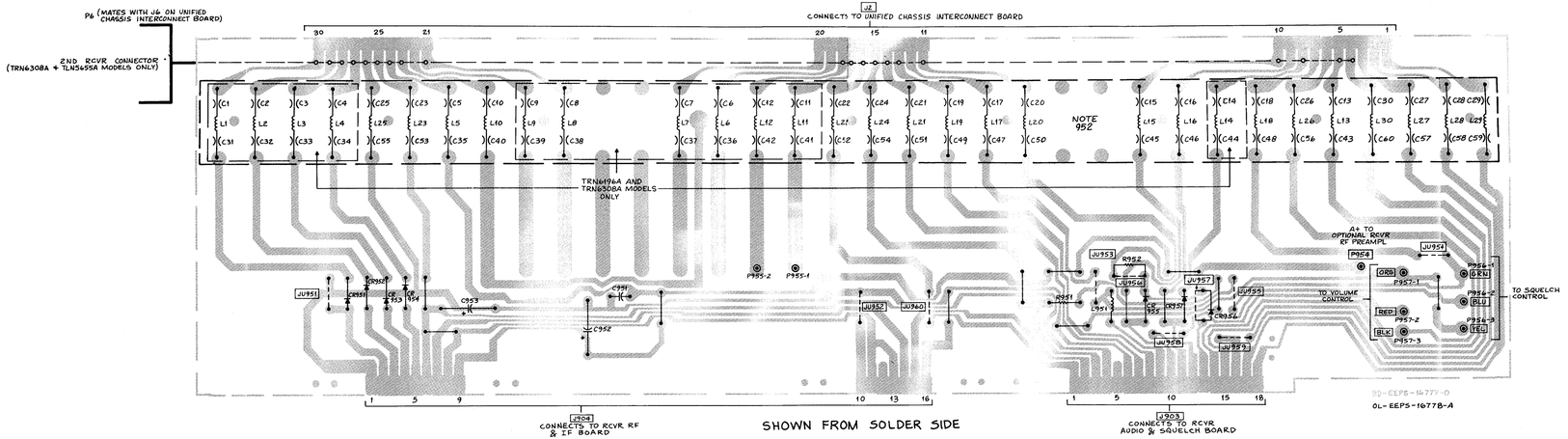
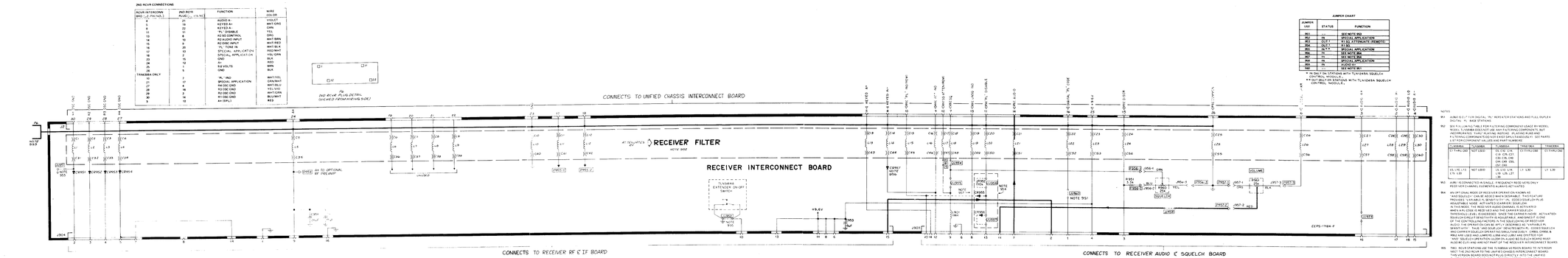
RECEIVER INTERCONNECT BOARD



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

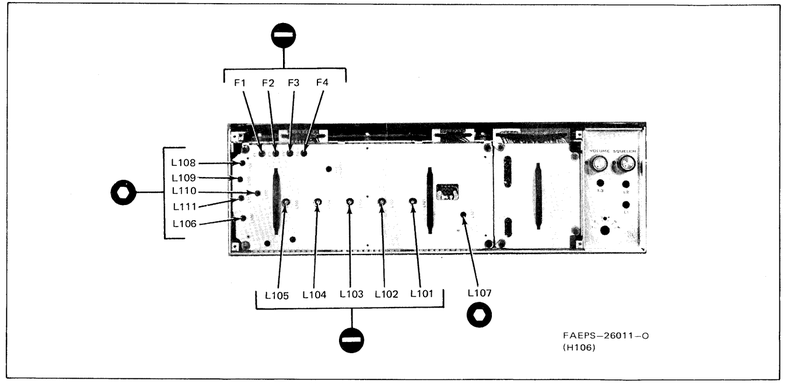
132-150.8 MHz

$$f_o = \frac{f_c + 11.7\ MHz}{9} \text{ or } \frac{f_c + 11.8\ MHz}{9}$$

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.

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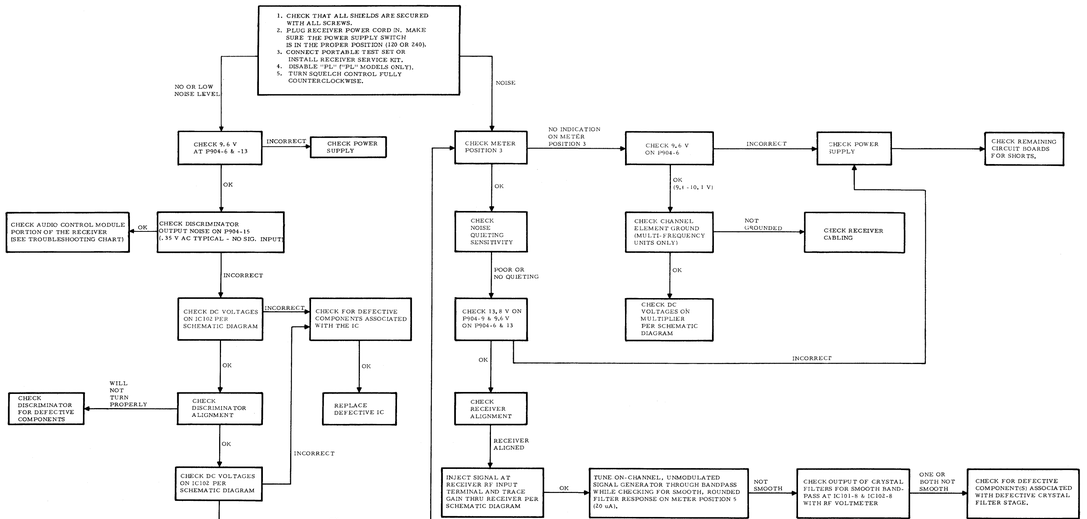
RECEIVER RF & IF CIRCUIT BOARD TROUBLESHOOTING CHART



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.

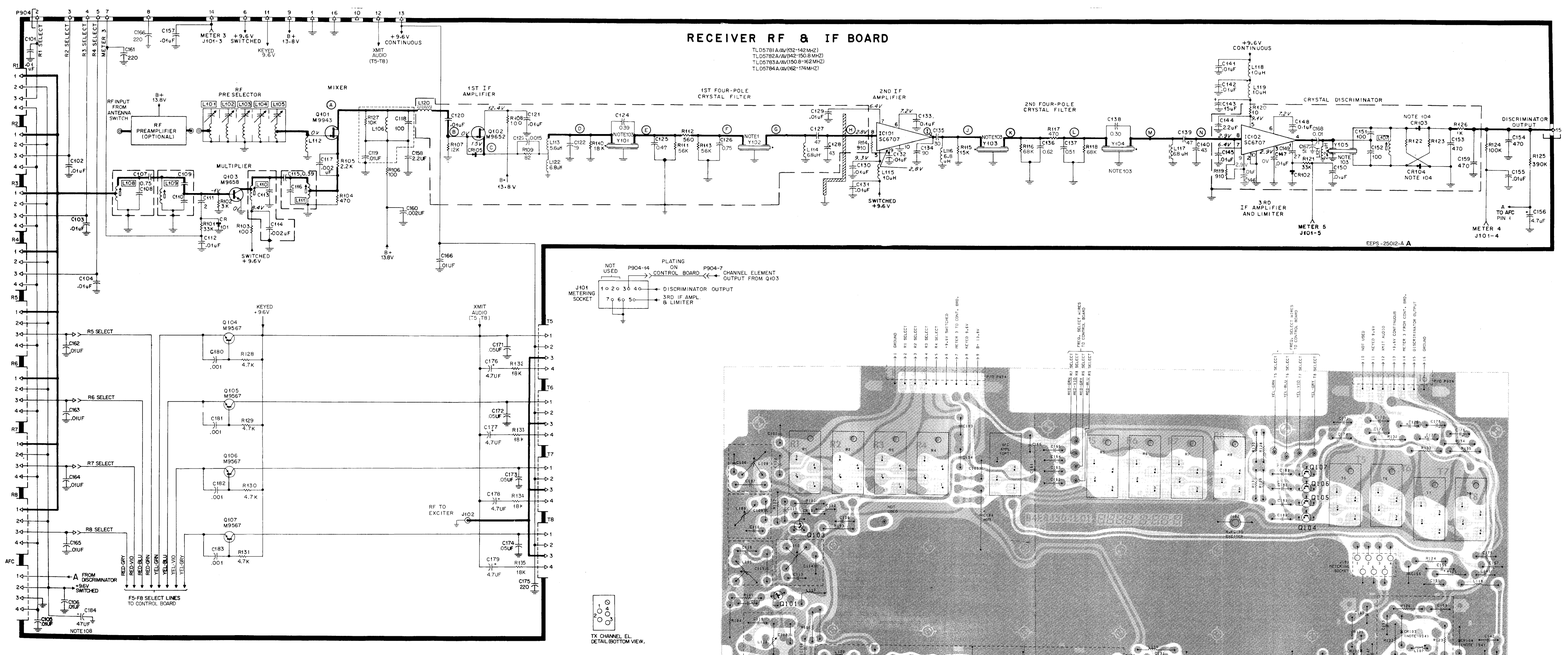
Before replacing the discriminator crystal, verify that all components associated with the discriminator circuitry are not defective. Also, verify, in a manner similar to that used for the filter crystals, that pin 2 is connected (less than 0.1 ohm) to the crystal case. The discriminator crystal should 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

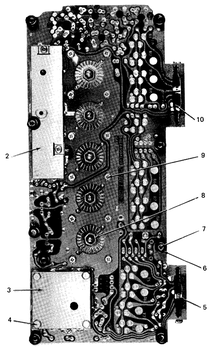
		CAPACITOR, fixed: pF, ±5%; 500 V unless otherwise stated
C101 thru 106	21-82428B62	.01 uF +80-20%; 200 V
C107	21-82450B06	0.7†
C108L	21-82610C22	20; NP0
C108M	21-82133G29	18; NP0
C108H	21-82133C44	24; NP0
C108HH	21-82133G29	18; NP0
C109L	21-83406D46	56; N150
C109M	21-82610C44	47; N080
C109H	21-83406D46	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.

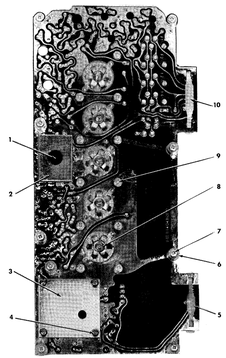
MECHANICAL PARTS LIST

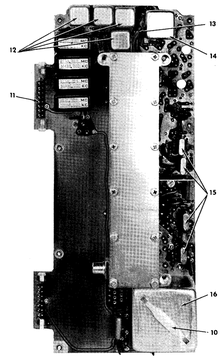
TLD5780A Series Receiver RF & IF Board PL-5781-A

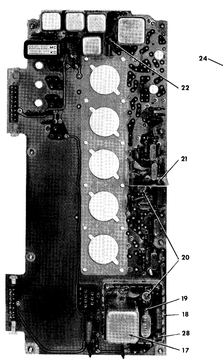
CODE	MOTOROLA PART NO.	DESCRIPTION
2	26-84641E01	SHIELD (IF)
3	26-84413B01	SHIELD (discriminator)
4	3-125913	SCREW, tapping: 6-18 x 1/2"; (4 req'd.)
5	55-84300B02	HANDLE (long) 2 req'd.
6	42-84284B01	RETAINER, screw: 9 req'd.
7,9	3-139506	LOCKSCREW: No. 4 x 5/16"; 21 req'd.
8	41-84410B03	SPRING, torque: 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

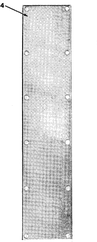


FEPS-29006-A
(9433,C433)









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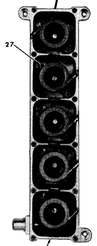

MOTOROLA INC.
Communications Sector

DIGITAL VOICE PROTECTION MICOR™ BASE AND REPEATER STATIONS WITH SHIFTED I-F

OPTIONS C228AK, C228AL
C228AM, C228AN

1. INTRODUCTION

A C228 option allows DVP™ *Micor* base and repeater stations to use an intermediate frequency (i-f) of 11.8 MHz rather than the usual 11.7 MHz i-f. This option may be customer specified or may be factory specified to avoid possible frequency selection conflicts in the system.

2. DESCRIPTION

2.1 When a C228 option is used, the following changes are made to the station:

- Model K1005A Channel Element(s) are replaced with Model KXN1022A Channel Element(s) as shown below.

Option	KXN1022A Channel Elements Supplied
C228AK	1
C228AL	2
C228AM	3
C228AN	4

- Model TLD5780AV Series Receiver Boards are replaced with Model TLD9370A Series Shifted I-F Receiver Boards as shown below.

Receiver Board (11.8 MHz I-F)	Frequency Range (MHz)
TLD9371A	132-142
TLD9372A	142-150.8
TLD9373A	150.8-162
TLD9374A	162-174

- A label, Model TRN9131A (Motorola Part No. 54-83295P01), is placed on the outer most receiver shield. The label reads:

"CAUTION: This receiver has been modified for an intermediate frequency of 11.8 MHz. Consult technical manual for further information".

This label should be ordered for any stations modified in the field for shifted i-f.

2.2 Use the following receiver frequency calculation formulas for calculating the frequency of the KXN1022A Channel Elements:

132-150.8 MHz:

$$f_c = 9\ f_o - 11.8\ \text{MHz}$$

or

$$f_o = \frac{f_c + 11.8\ \text{MHz}}{9}$$

150.8-174 MHz:

$$f_c = 9\ f_o + 11.8\ \text{MHz}$$

or

$$f_o = \frac{f_c - 11.8\ \text{MHz}}{9}$$

Where:

f_c = Carrier Frequency
f_o = Channel Element Frequency

2.3 The TLD9370A Series Shifted I-F Receiver Boards are the same as the TLD5780AV Series Receiver Boards described in instruction manual 68P81036E40 except for using 11.8 MHz i-f and discriminator crystals. Refer to the following information for crystal ordering information.

Reference Symbol	Motorola Part No.	Description
Y101	48-84755E15	Crystal; quartz, 11.8 MHz
Y102 thru Y104	48-84755E14	Crystal; quartz, 11.8 MHz
Y105	48-84669B02	Crystal; quartz, 11.8 MHz

NOTE

The schematic diagram, circuit board detail, parts list, and alignment and troubleshooting information for the TLD9370A Receiver Boards is the same as the TLD5780AV Receiver Boards (except for Y101-Y105) as shown in Instruction Manual 68P81036E40.

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1301 E. Algonquin Road, Schaumburg, Il. 60196

68P81114E53-O
9/18/83- UP

RECEIVER AUDIO & SQUELCH BOARD CIRCUIT DESCRIPTION

1. DESCRIPTION

1.1 The audio and squelch board performs two basic functions -- audio amplification and audio squelching. The first two stages in the audio circuitry amplify the signal from the discriminator and provide the proper frequency response. This signal is routed to the line driver module. The audio returns through a VOLUME control. The remaining stages in the audio circuitry take the signal returning from the line driver and VOLUME control and provide the necessary frequency response at the speaker. These latter stages also provide the driver required by the final audio amplifiers (located on a separate board) for rated power output.

1.2 The squelch circuitry disables the audio path during intervals between received messages. Also, in conjunction with the PL decoder and filter board in a PL station, this circuit provides unsquelching when PL signals are received.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 The audio signal from the receiver discriminator is routed to the emitter follower. The emitter follower output is coupled to the SQUELCH control mounted on the receiver chassis and also to the line level potentiometer mounted on the audio & squelch board. The signal from this control is next applied to the preamplifier. If JU201 is cut, the signal is first sent through the PL filter for attenuation of the PL tone. The preamplifier output is coupled off the board to the line driver. Audio returning from the line driver board is coupled through the appropriate VOLUME control to amplifier Q203. After amplification, the signal is applied to the audio amplification circuits. Here, the signal is raised to a level sufficient to drive the audio final amplifier. These are mounted on a separate board which is secured to the chassis to provide "heat-sinking" capability. The output of the audio power amplifiers is applied to an output transformer which drives a speaker.

2.1.2 The signal returned from the SQUELCH control is applied to the squelch section for noise squelch control. Squelch action is achieved by utilizing the inherent characteristic of a discriminator known as noise quieting. An input signal will cause more quietng of noise as the signal level is increased. When a desired level of noise quieting is reached, as determined by the squelch circuitry and the setting of the SQUELCH control, the audio portion of the board and line driver are enabled to allow a message to be heard. The squelch circuit disables the audio circuitry by shunting a point in the audio signal path to ground and also operating a series switch in the audio signal path of the line driver.

2.1.3 Upon completion of a received message, audio shut-off is either immediate or automatically delayed 150 milliseconds, depending upon the signal level of the previously received rf carrier. A strong signal produces the immediate shut-off and prevents an annoying, loud "squelch tail" burst from being heard. Weak signals (signals that produce less than 20 dB noise quieting) produce the long shut-off delay and prevent a message from being chopped under "flutter" conditions. Since the received signal level must be low for the long turn-off delay to occur and the "squelch tail" level is comparable to that of the received signal, the "squelch tail" is not annoying.

2.2 EMITTER FOLLOWER CIRCUIT

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

2.2.2 The output of the discriminator is capacitively coupled to the emitter follower input at U201-1 and may consist of noise and audio signals. The output of the emitter follower at U201-2 is routed through C207 to the SQUELCH control and also to the line level control.

2.3 PREAMPLIFIER CIRCUIT

This circuit amplifies the low-level audio signal to provide the drive necessary for proper line driver operation. In addition, a negative feedback network (C208 and C209) provides the necessary frequency response characteristics for phone line operation. In PL stations, jumper JU202 is cut and the negative feedback is provided by C209 only. The network of R210 and C210 provides additional frequency response shaping.

2.4 AMPLIFIER CIRCUIT

Transistor Q203 increases the signal level from the line driver to the level required by the audio amplification circuits. Jumper JU203 is out when the equipment leaves the factory. The gain of Q203 is sufficient to drive the audio amplification circuits if the signal strength from the line driver or squelch gate exceeds -10 dBm. With a signal strength below this level, it is advisable to put in JU203 which increases the gain of Q203. The RC network at the input to this stage provides additional frequency response shaping required at the speaker.

2.5 AUDIO AMPLIFICATION CIRCUIT

2.5.1 The signal from amplifier Q203 is applied to the differential amplifier through capacitors C211 and C213.

2.5.2 The differential amplifier output provides the drive for the complementary amplifier. Resistors R221 and R220 form a voltage divider biasing the differential amplifier at one-half of the supply voltage. Undesirable transient voltages are eliminated by capacitor C212.

2.5.3 Final audio amplification on the audio and squelch board occurs in the complementary amplifier. These stages provide the drive for the audio power amplifiers which are mounted on a separate board. The complementary amplifier emitter resistors (R218 and R219) are not included in U201 because of their high heat dissipation requirements.

2.5.4 Audio returned to the audio and squelch board (from the audio power amplifier transistors) is applied to the output transformer primary windings. This transformer consists of four windings -- two input primaries, an output secondary, and a feedback secondary. The output secondary winding couples audio power to an external 8-ohm speaker which can be driven with up to 10 watts at less than 5% distortion. Negative feedback from the output transformer winding through C216 and across R211 gives 6 dB per octave de-emphasis (roll-off) to the audio which has been pre-emphasized 6 dB per octave in the transmitter. Below 300 Hz, feedback from R213 and across C215 increases giving low frequency de-emphasis. Capacitor C238 rolls off the high frequency gain of the amplifier to prevent high frequency oscillation. Capacitors C223, C224, C240, C241, and C242 are rf bypass capacitors that shunt stray rf on the audio A+ and audio A- lines to ground.

2.6 NOISE ACTIVATED SQUELCH CIRCUIT

2.6.1 Squelch Input Circuit

2.6.1.1 The input signal from the SQUELCH control may consist of audio and noise. An input shaping network precedes U202 and passes high frequencies while attenuating low frequencies. Allowing the high frequencies to pass eliminates the effect of voice and results in more sensitive threshold squelch action.

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

2.6.1.3 The second amplifier amplifies the noise signal and applies it through an RC coupling network to the detector. Capacitor C233 and C234 form another high pass filter that attenuates the low frequencies. Capacitor C234 is used to produce a peak-to-peak detector action from the noise detector, and thus generate twice the output voltage of a peak detector. This capacitor does not affect frequency response.

2.6.2 Detector and Switching Circuits

2.6.2.1 The detector output level is a function of received signal strength and the setting of the SQUELCH control. The detector develops the dc output voltage across filter capacitor C235. The lowest dc output voltage corresponds to a no signal input (maximum noise) condition. The output voltage increases as the received rf carrier signal level increases (noise decreases).

2.6.2.2 The primary function of the detector output, however, is the control of shunt switching. This is done by applying the detector output to three squelch control circuits simultaenously:

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

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

2.6.2.4 As the input signal level increases (noise decreases), the detector output voltage increases. A detector output voltage above 2.8 volts dc results in enabling of the long "squelch tail" circuit. The long "squelch tail" circuit produces a voltage at U202-12 of 5.5 volts dc; this voltage causes the carrier squelch switching logic circuit to turn "off" and thereby enables the audio channel. Capacitor C236 and resistor R235 provide a rapid-rise, slow-decay time constant to the voltage applied to the carrier squelch switching logic circuit. This permits a weak signal to immediately enable the audio channel, yet delays the audio channel shut-off if the signal is in a "flutter" condition. The voltage necessary to enable the carrier squelch switching logic is approximately 3.8 volts dc.

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

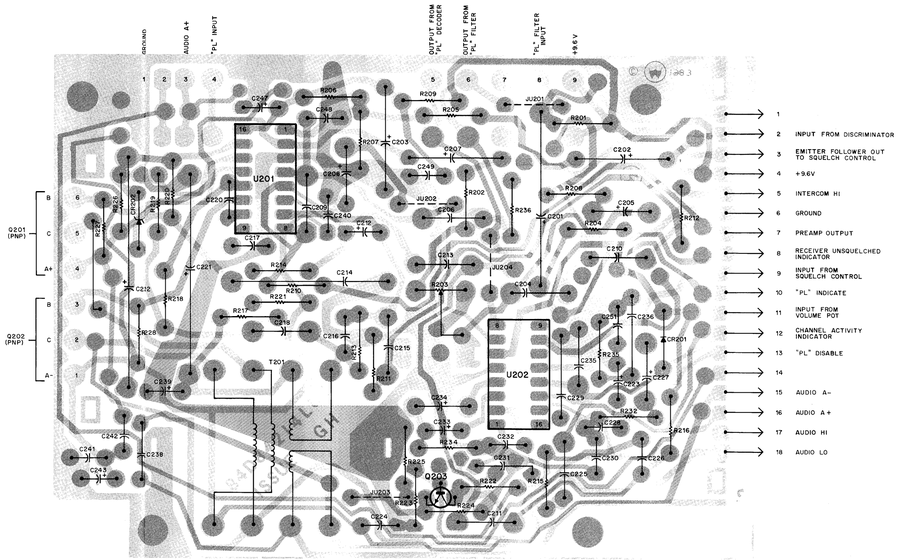
2.6.3 Squelch Output Circuit

The squelch control logic circuit directly controls the shunt switches.

2.6.3.1 The output of the squelch control logic circuit depends upon the output of the preceding carrier squelch switching logic circuit. With the carrier squelch switching logic circuit "off", the squelch control logic circuit will turn off the shunt switches, allowing a message to be heard. If the carrier squelch switching logic is "on", the squelch control logic circuit will turn on the shunt switches, disabling the audio channel, and activating the series switches in the line driver. Capacitor C237, connected to U202-10, slows the turn-off of the shunt switches to "soften" what would otherwise be an annoyingly abrupt turn-on of the audio. This same point (U202-10) supplies a digital output voltage that can be used as an indication of whether the receiver is squelched or unsquelched (audio channel enabled).

2.6.3.2 Two additional functions that may affect the squelch control logic output are associated with *Private-Line* tone-coded squelch operation. PL disable (U202-14) may be either shorted to ground or open. When an open is present at U202-14 (PL disabled), a received signal with or without a PL tone will be heard from the speaker. When at ground potential (PL enabled), the output of the carrier squelch switching logic circuit is inhibited. When the proper PL tone is received, a positive 9.5 volts dc from the PL decoder board to U202-8 turns off the squelch control logic circuit which turns off the shunt switches and allows a message to be heard. Jumper JU204 is normally in the circuit and is only cut when a field modification is made. The cutting of this jumper *and associated modifications of the receiver interconnect board* will provide "AND-SQUELCH" operation, changing the PL squelch circuitry from fixed sensitivity operation to variable sensitivity operation. Under this mode of operation, the SQUELCH control will affect the squelch sensitivity.

2.6.3.3 Audio disabling is performed by shunting the audio circuit to ground through a low impedance path and also by the operation of a series switch in the line driver. When the solid state shunt switch is turned "on" (U202-7), signals developed across R236 are shunted to ground. This prevents any signals from being heard at the speaker. Acting in tandem with the first shunt switch, the second shunt switch output is routed to the line driver and enables a set of switches on either of the boards. This breaks the audio path and prevents audio from appearing on the 600-ohm line.



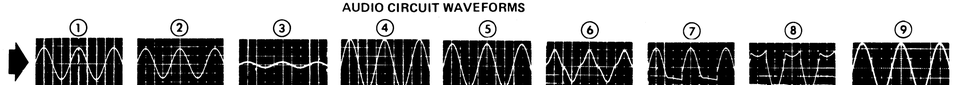
COMPONENT SIDE = 80-DEPS-41273-O SHOWN FROM SOLDER SIDE
SOLDER SIDE: 80-DEPS-41272-O
OL-DEPS-41274-O

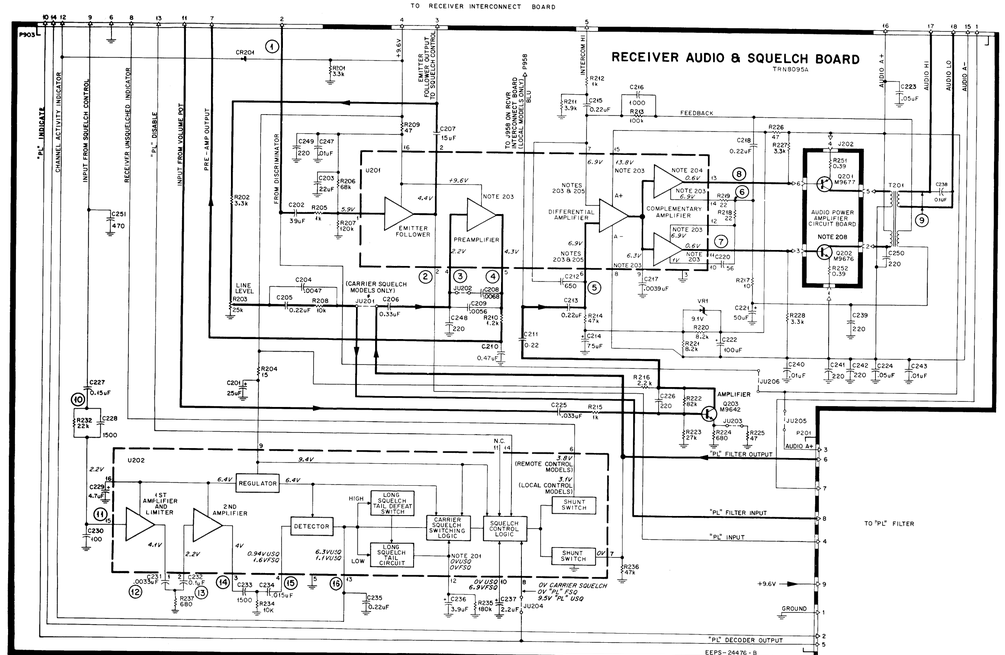
ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER THE FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = .25 msec/DIV.
3. SQUELCH CONTROL FULLY COUNTERCLOCKWISE (OFF). 1000 uV RF SIGNAL INPUT MODULATED WITH 1000 Hz TONE WITH ±3.0 kHz DEVIATION.
4. VOLUME CONTROL SET FOR 9.0 V rms AT LOAD.
5. OUTPUT TERMINATED IN 8 OHM LOAD.
6. R203 SET FOR 175 mV AT PIN 7 WITH ±5 kHz DEVIATION (1 kHz TONE).

EPS-8804-O

AUDIO CIRCUIT WAVEFORMS





NOTES:
201. +5.6 VOLTS WHEN THRESHOLD SIGNAL JUST OPENS SQUELCH (I.E., APPROXIMATELY 6 dB QUIETING SIGNAL WITH SQUELCH CONTROL AT THRESHOLD).
202. WHERE MORE THAN ONE VOLTAGE READING APPEARS: USQ= RECEIVER UNSQUELCHED
FSQ= RECEIVER FULLY SQUELCHED
203. VOLTAGE MEASURED WITH RESPECT TO A-.
204. VOLTAGE MEASURED WITH RESPECT TO A+.
205. VOLTAGES AT U201=6 AND =7 MUST BE THE SAME VALUE.
206. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS.
207. UNLESS OTHERWISE STATED, VOLTAGE MEASUREMENTS ARE FOR DC VOLTAGES ± 10%, MEASURED WITH AN 11 MEGOHM INPUT RESISTANCE VOLTMETER WITH RESPECT TO CHASSIS GROUND.
208. AUDIO POWER AMPLIFIER IS NOT PART OF AUDIO & SQUELCH BOARD.
209. JUMPER JU204 MUST BE REMOVED FOR "AND SQUELCH" OPERATION. (SEE "RECEIVER INTERCONNECT UNIT" SECTION). SEE JUMPER TABLE FOR JUMPER USE.

JUMPER TABLE

JUMPER	USE
JU201	CONNECTED IN CARRIER SQUELCH STATIONS.
JU202	CONNECTED IN CARRIER SQUELCH STATIONS.
JU203	CONNECTED TO PROVIDE 10 WATTS AUDIO AT SPEAKER WITH LINE LEVELS OF -10 dBM OR LESS (REMOTE CONTROL STATIONS ONLY).
JU204	CUT FOR "AND SQUELCH"
JU205	IN FOR ALL MODELS
JU206	OUT FOR ALL DVP MODELS

ALL SQUELCH CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY = 0.5 V/DIV.
2. HORIZONTAL DEFLECTION = 2 msec/DIV.
3. SQUELCH CONTROL FULLY CLOCKWISE (ON). NO EXTERNAL SIGNAL APPLIED.
*4. WAVEFORMS 15 AND 16 ARE DC COUPLED WITH ZERO AT BOTTOM, OTHERS AC COUPLED.

EPS-6534-O

SQUELCH CIRCUIT WAVEFORMS

RECEIVER AUDIO & SQUELCH BOARD

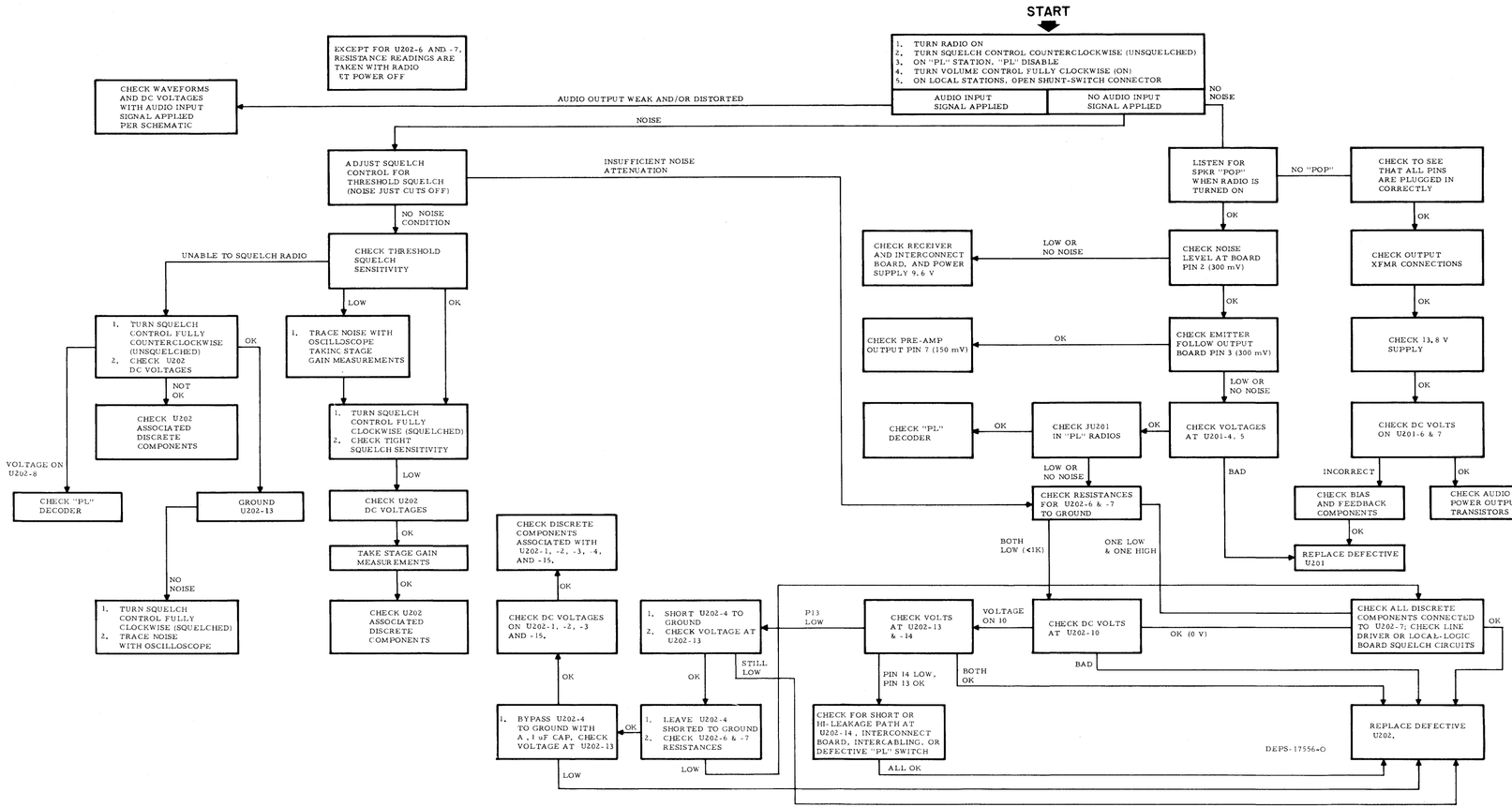
Motorola No. PEPS-24477-B
(Sheet 2 of 3)
5/30/85- UP

PARTS LIST

TRN8095A Receiver Audio & Squelch Board — PL-5656-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed; uF; ±10%; 100 V: unl. stated
C201	23-83210A01	25 +150-10%; 25 V
C202	23-82783B36	39; 10 V
C203	23-8476ZH10	22 ±20%; 15 V
C204	8-83813H12	.0047
C205	8-83813H11	0.22; 75 V
C206	8-83813H29	0.33; 50 V
C207	23-82783B24	15; 25 V
C208	8-83813H01	.0068
C209	8-83813H26	.0056 ±5%; 50 V
C210	8-82905C03	.047; 50 V
C211	8-83813H11	0.22; 75 V
C212	21-84823 6	650 pF ±5%; 500 V
C213	8-83813H11	0.22; 75 V
C214	23-84081B03	75 +150-10%; 15 V
C215	8-83813H11	0.22; 75 V
C216	21-82187B20	1000 pF
	21-82187B31	1500 pF
C217	21-82187B43	.0039; 200 V
C218	8-83813H11	0.22; 75 V
C219		NOT USED
C220	21-83406D46	56 pF ±5%; 500 V; N150
C221	23-84081B01	50 +100-10%; 25 V
C222	23-83210A08	100 +150-10%; 25 V
C223, 224	21-82372C04	.05 +80-20%; 25 V
C225	8-82905G16	.033
C226	21-859942	220 pF ±5%; 500 V
C227	8-83813H07	0.15; 75 V
C228	21-84426B63	1500 pF ±5%
C229	23-8476ZH07	4.7 ±20%; 10 V
C230	21-84426B06	100 pF ±5%; 500 V
C231	8-82905G25	.0033
C232	8-82905G30	.1
C233	21-84426B49	1500 pF
C234	8-83813H32	.015
C235	8-83813H11	0.22; 75 V
C236	23-8476ZH08	3.9 ±20%; 15 V
C237	23-8476ZH04	2.2 ±20%; 25 V
C238	21-82372C01	0.1 +80-20%; 25 V
C239	21-83596E10	220 pF ±20%; 500 V
C240	21-832501	.01 +60-40%; 250 V
C241, 242	21-83596E10	220 pF ±20%; 500 V
C243	21-832501	.01 +60-40%; 250 V
C244	21-82133G03	100 pF ±5%; 500 V
C245, 246		NOT USED
C247	21-832501	.01 +60-40%; 250 V
C248 thru 250	21-83596E10	220 pF ±20%; 500 V
C251	21-84426B11	470 pF ±5%; 500 V
CR201	48-83654H01	DIODE: (SEE NOTE) silicon
P201		CONNECTOR, plug: consists of contact pins mounted on circuit board
Q203	48-869642	TRANSISTOR: (SEE NOTE) NPN: type M9642
		RESISTOR, fixed; ±5%; 1/4 W: unl. stated
R201, 202	6-11009C61	3.3k
R203	18-83083G24	variable: 25k ±30%
R204	6-11009C05	15 ±10%
R205	6-11009C49	1k
R206	6-11009C93	68k
R207	6-11009C99	120k
R208	6-11009C73	10k
R209	6-11009C17	47 ±10%
R210	6-11009C51	1.2k
R211	6-11009C63	3.9k
R212	6-11009C49	1k
R213	6-11009C95	100k ±10%
R214	6-11009C89	47k
R215	6-11009C49	1k
R216	6-11009C57	2.2k
R217	6-11009C01	10 ±10%
R218, 219	6-11009C09	22
R220, 221	6-11009C71	8.2k
R222	6-11009C95	82k
R223	6-11009C83	27k
R224	6-11009C45	680
R225, 226	6-11009C17	47 ±10%
R227, 228	6-11009C61	3.3k
R229 thru 231	--	NOT USED
R232	6-11009C81	22k
R233	--	NOT USED
R234	6-11009C73	10k
R235	6-11009D04	180k ±10%
R236	6-11009C89	47k ±10%
R237	6-11009C45	680
T201	25-84083B02	TRANSFORMER, AF: pri: split winding; total res 0.5 Ohms max sec: res 0.8 Ohms max feedback: res 2 Ohms max
U201	51-82848M70	INTEGRATED CIRCUIT: (SEE NOTE) type M4870
U202	51-84561L79	type M6179
VR1	48-82256C38	DIODE: (SEE NOTE) Zener; 9.1 V; 400 mW
		NON-REFERENCED ITEMS
	42-84284B01	RETAINER; 4 req'd.
	3-138162	SCREW, tapping; Phillips rd. hd., 4-40 x 3/8"; 4 req'd. (used for mounting Retainers)
	55-84300B01	HANDLE (long)
	55-84300B02	HANDLE (short)
	29-84028H01	TERMINAL, contact; 18 req'd. (long)
	29-84028H02	TERMINAL, contact; 24 req'd. (short)

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



MOTOROLA INC.
Communications
Group

AUDIO POWER AMPLIFIER

MODEL TLN4290B

1. DESCRIPTION

The audio power amplifier provides the required power to drive an 8-ohm speaker with 10 watts of audio power, or a 16-ohm speaker with 5 watts of audio power, with less than 5% overall distortion. Two complementary power transistors (NPN and PNP types), operating class AB, with two current limiting resistors, develop this power. The audio drive from the audio and squelch board is routed to this board, amplified, and then returned to the audio and squelch board, where it is applied to the audio output transformer.

The aluminum transistor mounting plate is anodized with a thin, very tough material. This mounting plate provides excellent electrical insulation and thermal conduction properties between the transistors and the heatsink.

2. SERVICING

a. Performance Checks

Performance checks on this board consists of taking resistance readings as is done for any transistor or resistor. It should be noted, however, that many VTVM's and solid-state multimeters do not have sufficient voltage at the test probes to forward bias a transistor junction into conduction and, therefore, should not be used. An inexpensive volt-ohm meter of 1,000 to 20,000 ohms-per-volt sensitivity is sufficient for performing these checks.

NOTE

Do not insert meter test probe tips into female connectors on the board. To do so could cause damage to the connectors and result in poor electrical interconnection with the audio and squelch board.

b. Transistor Replacement

Care must be exercised to prevent damage (such as a scratch) to the mounting plate anodizing at the transistor-mounting plate interface. Should the anodizing in this area become scratched, original performance can only be restored by the use of a new anodized plate. The plate can *not* be "repaired" by the use of any type of insulating washer without a loss in thermal conduction capability.

Factory replacement transistors are supplied with pre-formed leads to properly fit onto the aluminum mounting plate and circuit board. A new nylon shoulder washer is also included.

Step 1. Apply a thin, even coat of silicon grease to the metallic area of the transistor.

Step 2. Mount the transistor using the *new* nylon shoulder washer. Do not solder leads at this time. Tighten the transistor mounting screw.

Step 3. Solder transistor leads to printed circuit board.

TRANSISTOR RESISTANCE MEASUREMENT CHECK
(BOARD REMOVED FROM RADIO — TRANSISTORS MOUNTED ON BOARD)

Ohmmeter Connections		Proper Resistance	
Positive Lead Connected to	**Negative Lead Connected to**	**P-N-P Transistor**	**N-P-N Transistor**
Base	Emmitter, then Collector	Infinite	5-30 Ohms, Both Cases
Emmitter, then Collector	Base	5-30 Ohms, Both Cases	Infinite
Collector	Emitter	Infinite	Infinite
Emitter	Collector	Infinite	Infinite

Failure to obtain these results indicates a defective transistor which must be replaced.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196
6/20/80- UP
68P81014E97-H

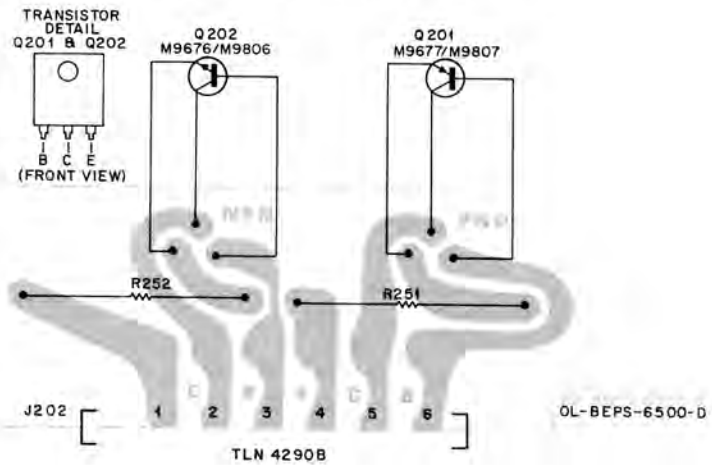
AUDIO POWER AMPLIFIER
MODEL TLN4290B

FUNCTION

— Provides up to 10 watts audio output.

AUDIO POWER AMPLIFIER

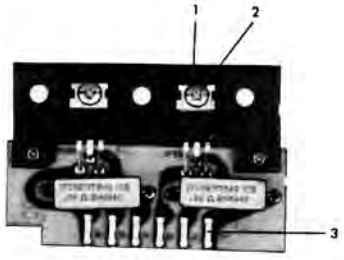
SHOWN FROM SOLDER SIDE



AUDIO POWER AMPLIFIER

TLN4290B Audio Power Amplifier PL-1061-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J202		CONNECTOR, receptacle: c/o: 9B83011H01 PIN, female; 6 req'd
		TRANSISTOR: (SEE NOTE)
Q201	48R869807 or48R869677	PNP: type M9807 PNP: type M9677
Q202	48R869806 or48R869676	NPN: type M9806 NPN type M9676
		RESISTOR, fixed: ±10%; 3 W:
R251	17D82177B49	0.39
R252	17D82177B49	0.39
	MECHANICAL PARTS	
1	4B84180C01	WASHER, shoulder
2	3S129841	SCREW, machine: No. 4-40 x 1/4"; incl. lockwasher
3	9B83011H01	PIN, female



FAEPS-6502-O

TONE "PRIVATE-LINE" DECODER

MODEL TRN6002A

Technical Characteristics

Frequency Determining Device	Vibrasponder resonant reed
PL Tone frequency	Selected from 67-210 Hz range
Tone Accuracy	±0.15%
Tone Bandwidth	Approximately 1 Hz
Tone Sensitivity	0.25 volt ac rms reed drive
Output	9.5 volts dc switched
Power Requirement	9.6 volts dc @ 15 milliamperes

1. DESCRIPTION

This decoder provides a dc output voltage to unsquelch the receiver's audio section only when the proper PL tone is received. The decoder will respond only to a specific, continuous low-frequency tone from a transmitter in the same *Private-Line* network.

2. FUNCTIONAL OPERATION

2.1 GENERAL

2.1.1 PL Tone Present

2.1.1.1 The PL filter passes low frequency PL tones and attenuates signals above 300 Hz. The noise switch shorts out high frequency noise signals. The tone from the PL filter is limited to a fixed level by the amplifier/clipper and then applied to the Vibrasponder resonant reed which vibrates when the tone is the same frequency as the reed's resonant frequency. When the reed is vibrating, the tone is applied to a detector which develops a dc output which activates the output switch. When the output switch is activated, 9.5 volts is present at its output to enable the audio circuits. The output also activates the noise switch.

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

2.1.2 PL Tone Absent

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

2.2 DECODER INPUT CIRCUITS

2.2.1 The receiver discriminator output signal consists of noise only when no carrier signal is being received. With a carrier signal input to the receiver, the noise is reduced and voice audio or voice audio and PL tone added.

2.2.2 These input signals are routed through the low pass filter and noise gate circuit. A receiver input signal that is modulated ±0.5 kHz with PL tone produces a nominal 60 millivolts rms signal at the input to the decoder. The low pass filter consisting of L801, C802, C803 and C805 attenuates sharply all signals above 300 Hz. Thus, voice and noise signals above 3000 Hz are blocked but PL tones are passed. High pass filter C801, R803, and C807 presents a parallel path for high frequency noise whenever the decoder is not activated. This condition is desirable so that low frequency noise (only) will not falsely activate the decoder. When the proper tone has been received and the decoder is activated, noise switch Q807 acts as a short and grounds all high frequency signals before they reach amplifier Q801.

2.3 INPUT AMPLIFIER CIRCUITS

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

2.4 VIBRASPONDER RESONANT REED

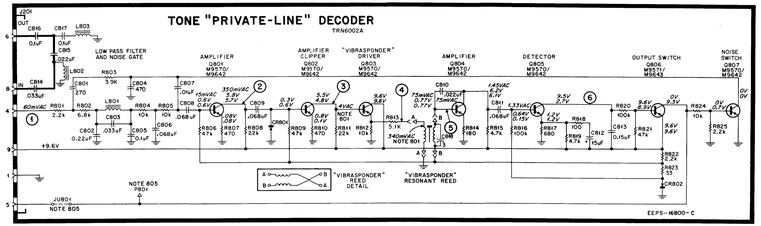
At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding.

2.5 OUTPUT CIRCUIT

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

2.6 AUDIO FILTER

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



NOTES:

801. DUE TO SQUARE WAVE CHARACTERISTIC SOME METERS RESPOND DIFFERENTLY. VOLTAGE SHOULD BE MEASURED WITH AN OSCILLOSCOPE.

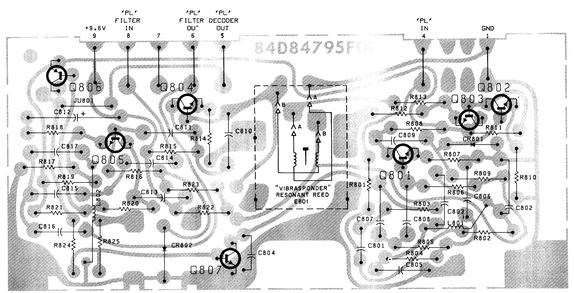
802. AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT, USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.

803. DC VOLTAGE READINGS TAKEN WITH HIGH IMPEDANCE (10 MEGOHM) DC VOLTMETER. TOP VALUE IS MEASURED WITHOUT "PL" TONE. BOTTOM VALUE IS MEASURED WITH 60 MILLIVOLTS "PL" TONE INPUT. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.

804. UNLESS OTHERWISE STATED: RESISTOR VALUES ARE IN OHMS. CAPACITOR VALUES ARE IN MICROFARADS.

805. JUMPER JU801 IS NOT INCORPORATED IN MODEL TRN6002A ONLY. JU801 IS REMOVED AND PB01 IS USED ONLY FOR CERTAIN OPTIONAL EQUIPMENT.

EARLIER VERSION



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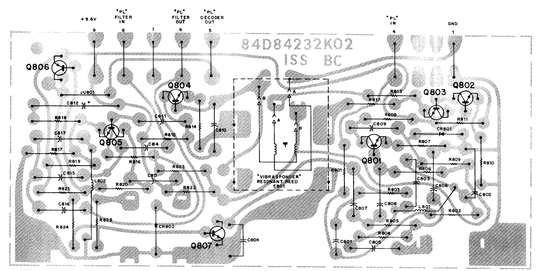
80-CEPS-16801-A
OL-CEPS-16802-B

LATER VERSION



SOLDER SIDE 80-CEPS-41276-G
OL-CEPS-41277-G

SHOWN FROM SOLDER SIDE

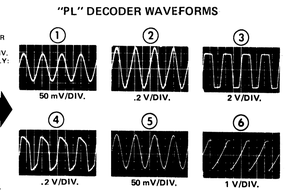
FUNCTION

Unsquelches receiver upon receipt of proper "Private-Line" tone.

WAVEFORMS MEASURED UNDER FOLLOWING CONDITIONS:

1. VERTICAL SENSITIVITY SHOWN UNDER EACH WAVEFORM.
2. HORIZONTAL DEFLECTION = 5 msec/DIV.
3. WITH RECEIVER OPERATING PROPERLY:
   - A. INJECT 1000 uV RF CARRIER AT ANTENNA CONNECTOR.
   - B. MODULATE CARRIER WITH "PL" TONE. ADJUST MODULATION FOR WAVEFORM ① ; I.E. 60 mV rms (170 mV P-P) AT J201-2.
4. RECEIVER NOT USED:
   - A. INJECT "PL" TONE AT J201-2.
   - B. ADJUST TONE LEVEL FOR WAVEFORM ①.
5. OSCILLOSCOPE VERTICAL INPUT – AC.
6. OSCILLOSCOPE SYNC – INTERNAL.
7. MEASUREMENTS MADE WITH RESPECT TO CHASSIS GROUND.

"PL" DECODER WAVEFORMS



EPS-6182-B

68P81026E73-J
5/30/85- UP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

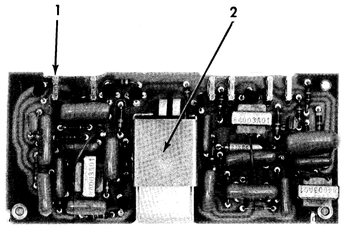
ELECTRICAL PARTS LIST

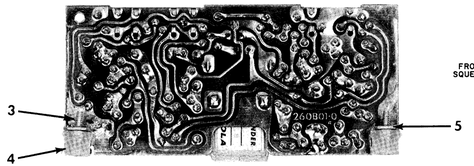
IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TRN6002A Tone "Private-Line" Decoder PL-3259-E

		CAPACITOR, fixed: uF ±10%; 50 V; unless otherwise stated
C801	21-82187B38	270 pF
C802	8-82905G32	0.22
C803	8-82905G08	.033; 100 V
C804	21-82187B39	470pF; 500 V
C805	8-83813H06	0.1; 100 V
C806	8-82905G04	.068; 100 V
C807	8-82905G01	.01
C808, 809	8-82905G04	.068; 100 V
C810	8-82905G02	.022
C811	8-82905G04	.068; 100 V
C812	23-83214C02	15 ±20%; 25 V
C813	8-82905G31	0.15
C814	8-83293B10	.033; ±5%
C815	8-83813H16	.022 ±5%
C816	8-82905G30	0.1
C817	8-82095G14	0.1 ±5%; 200 V
C818	21-83406D51	3 pF ±0.25 pF; 500 V
		DIODE: (SEE NOTE I)
CR801, 802	48-83654H01	silicon
		"VIBRASPONDER" RESONANT REED: (SEE NOTE II)
E801	TLN8381A	plug-in unit
		COIL, RF: choke
L801, 802, 803	24-84003A03	6 H
		TRANSISTOR: (SEE NOTE I)
Q801 thru	48-869642	NPN; M9642
805	or 48-869570	NPN; M9570
Q806	48-869643	PNP; M9643
	or 48-869571	PNP; M9571
Q807	48-869642	NPN; M9642
	or 48-869570	NPN; M9570
		RESISTOR, fixed: ±5%; 1/4 W; unless otherwise stated
R801	6-11009C57	2.2k ±10%
R802	6-11009C69	6.8k ±10%
R803	6-11009C63	3.9k
R804, 805	6-11009C73	10k ±10%
R806	6-11009C89	47k
R807	6-11009C41	470
R808	6-11009C81	22k
R809	6-11009C89	47k
R810	6-11009C41	470
R811	6-11009C81	22k
R812	6-11009C73	10k ±10%
R813	6-11009C66	5.1k
R814	6-11009C31	180
R815	6-11009C65	4.7k
R816	6-11009C97	100k
R817	6-11009C45	680
R818	6-11009C25	100 ±10%
R819	6-11009C65	4.7k
R820	6-11009C97	100k
R821	6-11009C89	47k
R822	6-11009C57	2.2k
R823	6-11009C13	33
R824	6-11009C73	10k ±10%
R825	6-11009C57	2.2k ±10%





AEPS-6105-O

MECHANICAL PARTS LIST

TRN6002A Tone "Private-Line" Decoder PL-3261-A

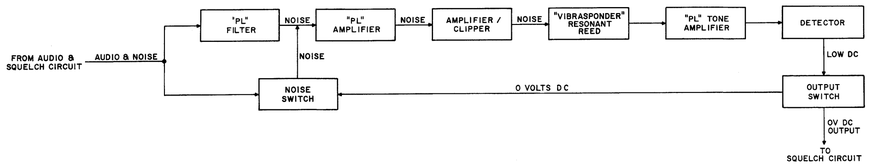
ITEM	MOTOROLA PART NO.	DESCRIPTION
1	9-83011H01	TERMINAL, pin: female; 6 req'd.
2	42-84116B01	SOCKET & CLAMP ASSY
3	3-136905	SCREW, lock: No. 4 x 5/16"; 2 req'd.
4	42-84284B01	RETAINER, Nylon: 2 req'd.
5	7-84223B01	BRACKET, retainer

NOTES:

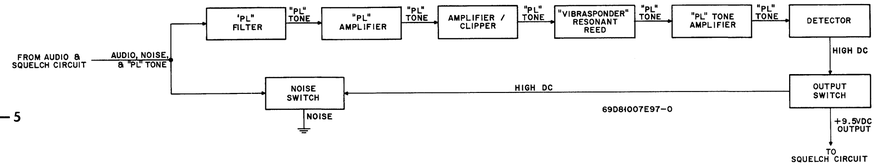
I. For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

II. The "Vibrasponder" Resonant Reed (Model TLN8381A) is not part of the decoder board. When ordering the complete board, the reed must be ordered separately.

"PL" TONE ABSENT



"PL" TONE PRESENT



REVISIONS 68P81026E73-E

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TRN6002A	C804	FROM 21-82187B26 .003 uF ±10%; 100 V TO 21-82187B39 470 pF ±10%; 500 V	Q801 BASE
	R803	FROM 6-124C73 10k ±10%; 1/4 W TO 6-124A63 3.9k ±5%; 1/4 W	
	R813	FROM 6-124A65 4.7k ±5%; 1/4 W TO 6-124A66 5.1k ±5%; 1/4 W	Q803 EMITTER

MAINTENANCE

a. Recommended Test Equipment

(1) Motorola R1040A Series RF Signal Generator. This solid-state unit provides receiver rf carrier signals.

(2) Motorola R2210B Service Monitor and Vibrasender resonant reed on the same frequency as the Vibrasponder resonant reed of the decoder. An audio signal generator may be used if it is accurately set to the decoder frequency. However, to obtain the accuracy necessary, the frequency should be adjusted while the signal is measured on a frequency counter.

(3) Motorola Solid-State Oscilloscope for tone signal measurement. Some measurements may be taken with a high impedance ac voltmeter.

(4) Motorola Solid-State DC Multimeter for dc voltage measurements.

b. Performance Tests

A 0.25 microvolt rf carrier signal modulated ±0.5 kHz with PL tone should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator to the receiver rf input receptacle. Set the signal generator to the receiver carrier frequency, then set the output to minimum.

(2) Modulate the signal generator output ±0.5 kHz with a PL tone of the frequency stamped on the Vibrasponder resonant reed. The tone can be generated with a Motorola R2210B Service Monitor and a Vibrasponder resonant reed. The Vibrasender reed from the PL encoder may be used if it is the proper frequency.

(3) Also modulate the signal generator with an audio tone in the 300 to 3000 Hz range at ±3.3 kHz.

(4) Increase the output of the signal generator until the receiver unsquelches and the audio tone is heard on the speaker. No more than 0.25 microvolt should be required to unsquelch the receiver.

c. Troubleshooting

If the PL decoder does not operate, or operates improperly, the following hints may be helpful in locating the malfunction.

(1) Testing the Vibrasponder Resonant Reed

One of the first tests should be a check of the Vibrasponder resonant reed. Inject a 340 millivolt rms PL tone of the proper frequency directly to the primary of the reed. Use an oscilloscope or ac voltmeter to check the output across the secondary of the reed. Approximately 75 millivolts rms should be measured. If the reed is good, continue with other decoder tests.

(2) Decoder Testing

To test the decoder, inject a 1000 microvolt carrier signal into the receiver. Adjust PL modulation for 60 millivolts rms tone signal at the input to the decoder (test point **1** on the schematic diagram and circuit board detail). If the PL tone is injected directly into the decoder for testing, an rf carrier signal should be injected into the receiver to quiet the receiver noise. Otherwise, noise and PL tone will both be present and will produce erroneous readings.

With 60 millivolts PL tone input, measure signal and dc voltages at various points in the decoder to isolate the trouble. Typical values for a normally operating decoder are given on the schematic diagram. Some waveforms are not sinusoidal and should be measured with an oscilloscope. Most ac voltmeters are calibrated to read accurately only for sinusoidal signals.

If under normal operating conditions, the PL tones are heard with the speaker audio, the high pass filter on the decoder board should be checked.

NOTE

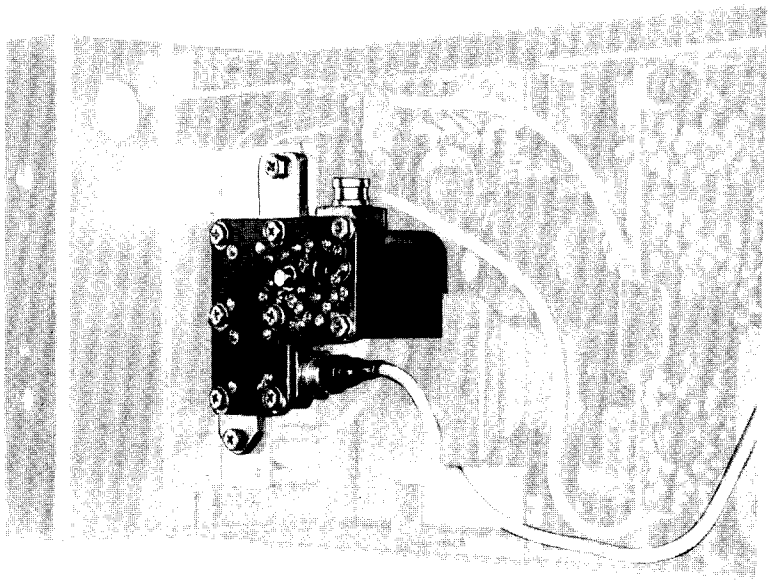
The PL decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

RF PREAMPLIFIER

MODELS TLD8421B AND TLD8422B

& CABLE

MODEL TKN6613A



AEPS-8824-O

MODEL	FREQUENCY
TLD8421B	132-150.8 MHz
TLD8422B	150.8-174 MHz

TECHNICAL CHARACTERISTICS

IMPEDANCE	50 ohm input, 50 ohm output
CURRENT DRAIN	20 mA at 13.8V
FREQUENCY	132-174 MHz
POWER GAIN	10 dB

RECEIVER WITH PREAMPLIFIER

SENSITIVITY	-20 DB QUIETING	0.25 uV
	EIA SINAD	0.175 uV
SELECTIVITY (EIA SINAD)		-95 dB at ±30 kHz
INTERMODULATION (EIA SINAD)		-75 dB
SPURIOUS AND IMAGE REJECTION		-95 dB minimum
SQUELCH SENSITIVITY		Threshold 0.1 uV max. at 6 dB max. quieting
		Tight 0.6 uV max. at 14 dB min. quieting

MOTOROLA INC. Communications Division
SERVICE PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

1. DESCRIPTION

The rf preamplifier is an optional accessory item that increases the input signal level to the receiver thereby increasing its operating range. Using the rf preamplifier in two-receiver stations results in an increase greater than 3dB in input signal level to both receivers. (In stations using two receivers, the input signal level, without preamplifier, to each receiver is reduced by 3dB as compared to one-receiver stations. Two-receiver stations also require the use of the optional two-receiver coupler).

The preamplifier kit includes a printed circuit board, a housing and a coaxial cable with rf phono-type connectors. The circuit board is plated on both sides with components mounted toward the inside of the housing. The preamplifier circuit consists of two aperture-coupled helical resonators, an FET amplifier, and an output coil.

NOTE

The rf preamplifier is capable of amplifying two or more input carrier frequencies providing that the maximum center frequency separation does not exceed 1.5 MHz. If carrier frequency separation does exceed 1.5 MHz, two rf preamplifiers are required.

2. OPERATION

The incoming rf signal is applied to the preamplifier input jack J1 through the receiver input cable. The input jack is connected to a tap on coil L1. The rf signal is coupled from L1 to L2 by utilizing the cavities in the housing to form two aperture-coupled helical resonator cells. The tapped output of L2 is applied to common-gate FET amplifier Q1 through rf bypass capacitor C6. Resistor R2 develops dc bias. Output coil L3 provides loading for Q1 and is capacitively matched by capacitor C4 to output jack J2. This provides a 50-ohm termination for the input of the rf preselector.

3. MAINTENANCE

a. General

This section provides the maintenance shop type procedures for the rf preamplifier. These bench tests include measurements with a Motorola portable test set, and procedures for testing and troubleshooting.

b. Alignment

NOTE

If the preamplifier is normally operated with more than one carrier frequency input, determine the center of the preamplifiers operating range and, if possible, use this frequency to perform the alignment. If this is not possible, align the preamplifier using the lowest carrier frequency.

Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable directly to the rf preselector input. Check and align the preselector according to the alignment procedure described in the receiver section of the manual. After the receiver has been aligned, disconnect the receiver input cable from the preselector and reconnect the preamplifier input and output cables. While monitoring position 5, align the preamplifier for maximum meter indication by adjusting the tuning coils in the following order; L3, L2, L1. For final tuning, repeak L3, L2, and L1; then tune L2 for maximum quieting.

c. Realignment

It is not necessary to bypass the preamplifier when aligning to the same frequency or to a new frequency if it is within ±1.0 MHz of the previously tuned frequency. Align the rf preselector first, then adjust the preamplifier as described in the preceding paragraph.

d. Troubleshooting

With the preamplifier connected, and the test set on position 5, perform the following:

(1) Increase the signal generator output for a maximum indication on the test set meter (saturation), then decrease until a convenient reference point is reached on the test set meter (not more than 10 uA below the saturation point). Note both the test set meter indication and the signal generator output level setting.

(2) Disconnect the preamplifier input and output cables and bypass the preamplifier by connecting the receiver input cable directly to the rf preselector input.

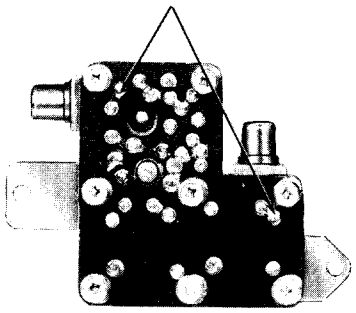
(3) Increase the signal generator output until the same reference point is obtained on the test set meter. Note the signal generator output level setting, it should be at least 3 times greater than the previous setting for a preamplifier gain of approximately 9-1/2 dB.

(4) Reconnect the preamplifier and check the alignment if the above indications are not obtained.

(5) If there is no output or insufficient gain after the preamplifier is aligned, check for faulty components or solder connections on the printed circuit board (refer to the circuit board removal and replacement illustration).

REMOVAL PROCEDURE

1. THOROUGHLY REMOVE SOLDER FROM INPUT AND OUTPUT FEED-THRU LEADS.



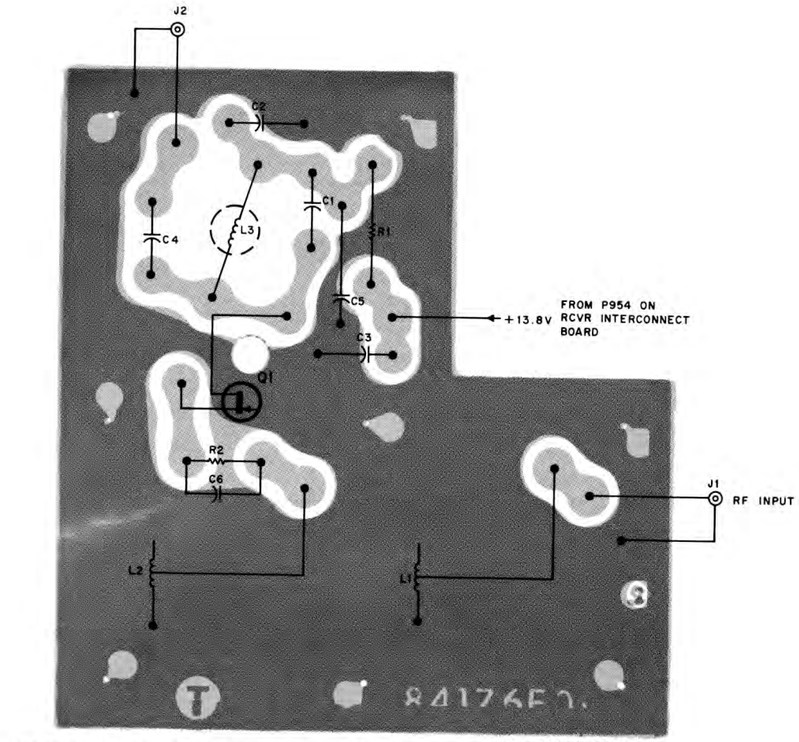
AEPS-8815-O

2. REMOVE 8 SCREWS AND LIFT OFF CIRCUIT BOARD.

REPLACEMENT PROCEDURE

3. REPLACE BOARD AND SECURE WITH SCREWS.
4. RESOLDER INPUT AND OUTPUT FEEDTHRU LEADS.

Preamplifier Circuit Board Removal and Replacement



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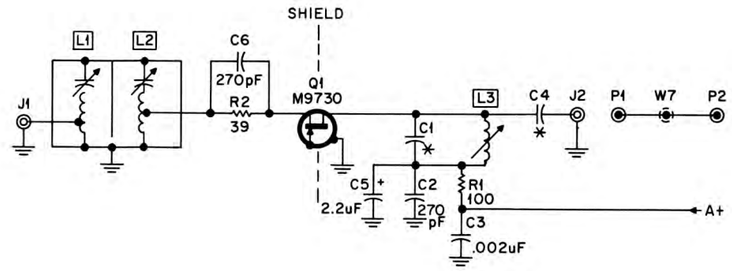
OL-BEPS-8822-A
BD-BEPS-7407-O



BEPS-8825-O

*=SEE PARTS LIST FOR VALUE.

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Receiver RF Preamplifier & Cable
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81016E34-A
7/3/85-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

ELECTRICAL PARTS LIST

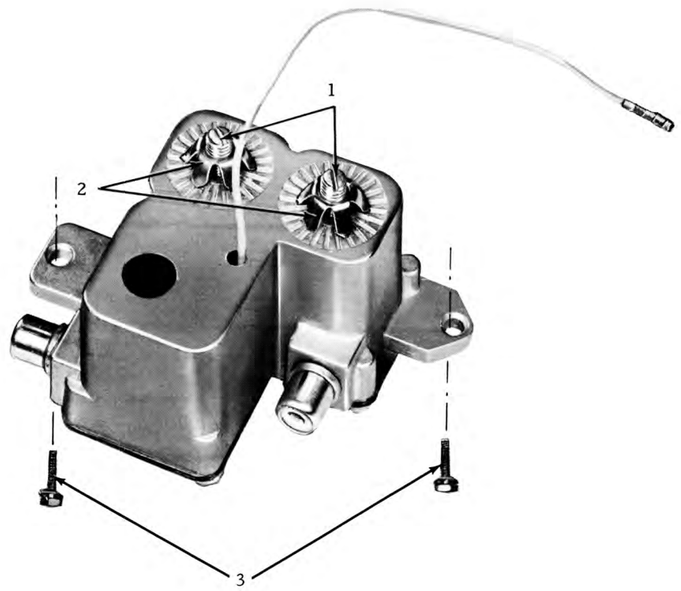
LEGEND:
L = 132-150.8 MHz
H = 150.8-174 MHz

TLD8421B RF Preamplifier (132-150.8 MHz)
TLD8422B RF Preamplifier (150.8-174 MHz) PL-1474-B

		CAPACITOR, fixed:
C1L	21-82133G40	3.9 pF ±0.25 pF; 500 V; NP0
C1H	21-83406D52	2 pF ±0.25 pF; 500 V; NP0
C2	21-82187B04	270 pF ±10%; 500 V
C3	21-83596E14	.002 uF ±10%; 200 V
C4L	21-83406D52	2 pF ±0.25 pF; 500 V; NP0
C4H	21-868487	1.5 ±0.25 pF; 500 V; NP0
C5	23-84762H04	2.2 uF ±20%; 25 V
C6	21-82187B04	270 pF ±10%; 500 V
		CONNECTOR, receptacle:
J1, 2	9-84135B02	female; coaxial; miniature type
		COIL, RF:
L1L	24-84418C01	tapped; coded BRN
L1H	24-84421B01	tapped; (not coded)
L2L	24-84418C02	tapped; coded RED
L2H	24-84421B02	tapped; coded YEL
L3	24-84422B01	(not coded)
		CONNECTOR, plug:
P1	28-82331G01	male, coaxial; miniature type
P2	28-82365D03	male, coaxial, right angle
P3	39-10184A24	female; single-contact (wire terminal)
		TRANSISTOR: (SEE NOTE)
Q1	48-869730	field-effect; N-channel; type M9730
		RESISTOR, fixed:
R1	6-129753	100 ±10%; 1/4 W
R2	6-185A15	39 ±5%; 1/8 W
		LINE, RF transmission:
W7 (Used in Mobile radio applications only)	1-80760B68	includes P1, P2 and 30-83794G01 CABLE, RF: coaxial; 4" length required

NOTE:

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



FBEPS-6486-C

MECHANICAL PARTS LIST

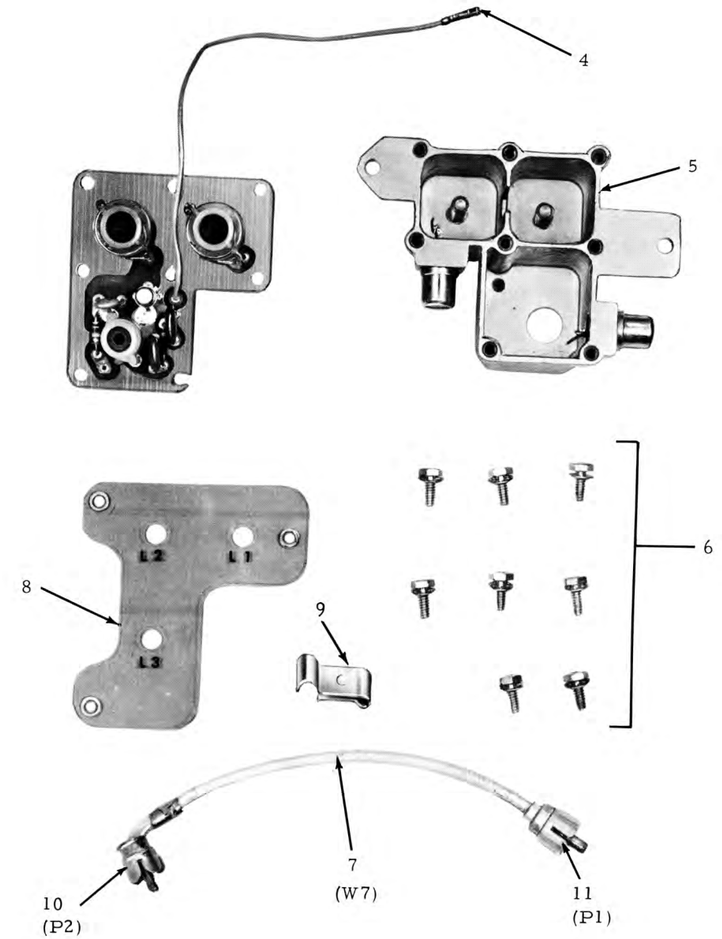
TLD8421B and TLD8422B RF Preamplifier
TLD8421A and TLD8422A RF Preamplifier PL-1035-G

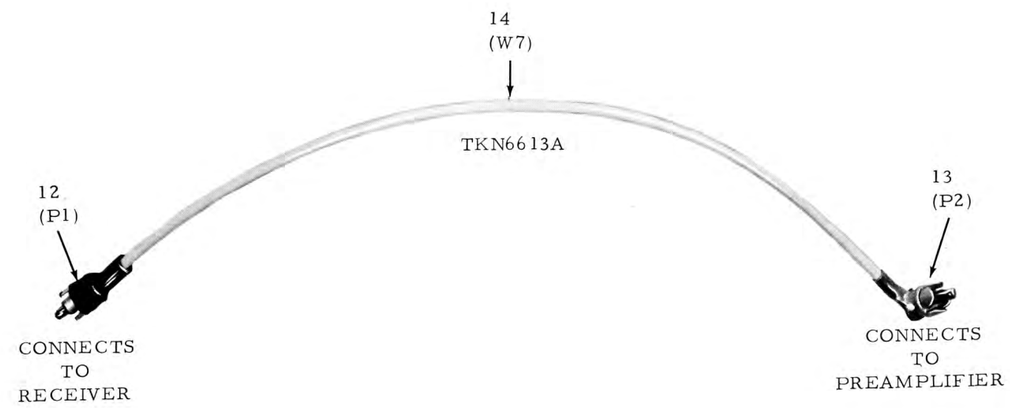
CODE	MOTOROLA PART NO.	DESCRIPTION
1	3S136923	SET SCREW, No. 10-32 x 1"; slotted head; 2 req'd
2	2B83677G01	LOCK NUT: 2 req'd
3	3S134268	LOCKSCREW, tapping: No. 4-40 x 7/16" "Phillips" hex head; 2 req'd
4	39S10184A24	CONNECTOR, receptacle: female
5	15D84416B01	HOUSING, preamplifier
6	3S136926	LOCKSCREW: No. 4-40 x 5/16" "Phillips" hex head; 8 req'd
*7	1V80760B68	CABLE ASSEMBLY
*8	14B84192C01	INSULATOR, mylar
*9	42B84816B01	CLIP, cable
*10	28-82365D03	CONNECTOR, plug; right angle
*11	28-82331G01	CONNECTOR, plug; phono type

* = Used in Mobile Radio applications only

TKN6613A Cable Kit PL-3205-O

12 (P1)	28-82331G01	CONNECTOR, plug: phono type
13 (P2)	28-82365D03	CONNECTOR, plug: right angle
14 (W7)	30-83794C01	CABLE, coaxial: 13" req'd.





FAEPS-8814-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN5654A Hardware Kit, "PL" Decoder PL-5093-O

	1-80775B28	BRACKET ASSEMBLY, board guide includes:
	1-80775B27	BRACKET SUBASSEMBLY includes:
	7-82912K01	BRACKET, circuit board
	3-138162	SCREW, tapping: 4-40 x 3/8
	42-84284B01	RETAINER, screw
	1-80775B30	BRACKET ASSEMBLY, mounting includes:
	1-80775B29	BRACKET SUBASSEMBLY includes:
	7-82617K01	BRACKET, RH
	3-138162	SCREW, tapping: 4-40 x 3/8" 2 used
	42-84284B01	RETAINER, screw; 2 used

TLN8498A Shield, Receiver PL-9611-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-139495	SCREW, machine: 6-20 5/16"; 5 used
	26-82156M01	SHIELD, receiver

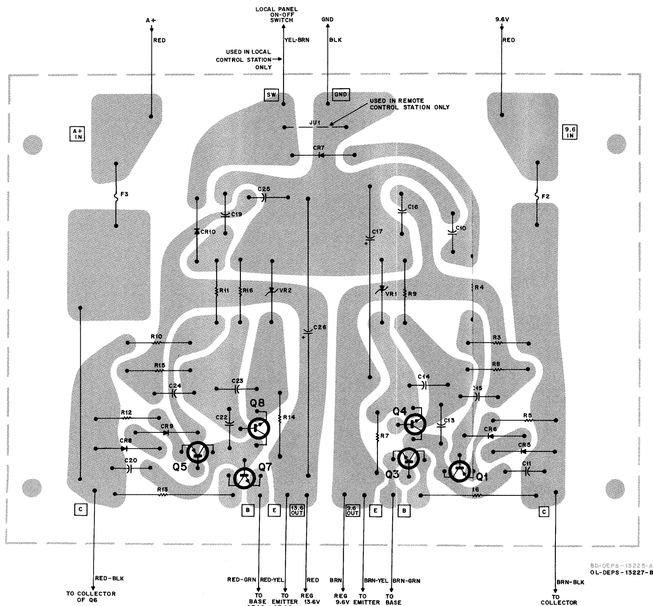
parts list

TRN8497A Hardware Continuous 1 Receiver High Band PL-9613-O

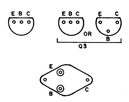
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-119913	NUT, 8-32 x 11/32 x 1/8"; 3 used
	2-82360B07	NUT, speed, 1/4-14"; 18 used
	2-84410P04	NUT, stamped: 1/4-14"; 18 used
	3-122777	SCREW, machine: 8-32 x 1/2"; 3 used
	3-134268	SCREW, tapping: 4-40 x 7/16"; 2 used
	3-135038	SCREW, tapping: 14-14 x 3/4"; 18 used
	3-138162	SCREW, tapping: 4-40 x 3/8"
	3-139495	SCREW, tapping: 6-32 x 5/16"; 2 used
	5-83885G01	RIVET, pull pin .057"; 2 used
	7-82683K01	BRACKET, filter
	13-813618	ESCUTCHEON, patent no.
	14-82903K01	INSULATOR; 2 used
	26-82911K01	HEAT SINK
	33-83051K01	NAME PLATE
	42-10217A02	STRAP, tie: .091 x 362"; 10 used
	42-10217A10	STRAP, tie: 0.184 x 7.78"; 3 used
	42-84284B01	RETAINER
	54-850440	LABEL, FCC
	54-83040C01	LABEL, audio
	54-84126C01	LABEL, replacement parts
	54-84857B01	LABEL, watt meter
	54-84901F02	LABEL; 2 used
	55-84300B01	HANDLE; 4 used
	66-84384C01	TOOL
	66-84690C01	TOOL, removal
	1-80709B39	Assembly Shield Receiver; includes:
	26-84081C04	SHIELD, receiver
	26-84405B01	SHIELD, receiver
	41-84811B01	SPRING
	42-10113A26	RING, retainer; 4 used
	46-84090G01	STUD, retainer; 4 used
	1-80728B57	Assembly Shield Audio & Squelch; includes:
	26-84981F01	SHIELD
	42-10113A26	RING, retainer; 4 used
	46-84090C01	STUD, retainer; 4 used
	1-80731B73	Assembly Exciter Shield; includes:
	26-84053E01	SHIELD
	26-84053E04	SHIELD
	42-10113A26	RING, retainer; 4 used
	46-84090C01	STUD, retainer; 4 used
	1-80756B17	Assembly Shield, Receiver; includes:
	26-84231F04	SHIELD, receiver
	26-84890F01	SHIELD
	41-84811B01	SPRING
	42-10113A26	RING, retainer; 4 used
	46-84090C01	STUD retainer; 4 used
	1-80775B77	Assembly Bracket, One Receiver; includes:
	7-82898K01	BRACKET, mounting BNC connector
	1-80792B92	Assembly Cover Receiver Channel Element; includes:
	3-138162	SCREW, tapping: 4-40 x 3/8"; 4 used
	1-80792B93	Assembly Cover Rivited
	42-84284B01	Retainer; 4 used
	75-82303N02	PAD, rubber

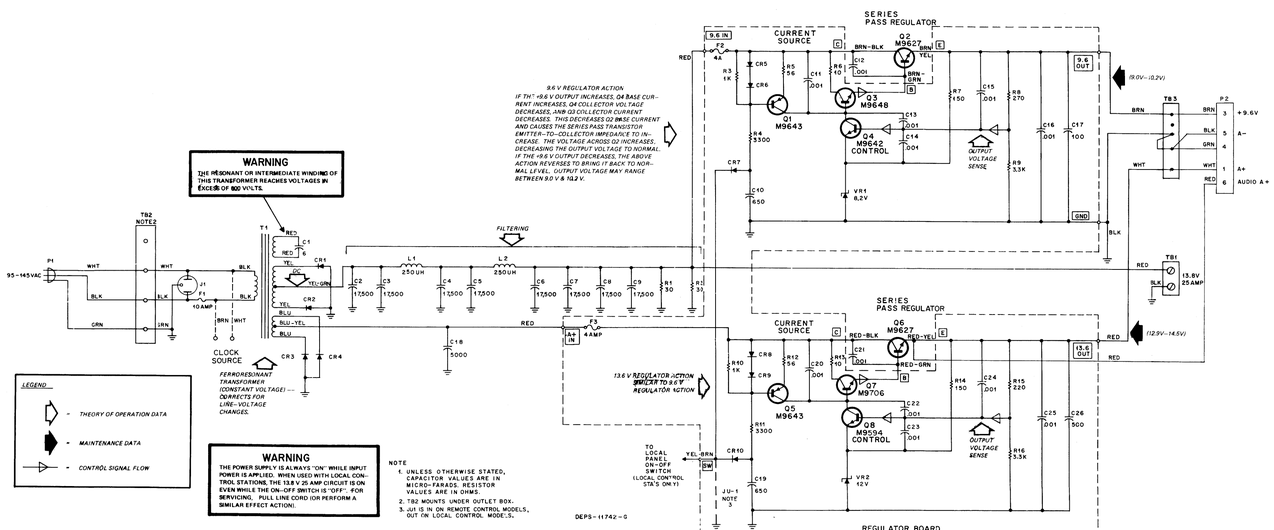
POWER SUPPLY

MODELS TPN1110A
TPN1110B



SHOWN FROM COMPONENT SIDE
9.6V AND 13.6V REGULATOR BOARD





Model Complement

Model	Version	Chassis & Hardware	Version	Regulator Board	Version	Cable
TPN1110A		TLN5123A		TLN5122A	1	TKN6658A
TPN1110B		TLN5123B		TLN5122A	1	TKN6658A

FUNCTION

Provides regulated 9.6 V dc and 13.6 V dc outputs and a 13.8 V dc unregulated output from a 121 V 60 Hz ac power input. 9.6 V and 13.6 V outputs are automatically adjusted for changes in load or input voltage.

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

68P81020E44-Q
5/30/85- UP

parts list

TLN5122A Power Supply Board — PL-2420-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±10%; 100 V: unless otherwise stated
C10	21-848236	650 pF ±5%; 300 V
C11	21-82187B29	.001
C13 thru 16	21-82187B29	.001
C17	23-82601A25	100 -10+150%; 20 V
C19	21-848236	650 pF ±5%; 300 V
C20	21-82187B29	.001
C22 thru 25	21-82187B29	.001
C26	23-83210A19	500 -10+100%; 20 V
		semiconductor device, diode: (see note)
CR5 thru 10	48-83654H01	silicon
		transistor: (see note)
Q1	48-869643	PNP, tye M9643
Q3	48-869648	NPN, type M9648
Q4	48-869642	NPN, type M9642
Q5	48-869643	PNP, type M9643
Q7	48-869706	NPN, type M9706
Q8	48-869594	NPN, type M9594
		resistor, fixed: ±5%; 1/4 W: unless otherwise state
R3	6-11009C49	1k
R4	6-11009C61	3.3k
R5	6-11009C19	56
R6	6-488022	10; 1 W
R7	6-11009C29	150
R8	6-11009C35	270
R9	6-11009C61	3.3k
R10	6-11009C49	1k
R11	6-11009C61	3.3k
R12	6-11009C19	56
R13	6-488022	10; 1 W
R14	6-11009C29	150
R15	6-11009C33	220
R16	6-11009C61	3.3k
		semiconductor device: (see note)
VR1	48-82256C08	Zener, 8.2 V
VR2	48-82256C25	Zener, 12 V
		non-referenced items
	42-82690A01	CLIP, fuse; 4 req'd.
	29-82713M01	STRAIN, relief; 11 used

TKN6658A Cable Kit — PL-2421-A

P2	9-84151B01	CONTACT, receptacle; 5 req'd.
	14-84590B01	INSULATOR, connector
	42-10217A02	STRAP, cable; 6 req'd.

NOTE:
For optimum performance, diode and transistor replacement parts must be ordered by Motorola part number only.

TLN5123B Chassis and Hardware Kit (p/o TPN1110B)
TLN5123A Chassis and Hardware Kit (p/o TPN1110A) — PL-2417-J

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±10%; 100 V unless otherwise stated
C1	8-82705M01	6; 660 V
C2 thru 9	23-83093G20	17,500 +150-10%; 20 V
C12	21-82187B14	.001
C18	23-82304B16	5000 -10+150; 35 V
C21	21-82187B14	.001
		semiconductor device, diode: (see note)
CR1, 2	1-80739B57	Assembly, siicon
CR3, 4	48-82525G13	silicon
		fuse:
F1	65-138179	10 A, 125 A
F2, 3	65-61688	4 A, 250 V
		connector, receptacle:
J1	9-83238C01	3 prong
		choke, filter:
L1, 2	25-84514G01	250 uH
		transistor: (see note)
Q2	48-869627	NPN, type M9627
Q6	48-869627	NPN, type M9627
		resistor, fixed:
R1, 2	17-83389G02	30 ±5%; 20 W
		transformer, power:
T1	25-84516G01	primary windings 1 & 2; 3 secondary windings 3 & 5 with 4 center top, 6 & 8 with 7 center top, and 9 & 10
		non-referenced items
	14-865854	INSULATOR, transistor; 2 req'd.
	5-84512G01	GROMMET, 4 req'd.
	9-82083C01	FUSEHOLDER, extractor post type
	14-84548A01	INSULATOR, diode; 2 req'd.
	37-107234	GROMMET, rubber
	9-84935D01	SOCKET, transistor; 2 req'd.
	64-83562D01	HEAT SINK; 2 req'd.
	30-83211C01	AC LINE CORD; includes molded plug (P1)
	43-10392A07	INSERT; 2 used
	3-2226	SCREW: 1/4 x 20 x 1-1/4; pin hex

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

REVISIONS

68P81020E44-N

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5122A-1	Q7	FROM 48-869648, M9648 TO 48-869706, M9706	13.6 V SERIES REGULATOR
	Q8	FROM 48-869642, M9642 TO 48-869594, M9594	
	C11, 13 THRU 16, 20, 22 THRU 25	FROM: 21-82187B20; .001 UF TO: 21-82187B29; .001 UF	PARTS LIST
TLN5123A, B	C1	FROM 8-84717G01 TO 8-82705M01	T1 RESONANT WINDING

DIGITAL VOICE PROTECTION AND TONE REMOTE CONTROL APPLICATIONS

1. DIGITAL VOICE PROTECTION APPLICATIONS

1.1 GENERAL

The following paragraphs describe applications for base and repeater stations with *Digital Voice Protection* (*DVP*). A wide variety of station models are available. Models are available with various power output levels, one, two, and four-frequency transmitters and receivers. Carrier and PL controlled squelch (for clear voice usage only) are also available. Tone remote control (as described in the next section) is used to provide all remote control functions at the station.

1.1.2 Two basic types of *DVP* stations are available. The first performs all voice encoding and decoding at the station and is termed an encode/decode type. The other has no voice encoding or decoding circuitry and is termed a transparent station.

1.2 ENCODE/DECODE STATIONS

1.2.1 All communications to and from the encode/decode type station on the telephone wire lines occur in clear voice and use only normal remote console products. For transmit operation, the console operator must first decide whether the transmission is to be clear voice or digitally scrambled voice. If the transmission is to be scrambled, the operator must place his scrambler control switch in the *DVP* "ON" position prior to transmission. When this function is decoded at the station, the station will disable all normal audio paths to the transmitter modulator, and enable the path from the digital encoding/scrambling circuitry. Selection of the *DVP* "OFF" or "clear voice" mode disables the digital scrambler output and enables the clear voice path to the modulator.

1.2.2 Automatic coded/clear operation on receive ensures that no messages will be either garbled or lost. The coded/clear detection circuitry operates by examining the frequency content of the receiver discriminator signal, determining it to be either voice or coded data, and automatically routing it to the correct processing circuitry. The discriminator signal is first applied to amplifier and limiting circuitry and then sent to the code detector. The coded detector generates a single output, a logic "high" for a coded signal, and a "low" for clear. If clear, the signal is de-emphasized, routed through the receiver notch filter, and applied to the line driver. If coded, the signal is applied to reclocking circuitry which removes any phase jitter and aligns the incoming data bits with the stations's receive clock. This ensures that, during decoding, all bits will be sampled correctly. Once the data has been digitally unscrambled, it is reconstructed into voice via the CVSD, low pass filtered to remove noise generated in the reconstruction process, notch filtered, and applied to the line driver. This action is completely independent of the selected transmit mode.

1.2.3 While voice communications may be completely protected on-the-air, it should be emphasized that, with this type of station, the protection does not extend to the wirelines or to the local station speaker. Transmit audio to the station will be clear voice only, while received audio will be either clear audio, or decoded audio. Therefore, voice protection both at the site and on the wirelines to the site must be considered.

1.2.4 Since coding is performed at the station, code key entry via the programmer must also be done at the station site. The procedure is detailed in the installation section of this manual.

1.2.5 The optional TLN5780A Series *Digital Voice Protection* Module (with proper code detection), in addition to voice coding and decoding, performs the function of detecting properly coded incoming messages. This function determines if the 12 kilobit message received by the decoder is ciphered in the same code as that programmed in the decoder. If so, the reconstructed voice signal will be passed to the line and speaker outputs. If the received code is not the same as that programmed, the output will remain muted. This prevents noise from being applied to the line or console speaker whenever an invalid code is received. The proper code function may be defeated by activating the

PL monitor function. This permits the operator to monitor the radio channel for either clear or coded signals.

1.3 TRANSPARENT STATIONS

1.3.1 A transparent station differs from an encode/decode type in that no voice coding is done at the station. The station is capable of sending and receiving through its wire line inputs either clear voice or digital coded voice data. This allows the voice encoding and decoding circuitry to be removed from the station and located at the console site. *All* communications leaving the customer's premises may now be protected since, when transmitting or receiving in the coded mode, no clear audio will be available on the wireline paths, or anywhere within the station inself.

IMPORTANT

Voice grade telephone circuits do **not** provide adequate characteristics for the passage of digital voice data. Refer to the installation section of this manual for details.

1.3.2 In the receive mode, the discriminator signal is again applied to the limiter and the code detector. If the signal is clear voice, it is treated as previously described. If coded, the limited data is reclocked and sent to the low pass *DVP* "splatter" filter, where higher order harmonics of the digital signal are attenuated. The filter output is then routed to a separate line driver input, amplified, and applied to the wire line output.

1.3.3 In the transmit mode, the signal coming from the console site into the stations's wire line input is applied to the limiters and to the code detector. If the incoming signal is clear voice, the line input is routed to the exciter input where it goes through the IDC circuitry and then to the modulator. A coded signal will cause the limiter output to be reclocked and sent through the *DVP* splatter filter. This signal is then applied directly to the modulator.

1.3.4 A separate unit, known as a console interface unit, is required in this type of system configuration to provide coding capability. The console interface unit (CIU) is located at the control console site and connected to it by one or two pairs of wirelines (2-wire or 4-wire audio). The CIU then provides the following outputs: one (or two) wireline pairs that carry transmit and receive audio (or *DVP* code if the CIU has been commanded to encode transmitted audio), and a separate wireline pair that carries tone signaling or station control. The separate tone control pair allows isolation of coded and analog signaling - vital for system protection and proper coded performance.

1.3.5 With voice coding being done at the console site, it is not necessary to go to the base station site to perform code key insertion, or to do code changes. All code insertion for the system is done at the CIU. From the standpoint of console operation, the transparent system is identical to the encode/decode station system. The operator must manually select the transmit mode, and when receiving only clear audio will be heard at the console speaker.

1.4 REPEATER (RT) STATIONS

1.4.1 Motorola *DVP* Repeater (RT) Stations are for use in two-way protected communications systems where extended range operation is required or man-made limitations to direct communications are encountered. Repeater stations have the capability of functioning both with a receiver rf input (RT) and tone remote wire line control (base station).

1.4.2 In repeater (RT) operation, a clear mode received signal is automatically applied to the transmitter modulator. Input is rebroadcast at greatly increased power on the repeater's transmitter frequency. As in the case of the transparent station, the coded/clear detection circuitry causes all signal routing to occur automatically. A coded mode signal from the discriminator will be applied to the limiter, and then reclocked prior to application to the *DVP* splatter filter and the transmitter modulator. The additional limiting and reclocking in the repeat path "cleans up" the digital signal. Retransmitting a reprocessed digital signal in this way prevents the excessive accumulation of bit errors in the radio that receives the repeater's output.

1.4.3 Nowhere in the RT path for a coded signal is the signal decoded. Thus an unattended nonwireline controlled repeater (RT) station contains no decoding circuity, and is protected against monitoring of coded signals, even given site access. Wireline controlled repeaters also do not decode the digital signal before retransmitting it. A repeater station may have voice encoding and decoding capability in it, but the coding is used only for interface to the line and local speaker. Repeaters may also be transparent to the wire line.

1.4.4 The audio routing section gives details on signal routing for receive and transmit signals in both encode/decode and transparent stations. This section, along with the supplied troubleshooting flow charts will aid in isolating any station problems to specific modules. Consult either the tone remote control section or the module section for specific information on module operation.

2. TONE REMOTE CONTROL APPLICATIONS

2.1 GENERAL

The basic function of remote control is to allow operation of a base station or repeater station from a remote control point. The station can be located a considerable distance from the control point; however, a compatible

remote control console must be used at the control point in order to control the station. In these stations, remote control is accomplished via tones which are converted into commands that perform such functions as:

- Transmitter turn on
- Selection of transmitter and receiver frequencies
- Disable receiver *Private-Line* coded squelch circuit

2.2 TONE CONTROL

In systems using tone control functions, a wire line must be connected between the control point and the base station. Each different tone is detected in its own frequency-sensitive circuit and is then converted into a control signal (usually the output of a bistable or other switching device). By generating and detecting different tones, it is possible to remotely control several different functions:

- PL disable (receiver)
- Turn on transmitter and select F1 or F2 channel element
- Two squelch settings
- Repeater on-off
- PL on-off
- Selection of coded or clear mode
- Selection of one of two codes

3. TONE CONTROL FUNCTIONAL DESCRIPTION

Refer to the attached functional interconnect diagram.

3.1 TONE CONTROL FORMAT

3.1.1 In all tone control applications, the tones are sent from the control point in a particular timing sequence (tone control format). All tones must be preceded by a 2175 Hz guard tone. The guard tone is used to activate circuits which detune a 2160 Hz bandpass filter in the guard tone decoder module. With the 2160 Hz bandpass detuned, all tones can pass through the guard tone decoder and then be routed to their respective decoders. The tone control format is shown in Figures 1 and 2.

3.1.2 As shown in the format, there are two distinct types of commands; transmit commands, and non-transmit commands. As shown in the format illustration, the 2175 Hz guard tone always precedes the function tone(s); however, in the case of transmit commands the guard tone continues (at a 30 dB lower level) in order to keep the transmitter keyed.

3.2 TRANSMITTER TURN-ON: F1 OSCILLATOR

3.2.1 General Description

In this application, only one transmitter frequency can be selected. In order to turn on the channel element, the F1 transmit command format (2175 Hz guard tone followed by 1950 Hz F1) is applied to pins 22 and 23 in the line driver module. The tones are then routed out of the line driver module on pin 18 and are applied to pin 9 of the guard tone decoder.

3.2.2 Line PTT

3.2.2.1 The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder also provides a line PTT output at pin 16 and a decoder bias output at pin 15; both resulting from the 2175 Hz tone.

3.2.2.2 The line PTT output at pin 16 is used for energizing the antenna relay, muting receiver audio, and applying keyed A- to the transmitter.

3.2.2.3 The 2175 Hz guard tone signal continues to be received as long as the transmitter is being keyed; however, the level is decreased by 30 dB. Circuits within the guard tone decoder compensate for the lower guard tone level and insure that line PTT output is provided even during the lower level input.

3.2.3 F1 Channel Element Enable

With the 2160 Hz bandpass filter disconnected, The F1 tone (1950 Hz), which follows the high level guard tone, is allowed to pass through the guard tone decoder via the function hi output at pin 11. The 1950 Hz portion of the signal is applied to the F1-PL (or F1) module for detection. (Although the 1950 Hz tone is applied to other modules, it can only be detected in the F1-PL or F1 module.) When the 1950 Hz tone is detected in the F1-PL module, the F1 bistable produces a low F1 Osc output at pin 3 which provides a ground enable for the transmitter F1 channel element to completely key the transmitter.

3.2.4 Function Tone Enable

In order for the tone detector circuits to function, an enable signal must be provided during the control format time. This signal originates in the guard tone decoder module as the decoder bias output at pin 15 and is the result of guard tone detection. The decoder bias signal is a high-level, 350 millisecond window that is applied to the F1 tone decoder (pin 15). The F1 module converts the signal to a low-level function enable output at pin 20. The 350 millisecond low level function enable is applied to all of the tone detector circuits (in four

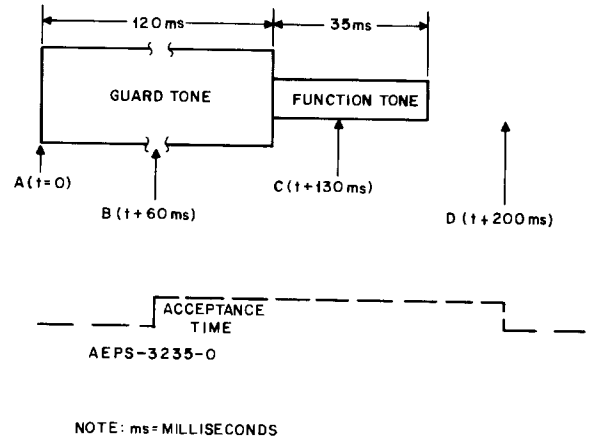


Figure 1. Tone Control Format, Non-Transmit Command

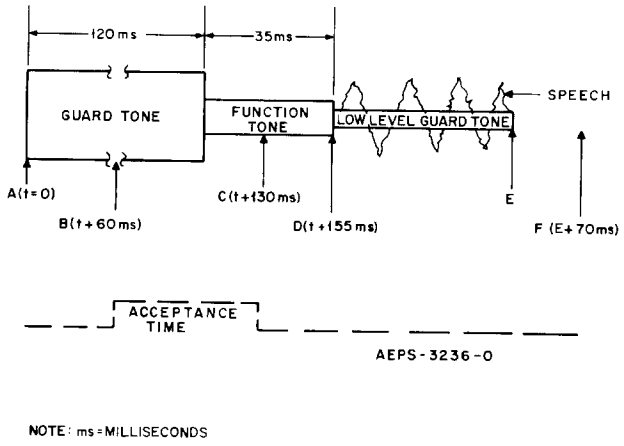


Figure 2. Tone Control Format, Transmit Command

different tone modules) so that tones can only be detected during the 350 millisecond window.

3.3 TRANSMITTER TURN-OFF

3.3.1 General Description

When low level 2175 Hz guard tone ends, transmitter turn-off begins. First, the guard tone loss is detected by activity checker Q20 in the guard tone decoder. After a 75 millisecond turn-off delay, the line PTT output (pin 16) reverts to a high.

3.3.2 Reverse Burst PL Transmission

Loss of the line PTT causes loss of keyed A+ in the station control module (pin 19). In turn, loss of keyed A+ starts the PL reverse burst transmission via the *Private-Line* encoder. The PL encoder provides delayed keyed A+ for an additional 150 milliseconds while the burst is transmitted. The delayed keyed A+ keeps the

F1 bistable on (F1-PL module) to continue providing F1 channel element ground.

3.3.3 RF Shut-Down

After the 150 millisecond reverse burst period, delayed keyed A+ is removed which turns off the F1 bistable and removes keyed A-. This turns off the channel element which removes the signal drive to the Class C rf amplifiers.

3.3.4 Antenna Switchover

30 milliseconds after keyed A- is removed, the antenna switch/audio mute signal (station control, pin 15) allows the antenna relay to de-energize and unmutes audio in the line driver.

3.4. TRANSMITTER TURN-ON; F2 OSCILLATOR

3.4.1 F2 Control

In this application a different transmit channel element is selected for each of the two operating frequencies. In order to turn on the transmitter and select the second (F2) channel element, the F2 transmit command format (2175 Hz) guard tone followed by 1850 Hz (F2) is applied to pins 22 and 23 in the line driver module. From this point the circuit operation is the same as that described for F1 selection except that the F2 channel element is selected by detection of the 1850 Hz tone in either the C2-R2, F2-R2 Mute, or F2 Control Module. The low level (ground) F2 channel element output at pin 4 is then applied to the transmitter.

3.5 RECEIVER *PRIVATE-LINE* DISABLING

3.5.1 General Description

3.5.1.1 In this application a transmit channel element is not selected, therefore, the transmitter is not keyed. In order to generate a PL disable signal, the PL monitor command format (2175 Hz guard tone followed by 2050 Hz PL disable) is applied to pins 22 and 23 in the line driver module. The tones are then routed out of the line driver module on pin 18 and are applied to pin 9 of the guard tone decoder.

3.5.1.2 The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder provides a bias output at pin 15 which is the result of the 2175 Hz tone. (A line PTT is also generated, however, it cannot key the transmitter because a channel element is not selected.)

3.5.2 PL Disable Function

With the 2160 Hz bandpass filter disconnected, the PL disable tone (2050 Hz) passes through the guard tone decoder via the function hi output at pin 11. The 2050 Hz signal is applied to the F1-PL module for detection. (Although the 2050 Hz tone is applied to other modules, it can only be detected in the F1-PL module.) When the 2050 Hz signal is detected in the F1-PL module, the PL disable bistable provides a low level PL disable control output at pin 21. The low level PL disable control is applied to the station control module at pin 23. This results in a high level PL disable output, at pin 24, to disable the *Private-Line* operation of the receiver for channel monitoring before transmission. The PL disable condition remains until a line PTT input is applied to pin 3; this occurs when the transmitter is next keyed.)

3.5.3 Function Tone Enable

In order for the tone detector to function, the guard tone decoder generates a 350 millisecond, high-level, decoder bias signal (at pin 15). The decoder bias signal is originated by the 2175 Hz guard tone detection and is present during the 350 millisecond time period that follows. The F1-PL module converts the decoder bias signal into a 350 millisecond low level, function enable signal that enables the detectors within the module during the 350 millisecond window. In addition, the function enable is also applied to other modules so that their detectors can also function during the 350 millisecond window.

3.6 C2-R2 OPERATION

3.6.1 In this application (for two frequency transmit and receive stations) one function tone selects both transmit and receive frequencies simultaneously. Operation is as follows:

3.6.2 A transmit command (2175 Hz guard tone followed by a 1950 Hz function tone) will cause the F1 transmit channel element to be grounded as described previously. This grounding function is routed to pin 6 of the C2-R2 control module where it is applied to the "R2 Mute" bistable multivibrator. The output of this bistable is used to turn on transistor switch Q11, thus grounding the F1 receive oscillator. That line will remain grounded until an F2 transmit command is received. Then the grounding of the F2 transmitter element will set the "R2 unmute" bistable. This grounds the F2 receive element and removes the ground from the F1 receive element. For this application, JU1 and JU2 on the C2-R2 control module must be installed.

3.7 *DVP* CONTROL/CODE SELECT

3.7.1 The TLN5972 *DVP* Control Module converts control tones into a switched output to select either the coded or clear mode. An 1150 Hz function tone sets the

DVP control on bistable (Q9, Q10) to produce a switched ground output at pin 24. In normal operation, this low output sets the station in the coded mode. A 1050 Hz function tone sets the *DVP* control off bistable (Q12, Q13), which applies a reset to the Q9, Q10 bistable. This removes the ground from pin 24, setting the station in the clear mode. This mode selection controls only the transmitter - receive operation is automatic.

3.7.2 The TLN5978 code select version of this module performs the same function as the TLN5972A version. In addition, this module allows selecting either of the two available codes. In this case, a 1750 Hz function tone sets the code 1 select bistable (Q4, Q5), which produces a low on pin 21. In normal operation, this low places the encoder/decoder hybrid, on the voice protection module, in the code 1 mode. A 1650 Hz tone sets code 2 select bistable (Q6, Q7), which resets the Q4, Q5 bistable. This removes the ground from pin 21, setting the encoder/decoder hybrid in the code 2 mode. The code changes for both transmit and receive operation.

3.8 REPEATER SET-UP

3.8.1 In this application, the repeater keying circuits are enabled, thus allowing the repeater to be keyed by the squelch gate module. In order to generate a repeater turn on enable signal, the non-transmit format (2175 Hz guard tone followed by a 1450 Hz repeater on) is applied to pins 22 and 23 in the line driver module. The tones are then routed out of the line driver module on pin 18 and are applied to pin 9 of the guard tone decoder.

3.8.2 The guard tone decoder detects the 2175 Hz guard tone and uses a portion of the detected voltage to effectively disconnect the 2160 Hz bandpass filter at the guard tone decoder input. In addition, the guard tone decoder provides a 350 millisecond decoder bias output gate at pin 15 which is the result of the 2175 Hz tone.

3.8.3 With the 2160 Hz bandpass disconnected, the repeater on tone (1450 Hz) passes through the guard tone decoder via the function hi output at pin 11. The 1450 Hz tone is applied to the repeater control module for detection. When the 1450 Hz tone is detected, the repeater turn off bistable is set and the low Q output is cross-coupled to the clear side of the repeater turn off bistable. The cross-coupling produces high level output at pin 9, and because this output is high, the function becomes repeater turn-on instead of repeater turn-off.

3.8.4 The high output from pin 9 in the repeater control is applied to pin 21 of the squelch gate module. This high level is an enabling input which allows the squelch gate module to produce the repeater PTT output at pin 18 when the receiver quiets because of an incoming rf signal.

3.9 REPEATER TURN-OFF

In this application, the repeater keying circuits are disabled in order to generate the repeater turn-off function. The circuit operation is similar to that described for repeater turn-on except.:

- A 1550 Hz tone is used.
- When the repeater control module detects the 1550 Hz tone, it generates a low output at pin 9 that disables the repeater keying function, preventing the repeater from being keyed.

3.10 MAX SQUELCH AND MIN SQUELCH

In these two applications, an attenuator is either switched in or out of the squelch control circuit. The squelch control module is used in place of the repeater control module and is the same except that only jumper JU2 is connected. Circuit operation for this application is similar to that described above for repeater turn-on and turn-off except:

- When a 1450 Hz tone is detected, the turn-on bistable switches the attenuator into the circuit for threshold squelch.
- When a 1550 Hz tone is detected, the turn-off bistable cross-couples to the turn-on bistable which then switches the attenuator out of the circuit for maximum squelch.
- The squelch attenuator output at pin 18 reflects the condition of the attenuator; squelch ratio changes.

3.11 RECEIVER PL ON—PL OFF

3.11.1 In these two applications the type of squelch is selected; *Private-Line* coded squelch or carrier squelch. The *Private-Line* control module is used instead of the repeater control module, and only jumpers JU3 and JU4 are connected. Circuit operation for this application is similar to that described above for repeater turn-on and turn-off except:

- When a 1450 Hz tone is detected, the operate carrier squelch bistable provides a low output on pin 20 (high on pin 5) which disables the receiver PL coded squelch circuit.
- When a 1550 Hz tone is detected, the operate PL bistable provides a low output on pin 5 (high on pin 20) which enables the receiver PL coded squelch circuit.

3.11.2 The low PL disable output on pin 20 (pin 5 high) is applied to the station control module pin 23. This produces a high PL disable output from this module, at pin 24, to disable the PL and change operation to the carrier squelch mode.

3.11.3 The low PL enable output on pin 5 is applied to the F1-PL module to produce high PL disable and function enable outputs from this module. This insures that no other function tones can be expected and that operation remains in the PL mode.

3.12 FOUR-FREQUENCY SELECTION

3.12.1 General Description

3.12.1.1 The 4-frequency module converts a function tone signal from a remote source to a switched ground function for transmit and receive channel element selection. The function tone is applied to a clipper amplifier and passed to resonant tank circuits which are tuned to respond to a specific frequency: 1250 Hz, 1350 Hz, 1850 Hz or 1950 Hz.

3.12.1.2 The tone signal passes through the resonant tank circuit to a detector circuit where it is converted, upon application of a function enable signal from the guard tone decoder module, from a function tone to a dc voltage. This dc signal is inverted and applied to the transmit and receive latches. These latches, upon application of a clock pulse, activate the channel element drivers to provide a switched ground to the selected transmit and receive channel elements.

3.12.2 Transmit Frequency Selection

3.12.2.1 Since all frequency selection circuits are the same except for the specific frequency to which they respond, only one circuit is described, the F2 (1850 Hz) circuit. When an 1850 Hz function tone is sent from the remote control console, it is received at pin 11 of the four-frequency control module. It is then amplified and passed through the respective tank circuit. The signal is detected by the F2 detector and is converted from a 1850 Hz function tone to a logic low dc voltage. The F2 detector is enabled by the presence of the function enable signal at pin 13 from the bias switch in the F1 of F1-PL control module. This signal is developed only after the high level guard tone has been detected.

3.12.2.2 The logic low detector output is inverted and applied to transmit latch flip-flop U11B and to the transmit latch clock. The clock pulse is applied to the F2 flip-flop which changes state and produces a high level Q output. This output is inverted to a logic low and is applied to the T2 transmitter channel element. As this happens, the other transmit latch flip-flops reset, cancelling any previous frequency selection.

3.12.3 Receive Frequency Selection

3.12.3.1 The logic high from the F2 transmit latch flip-flop is also applied to the receiver latch clock circuit and receiver latch flip-flop U2B. The receiver latch clock sends a pulse to receiver latch flip-flop which causes the Q output to becomes high. The receiver latch flip-flop now remains in this state until reset. AND gate U3B applies a high to inverter Q23. The output of Q23 is a ground which selects the R2 receiver channel element.

3.12.3.2 After transmission has been completed and PTT has been released, switch 9.6 V is removed from pin 8, causing C14 is discharge. The discharge of this capacitor turns on the transmit clock causing a second pulse to be applied to the multivibrator which resets the transmit latch back to its original state (all Q outputs low).

3.12.3.3 The receiver latch does not reset after transmission has been completed. The receiver channel, in this explanation R2, remains activated. When transmission is changed to F1, F3, F4, the receiver clock will pulse the receiver flip-flop, thus resetting R2 and turning on the appropriate receiver frequency for proper communications.

3.12.3.4 The power on reset circuit pulses receiver latch U2A, resetting the multivibrator to R1 channel element select any time power is lost due to removal of the card or power outage.

4. AUDIO ROUTING

4.1 GENERAL

The following paragraphs provide information which will assist in tracing audio and code signals through the remote control chassis. Sources of transmit signal are either the local microphone (if supplied) or the wireline input. Received signals are traced from the receiver discriminator.

4.2 LINE TRANSMITTING CLEAR AUDIO

In this case, the remote control point sends clear audio to the station which is set in the clear mode. The audio flow is as follows:

- From the line via TB1-1 and 3 to line diver pins 22 and 23.
- Through line transformer T1, XCTR LEVEL control, and out on pin 15 to F1 module pin 18.
- Through transmitter notch filter and out on pin 22 to pin 2 of station control module.
- Through amplifier Q5, audio gate Q4, out on pin 6 to J5-24 and the exciter.

4.3 CLEAR LINE AUDIO IN THE CODED MODE

In this case, clear audio from the control point must be encoded before transmission. The audio path is as follows:

- Through the line driver and F1 modules, as described previously, to pin 2 of the station control module and out on pin 5.

NOTE

Since the coded mode is selected, audio gate Q4 is inhibited as a result of the low on pin 9 (*DVP* control). This prevents clear audio from reaching the transmitter.

- From pin 5, the clear audio is routed to pin 3 of the voice protection module.
- Through audio gate Q4, amplifier and comparator U3, and amplifier U2 to pin 3 of the CVSD U4.
- Digitized audio from the CVSD is applied to the encode/decode hybrid (pin 17) for encoding.
- Encoded audio (data) exists the module on pin 22 via level shifter Q1.
- Data is routed to pin 21 of the code processor module through audio gate 4.

NOTE

Gate 4 is enabled at this time by the low at pin 16 (*DVP* control).

- Through the splatter filter, audio gate 8 (enabled by low on pin 16), and out on pin 5 to the transmitter via J5-12.
- Local microphone audio (originating from J4-15 or J3-7) entered the station control module at pin 4. Clear and coded signal path are the same as previously described.

4.4 TRANSMIT CODED LINE AUDIO (LINE DATA)

In this case, the audio is encoded at the control point before application to the line. The path is as follows:

- From the line through the line driver module, as described previously, and out on pin 15 to pin 3 of the code processor module.
- Through audio gate 2 (enabled by antenna switch), the data limiter, audio gate 3, to the D input of the flip-flop (clocked through).
- Through audio gate 6, the splatter filter, audio gate 8, and out on pin 5 to the transmitter via J5-12.

4.5 RECEIVE CLEAR AUDIO

In this case, received clear audio is applied to the line and routed to the control point as follows:

- R1 audio from J2-14 is routed to pin 19 of the line driver module, through the audio gate and out on pin 13 to pin 6 of the F1 module.
- Through the receiver notch filter and out on pin 7 to pin 24 of the line driver.
- Through the line level control, line amplifier, line transformer, to the line terminals (TB-1 and 3) via pins 22 and 23.

4.6 RECEIVE CODED AUDIO (DATA)

In this case, received coded audio is decoded before application to the line. The path is as follows:

- Discriminator audio from J2-15 is routed to pin 2 of the code processor module, through audio gate 1, data limiter, and through gate 3 to flip-flop D input.
- Data is clocked through the flip-flop (reclocked data) and exists on pin 20.
- The data is routed to pin 9 of the voice protection module where it is decoded, applied to the CVSD, integrated, filter and exits on pin 2 via the level control, amplifier U1, and audio gate Q3.
- Recovered audio is applied to pin 8 of the line driver, exists on pin 13, and is routed to pin 6 of the F1 module.
- Through the receiver notch filter and out on pin 7 to pin 24 of the line driver.
- Through the line level control, line amplifier, line transformer, to the line terminals TB1-1 and 3) via pins 22 and 23.

4.7 APPLY RECEIVED CODE AUDIO DATA TO THE LINE

In this case, the received coded audio is not decoded before application to the line. The path is as follows:

- Discriminator audio from J2-15 is routed to pin 2 of the code processor module, through audio gate 1, data limiter, and through gate 3 to flip-flip D input.
- Data is clocked through the flip-flop (reclocked data), through audio gate 6, the splatter filter, audio gate 7, and exists on pin 6.

- Routed from pin 6 to pin 20 on the line driver through the line level control, line amplifier, line transformer, to the line terminals (TB1-1 and 3) via pins 22 and 23.

4.8 REPEAT CLEAR AUDIO

Repeaters for *DVP* applications automatically retransmit in the same mode as the incoming signal (i.e., if the received signal is clear, it is retransmitted clear). Receive clear audio is repeated as follows:

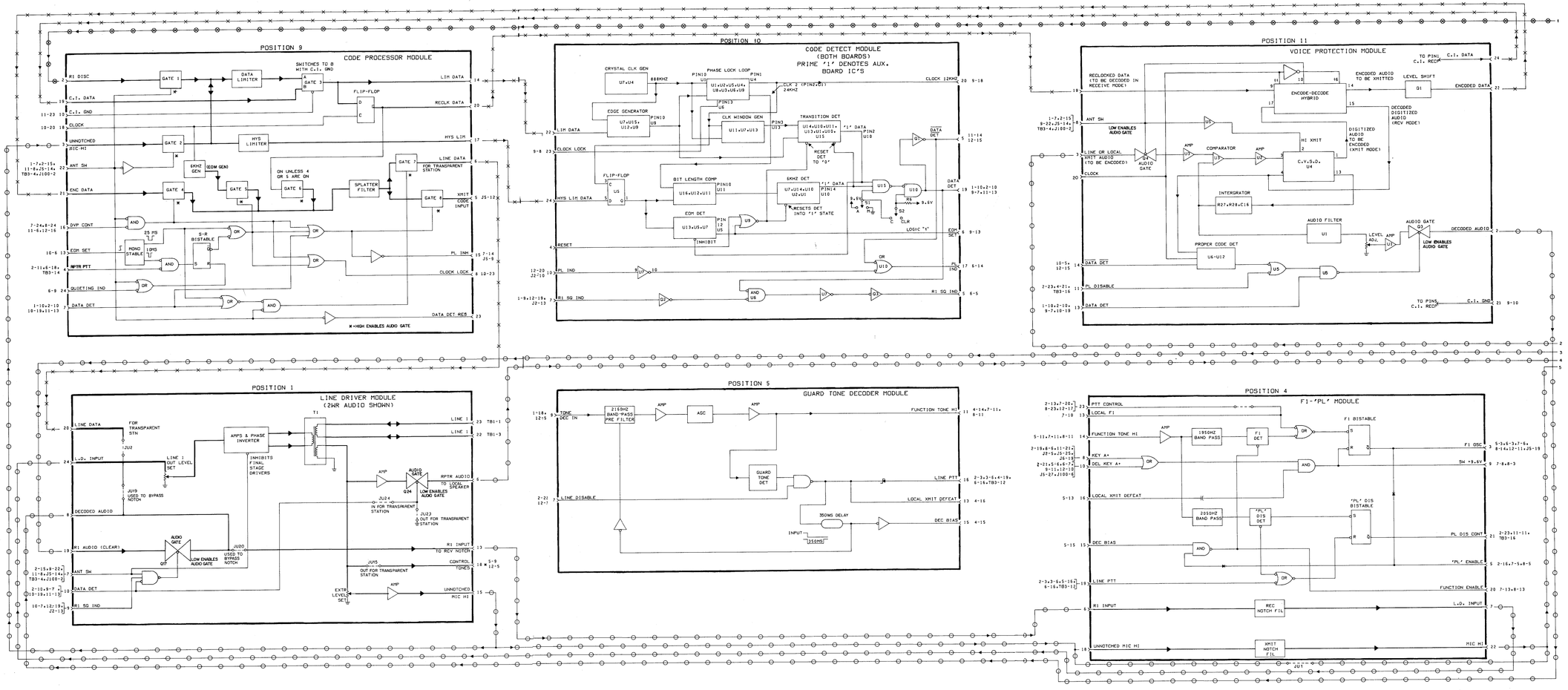
- R1 audio from J2-14 is routed to pin 17 of the squelch gate, through the audio gate, RPTR LEVEL control, amplifier and out on pin 11 to the transmitter.

4.9 REPEAT CODED AUDIO

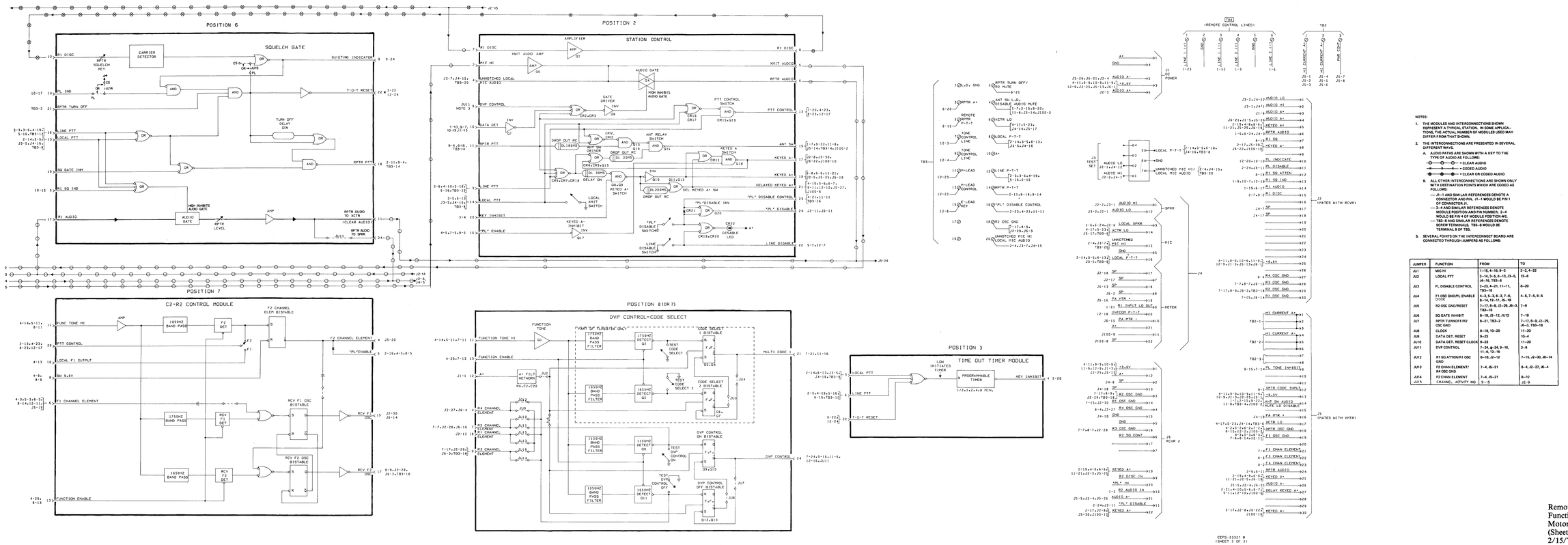
If the received audio is coded, it will be reshaped and reclocked before being re-transmitted. The audio path is as follows:

- Audio from J2-15 is applied to pin 2 of the code processor module through audio gate 1, the data limiter, audio gate 3, to the flip-flop D input.

- After being clocked through the flip-flop, the reclocked data passes through audio gate 6, the splatter filter, audio gate 8, and out on pin 5 to the transmitter via J5-12.



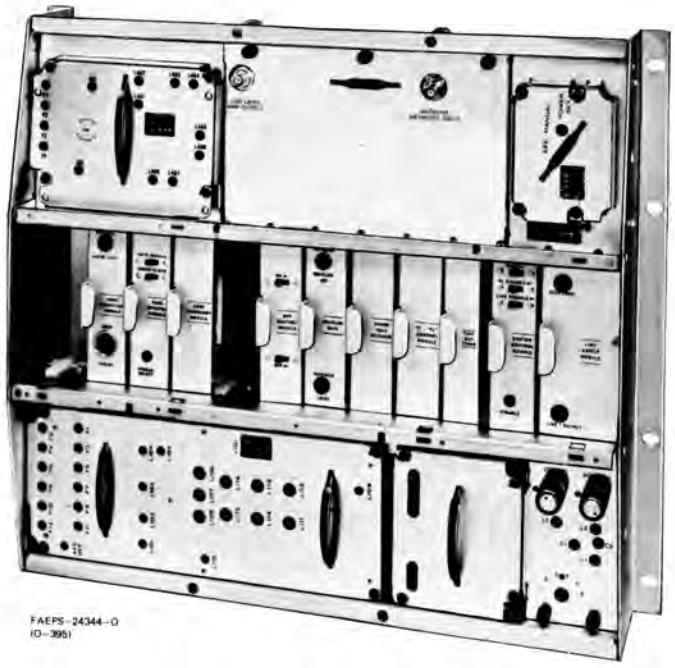
Remote Control Chassis
Functional Interconnect Diagram
Motorola No. PEPS-24349-A
(Sheet 1 of 2)
2/15/78-UP



Remote Control Chassis
Functional Interconnect Diagram
Motorola No. PEPS-24349-A
(Sheet 2 of 2)
2/15/78-UP

DVP AND TONE REMOTE CONTROL

REMOTE CONTROL CHASSIS



Typical Remote Chassis

1. DESCRIPTION

1.1 Various remote control chassis models are described in this manual section (see model chart). These models utilize a unified chassis which interconnects the remote control chassis modules to the transmitter and receiver interconnect boards.

1.2 The remote control chassis mounts plug-in modules that perform switching functions for station operation. Nylon guide rails in the chassis align the modules with the mating connecting pins on the interconnect circuit board at the rear of the chassis.

2. APPLICATION

2.1 TONE REMOTE CONTROL

The remote control chassis, together with the associated plug-in modules, permits a station to be operated from a remote location and performs various control or operational functions for the station. Tones generated at a remote location (3) are carried over wire lines to the station remote control chassis to implement the desired type of operation. The remote control chassis and its modules convert the tones into switching functions to perform any or all of the operations listed in Table 1 and 2 depending on the modules used:

MODEL CHART

FOR

UNIFIED REMOTE CONTROL CHASSIS

USED IN

DVP (DIGITAL VOICE PROTECTION)

STATIONS

KIT NO.	DESCRIPTION
TRN6935A	CHASSIS & HARDWARE KIT
TRN9378A	CHASSIS & HARDWARE KIT
*TLN5979A	REMOTE INTERCONNECT BOARD
*TLN5648A	RECEIVER INTERCONNECT BOARD (BASE)
*TLN5646A	RECEIVER INTERCONNECT BOARD (RPTR)
TLN6196A	RECEIVER INTERCONNECT BOARD (FULL FILTERING OPTION)
*TLN5893A	TRANSMITTER INTERCONNECT BOARD (BASE)
*TLN5894A	TRANSMITTER INTERCONNECT BOARD (RPTR)
TLN5895A	TRANSMITTER INTERCONNECT BOARD (FULL FILTERING OPTION)
TLN5647A	TRANSMITTER INTERCONNECT BOARD (BASE)
TLN5645A	TRANSMITTER INTERCONNECT BOARD (RPTR)
TRN6195A	TRANSMITTER INTERCONNECT BOARD (FULL FILTERING OPTION)
TKN6570A	RF CABLE KIT, RECEIVER
*TRN8105A	CHASSIS & HARDWARE KIT
*TRN6935A	CHASSIS & HARDWARE KIT
TRN9379A	CHASSIS & HARDWARE KIT

CODE:

● = ONE ITEM SUPPLIED

* = INDICATES ITEMS COVERED IN THIS REMOTE SECTION; REMAINING ITEMS ARE COVERED IN THE APPLICABLE VHF OR UHF STATION MANUALS

MODEL	DESCRIPTION	KIT NO.																
	VHF STATIONS																	
TCN1280A	REMOTE CONTROL CHASSIS (BASE STATION APPLICATION)				●	●				●					●		●	
TCN1281A	REMOTE CONTROL CHASSIS (RPTR STATION APPLICATION)				●		●				●				●	●		
TCN1301A	REMOTE CONTROL CHASSIS (FULL FILTERING APPLICATION)				●			●				●			●	●		
	UHF STATIONS																	
TCN1264A	REMOTE CONTROL CHASSIS (BASE STATION APPLICATION)		●		●	●					●							
TCN1273A	REMOTE CONTROL CHASSIS (RPTR STATION APPLICATION)		●		●							●						
TCN1302A	REMOTE CONTROL CHASSIS (FULL FILTERING APPLICATION)				●		●						●			●		

EPS-24627-B

Table 1. Guard Tone

Tone Freq. (Hz)	Operation
2175	Function Tone Enable

Table 2. Tone Commands

Tone Freq. (Hz)	Operation
2050	Receiver PL Disable
1950	Transmit T1/Select F1
1850	Transmit T2/Select F2
1750	Select Code 1/Select R1
1650	Select Code 2/Select R2
1550	Repeater Turn-Off
1450	Repeater Set-Up
1350	Transmit T3/Select F3
1250	Transmit T4/Select F4
1150	Select Coded Mode
1050	Select Clear Mode

2.2 PLUG-IN MODULES

2.2.1 All stations are equipped with a basic complement of modules as follows:

Guard Tone Decoder Module
F1 Control Module
F2, or C2-R2, Decoder (2-Frequency Stations)
Station Control Module
Line Driver Module
Code Detect Module
Voice Protection Module
Code Processor Module
Code Select Module

2.2.2 Repeater Stations are also equipped with a Squelch Gate Module and Time-Out-Timer Module. Repeaters without wire-line control and transparent stations (without encode/decode capability) may have certain modules omitted. Additional space is provided for optional accessory modules.

3. SERVICE AND MAINTENANCE

3.1 LOCAL STATION OPERATION

WARNING

Always line disable this station when performing local maintenance duties. Failure to do so may result in personal injury or equipment damage. Selection of frequency at the remote control console momentarily keys this station even though the microphone push-to-talk switch has not been depressed. Upon completion of local testing, return line disable switch to its normal position.

3.2 REMOVAL AND REPLACEMENT OF MODULES

3.2.1 Modules may be removed by simply pulling outward on the module, and may be replaced by pushing the module into its position in the panel. The modules are labeled and the mounting positions are marked on the interconnect board at the inside rear of the module housing.

CAUTION

1. Never attempt to plug a module into the pins on the back of the remote control unit.
2. Always be sure of the correct module position before plugging in a module.

3.2.2 Technicians who service many of these stations may wish to carry spares and replace malfunctioning modules for immediate restoration of operation. The module may then be repaired at the shop and used as the next replacement spare

NOTE

All jumper connections must be identical on modules that are removed and modules that are inserted before swapping can be successfully used as a troubleshooting technique.

3.3 INSTALLATION OF ADDITIONAL MODULES

When new functions (optional modules) are added, refer to the pertinent module section in this manual for proper jumpering information.

3.4 IN-CIRCUIT MODULE SERVICING

The Motorola Model TLN8799A Service Board Kit can be used for extending the module to provide access for service and maintenance without interrupting the power and signal connections when taking readings. See Figure 1.

3.5 OUT-OF-CIRCUIT MODULE SERVICING

A Motorola TEK-38 Base Station Module Servicing Adapter, shown in Figure 2, can be used for convenient bench testing or repair of base station modules. The board provides an easy method of connecting a 12-volt power supplying and an audio oscillator and allows jumpering and strapping between any pins on the module.

4. SPECIAL MODIFICATIONS

To change the Tone Decoder frequencies from the standard value, change those parts indicated in Figure 3 and Table 3.

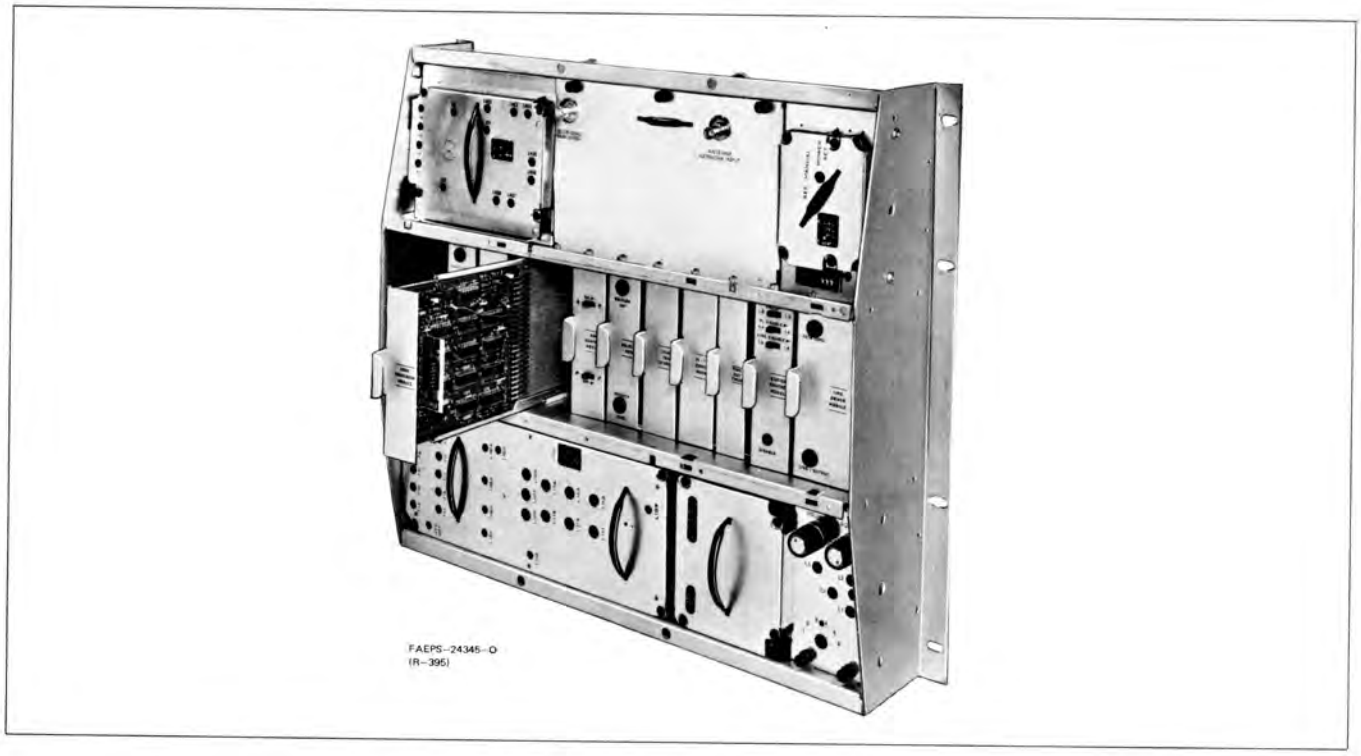


Figure 1. Typical In-Circuit Module Servicing

Figure 2. Out-Of-Circuit Module Servicing

Table 3. Function Tone Modification Table

To Change Function Tone Tank Freq. To	R1 ±5% (In Ohms)	R2 ±5% (In Ohms)	R3 ±1% (In Ohms)	R4 ±1% (In Ohms)	C1 ±2% (In uF)	Capacitor Part No.
2050	27k	1.5k	2.7k*	221	.0056	8D84326A13
1950	22k	1k	2.2k*	221	.0062	8D84326A14
1850	18k	1.5k	2.7k*	221	.0069	8D84326A15
1750	22k	1k	2.43k	221	.0077	3D84326A16
1650	18k	1k	2.21k	221	.00865	8D84326A17
1550	15k	1k	2.21k	221	.0098	8D84326A18
1450	12k	1k	2.21k	221	.0112	8D84326A19
1350	10k	1k	2.21k	221	.0129	8K84326A20
1250	9.1k	1k	2.43k	221	.015	8D84326A21
1150	8.2k	1k	2.43k	221	.0178	8D84326A22
1050	6.8k	1k	2.43k	221	.0213	8K84326A23

* ±5% is allowable

EXAMPLE: Changing decoder frequency to 1850 Hz

Freq.	R1	R2	R3	R4	C1
1850	18k ±5%	1.5k ±5%	2.7k ±5%	221 ±1%	.0069 uF ±2%

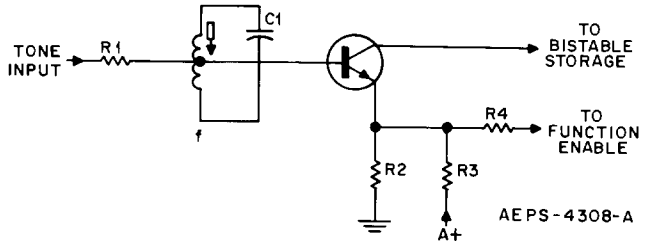


Figure 3. Typical Function Tone Detector

	GROUND	A+	TOT RESET	KEY INHIBIT	LOCAL PTT	LINE PTT	KEYED A+	PTT CONTROL	XMIT OSC GND/ CHANNEL ELEM. GND	XCTR LO	DELAYED KEYED A+	UNNOTCHED MIC HI	"PL" DISABLE CONTROL	F1 OSC GND/F1 CHAN ELEM.	9.6 VOLT	DC LINE DISABLE/ LOC XMIT DEFEAT	L.D. INPUT	R1 INPUT	"PL" ENABLE	SWITCHED 9.6 VOLT	LOCAL F1	FUNCTION TONE HI	DECODER BIAS SWITCH	FUNCTION ENABLE
1 LINE DRIVER	1	12										15*					24	13*						
2 STATION CONTROL	1	12		20	14*	3	19*	13*			21*		23*						16					
3 TIME OUT TIMER	1	12	22	4*	5	6																		
4 F1/F1–PL	1, 4	12				19	8	23	2	17	10	18	21*	3*	11	16	7*	6	5*	9*	13	14	15	20*
GUARD TONE DECODER	1, 17	12				16*			2	23	$\overline{6}$			3		13*						11*	15*	
6 SQUELCH GATE	1, 23	12	22*		13	16	6		2		7			3*										
7 F2/DVP CONTROL	1, 16	12						20	2					6*					5*	8	10*	11		13
8 OPTIONS/4 FREQ/ DVP CONTROL	1	12						23	15					14*					5*	3		11		13
9 CODE PROCESSOR	1	12									11	3			9									
10 CODE DETECT	1	12													9									
11 VOICE PROTECTION (OPTIONAL CODE DET)	1	12					21						11		9									
12 LINE INTERFACE	1	12	24					17	2*		10			11*	9									
13 JUMPERS					2							1	3	4					4					
14 J1 POWER SUPPLY	4*	1*													3*									
15 J2 RCVR	23, 26	24					5								25									
16 J3 TEST SET METER	6				5																			
17 J4 METERING	5	21			16*					14														
18 J5 XMTR	20	28					25		18*	17*	27*			19	13									
19 J6 2ND RCVR	5, 19	12					19								1									
20 TB1 REMOTE CONTROL																								
21 TB2 HIGH CURRENT																								
22 TB3 EXTERNAL	1	10			8	12				6			16											
23 INDIVIDUAL PINS J100	4, 5	1, 7							3		6													

	MIC HI	LINE DISABLE	CONTROL TONES TO GUARD TONE DECODER	REPEATER PTT	R1 DISC	RPTR AUDIO	R1 AUDIO	R1 SQUELCH INDICATE	RPTR AUDIO TO LOCAL SPEAKER	ADL OUTPUT	"PL" OR "DD" INDICATOR/SW A+	XMTR CODE INPUT	REPEATER TURN–OFF/R2 MUTE	12 W PA MTR +	REPEATER A+	REMOTE REPEATER PTT	E LEAD KEY	TONE CONTROL LINE	TONE CONTROL LINE	"PL" INDICATE	R1 SQUELCH IND. TO SQ. GATE	DVP CONTROL1 (EOM–T)	$\overline{\text{DATA DETECT}}$	STATUS TONE OUT
1 LINE DRIVER			18*			6*	19	9																11
2 STATION CONTROL	2	22*		11	8*				6*															
3 TIME OUT TIMER																								
4 F1/F1–PL	22*																							
GUARD TONE DECODER		7	9																					
6 SQUELCH GATE				18*	10	24*	17		11*		14		21		20*	15*					5			
7 F2/DVP CONTROL																						24*		
8 OPTIONS/4 FREQ/ DVP CONTROL																						24*		
9 CODE PROCESSOR				4								5*										16		
10 CODE DETECT								7			17*									10	15*		5*	
11 VOICE PROTECTION (OPTIONAL CODE DET)																						6	14	
12 LINE INTERFACE		7	5*					19									8	3	4	20		16	15	21*
13 JUMPERS	1												7									11		
14 J1 POWER SUPPLY																								
15 J2 RCVR						6	14*	13*												10*				
16 J3 TEST SET METER																								
17 J4 METERING						3								19										
18 J5 XMTR									24	7, 8*		12		16										
19 J6 2ND RCVR																								
20 TB1 REMOTE CONTROL																								
21 TB2 HIGH CURRENT										3														
22 TB3 EXTERNAL				14									2		3	5	15	7	9					
23 INDIVIDUAL PINS J100																								

	M–LEAD	M–LEAD OPTIONAL	12 W PA MTR	E–LEAD PTT	R1 DISC AMP IN	INTERCOM PTT	UNNOTCHED LOCAL MIC AUDIO	DATA DETECT	C.V.S.D. AUDIO	NA	KEYED A–	ANT SW/AUDIO MUTE/L.D. DISABLE	"PL" DISABLE	NA	LINE DATA	R2 AUDIO/INPUT	INTERCOM AUDIO	DECODED AUDIO	AUDIO HI	AUDIO LO	NA	LINE 1	LINE 1	LINE 2	LINE 2
1 LINE DRIVER								10				7			20	2	21	8				23*	22*	3*	4*
2 STATION CONTROL					7		4	10	5*		17*	15*	24*												
3 TIME OUT TIMER																									
4 F1/F1–PL																									
GUARD TONE DECODER																									
6 SQUELCH GATE																									
7 F2/DVP CONTROL																									
8 OPTIONS/4 FREQ/ DVP CONTROL																									
9 CODE PROCESSOR					2			7				22			6										
10 CODE DETECT								19*																	
11 VOICE PROTECTION (OPTIONAL CODE DET)								13	3			8						2*							
12 LINE INTERFACE	23*	22*		6*		18																			
13 JUMPERS				2																					
14 J1 POWER SUPPLY																									
15 J2 RCVR					15*						8		11						2*	1*					
16 J3 TEST SET METER							7*												1	2					
17 J4 METERING			10			20*	15*			18				8			9		1	12	11				
18 J5 XMTR			15								30	14													
19 J6 2ND RCVR										13	22		11	2		10*									
20 TB1 REMOTE CONTROL																						1	3	4	6
21 TB2 HIGH CURRENT																									
22 TB3 EXTERNAL	11	13					20					4													
23 INDIVIDUAL PINS J100											10	2									9				

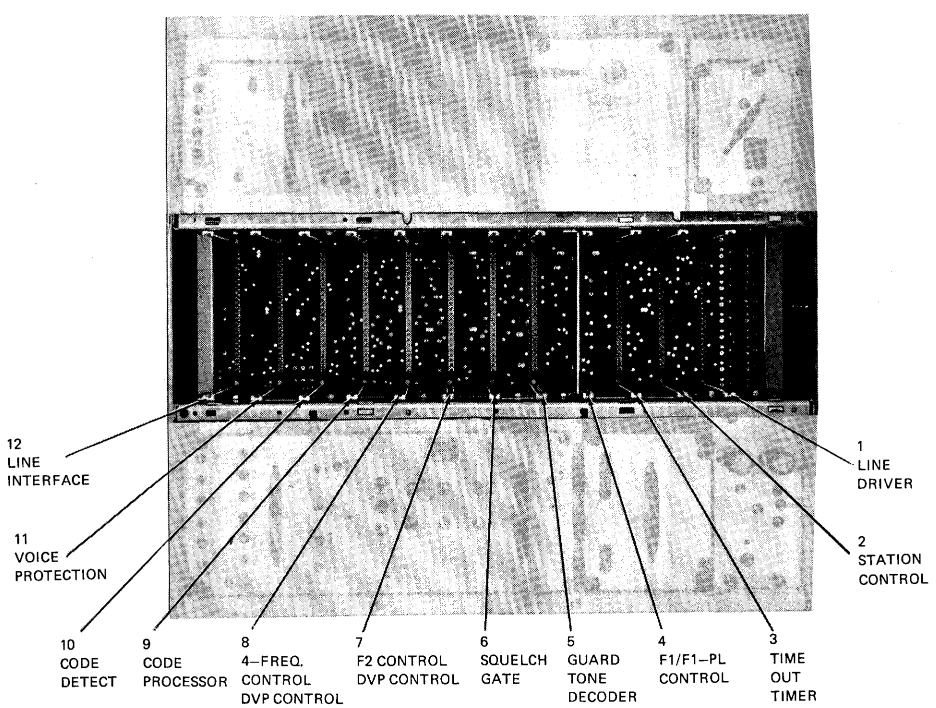
	R1 SUQLECH	MULTI CODE 1	HI CURRENT A+	HI CURRENT A–	RECLOCKED DATA (TRANS DAT DET)	CLOCK	ENCODED DATA OUT (DATA LIMIT)	CODE INSERTER GROUND (CLOCK LOCK)	CODE INSERTER DATA (HYS LIMIT)	+5 VOLT	PL DISABLE CONT	NA	R1 SQ ATTEN	F2 CHANNEL ELEMENT	NA	F3 CHANNEL ELEMENT	R3 OSC GND	F4 CHANNEL ELEMENT	R4 OSC GND	NA	PL TONE INHIBIT	CLOCK LOCK	LIMITED DATA	DATA DET RESET	HYSTERESIS LIMITER
1 LINE DRIVER																									
2 STATION CONTROL																									
3 TIME OUT TIMER																									
4 F1/F1–PL																									
GUARD TONE DECODER																									
6 SQUELCH GATE																									
7 F2/DVP CONTROL		21												4*			7				14*				
8 OPTIONS/4 FREQ/ DVP CONTROL	19	21								22	20*		18	10*		6	7*	2	4*						
9 CODE PROCESSOR					20	18	21	10	19												15*	8	14	23*	17
10 CODE DETECT						20*																23	22		24
11 VOICE PROTECTION (OPTIONAL CODE DET)		16			19		22*	23*	24*																
12 LINE INTERFACE																									
13 JUMPERS						8					3		12, 6	13, 14					13		15			9,10	
14 J1 POWER SUPPLY																									
15 J2 RCVR	7*												12		17		28		27	18					
16 J3 TEST SET METER																									
17 J4 METERING												22			7					17					
18 J5 XMTR			1,2,3	4,5,6										21		22		23			9				
19 J6 2ND RCVR																	16		4						
20 TB1 REMOTE CONTROL																									
21 TB2 HIGH CURRENT			1*	2*																					
22 TB3 EXTERNAL																									
23 INDIVIDUAL PINS J100												8													

	E.O.M. SET	R1 OSC GND	R2 OSC GND	QUIETING INDICATOR	SQUELCH GATE INHIBIT	RESET	AUDIO A+	AUDIO A–		CLOCK	DATA DET RESET	DVP CONTROL	NA	CHANNEL ACTIVITY IND
1 LINE DRIVER														
2 STATION CONTROL												9		
3 TIME OUT TIMER														
4 F1/F1–PL														
GUARD TONE DECODER														
6 SQUELCH GATE				9										
7 F2/DVP CONTROL		15*	17*		18	9								
8 OPTIONS/4 FREQ/ DVP CONTROL			9*										10	
9 CODE PROCESSOR	13			24										
10 CODE DETECT	6*										4			
11 VOICE PROTECTION (OPTIONAL CODE DET)										20				
12 LINE INTERFACE														
13 JUMPERS		12	7, 5		6	5				8, 10	9	11	14	15
14 J1 POWER SUPPLY							6*	5*						
15 J2 RCVR		30	29				3	4						9
16 J3 TEST SET METER														
17 J4 METERING														
18 J5 XMTR								26						
19 J6 2ND RCVR		14	3					21						
20 TB1 REMOTE CONTROL														
21 TB2 HIGH CURRENT														
22 TB3 EXTERNAL			18											
23 INDIVIDUAL PINS J100														

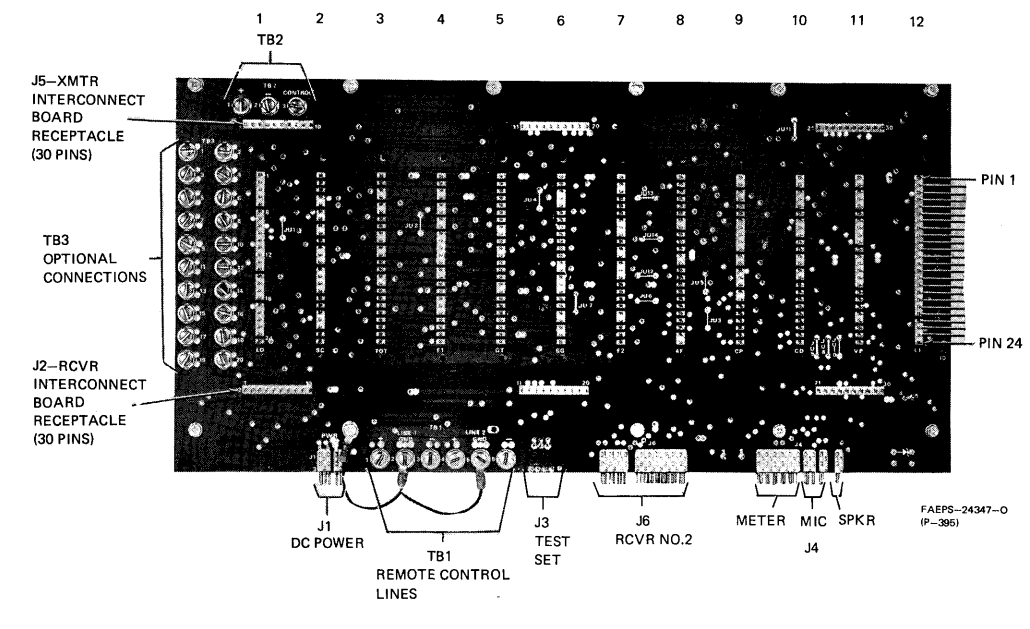
* = SIGNAL SOURCE

EEPS–23315–B

TCN1280A/TCN1281A/TCN1301A/
TCN1264A/TCN1273A/TCN1302A
Unified Remote Control Chassis
Interconnect Board Diagram and Wiring Chart
Motorola No. ***PEPS-24348-D***
(Sheet 1 of 2)
*5/30/85-*UP



FAEPS–24346–O
(O–395)



FAEPS–24347–O
(P–395)

parts list

TLN5979A Interconnect Board — PL-5774-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode:
CR1	48-83654H01	silicon
		spark gap:
E1, 2	80-83029H01	240 V
E3, 4	80-83029H01	240 V (p/o 4-wire line driver module)
		connector, receptacle:
J3	9-84207B01	7-contact
		non-referenced items
	29-8478S4	LUG, slotted tongue; 3 used
	1-80795B13	CIRCUIT BOARD ASSEMBLY, includes:
	3-1976	SCREW, machine: 6-32 x 5/16"; 29 used
	28-84269C01	TERMINAL, contact: low profile; 23 used
	28-84269C02	TERMINAL, contact: high profile; 20 used
	29-83382G01	TERMINAL, 6-32 threaded; 29 used
	29-84028H09	PIN, terminal; 348 used
	39-10184A10	CONTACT, chain form; 10 req'd.

TRN6935A Chassis & Hardware Kit — PL-5775-A

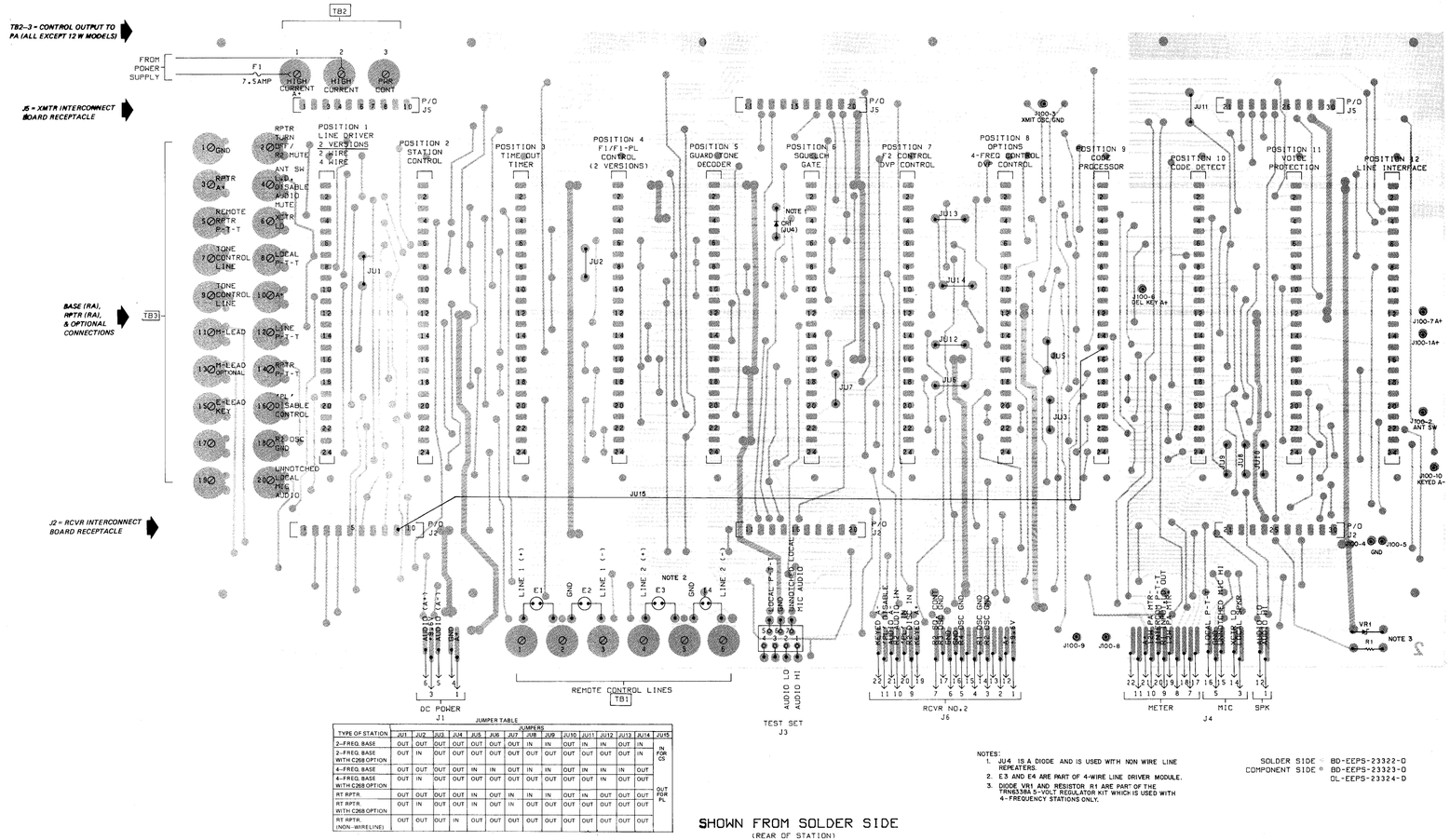
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C921, 922	21-82372C07	.05 uF; 25 V
		connector, plug:
P1002		includes:
	15-83498F04	housing, connector:
	29-83499F01	contact, connector; 3 req'd.
	46-84549F01	plug, polarizing
		transistor: (see note)
Q902	48-869701	PNP; type M9701
		resistor, variable:
R960, 961	18-82515B50	25k (receiver volume and squelch controls)
		non-referenced items
	1-80775B02	BRACKET ASSEMBLY (receiver control) includes ref. items R960, 961
	1-80775B01	BRACKET SUBASSEMBLY; includes:
	7-82172K01	BRACKET, mounting
	2-7018	NUT, hex: 3/8-32 x 1/2 x 3/32"; 2 used
	3-138162	SCREW, tapping: 4-40 x 3/8"; 4 used
	4-7698	WASHER, lock: #3/8 (internal tooth); 2 used
	36-82629H01	KNOB, control; 2 used
	37-82603D60	SLEEVE, numbered (blank); 6 used
	39-10184A24	CONTACT, female; 6 used
	42-10217A02	STRAP, cable harness
	42-84284B01	RETAINER, screw; 4 used
	1-80775B04	BRACKET ASSEMBLY (power control) includes: ref. items C921, 922, P1002 and Q901
	1-80775B06	COVER ASSEMBLY, xmtr channel element, includes:
	1-80775B05	COVER SUBASSEMBLY; includes:
	27-82873K01	COVER
	42-84284B01	RETAINER, screw; 2 used
	3-138162	SCREW, tapping: 4-40 x 3/8"; 2 used
	75-82303N04	PAD, rubber
	1-80775B08	COVER ASSEMBLY, rcvr channel element
	3-139495	SCREW, tapping: 6-20 x 5/16"; 55 used
	7-83564L01	BRACKET (part no. stamped on bracket)
	14-83976L01	INSULATOR, circuit board
	15-84612L01	HOUSING
	27-82624K01	CHASSIS, exciter
	46-84703E01	GUIDE, circuit board; 12 used
	54-83570K06	LABEL, module location

TRN6338A 5-V Regulator Kit — PL-3453-O

R1	17-83122D09	RESISTOR, fixed: 22 ±5%; 3 W
VR1	48-83461E34	VOLTAGE REGULATOR Zener type; 5.6 V

TRN9379A Chassis Hardware — PL-9612-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor:
R960, 961	18-82515B50	variable: 25k ±30%; 0.16 W
		mechanical parts
	3-139495	SCREW, tapping: 6-32 x 5/16"; 52 used
	5-83314K01	RIVET, snap; 24 used
	7-83564L01	BRACKET, receiver
	14-83976L01	INSULATOR
	15-8462L01	HOUSING
	46-84703E01	GUIDE; 12 used
	54-83570K06	LABEL, chasss
	1-80775B02	Assembly Receiver Bracket; includes:
	1-80775B01	BRACKET, assembly rivet
	3-138162	SCREW, tapping: 4-40 x 3/8"; 4 used
	4-7698	LOCKWASHER, #3/8" internal; 2 used
	36-83629H02	KNOB, control; 2 used
	37-82603D60	SLEEVING, number blank; 6 used
	39-10184A24	CONTACT, receptacle; 6 used
	42-10217A02	STRAP, tie: .091 x 3.62"
	42-84284B01	RETAINER; 4 used
	1-80775B06	Assembly Transmitter Channel Element; includes:
	1-80775B05	COVER, assembly
	3-138162	SCREW, tapping: 4-40 x 3/8"; 2 used
	42-84284B01	RETAINER; 2 used
	75-82303N04	PAD, rubber



JUMPER TABLE

TYPE OF STATION	JUMPERS JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11	JU12	JU13	JU14	JU15
2-FREQ. BASE	OUT	OUT	OUT	OUT	OUT	OUT	OUT	IN	IN	OUT	IN	IN	OUT	IN	
2-FREQ. BASE WITH CB88 OPTION	OUT	IN	OUT	OUT	OUT	OUT	OUT	IN	IN	OUT	OUT	OUT	OUT	IN	IN FOR CS
4-FREQ. BASE	OUT	OUT	OUT	OUT	IN	IN	OUT	IN	IN	OUT	IN	IN	IN	OUT	
4-FREQ. BASE WITH CB88 OPTION	OUT	IN	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	IN	IN	OUT	OUT	
RT RPTR	OUT	OUT	OUT	OUT	IN	OUT	IN	IN	IN	OUT	IN	OUT	OUT	OUT	OUT FOR PL
RT RPTR WITH CB88 OPTION	OUT	IN	OUT	OUT	IN	OUT	IN	IN	OUT	OUT	OUT	OUT	OUT	OUT	
RT RPTR (NON-WIRELINE)	OUT	OUT	OUT	IN	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	

NOTES:
1. JU4 IS A DIODE AND IS USED WITH NON WIRE LINE REPEATERS.
2. E3 AND E4 ARE PART OF 4-WIRE LINE DRIVER MODULE.
3. DIODE VR1 AND RESISTOR R1 ARE PART OF THE TRN6338A 5-VOLT REGULATOR KIT WHICH IS USED WITH 4-FREQUENCY STATIONS ONLY.

SOLDER SIDE = BD-EEPS-23322-O
COMPONENT SIDE = BD-EEPS-23323-O
DL-EEPS-23324-O

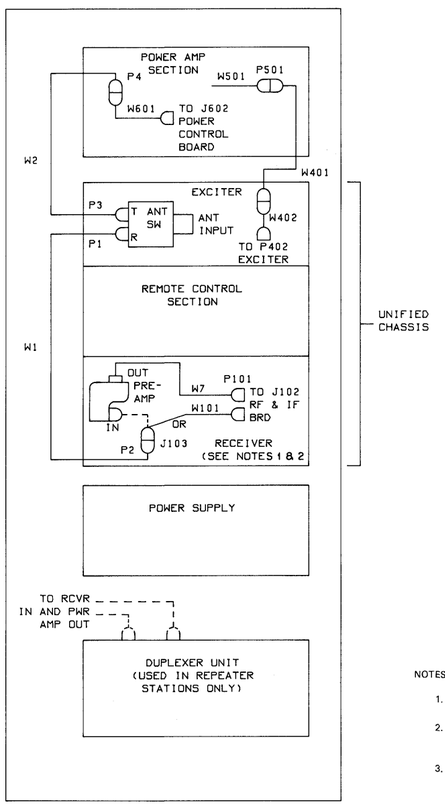
SHOWN FROM SOLDER SIDE
(REAR OF STATION)

TCN1280A/TCN1281A/TCN1301A/
TCN1264A/TCN1273A/TCN1302A
Unified Remote Control Chassis
Interconnect Board Diagram and Wiring Chart
*Motorola No. **PEPS-24348-D***
(Sheet 2 of 2)
5/30/85- UP

RF INTERCABLING

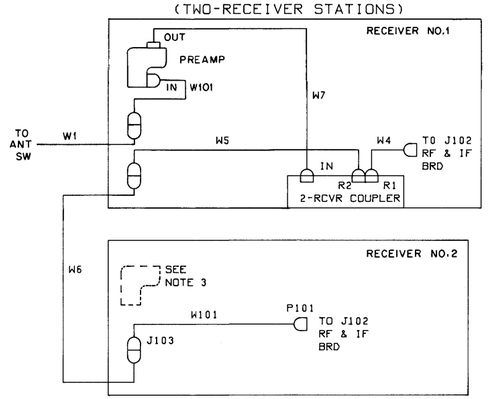
(CONTINUOUS DUTY STATIONS
WITH UNIFIED CONTROL CHASSIS)

SINGLE RECEIVER STATIONS

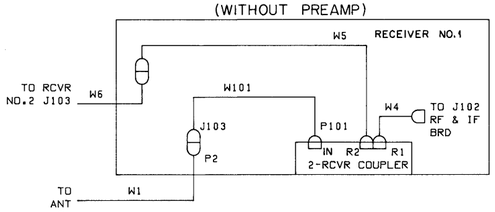


REAR VIEW

DETAIL A
(TWO-RECEIVER STATIONS)



DETAIL B
(WITHOUT PREAMP)



NOTES:

1. REFER TO DETAIL A FOR RECEIVER RF CONNECTIONS IN TWO-RECEIVER STATIONS.
2. REFER TO (WITHOUT PREAMPLIFIER) DETAIL B FOR RECEIVER NO. 1 RF CONNECTIONS IF PREAMPLIFIER IS NOT USED.
3. TWO-RECEIVER STATIONS WITH WIDELY SEPARATED FREQUENCIES AND OPTIONAL PREAMPLIFIER USE A PREAMPLIFIER WITH EACH RECEIVER. ANTENNA CONNECTS TO TWO-RECEIVER COUPLER, TWO OUTPUTS OF COUPLER CONNECT TO PREAMPLIFIERS.

CEPS-22901-D

MOTOROLA

RF CABLE REQUIREMENTS

FOR

CONTINUOUS DUTY STATIONS

WITH UNIFIED CHASSIS

(132-174 MHz)

STATION DESCRIPTION	REF. DESIG.	RF CABLE DESCRIPTION PART NO.	PART OF
	W1	1-80792B97	TKN6882A
	W2	1-80792B96	TKN6882A
	W401	1-80792B95	TKN6882A
	W101	-	TKN6570A
	W402	-	TKN6581A
	W7	-	TKN6613A
	W4	1-80737B80	TLN4758A
	W5	1-80737B77	TLN4758A
	W6	1-80737B79	TLN4758A
	W501	1-80727B92	TRN3012A
	W601	1-80727B96	TRN3012A
	W401	1-80792B95	TKN6883A
BASE STATION - 1 RECEIVER		1 - - 1 1 - - - - - -	
BASE STATION - 1 RECEIVER WITH OPTIONAL PREAMPLIFIER (TLD8421B OR TLD8422B)		1 1 1 1 1 1 - - - 1 1	
BASE STATION - 2 RECEIVERS WITH 2-RECEIVER COUPLTER (TLN4758A)		1 1 - 2 1 - 1 1 1 1 -	
BASE STATION - 2 RECEIVERS WITH 2-RECEIVER COUPLTER (TLN4758A) AND OPTIONAL PRE-AMPLIFIER (TLD8421B OR TLD8422B)		1 1 - 2 1 1 1 1 1 1 1	
REPEATER STATION		- - - 1 1 - - - - 1 1 1	

EPS-22904-B

RF INTERCABLING

PARTS LIST SHOWN ON
BACK OF THIS SHEET

MOTOROLA INC.
Communications Division

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

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TKN6882A RF Cabling Kit — PL-5143-O

		CABLE ASSEMBLY:
W1	1-80792B97	includes:
P1	28-82331G02	CONNECTOR, plug: phono
P2	28-84967D01	CONNECTOR, plug: BNC type
	30-84173E01	CABLE, coaxial: 24" lg.
W2	1-80792B96	includes:
P3	28-82331G02	CONNECTOR, plug: phono
P4	28-84967D01	CONNECTOR, plug: BNC type
	30-84173E01	CABLE, coaxial: 21" lg.
W401	1-80792B95	includes:
	28-84967D01	CONNECTOR, plug: BNC type; 2 used
	30-84173E01	CABLE, coaxial: 16" lg.
NON-REFERENCED ITEMS		
	1-80793B01	CABLE ASSEMBLY includes:
	37-82603D60	SLEEVE, number: 2 used
	39-10184A24	CONTACT, female; 2 used
	42-10217A02	STRAP, cable harness
	1-80793B02	CABLE ASSEMBLY includes:
	9-84234E10	JACK, test (white)
	29-824151	LUG, slotted tongue; 2 used
	29-824154	LUG, ring tongue; 2 used
	30-813233	CABLE, battery: #10 (red) 44" lg.
	30-831572	CABLE, battery: #10 (black) 44" lg.
	37-82603D60	SLEEVE, number (blank)
	39-10184A24	CONTACT, female
	42-10217A02	STRAP, cable harness; 7 used
	3-134212	SCREW, tapping: 4-40 x 5/16"; 2 used
	3-136934	SCREW, tapping: 6-32 x 3/8"; 2 used
	7-82674L01	BRACKET, relay mounting

TRN8012A Input Bracket & Cable Kit — PL-5342-O

		CABLE ASSEMBLY:
W501	1-80727B92	includes:
P501	9-84968D01	CONNECTOR, plug: BNC bulkhead type
	30-83794C01	CABLE, coaxial: 8" lg.
W601	1-80727B96	includes:
	28-82365D03	CONNECTOR, plug: single contact
	9-844509	CONNECTOR, plug: BNC bulkhead type
	30-82921H01	CABLE, coaxial: 8" lg.

NOTE: Additional electrical components and hardware for TRN8012A are listed in the Transmitter Section.

TKN6581A RF Cable (W402) — PL-5177-O

	9-84968D01	CONNECTOR, plug: BNC bulkhead type
	28-82331G01	CONNECTOR, plug: single contact
	30-83794C01	CABLE, coaxial: 8" long

TKN6570A Cable Assembly Receiver (W101) — PL-5144-O

		CONNECTOR, plug:
J103	9-84968D01	BNC bulkhead type
P101	28-82331G01	single contact
NON-REFERENCED ITEM		
	30-83794C01	CABLE, coaxial; 17" lg.

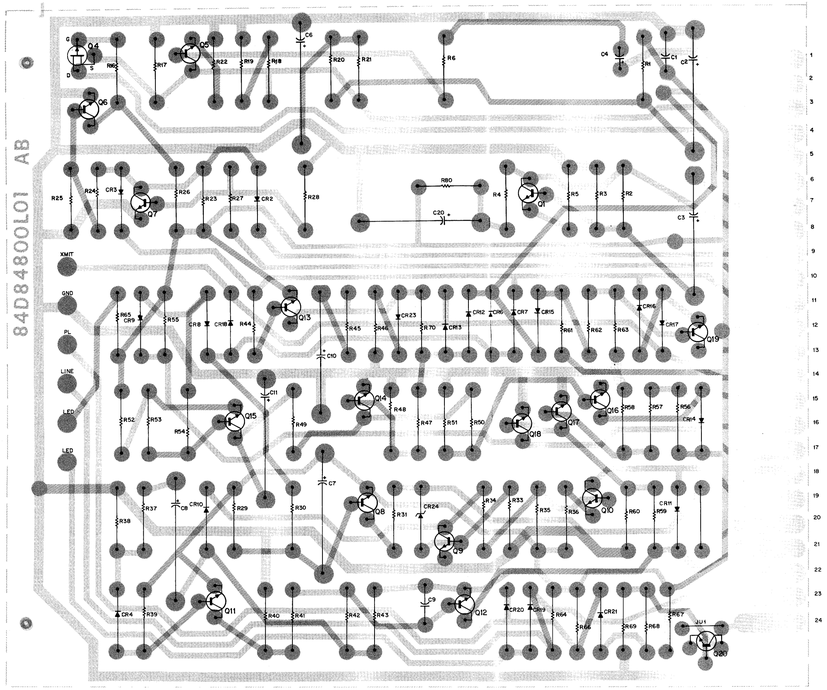
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TKN6883A RF Cable Kit, RPTR — PL-5148-O

		CABLE ASSEMBLY:
W401	1-80792B95	includes:
	28-84967D01	CONNECTOR, plug: BNC type; 2 used
	30-84173E01	CABLE, coaxial: 16" lg.
NON-REFERENCED ITEMS		
	1-80793B02	CABLE ASSEMBLY includes:
	9-84234E10	JACK, test: (White)
	29-824151	LUG, slotted tongue: 2 used
	29-824154	LUG, ring tongue: 2 used
	30-813233	CABLE, battery: #10 (red); 44" lg.
	30-831572	CABLE, battery: #10 (black) 44" lg.
	37-82603D60	SLEEVE, number: (blank)

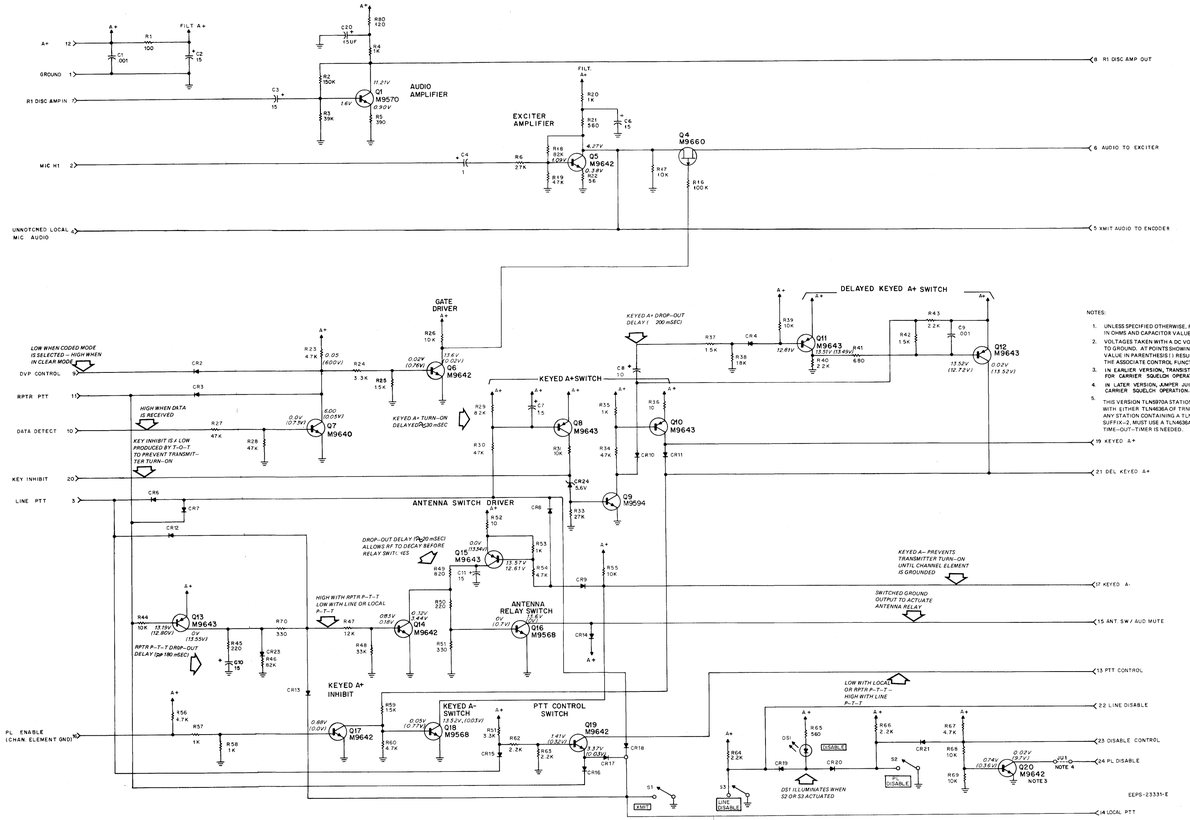
LATER VERSION

EARLIER VERSION SHOWN ON BACK



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE 80-DEPS-25492-A
SOLDER SIDE 80-DEPS-25493-A
80-DEPS-25494-B



NOTES:

1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. VOLTAGES TAKEN WITH A DC VOLTMETER REFERENCED TO GROUND. AT POINTS SHOWING TWO VOLTAGES, THE VALUE IN PARENTHESIS ( ) RESULTS FROM ACTIVATING THE ASSOCIATE CONTROL FUNCTION.
3. IN EARLIER VERSION, TRANSISTOR Q20 IS REMOVED FOR CARRIER SQUELCH OPERATION.
4. IN LATER VERSION, AMPER JU1 IS REMOVED FOR CARRIER SQUELCH OPERATION.
5. THIS VERSION TLN5970A STATION CONTROL MODULE PROVIDES COMPATIBILITY WITH EITHER TLN4629A OF TLN5884B TIME-OUT-TIMER MODULE OPERATION. ANY STATION CONTAINING A TLN4629A CONTROL STATION CONTROL MODULE EARLIER THAN SUFFIX-Z, MUST USE A TLN4629A TIME-OUT-TIMER IF A NEW OR REPLACEMENT TIME-OUT-TIMER IS NEEDED.

STATION CONTROL MODULE

MODEL TLN5970A

FUNCTION

--Integrates control functions from other modules to key the station transmitter.

--Amplifies receiver discriminator signals which are used externally.

--Sets audio paths as dictated by the mode selected

--Provides front panel controls for local operation or maintenance purposes.

PARTS LIST SHOWN ON BACK

68P81035E58-C

5/30/85- **UP**

STATION CONTROL MODULE

FUNCTIONAL DESCRIPTION

The station control module provides the switching interface between the tone control modules and the transmitter-receiver units. Clear local and line transmit audio signals are gated to the exciter via this module also.

To activate the transmitter, the following sequences of events must occur. A PTT input (line, local, or repeater) initializes three separate switching circuits. One circuit is used to derive keyed A+, delayed keyed A+, and keyed A-. The first stage turned on by any of the three PTT's is Q8 which provides a high to turn on Q9. If however, pin 20 (key inhibit) is low, Q9 is prevented from conducting which in turn shuts down the transmitter. Key inhibit is produced by the time-out-timer (if used) to prevent the transmitter from remaining on the air in case of a continuous PTT. Once Q9 has been turned on, Q10 and Q12 simultaneously switch to provide keyed A+ (pin 19) and delayed keyed A+ (pin 21). These two outputs are used to turn on Q18 (keyed A- switch) unless prevented by the lack of channel element ground (pin 16). If no channel element ground is present, Q17 is turned on and prevents Q18 from turning on. Keyed A- is available on pin 17 of the module.

Another circuit, activated by line or local PTT, is used to drive antenna relay switch Q16. The PTT function turns on Q15 and Q16 which provides a switch ground on pin 15 to activate the antenna relay. If however, a repeater PTT is present, Q13 and 14 are turned on providing a low to Q16 which inhibits the antenna switch.

The third circuit, activated by local or repeater PTT, is used to derive PTT control (pin 13). Local or repeater PTT provides a switched ground to the emitter of PTT control switch Q19. This turns Q19 on which provides a switched ground at pin 13. Line PTT prevents Q19 from turning on which prevents PTT control.

Upon the release of any of the three PTT's, a delay network (C8, R37, R38, and Q11) allows delayed keyed A+ to remain for an additional 150 msec. This supplies drive to Q18 which keeps keyed A- on for the additional 150 msec. In addition, Q15 is held on to provide drive to Q16 which keeps antenna switch active for the additional 150 msec. The purpose of this delay is to provide time for EOM or reverse PL burst to be sent at the end of every transmission.

Another delay network (C10, R47, R48) is used to prevent the occurrence of antenna switching following repeater PTT. Q14 is enabled for approximately 200 msec following repeater PTT to prevent Q16 from turning on during the delayed keyed A+ period.

Line transmit audio enters the module on pin 2, is applied by Q5 and exists the module either via pin 5 (audio to be encoded) or through audio gate Q4 to pin 6 (audio to be transmitter clear). When either a data detect (pin 10), *DVP* control (pin 9), or RPTR PTT (pin 11) is active, Q4 turns off, preventing audio from reaching pin 6.

Local mic audio enters the module on pin 4 and either exists directly on pin 5 or is gated through Q4 to pin 6 in the same manner as line audio.

R1 discriminator audio enters the module on pin 7, is amplified, and then set out on pin 8 where it is routed to the squelch gate module for the squelch detector.

The line disable switch prevents line PTT from occurring in the guard tone decoder. The PL disable switch provides a low on pin 23 and a high on pin 24. Note that on carrier squelch stations Q20 must be removed. PL disable allows the user to monitor the receive channel.

PARTS LIST

TLN5970A Station Control Module — PL-5437-D

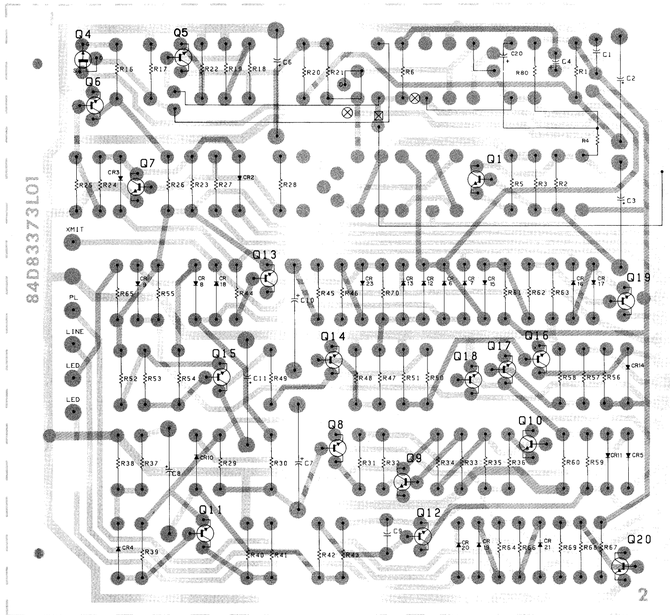
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed:
C1,9	21-83596E01	.001 uF ±10%; 500 V
C2,3	23-82783B13	15 uF ±5%; 25 V
C4,12	23-84538G14	1.0 uF ±10%; 35 V
C6,7	23-82783B13	15 uF ±5%; 25 V
C8	23-82783B27	10 uF ±10%; 25 V
C9	21-83596E01	.001 uF ±10%; 500 V
C10,11	23-82783B13	15 uF ±15%; 25 V
C20	23-82783B13	15 uF ±10%; 25 V
		DIODES: (SEE NOTE)
CR2 thru 4 6 thru 21, 23	48-83654H01	silicon
CR22	48-88245C08	LED, red
CR24	48-82256C12	silicon
		TRANSISTOR: (SEE NOTE)
Q1	48-869570	NPN; type M9570
Q4	48-869660	FET; type M9660
Q5,6,7	48-869642	NPN; type M9642
Q8	48-869643	PNP; type M9643
Q9	48-869594	NPN; type M9594
Q10 thru 13	48-869643	PNP; type M9643
Q14	48-869642	NPN; type M9642
Q15	48-869643	PNP; type M9643
Q16,18	48-869568	NPN; type M9568
Q17	48-869642	NPN; type M9642
Q19,20	48-869642	NPN; type M9642
		RESISTORS, fixed ±10%; 1/4 W; unless otherwise stated
R1	6-124C25	100
R2	6-124D02	150k
R3	6-124C87	39k
R4	6-124C49	1k
R5	6-124C39	390
R6	6-124A83	27k ±5%
R9	6-124C61	3.3k
R16	6-124C97	100k
R17	6-124C73	10k
R18	6-124A95	82k ±5%
R19	6-124A89	47k ±5%
R20	6-124C49	1k
R21	6-124C43	560
R22	6-124A19	56 ±5%
R23	6-124C65	47k
R24	6-124C61	3.3k
R25	6-124C53	1.5k
R26	6-124C73	10k
R27,28	6-124C89	47k
R29	6-124C71	8.2k
R30	6-124C89	47k
R31	6-124A73	10k ±5%
R33	6-124A83	27k ±5%
R34	6-124C65	4.7k
R35	6-124C49	1k
R36	6-124C01	10
R37	6-124C53	1.5k
R38	6-124C79	18k
R39	6-124C73	10k
R40	6-124C57	2.2k
R41	6-124C45	680
R42	6-124C53	1.5k
R43	6-124C57	2.2k
R44	6-124C73	10k
R45	6-124A33	220 ±5%
R46	6-124A95	82k ±5%
R47	6-124A75	12k ±5%
R48	6-124C61	3.3k
R49	6-124C47	820
R50	6-124C33	220
R51	6-124C37	330
R52	6-124C01	10
R53	6-124C49	1k
R54	6-124C65	4.7k
R55	6-124C73	10k
R56	6-124C65	4.7k
R57,58	6-124C49	1k
R59	6-124C53	1.5k
R60	6-124C65	4.7k
R61	6-124A61	3.3k ±5%
R62,63,64	6-124C57	2.2k
R65	6-124C43	560
R66	6-124C57	2.2k
R67	6-124C65	4.7k
R68,69	6-124C73	10k
R70	6-124A37	330 ±5%
R80	6-124A27	120 ±5%
		SWITCHES, slide
S1	40-83468E01	spdt
S2, 3	40-83204B01	dpdt
		VOLTAGE REGULATOR:
VR1	48-82256C12	ZENER, 5.6 V
		MECHANICAL PARTS
	1-80795B14	PANEL ASSEMBLY, includes: ref, items S1, 2, 3
	64-83364L01	PANEL
	1-80795B15	CIRCUIT BOARD ASSEMBLY, includes:
	9-83011H11	RECEPTACLE, board mounting; 24 used
	43-865080	BUSHING, threads; 2 used
	3-8022	SCREW, machine; 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock #4 int.; 2 used

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

revisions

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5970A-2	CR5	DELETED AND REPLACED WITH WIRE JUMPER	KEYED A+ SWITCH CIRCUIT
	Q9	FROM 48-869642, M9642 TO: 48-869594, M9594	
	R33	FROM 6-124C57, 2.2k TO: 6-124A83; 27k	
	R31	FROM 6-124A71, 82.k TO: 6-124A73; 10k	
	R32	DELETED	
	VR1	ADDED	

EARLIER VERSION



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE @ 80-DEPS-23258-D
SOLDER SIDE 80-DEPS-23259-D
OL-DEPS-23309-B

PLATING CUTS
⊠ = COMPONENT SIDE
⊗ = SOLDER SIDE

FUNCTIONAL DESCRIPTION

The line driver provides an audio and control interface between the base or repeater station and the 600 ohm wire lines from the remote control console. The line driver can operate in either the encode/decode mode in which only clear or coded audio is handled or in the transparent mode in which clear or coded audio is handled. Two different line driver versions are available: the 2-wire version (TLN5971A) utilizes one 600 ohm line for transfer of information to and from the console and the 4-wire version (TLN5977A) utilizes 2-600 ohm lines for transfer of information to and from the console.

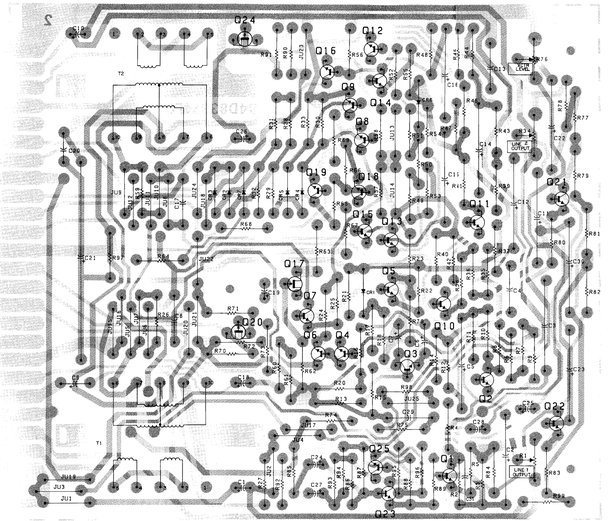
Receiver audio enters the module on pin 19 and passes through audio gate Q17 if R1 squelch indicate, pin 19, is high (about 4.0 volts dc) or if data detect, pin 10, is low. If JU18 is installed, antenna switch, pin 7, will inhibit audio gate Q17 when in a low state. After passing through the audio gate, the receiver audio is sent through the receive notch filter on the F1-P1 module via pin 19. This notched audio is brought back to the line driver on pin 24. If the line driver is a 4-wire version JU20 is out and JU19 is installed which bypasses the receive notch filter. The receive audio passes through the level set potentiometer and is presented to an amplifier string consisting of Q1 and Q2 which provides about 35 dB of gain. Q3 provides the necessary phase inversion on the emitter and collector for the interface to the audio transformer T1 via Q4, Q6 and Q5, Q7 respectively. Receiver audio exits the line driver on pins 22 and 23. If a TLN5977A Line Driver is used (4-wire) the audio on pin 24 is routed to the line 2 level control and through an identical amplifier string as in the 2-wire version. Line 2 audio exits the module on pins 3 and 4.

Console audio is presented to the line driver on pins 22 and 23 (line 1). The console audio is then routed to two different areas: control tones are picked up on pin 7 of T1, exit on pin 18, and are then set to the guard tone decoder; line audio is sent through the exciter level control and the exciter amplifier which provides audio to the exciter for transmitting.

Antenna switch (pin 7) is used to mute the R1 audio at Q17 and disable line drivers Q6 and Q7 to allow non-interference with function tones for function tone detection.

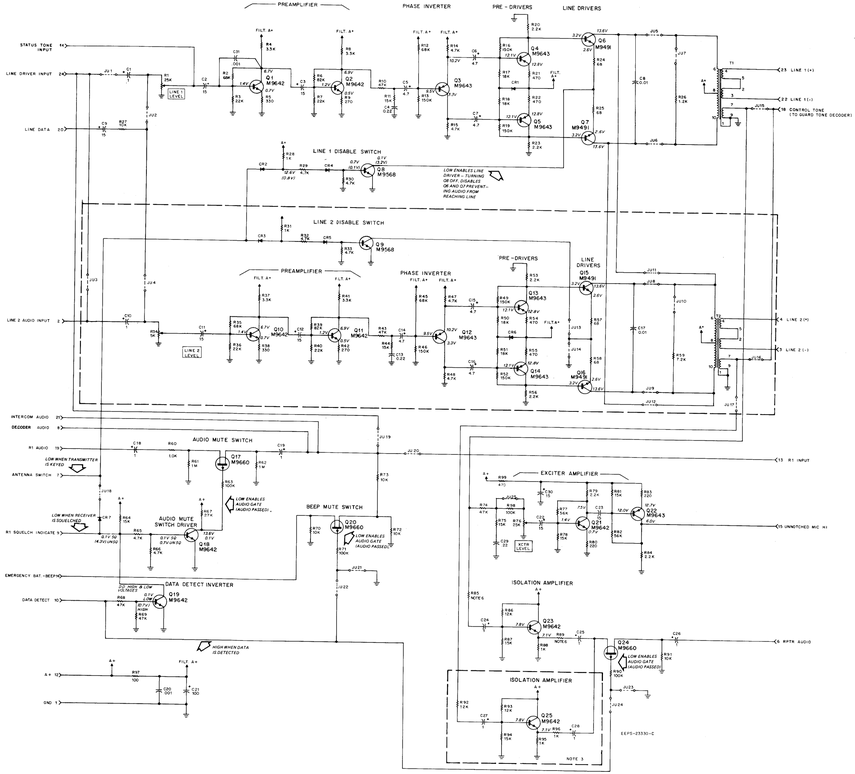
Local speaker audio which is taken from pin 7 of T1 and routed through the isolation amplifier Q23, audio gate Q24, and exits on pin 6. One an encode/decode station, Q24 is forced into a conducting mode at all times by installing JU23. This allows the local speaker to monitor clear and decoded audio from the receiver and line. For a transparent station, Q24 is prevented from conducting whenever a data detect (+9.0 volts at pin 10) is present. This allows the local speaker to monitor only clear audio. In the 4-wire version (TLN5977A), console audio is monitored at pin 7 of T1 and receive audio is monitored at pin 7 to T2. This received audio is routed through isolation amplifier Q25, audio gate Q24, and exits the module on pin 6.

On a transparent station, received coded audio enters the module on pin 20 and is routed to the console via line 2.



VIEWED FROM SOLDER SIDE

COMPONENT SIDE 80-DEPS-23255-D
SOLDER SIDE 80-DEPS-23256-D
GL-DEPS-23257-D



LINE DRIVER MODULES

MODEL TLN5971A (2-WIRE AUDIO)
MODEL TLN5977A (4-WIRE AUDIO)

FUNCTION

TLN5971A 2-Wire Audio Module - Accepts audio from one receiver, amplifies the audio and routes it either through an amplifier section or as a direct output; a single transformer is used to accept the transmit audio and control signals and also provide line audio to a remote point; gating circuits allow external control of R1 mute and line driver disable functions.

TLN5977A 4-Wire Audio Module - Accepts audio from up to two different receivers. Amplifies the audio and routes it out to either of (two line outputs, or the local speaker); two transformers are provided. One is used for accepting the transmit audio and control signals, and the other is used to provide line audio to a remote point; gating circuits allow external control of R1 mute, R2 mute, and line driver disable functions.

PARTS LIST SHOWN ON BACK
68P81035E57-C
5/30/85- UP

PARTS LIST

TLN5971A 2-Wire Line Driver Module
TLN5977A 4-Wire Line Driver Module PL-5431-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed: uF ±10%; unless otherwise stated
C1	23-84538G14	1.0; 35 V
C2,3	23-82783B13	15 ±5%; 25 V
C4	8-82905G11	0.22; 50 V
C5	23-82783B11	4.7 ±20%; 35 V
C6,7	23-84538G02	4.7 ±20%; 20 V
C8	8-82905G01	.01; 50 V
C9	23-82783B13	15 ±5%; 25 V
C10	23-84538G14	1.0; 35 V (TLN5977A only)
C11,12	23-82783B13	15 ±5%; 25 V (TLN5977A only)
C13	8-82905G01	.022; 50 V (TLN5977A only)
C14,15,16	23-82783B11	4.7 ±20%; 35 V (TLN5977A only)
C17	8-82905G01	.01; 50 V
C18,19	23-84538G14	1.0; 35 V
C20	21-83596E01	.001; 500 V
C21	23-83210A08	100 -10+150%; 25 V
C22,23	23-82783B13	15 ±5%; 25 V
C24,25,26	23-84538G14	1.0; 35 V
C27,28	23-84538G14	1.0; 35 V (TLN5977A only)
C29	8-82905G11	0.22; 50 V
C30	23-84538G04	15 ±20%; 20 V
C31	21-82187B14	.001; 100 V
		DIODES: (SEE NOTE)
D1,2	48-83654H01	silicon
D3	48-83654H01	silicon (TLN5977A only)
D4	48-83654H01	silicon
D5,6	48-83654H01	silicon (TLN5977A only)
D7	48-83654H01	silicon
		TRANSISTORS: (SEE NOTE)
Q1,2	48-869642	NPN; type M9642
Q3,4,5	48-869643	PNP; type M9643
Q6,7	48-869491	NPN; type M9491
Q8	48-869568	NPN; type M9568
Q9	48-869568	NPN; type M9568 (TLN5977A only
Q10,11	48-869642	NPN; type M9642 (TLN5977A only)
Q12,13,14	48-869643	PNP; type M9643 (TLN5977A only)
Q15,16	48-869491	NPN; type M9491 (TLN5977A only)
Q17	48-869660	FET; type M9660
Q18,19	48-869642	NPN; type M9642
Q20	48-869660	FET; type M9660
Q21	48-869642	NPN; type M9642
Q22	48-869643	PNP; type M9643
Q23	48-869642	NPN; type M9642
Q24	48-869660	FET; type M9660
Q25	48-869642	NPN; type M9642 (TLN5977A only)
		RESISTORS; fixed: ±10%; 1/4 W; unless otherwise stated
R1	18-83083G03	var. 25k
R2	6-124A93	68k ±5%
R3	6-124C81	22k
R4	6-124C61	3.3k
R5	6-124C37	330
R6	6-124C95	82k
R7	6-124C81	22k
R8	6-124C61	33k
R9	6-124C35	270
R10	6-124C89	47k
R11	6-124C77	15k
R12	6-124A93	68k ±5%
R13	6-124B02	150k ±5%
R14,15	6-124A65	4.7k ±5%
R16	6-124B02	150k ±5%
R17,18	6-124A79	18k ±5%
R19	6-124B02	150k ±5%
R20	6-124A57	2.2k ±5%
R21,22	6-124C41	470
R23	6-124A57	2.2k ±5%
R24,25	6-124C21	68
R26	6-124C51	1.2k
R27	6-124C73	10k
R28	6-124C49	1k

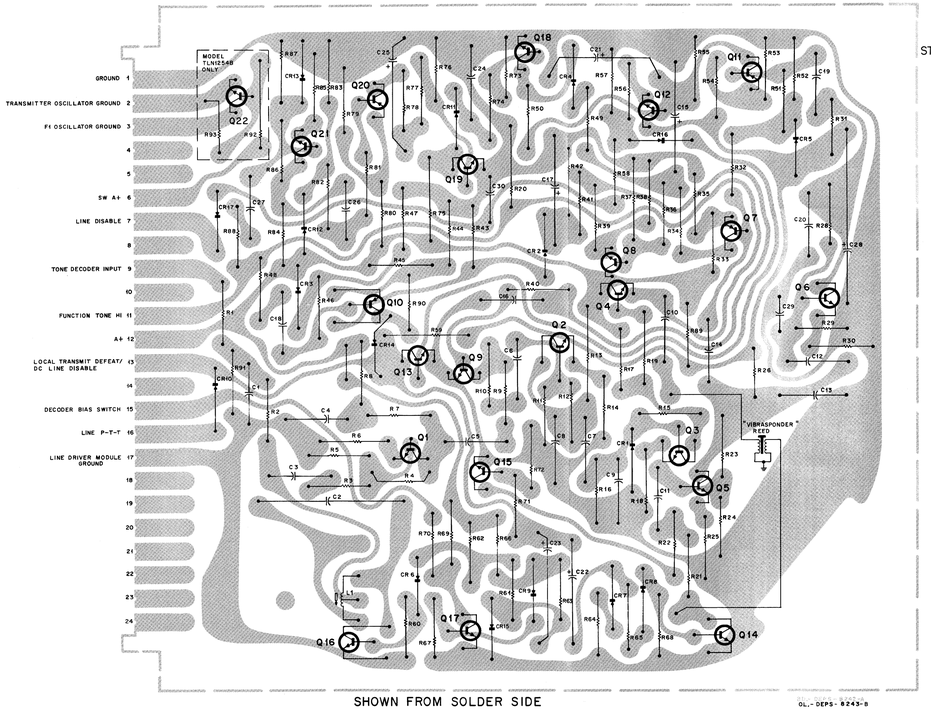
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R29,30	6-124C65	4.7k
R31	6-124C49	1k (TLN5977A only)
R32,33	6-124C65	4.7k (TLN5977A only)
R34	18-83083G03	var. 25k (TLN5977A only)
R35	6-124C93	68k (TLN5977A only)
R36	6-124C81	22k (TLN5977A only)
R37	6-124C61	3.3k (TLN5977A only)
R38	6-124C37	330 (TLN5977A only)
R39	6-124C95	82k (TLN5977A only)
R40	6-124C81	22k (TLN5977A only)
R41	6-124C61	3.3k (TLN5977A only)
R42	6-124C35	270 (TLN5977A only)
R43	6-124C89	47k (TLN5977A only)
R44	6-124C77	15k (TLN5977A only)
R45	6-124C93	68k (TLN5977A only)
R46	6-124B02	150k ±5% (TLN5977A only)
R47,48	6-124A65	4.7k ±5% (TLN5977A only)
R49	6-124B02	150k ±5% (TLN5977A only)
R50,51	6-124A79	18k ±5% (TLN5977A only)
R52	6-124B02	150k ±5% (TLN5977A only)
R53	6-124A57	2.2k ±5% (TLN5977A only)
R54,55	6-124C41	470 (TLN5977A only)
R56	6-124A57	2.2k ±5% (TLN5977A only)
R57,58	6-124C51	1.2k (TLN5977A only)
R59	6-124C51	1.2k (TLN5977A only)
R60	6-124C49	1k
R61,62	6-124D22	1 meg
R63	6-124C97	100k
R64	6-124C77	15k
R65,66	6-124C65	4.7k
R67	6-124C83	27k
R68,69	6-124C89	47k
R70	6-124C73	10k
R71	6-124C97	100k
R72,73	6-124C73	10k
R74	6-124C97	100k
R75	6-124C77	15k
R76	18-83083G03	var. 25k
R77	6-124C93	68k
R78	6-124C77	15k
R79	6-124C65	4.7k
R80	6-124A29	150 ±5%
R81	6-124C77	15k
R82	6-124A93	68k ±5%
R83	6-124A29	150 ±5%
R84	6-124C65	4.7k
R85	6-124C79	18k (TLN5971A)
	6-124C75	12k (TLN5977A)
R86	6-124C75	12k
R87	6-124C77	15k
R88	6-124C49	1k
R89	6-124C55	1.8k (TLN5971A)
	6-124C49	1k (TLN5977A)
R90	6-124C97	100k
R91	6-124C73	10k
R92,93	6-124C75	12k (TLN5977A only)
R94	6-124C77	15k (TLN5977A only)
R95,96	6-124C49	1k (TLN5977A only)
R97	6-124C25	100
R98	6-124C77	15k
R99	6-124A41	470 ±5%
		TRANSFORMER
T1	25-83000H01	pri. #1 resist. 150 ohms pri. #2 resist. 150 ohms sec. #1 resist. 1200 ohms sec. #2 resist. 600 ohms
T2	25-83000H01	pri. #1 resist. 150 ohms (TLN5977A only) pri. #1 resist. 150 ohms sec. #1 resist. 1200 ohms sec. ±2 resist. 600
MECHANICAL PARTS		
	1-80795B16	CIRCUIT BOARD ASSEMBLY includes:
	9-83011H01	RECEPTACLE, board mounting
	43-865080	BUSHING, threaded

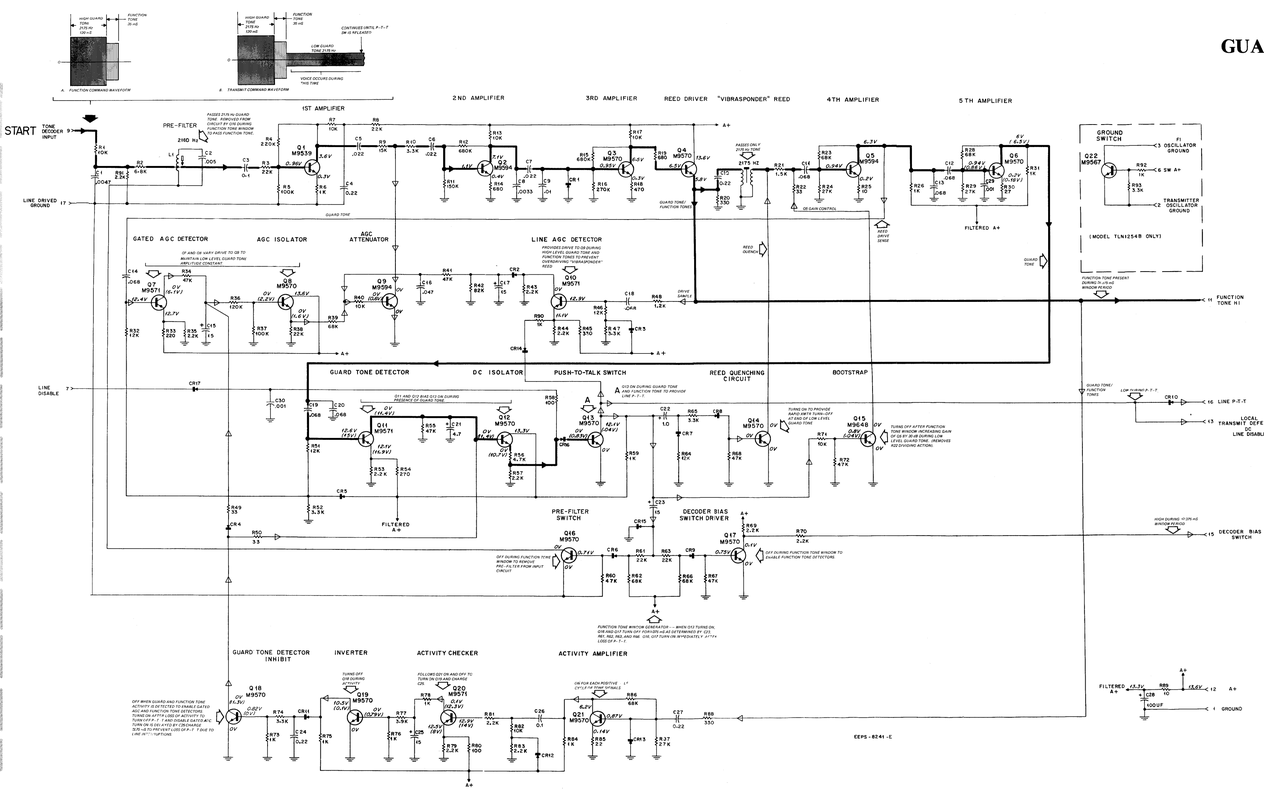
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock #4 int.; 2 used
	7-82613K01	BRACKET, circuit board
	43-82721C01	BUSHING, snap; 3 used
	45-83914G01	GUIDE, card; 2 used
	64-83361L02	PANEL
	80-83029H01	SPARK GAP; 2 used

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

GUARD TONE DECODER MODULES

MODELS TLN1245B
TLN1254B





FUNCTION

— Converts 2175 Hz guard Tone Signal to line PTT signal.
— Amplifies and distributes received function tones to other function decoders.
— Provides security against remote control chassis falsing from function tone signals outside predetermined time frame.
— Turns transmitter off at end of PTT.
— Transmitter channel element ground provided with TLN1254B Module. (A guard tone relay control station does not include this circuitry on any other module.)

Model Complement

Model	Version	Module	Version	Reed (2175 Hz)
TLN1245B		TLN4852A		TLN6709BH
TLN1254B		TLN5458A		TLN6709BH

68P81016E22-K
(Sheet 1 of 2)
7/15/83-PHI

GUARD TONE DECODER MODULES

MAINTENANCE & TROUBLESHOOTING

1. CONNECTIONS

This module may be serviced either while connected to the control chassis or while connected to separate external test equipment. Refer to control chassis servicing information in the manual for additional "Set-Up" details.

Make the following connections to the module.

Pin Number	Connection
1, 17	Ground
9	Audio oscillator through .1 uF
11	AC Voltmeter
12	A + 13.6 Volts DC

2. NORMAL CONDITIONS

Excessive deviations from these values indicate abnormal conditions.

Function	Typical Value
Pull-In Line Level @2175 Hz	– 31 dBm
Drop-Out Line Level @2175 Hz	– 51 dBm
PTT Turn-On Time	Less than 100 Milliseconds
PTT Turn-Off Time	Less than 100 Milliseconds
Prefilter Switch Time	375 Milliseconds
Gated AGC Threshold	– 45 dBm
Line AGC Threshold	– 18 dBm
Prefilter Frequency	2160 Hz
"Vibrasponder" Frequency	2175 Hz

3. MODULE MALFUNCTION LOCATION TECHNIQUES

Step 1. Inject a 15 millivolt, 2175 Hz audio tone into pin 9.

Step 2. Measure the dc voltage from pin 13 to ground as the tone input voltage reaches 15 millivolts, pin 13 should go to ground if the ground does not occur. Check voltages on transistors Q1 through Q6, Q11, Q12 and Q13.

Step 3. Connect an ac voltmeter across pin 11 and ground, and a dc voltmeter to pin 13 and ground. With an accurate 2175 Hz tone injected at pin 9, pin 13 should go to ground and remain. When pin 13 is at ground the output level at pin 11 should remain constant at 180 millivolts ± 3 dB when the input level is slowly varied from 3 millivolts to 80 millivolts. If this does not occur, check Q1, Q2, Q3, Q4 and Q5, Q7, Q8, Q9.

Step 4. Ground the base of the Q16 prefilter switch. With the ac voltmeter connected to pin 11, inject a 2000 Hz tone into pin 9. As the input level is raised to 40 millivolts ± 3 dB. The level measured at pin 11 should reach approximately 3 volts ac and then level off with proper operation, increasing the signal amplitude at pin 9 to 4 volts ac should cause only a 3 dB increase in the level at pin 11 from that with 40 millivolt input. If Step 3 was ok and Step 4 did not operate, check Q10.

Step 5. Repeat Steps 1 and 2 with an accurate 2175 Hz tone. To check the drop-out level, slowly reduce the signal amplitude at pin 9 until the voltage at pin 13 goes to the A+ level. Measure the ac voltage at pin 9. Extra attenuation may be required between the audio oscillator and pin 9, since the dropout level is typically less than – 60 dBm (1 mV).

parts list

TLN4852A Guard Tone Decoder
TLN5458A Guard Tone Decoder — PL-1771-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	8-82905G26	.0047
C2	8-84326A29	.005 ± 2%
C3	8-82905G07	0.1
C4	8-82905G11	0.22
C5 thru 7	8-82905G02	.022
C8	8-82905G25	.0033
C9	8-82905G01	.01
C10	8-82905G11	0.22
C11 thru 14	8-82905G04	.068
C15	23-865136	15 ± 20%; 25 V
C16	8-82905G03	.047
C17	23-865136	15 ± 20%; 25 V
C18 thru 20	8-82905G04	.068
C21	23-865137	4.7 ± 20%; 25 V
C22	23-82783B08	1.0 ± 20%; 35 V
C23	23-865136	15 ± 20%; 25 V
C24	8-82905G11	0.22
C25	23-865137	15 ± 20%; 25 V
C26	8-82905G07	0.1
C27	8-82905G11	0.22
C28	23-82601A25	100 + 150-10%; 20 V
C29, 30	21-82187B20	.001; 100 V
		semiconductor device, diode: (see note)
CR1 thru 17	48-82392B03	silicon
		coil, assembly; inductor:
L1	1-80702B11	1H; incl. ground clip
		transistor: (see note)
Q1	48-869539	NPN; type M9539
Q2	48-869594	NPN; type M9594
Q3, 4	48-869570	NPN; type M9570
Q5	48-869594	NPN; type M9594
Q6	48-869570	NPN; type M9570
Q7	48-869571	PNP; type M9571
Q8	48-869570	NPN; type M9570
Q9	48-869594	NPN; type M9594
Q10, 11	48-869571	NPN; type M9571
Q12 thru 14	48-869570	NPN; type M9570
Q15	48-869648	NPN; type M9648
Q16 thru 19	48-869570	NPN; type M9570
Q20	48-869571	PNP; type M9571
Q21	48-869570	NPN; type M9570
Q22	48-869567	NPN; type M9567 (TLN5458A only)
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C69	6.8k
R3	6-11009C81	22k
R4	6-11009D06	220k
R5	6-11009C97	100k
R6	6-11009C48	1k
R7	6-11009C73	10k
R8	6-11009C81	22k
R9	6-11009C77	15k
R10	6-11009C61	3.3k
R11	6-11009D02	150k
R12	6-11009D18	680k
R13	6-5556	10k; 1/2 W
R14	6-11009C45	680
R15	6-11009D18	680k
R16	6-11009D08	270k
R17	6-11009C73	10k
R18	6-11009C41	470
R19	6-11009C45	680
R20	6-6022	330; 1/2 W
R21	6-11009C53	1.5k
R22	6-11009C13	33
R23	6-11009C93	68k
R24	6-11009C83	27k
R25	6-11009C01	10
R26	6-11009C49	1k
R28	6-11009C93	68k
R29	6-11009C83	27k
R30	6-11009C11	27
R31	6-11009C49	1k
R32	6-11009C75	12k
R33	6-11009C33	220
R34	6-11009C89	47k
R35	6-11009C57	2.2k
R36	6-11009C99	120k
R37	6-11009C97	100k
R38	6-11009C81	22k
R39	6-11009C93	68k
R40	6-11009C73	10k
R41	6-11009C89	47k
R42	6-11009C95	82k
R43, 44	6-11009C57	2.2k
R45	6-11009C37	330
R46	6-11009C75	12k
R47	6-11009C61	3.3k
R48	6-11009C51	1.2k
R49, 50	6-11009C13	33
R51	6-11009C75	12k
R52	6-11009C61	3.3k
R53	6-11009C57	2.2k
R54	6-11009C35	270
R55	6-11009C89	47k
R56	6-11009C65	4.7k
R57	6-11009C57	2.2k
R58	6-11009C25	100
R59	6-6229	1k; 1/2 W
R60	6-11009C89	47k
R61	6-11009C81	22k
R62	6-11009C93	68k
R63	6-11009C81	22k
R64	6-11009C75	12k
R65	6-11009C61	3.3k
R66	6-11009C93	68k
R67, 68	6-11009C89	47k
R69, 70	6-11009C57	2.2k
R71	6-11009C73	10k
R72	6-11009C89	47k
R73	6-11009C49	1k
R74	6-11009C61	3.3k
R75	6-6229	1k; 1/2 W
R76	6-11009C49	1k
R77	6-11009C63	3.9k
R78	6-11009C49	1k
R79	6-11009C57	2.2k
R80	6-11009C25	100
R81	6-11009C57	2.2k
R82	6-11009C73	10k
R83	6-11009C57	2.2k
R84	6-11009C49	1k
R85	6-11009C09	22
R86	6-11009C93	68k
R87	6-11009C83	27k
R88	6-11009C37	330
R89	6-11009C01	10
R90	6-11009C49	1k
R91	6-11009C57	2.2k
R92	6-6229	1k (TLN5458A only)
R93	6-11009C61	3.3k (TLN5458A only)
		non-referenced items
	64-84316A01	PANEL (screened)
	45-83914G01	GUIDE, card
	3-8022	SCREW, machine #4-40 x 1/4"; 2 used
	4-7683	LOCKWASHER: #4 int.; 2 used

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

Vibrasponder Resonant Reed — PL-479-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	TLN6709BH	2175.0 Hz

REVISIONS 63P81016E22-K

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN1254B	Q22	ADDED TYPE M9567	BOARD PINS 2, 3, 6
	R92	ADDED 6-6229 1K	Q22 BASE
	R93	ADDED 6-129231 3.3K	Q22 BASE
	Q15	FROM 48-869570 TYPE M9570 TO 48-869648 TYPE M9648	
	R64	FROM 6S129753 100 OHM TO 6S124C75 12K OHM	

VOICE PROTECTION MODULES

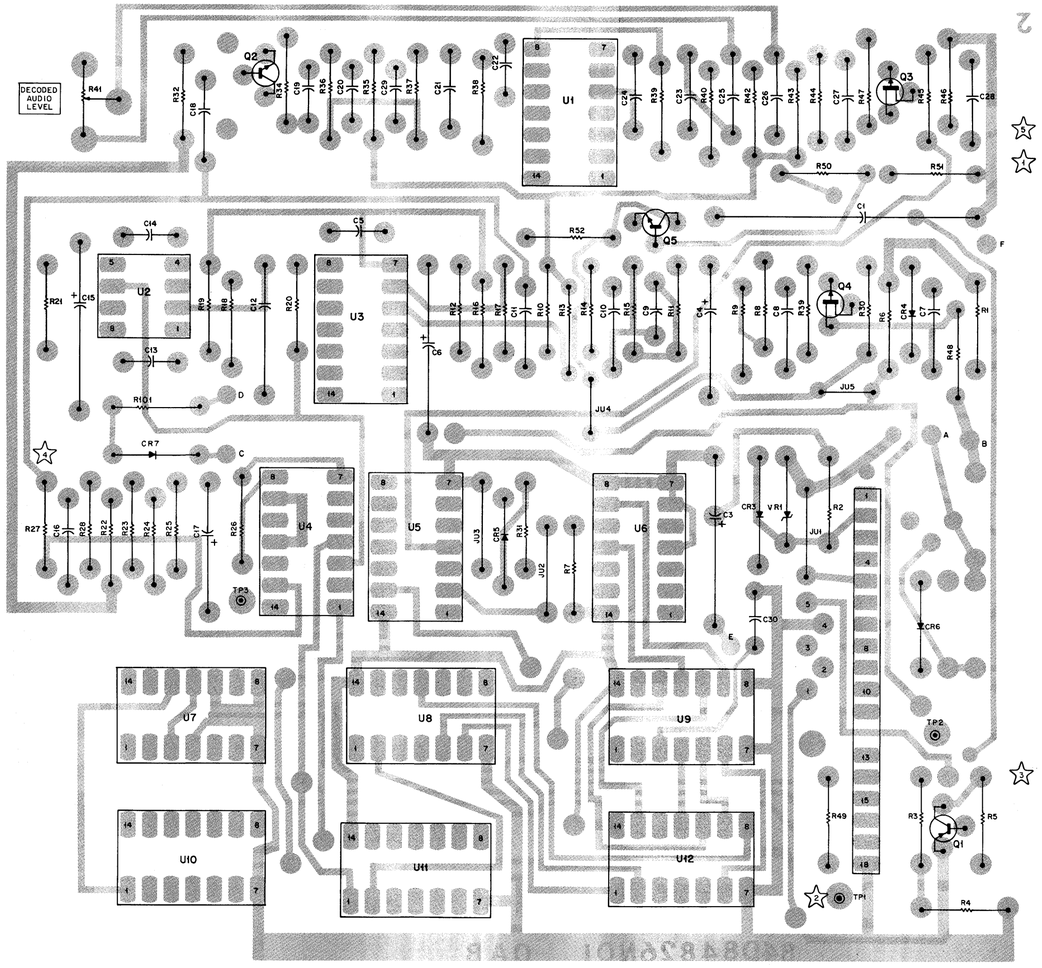
MODEL TLN5976B
MODEL TLN5780B (PROPER CODE)

parts list

TLN5976B Voice Protection Module
TLN5780B Voice Protection Module w/Proper Code Detect — PL-5432-E

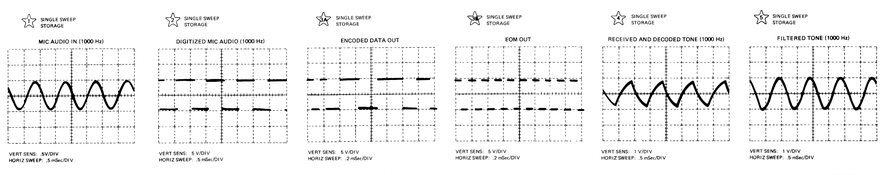
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitors, fixed; uF: unless otherwise stated:
C1	23-82601A25	100 +150-10%; 20 V
C3	23-865136	15 ±20%; 25 V
C4	23-82783B14	1.0 ±10%; 15 V
C5	21-83596E01	.001 ±10%; 500 V
C6	23-82783B27	10 ±10%; 25 V
C7, 8	21-82372C01	0.1 +80-20%; 25 V
C9	21-82428B34	600 pF ±10%; 500 V
C10, 11	21-82372C01	0.1 +80-20% 25 V
C12	23-82783B14	1.0 ±10%; 15 V
C13	21-82133G01	10 ±5%; 500 V
C14	21-83596E01	.001 ±10%; 500 V
C15	23-82783B27	10 ±10%; 25 V
C16	8-82905G03	.047 ±10%; 50 V
C17	23-82783B14	1.0 ±10%; 15 V
C18	21-82372C01	0.1 +80-20%; 25 V
C19, 20	21-82428B57	.0033 ±10%; 200 V
C21	21-84426B49	1500 pF ±5%; 500 V
C22	21-84426B18	130 pF ±5%; 500 V
C23	21-84426B49	1500 pF ±5%; 500 V
C24	21-84428B44	180 pF ±5%; 500 V
C25 thru 28	21-82372C01	0.1 +80-20%; 25 V
C29	21-84426B18	130 pF ±5%; 500 V
C30	21-847065	500 pF; 25 V
		diode: (see note)
CR2	48-82256C15	Zener; 5.1 V
CR3, 7	48-82139G01	germanium
CR4, 5, 6	48-83654H01	silicon
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
Q3, 4	48-869660	FET, type M9660
Q5	48-86748	NPN; type M9648
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009C01	10
R2	6-11009C31	180
R3, 4	6-11009C89	47k
R5, 6	6-11009C73	10k
R7	6-11009C89	47k
R8, 9	6-11009C87	39k
R10, 11	6-11009C73	10k
R12	6-11009C25	100
R13	6-11009D06	220k
R14	6-11009C73	10k
R15	6-11009C87	39k
R16	6-11009D06	220k
R17	6-11009C73	10k
R18, 19	6-11009C97	100k
R20	6-11009D22	1 meg
R21	6-11009C25	100
R22	6-11009C87	38k
R23	6-11009C92	62k
R24	6-11109C81	22k
R25, 26	6-11009C65	4.7k
R27, 28	6-11009C79	18k
R29	6-11009C89	47k
R30	6-11009D22	1 meg
R31	6-11009C89	47k
R32, 33	6-11009C93	68k
R34	6-11009C73	10k
R35	6-11009D12	390k
R36	6-11009D08	270k
R37, 38	6-11009D04	180k
R39	6-11009D02	150k
R40	6-1110D05	200k
R41	18-83083G26	var. 50k
R42	6-124C73	10k
R43	6-124C59	2.7k
R44	6-124C73	10k
R45	6-124D22	1 meg
R46	6-124C89	47k
R47, 48	6-124D22	1 meg
R49	6-124D06	220k
R50, R51	6-11009C89	4.7k
R52, 101	6-11009C73	10k
		integrated circuit: (see note)
U1	51-84561675	type M2121
U2	51-83629M15	type M2126
U3	51-84561L75	type M2121
U4	51-84768F31	type SC76831
U5	51-82884L05	type CD4011
U6, 7	51-82884L13	type CD4013 (TLN5780A only)
U8	51-82884L19	type 4024 (TLN5780A only)
U9	51-82884L18	type 4030 (TLN5780A only)
U10, 11	51-82884L19	type 4024 (TLN5780A only)
U12	51-82884L06	type CD4023 (TLN5780A only)
		mechanical parts
	1-80766D42	CIRCUIT BOARD ASSEMBLY, includes:
	39-10184A10	CONTACT, chain-form; 4 used
	9-83697M01	RECEPTACLE, board mounting; 24 used
	43-865080	BUSHING, threaded; 2 used
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock: #4 int.; 2 used
	9-82071K02	SOCKET, multi-contact
	15-83061L02	HOUSING, receptacle
	43-82721C01	BUSHING, snap
	45-83914G01	GUIDE, card; 2 used
	64-83363L01	PANEL

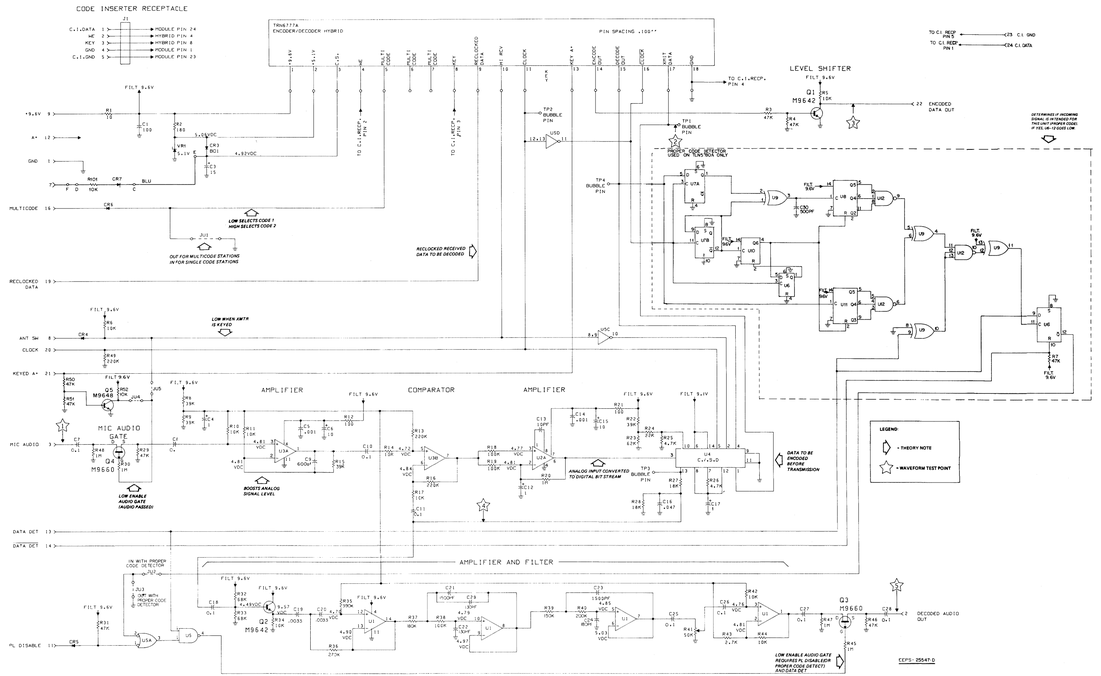
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE — DEPS-35799-O
SOLDER SIDE — DEPS-35800-O
OVERLAY — DEPS-35907-A





VOICE PROTECTION MODULES

MODEL TLN5976B
MODEL TLN5780B (PROPER CODE)

FUNCTION

- Processes transmit audio into a digital format for encoding.
- Encodes the digitized audio (data) for transmission.
- Decodes received data and processes this decoded data into an analog (audio) signal.
- The proper code detection version of this module, contains circuitry to inhibit the audio until the proper code is received.
- A connector on the front panel of this module mates with the code inserter whenever the code is to be changed.

NOTES:

1. Unless specified otherwise, resistor values are in ohms and capacitor values are in microfarads.
2. Voltages are taken with a dc voltmeter referenced to ground.

Voice Protection Module IC Data Chart

IC Ref. Symbol	Description	Supply Voltage (VDD) Pin No.	Ground (VSS) Pin No.
U1, U3	Quad Operational Amplifier	4	11
U2	Dual Comparator	7	4
U4	CVSD	6 & 14	9 & 11
U5	Quad 2 Input NAND Gate	14	7
*U6, U7	Dual D Flip-Flop	14	7
*U8, U10, U11	7-Stage Ripple Counter	14	7
*U9	Quad Exclusive OR Gate	14	7
*U12	Triple 3 Input NAND Gate	14	7

* These items are part of proper code detector.

VOICE PROTECTION MODULES

MODEL TLN5976B
MODEL TLN5780B (PROPER CODE)

FUNCTIONAL DESCRIPTION

GENERAL

Voice coding is performed by sending microphone audio into a Continuously Variable Slope Delta Modulator (CVSD) which converts it into a digital waveform. This digitized audio is then clocked at a 12 kHz rate into an encoder/decoder hybrid which "scrambles" it via an internally programmed algorithm. The resulting digital waveform occupies a bandwidth from 10 to 6000 Hz. This signal modulates the transmitter channel element directly via the code processor module. Coded data from the receiver is "unscrambled" into clear voice via an inverse operation.

RECEIVE MODE

In the receive mode, pin 10 of the encoder/decoder hybrid (TRN6777A) is high, and pin 2 of the CVSD is low. Reclocked scrambled data is applied to pin 9 of the hybrid via module pin 19 (Reclocked Data). Decoded digital audio is routed from pin 15 of the hybrid to pin 4 of the CVSD (U4). The CVSD output at pin 13 of U4 (TP3) varies from 400 mV P-P (no modulation) to approximately 6.0 volts P-P (full modulation). This amplitude varying digital signal is filtered by integrator network (R27, R28, and C16), and filter network U1. This filtered signal is amplified and gated by Q3 to module pin 2. Q3 turns on only when a data detect input is present on pin 13. For TLN5780B models, a data detect input and a proper code detect input is required to gate Q3.

TRANSMIT MODE

In the transmit mode, hybrid pin 10 is low, hybrid pin 13 is high, and pin 2 of U4 is high. MIC audio is applied to pin 3 of the module and gated through Q4 to amplifier U3A. Once amplified the audio is sent to comparator U3B, where it is compared with the integrated output of the CVSD. The comparator output is a digital signal with a bit length dependent upon the amount of error between the CVSD output and the MIC audio input. The polarity and length of this bit controls the voltage on C17, which in turn controls the amplitude of the voltage fed back to the comparator. Using this type of feedback, the CVSD provides amplitude variations that correspond to the audio input. The output of the comparator is routed to the CVSD where it is reclocked, and routed via pin 1 to pin 17 of the hybrid for encoding. This encoded signal is routed from hybrid pin 14 to level shifter Q1, and then via pin 22 to the exciter where it directly modulates the transmitter channel element.

EOM

An EOM (End of Message Signal) consists of a 6 kHz square wave generated in the hybrid. The EOM signal is routed from pin 14 of the hybrid to module pin 22 (via level shifter Q1), when line PTT or local PTT is released. The duration of the EOM is determined by the delay provided by delayed keyed A+, which keeps the station on the air for approximately 150 msec after PTT is released.

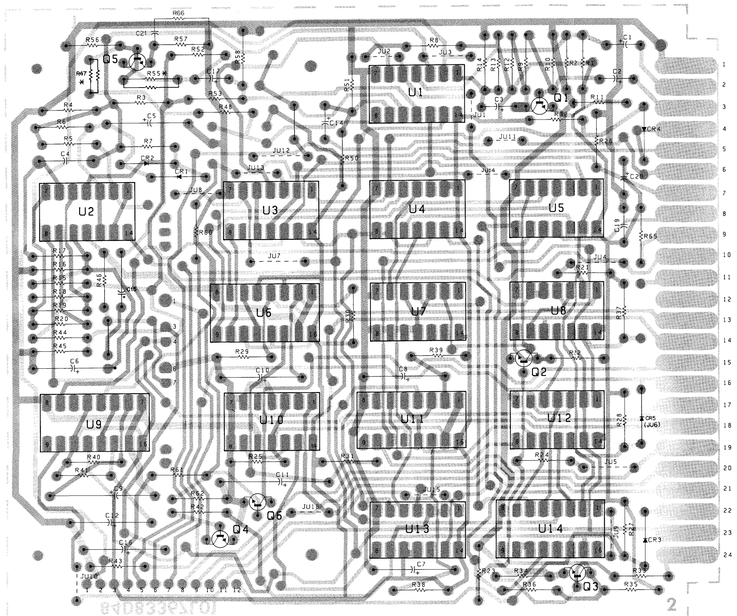
CODE INSERTION

When the code inserter (C1) plug is placed in receptacle J1, a ground (C1 ground) is produced at module pin 23, and upon activation of the code inserter C1 data is routed to the code processor module (via module pin 24) to be reclocked. After the C1 data is reclocked, it returns to the voice protection module on pin 19 which is directly connected to pin 9 of the hybrid. The WE (Write Enable) input on pin 4 of the hybrid pulses low during code insertion, and a digital signal is applied to pin 8 of the hybrid. After the code is loaded into the hybrid, a decoded digital tone followed by an EOM signal is routed from pin 15 of the hybrid to the CVSD, filtered by U1, and gated to pin 2 (Decoder Audio Out) by Q3. This tone is audible in the local speaker of the station, and on the 600 ohm line. The particular code loaded into the hybrid is retained as long as power is supplied to the station. If a power interrupt of less than 15 seconds occurs, the code storage capacitor (C3) prevents the hybrid from losing the programmed code.

PROPER CODE DETECTOR (MODEL TLN5780B ONLY)

The proper code detector samples the frequency content of the decoded audio (pin 15 of the encode/decode hybrid) to determine if the digital signal present is decoded audio or decoded noise (present if not programmed for the code being transmitted to the station). If the pin 15 output is not decoded audio, a proper code detect input is not applied to U5A, and unwanted decoded noise is not gated to pin 2 (Decoded Audio Out).

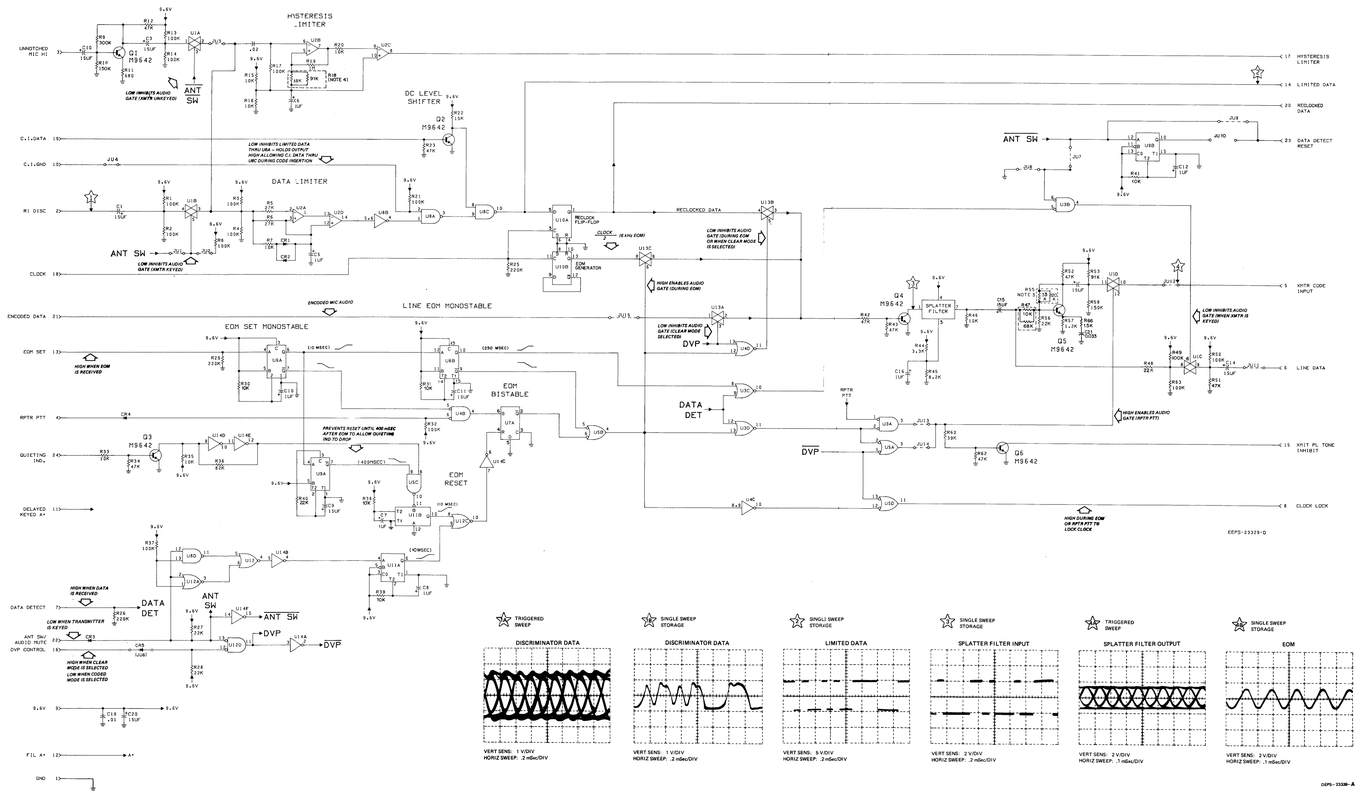
Counter U8 triggers when the decoded frequency at pin 15 of the hybrid is 1.1 kHz or less. Counter U11 triggers if the decoded frequency is greater than 5.2 kHz. The two counter outputs at pin 9 of U12 and pin 6 of U12 are gated by U9. The output of U9 pin 11 is used to clock in the signal on the D input (U6 pin 9). The D input is data detect, therefore, the proper code detector will have an output only if there has previously been a data detect. The output (U6 pin 12) is fed to U5A pin 2 and used with the data detect input to enable audio gate Q3 coupling audio to pin 2 of the module.



* R47 AND R55 CONSISTS OF 2-RESISTORS EACH

SHOWN FROM COMPONENT SIDE

COMPONENT SIDE ◎ 80-DEPS-23246-D
SOLDER SIDE ◎ 80-DEPS-23247-D
GL-DEPS-23248-C



DEPS-23328-A

CODE PROCESSOR MODULE

MODEL TLN5973A

FUNCTION

--Provides audio gating and gate control logic.

--Reshapes (reclocks) limited data so that data transitions coincide with the clock.

--Generates 180 msec end of message (EOM) signal when transmission is completed.

CODE PROCESSOR MODULE IC DATA CHART

IC REF SYMBOL	TYPE	DESCRIPTION	SUPPLY VOLTAGE (VDD) PIN NO.	GROUND (VSS) PIN NO.
U1, U13	MC14016	QUAD BILATERAL SWITCH	14	7
U2	MC3403	QUAD OPERATIONAL AMPLIFIER	4	11
U3, U9, U12	MC14001	QUAD 2 INPUT NOR GATE	14	7
U5, U8	MC14011	QUAD 2 INPUT NAND	14	7
U7, U10	MC14013	DUAL D FLIP-FLOP	14	7
U6, U8, U11	MC14538	DUAL MONOSTABLE MULTIVIBRATOR	16	8
U14	MC14069	HEX INVERTER/BUFFER	1	8

LEGEND:
- = THEORY NOTE
- = WAVEFORM TEST POINT

NOTES:

1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE GIVEN IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. JUMPER USAGE ON THIS MODULE IS GIVEN IN THE FOLLOWING CHART:

JUMPER	ENCODE/ DECODE STATIONS	TRANSPARENT STATIONS (COMB OPTION)
JU1	OUT	IN
JU2	IN	OUT
JU3	OUT	IN
JU4	IN	OUT
JU5	IN	OUT
JU6	IN	OUT
JU7	OUT	IN
JU8	IN	OUT
JU9	OUT	OUT
JU10	OUT	IN
JU11	OUT	IN
JU12	IN	IN
JU13	OUT	OUT
JU14	IN	OUT
JU15	IN	OUT
JU16	IN	OUT

3. R65 IS FACTORY ADJUSTED TO OBTAIN THE PROPER DEVIATION LEVEL IN SOME CASES THE 120K RESISTOR IS REMOVED.
4. R18 CONSISTS OF 68K AND 91K FOR VHF MODELS FOR UHF MODELS, 91K IS REMOVED.

PARTS LIST SHOWN ON BACK
68P81035E63-C
8/15/82-UP

CODE PROCESSOR MODULE

FUNCTIONAL DESCRIPTION

GENERAL

The code processor module performs transmit and receive functions required to interface the voice coding circuitry to the radio. Received data is put into sync with the station's internal clock prior to decoding or retransmission. Data to be transmitted, in addition to being relocked, it also low pass filtered to prevent excessive modulation splatter.

RECEIVE MODE

Data received from the radio discriminator, enters the module on pin 2 and is gated to two separate limiters via gate U1B. Gate U1B is enabled when the antenna switch signal (derived from pin 22) is high, indicating that the station is in the receive mode. The data limiter is a "hard" limiter that slices about the dc average of the input signal. This limited signal is routed to the code detect module via pin 14, and is also applied to flip-flop U10A, where it is put in sync with the station decoding clock (reclocked). This reclocked data is routed to the voice protection module, via pin 20, where it is decoded into clear voice. The hysteresis limiter is a lower gain circuit which requires a higher input level to block limiting. This lower gain prevents noise riding on the coded signal from being interpreted as data transitions. The limiter output is routed to the code detect module via pin 17 of this module.

In a repeater (RT) application, the reclocked data is applied to level shifter Q4 and the data splatter filter through gate U13B. Gate U13B is enabled by a high output from U4D. This requires a low output from U12D (indicating that the line or local mic is not keying the station) and a low output from the end-of-message control gate U5B. This low condition will exist as long as the logic has not been commanded to send an end-of-message signal.

After passing through the low pass splatter filter, the reclocked data is applied to amplifier Q5 and gated through U1D to the modulator. Gate U1D is enabled when (1) DVP indicating coded transmission in an encoder/decoder station applies a low, to gate U5A pin 1 or (2) either the data detect signal or the end-of-message signal is a high. In this case, for repeater (RT) usage, gate U3D applies a low to U5A pin 2, also causing U5A pin 3 to be high. Gate U5A also applies the high to transistor Q6 which supplies a switched low to prevent a PL tone from being applied to the modulator at the same time as code.

TRANSMIT MODE

An encode/decode type station supplies coded data for transmission to gate U13A via pin 21. Gate U13A is enabled when DVP is high which occurs for line or local keying in the coded mode. As in the clear mode, line or local keying takes priority over repeater operation.

The OR function provided by gate U12D provides transmit control and switching for coded mode operation. In stations having internal voice coding, the DVP control function (developed on the DVP control module) will be low for coded operation. For line or local keying of the station, the antenna switch signal (pin 22) will also go low, causing a high output at U12D and a low output at U14, the DVP and $\overline{\text{DVP}}$ supervisory signals.

For transparent type stations (those which send and accept coded signals on the wire line inputs) one additional input and one additional output are used. Module pin 3 receives coded data from the line driver module which is gated through U1A to the data and hystersis limiters. The gating function operates at the limiter inputs so that the limiters receive the receiver input (pin 2) when the station is not keyed, and the line input (pin 3) when the station is keyed. This is accomplished by using the antenna switch signal to control gates U1A and U1B. Once the line data has passed the data limiter, it is relocked in flip-flop U10A and passed on to pin 5 for transmission in the same manner as data during repeater operation. Received data in a transparent station will be limited, reclocked, and splatter filtered as though it were about to be repeated but instead will be passed out to pin 6 of the code processor and sent to the line driver input.

EOM

The remaining circuitry on the module provides control of the end-of-message (EOM) signal sent at the end of every coded transmission. An encode/decode type station provides the EOM signal input from the voice protection module at pin 21 which is gated through U13A for as long as the transmitter remains on the air after PTT is released (approx. 150 msec).

The transparent type station begins to transmit the EOM signals as soon as a positive going pulse occurs at pin 13 (this is an indication from the code detector that the EOM signal from the encoding source has been detected). Monostable U6A provides a short pulse to the second monostable U6B, which then times for approximately 150 msec and controls two other functions. The Q output of U6B provides a negative pulse of 150 msec to gate U5B. The resulting high from U5B enables gate U13C and allows the clock/2 EOM (6 kHz) signal to pass on to the modulator via pin 5. The Q output of U6B provides a 150 msec positive pulse which through U3C and U3B, holds the line data gate U1C open so that the clock/2 EOM signal is routed to the line driver.

A repeater station transmits an EOM signal through the entire transmitter turn-off cycle. Since the repeater may be set up to transmit several seconds of drop out delay, the code processor in this cases latches into an EOM sending mode. If the station has been repeating (indicated by a low at pin 4 of the module) the EOM set pulse from U6A pin 7 provides a set pulse to U7A via U4B causing a low on the Q output of U7A. This low holds gates U13C and U1D enabled routing the EOM signal to the transmitter.

EOM reset circuitry has been incorporated so that the repeater may be reaccessed during the dropout cycle. This circuitry receives an indication on pin 24 (high to low transition) when the receiver has a new signal input. This transition causes a high to low transition at U5C triggering monostable U11B to reset EOM latch U7A via U12C and U14C. Resetting the EOM latch shuts off the EOM gate U13C and removes the clock lock signal (pin 8). Exchanges through the repeater may occur rapidly enough that quieting indicate (pin 24) is unable to make any transition, but will stay low throughout. In this case, the 400 msec monostable U9A provides a low to high transition after EOM has been detected. If U5C-8 is still high (indicating quieting) the edge from the time out of U9A provides a reset to the EOM latch, and the new message may commence.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
TLN5973A Code Processor Module		PL-5433-C
		CAPACITORS, fixed: uF; unless otherwise stated
C1,2	23-82783B13	15 ±15%; 25 V
C3	23-84538G04	15 ±10%; 20 V
C4	8-82905G23	.02 ±10%; 100 V
C5 thru 8	23-82783B08	1.0 ±10%; 35 V
C9	23-84538G04	15 ±20%; 20 V
C10	23-82783B08	1.0 ±10%; 35 V
C11	23-84538G04	15 ±20%; 20 V
C12	23-82783B08	1.0 ±10%; 35 V
C14, 15	23-84538G04	15 ±20%; 20 V
C16	23-82783B08	1.0 ±10%; 35 V
C17,18	23-84538G04	15 ±20%; 20 V
C18		NOT USED
C19	21-82428B12	.01 +70-30%; 100 V
C20	23-84538G04	15 ±20%; 20 V
C21	8-83813H09	.033 ±10%;50 V
		DIODES: (SEE NOTE 1)
CR1,2	48-84616A01	hot-carrier
CR3,4,5	48-83654H01	silicon
		TRANSISTORS: (SEE NOTE 1)
Q1 thru 6	48-869642	NPN; type M9642
		RESISTORS, fixed: ±10%; 1/4 W unless otherwise stated
R1 thru 4	6-124C97	100k
R5,6	6-124A83	27k ±5%
R7	6-124A73	10k ±5%
R8	6-124C97	100k
R9	6-124B09	300k ±5%
R10	6-124D02	150k
R11	6-124A45	680 ±5%
R12	6-124A65	4.7k ±5%
R13,14	6-124C97	100k
R15,16,17	6-124A73	10k ±5%
R18	6-124A93	68k ±5% (SEE NOTE 2)
	6-124A96	91k ±5% (SEE NOTE 2)
R19	6-124B22	1.0 meg ±5%
R20	6-124C73	10k
R21	6-124C97	100k
R22	6-124C77	15k
R23	6-124C89	47k
R24	6-124A93	68k ±5%
R25,26	6-124D06	220k
R27,28	6-124A81	22k
R29	6-124D06	220k
R30, 31	6-124A73	10k ±5%
R32	6-124C97	100k
R33	6-124C73	10k
R34	6-124C89	47k
R35	6-124C73	10k
R36	6-124C95	82k
R37	6-124C97	100k
R38,39	6-124A73	10k ±5%
R40	6-124A81	22k
R41	6-124C73	10k ±5%
R42,43	6-124C89	47k
R44	6-124A61	3.3k ±5%
R45	6-124A71	8.2k ±5%
R46	6-124A73	10k ±5%
R47	6-124A93	68k ±5%; (SEE NOTE 3)
	6-124A73	10k ±5%; (SEE NOTE 3)
R48	6-124A65	4.7k ±5%
R50	6-124C97	100k
R51	6-124C89	47k
R52	6-124C65	4.7k
R53	6-124A96	91k ±5%
R54		NOT USED
R55	6-124A85	33k (SEE NOTE 3)
	6-124A99	120k (SEE NOTE 3)
R56	6-124A73	10k ±5%
R57	6-124A41	470 ±5%
R58	6-124D02	150k
R59		NOT USED
R60	6-124A87	39k ±5%
R61		NOT USED
R62	6-124C89	47k
R64, 65		NOT USED
R66	6-124A53	1500 ±5%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		INTEGRATED CIRCUITS: (SEE NOTE)
U1	51-82884L14	type 4016
U2	51-82884L75	type M2121
U3,4	51-82884L04	type CD4001
U5	51-82884L05	type CD4011
U6	51-82884L53	type MC14538
U7	51-82884L13	type 4013
U8	51-82884L05	type 4011
U9	51-82884L53	type MC14538
U10	51-82884L13	type 4013
U11	51-82884L53	type MC14538
U12	51-82884L04	type CD4001
U13	51-82884L14	type CD4016
U14	51-82884L02	type CD4049
U15	1-80793B98	Hybrid Splatter Filter
MECHANICAL PARTS		
	1-80795B22	CIRCUIT BOARD ASSEMBLY includes:
		RECEPTACLE, board mounting 24 used
		BUSHING, threaded; 2 used
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock; #4 int.; 2 used

NOTES:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. R18 consists of both resistors in VHF models; only 68k is used in UHF models.
3. R47 and R55 consists of 2 resistors; factory selects proper arrangement.

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DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
	TLN5973A-1	C13	DELETED 23-84538C04. 15 uF. REPLACED WITH JUMPER	Q5 CIRCUIT
		R49, 63	DELETED 6-124C97. 100k	
		R56	FROM 6-124C81. 22k TO 6-124A71. 10k	
		R57	FROM 6-124A51. 1.2k TO 6-124A41. 470	
		R48	FROM 6-124C81. 22k TO 6-124A65. 4.7k	
		R47	FROM 6-124A68. 6.2k TO 6-124A93. 68k and 6-124A73. 10k IN PARALLEL	

FUNCTIONAL DESCRIPTION

GENERAL

The code detect module contains a clock and three detector circuits. The clock is capable of tracKing with an incoming coded signal within a certain lock range. This prevents possible errors due to differences in clock frequencies between transmitting and receiving units.

Two of the detector circuits are used to determine if the incoming signal is coded or clear. The transition detector output is in the "active" state on a coded signal, in the "off" state on noise, and in an indeterminant state on clear audio signals. The 6 kHz detector is in the active state on noise and coded signals, and off on clear audio signals. These detector outputs are gated together so that the data detector output (pins 19 and 5) will be active only on coded signals.

The third detector circuit operates when the 6 kHz end-of-message (EOM) signal is received. This signal is used to rapidly deactivate the data detector in a manner similar to the reverse burst in PL systems.

CLOCK CIRCUITRY (See Figure 1)

The clock reference is a 1.776 MHz crystal controlled oscillator consisting of U7B, U7C and Y1. The oscillator output is divided by U4B to produce the 888 kHz hi-speed clock reference which is applied to counter U1. The counter outputs are applied to gates U2A, U2B, U2C, and U5B which control the division rate.

Limited discriminator data enters the module on pin 22. An edge generator circuit (U7, U15, U12, U9) generates a pulse (1.1 usec) on every transition of the limited data. These edges are compared with CLK and $\overline{\text{CLK}}$ at U9B and U9A respectively. If the edge occurs during the positive portion of the CLK, U3B is set and the counter control gates limit the count to 36 which when divided by 2 (U4A) gives 12.333 kHz. If the edge occurs during the positive portion of $\overline{\text{CLK}}$, U3A is set and the counter counts to 38 which when divided by U4A gives 11.684 kHz. If no edge occurs during CLK or $\overline{\text{CLK}}$, the counter counts to 37 which when divided by 2 is exactly 12 kHz. The counter is reset every half cycle of the clock, so that the frequency can be increased or decreased slightly in order to track with the data that appears on the discriminator. In this manner, the clock "locks" to the data which is necessary due to differences in clock frequencies between transmitting and receiving units. Once the clock has achieved lock, the discriminator data can be reliably reclocked in the center of the bit and remove any erroneous information produced by phase shifts.

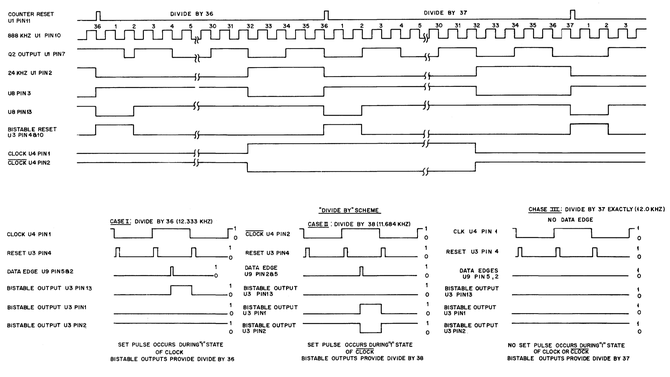


Figure 1. Clock Recovery Timing

NOTE
In the following paragraphs, certain component references are preceded by an asterisk (*). These items are located on the TLN5783A Auxiliary Board.

TRANSITION DETECTOR

The transition detector utilizes the fact that the 12 kHz clock locks to data in such a way that every transition of limited data lines up with the negative edge of clock. A pulse window with a duration of 13.5 usec is generated on the positive edge of clock. These pulse windows and the edges (discussed in the clock section) are applied to the D and C inputs of U14A respectively. On a strong RF signal modulated with code, the logic state of the D input at the time the C input goes high is a constant (provided the clock is locked). Therefore, the Q output of U14A which drives the reset of counter U11B via U10D, remains high during a strong code modulated RF signal. This allows counter U11B to count the reference #1 clock (2.75 msec) to the preselected count which produces a low on the output of U13D to reset the counter via flip-flop U14B and U10D. In this way, the status of U14A pin 1 can be checked after each count. The timing of events is such that when U13D pin 11 switches low, U10D pin 11 doesn't go low until U14B pin 13 goes high. This assures that *U1 pin 5 has been established prior to being clocked at pin 2. Thus again, on a strong RF signal, *U1A pin 2 is always clocked to a high which prevents counter *U15A from counting ref. #3 clock pulses (88 msec) by holding the reset (pin 7) high. This forces *U15A pin 6 low and *U15A pin 2 high. This point is brought back to the main board at U15A pin 13 to supply half the information necessary for a data detect output.

As the RF signal gets weaker, the limited data edges are no longer aligned with the negative transition of the clock as well as on the strong RF signal. The additional noise causes the output of flip-flop U14A (pin 1) to alternate between high and low. When there are enough pulses present at pin 1, counter U11B is not able to reach its preselected count before the reset appears at pin 15. This means that when flip-flop *U1A gets a positive going clock pulse at pin 3, the D input (pin 5) will be high which forces the reset on counter *U15A pin 7 low. This enables the counter to count ref. #3 clock pulses and after a count of 8, the Q3 output (pin 6) goes high. This high is inverted and applied to *U15A pin 2 which results in module pin 19 going low (via U15C and U10C) to indicate code is not being received.

6 kHz DETECTOR

Since the 6 kHz detector circuitry from *U7C pin 10 to U15B pin 12 is very similar to the transition detector circuitry (described previously), the discussion will be concentrated on the front end of the 6 kHz detector (U5, U16, U12, U11 on the auxiliary board). The hysteresis limiter input (module pin 24) is reclocked at *U5A pin 5 with the 12 kHz clock. The output of the flip-flop (*U5A pin 1) is applied to the D input (pin 7) of the 4-bit shift register *U16. Information is shifted through at a clock rate of 24 kHz (*U16A pin 9). If the limited signal is coded, the frequency content is such that there is a predominate alternating bit pattern seen at the outputs of the shift register. The exclusive OR gates (*U12) provide high going outputs which toggle the output (*U11C pin 10) when all three inputs are in a high state. The frequency of occurrance of these low going pulses is enough to keep counter *U14A from counting the ref. #1 clock pulses. This results in a logic high at pin 12 of U15B on the main board.

If the limited signal is clear audio, the frequency content is much lower than that of data and when clocked through shift register *U16A, long strings of zero's or one's are seen at the outputs of the shift register. This assures that at least one of the exclusive OR gates is in the off state and prevents any change at *U11 pin 10. This allows the counter U14A to count up which will result in a logic low at U15C pin 12, providing a low at pin 19 of the module to indicate the received signal is clear audio.

END OF MESSAGE (EOM) DETECTOR (See Figure 2)

At the end of every coded transmission, a burst of 6 kHz tone (EOM signal) is sent to rapidly shut down the data detector to a low state, similar to the way reverse burst is used in PL systems. The EOM detector is located on the auxiliary board and consists of U13, U7A, U5B, and U11. Reclocked hysteresis limited data from U5A is presented to *U13A pin 1 where the frequency content is sampled. Ref. #2 (44 msec) provides a sample window period in which the number of positive transitions are counted. If the count exceeds 160 (which only happens on a burst of 6 kHz), U5B pin 12 goes high when the ref. #2 pulse clocks flip-flop U5B. The detect time is between 15-44 msec on a strong RF signal. The output of the EOM detector is used to gate 12 kHz clock into the clock inputs of counters *U14A and *U15A instead of ref. #3 (88 msec clock). This provides a rapid switch to the standby condition (transition detect in a low state and the 6 kHz detect in a high state).

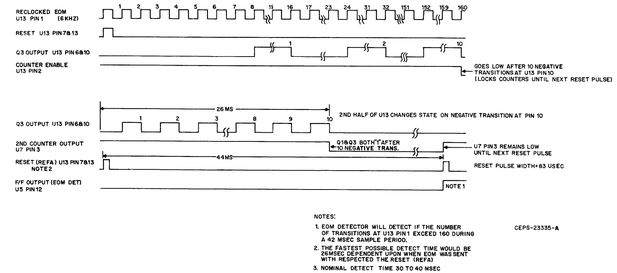


Figure 2. EOM Detector Timing

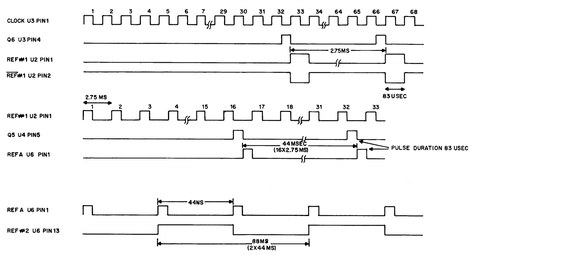
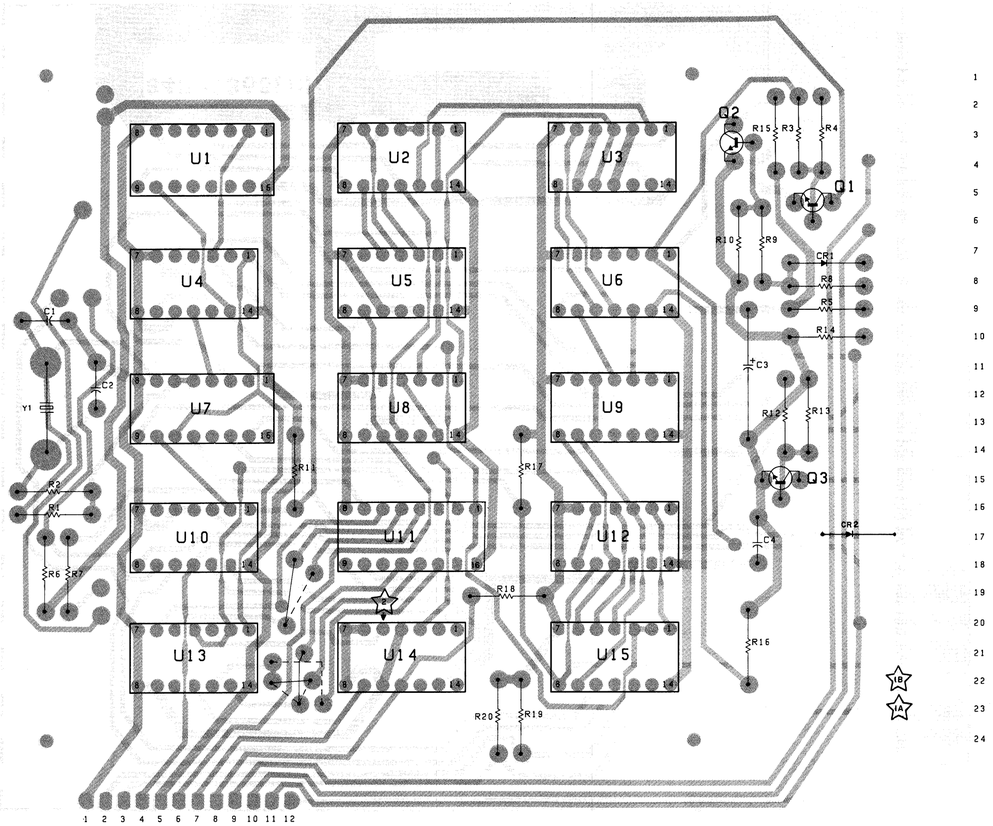


Figure 3. Clock Reference Generator

MODEL TLN5974A



COMPONENT SIDE ● BD-DEPS-23319-A
SOLDER SIDE BD-DEPS-23320-A
OL-DEPS-23321-A

SHOWN FROM COMPONENT SIDE

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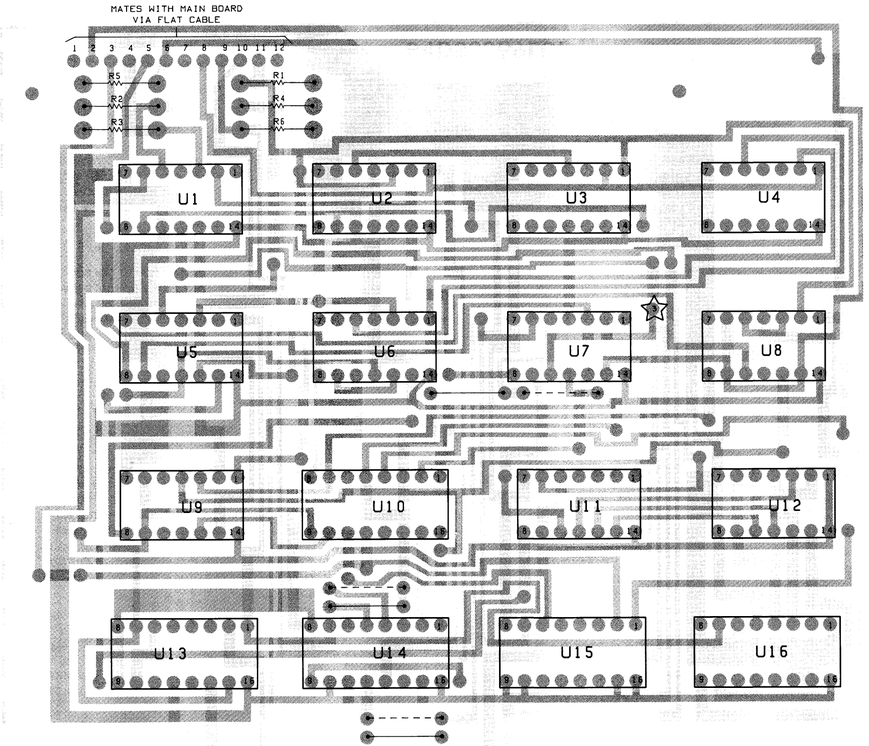
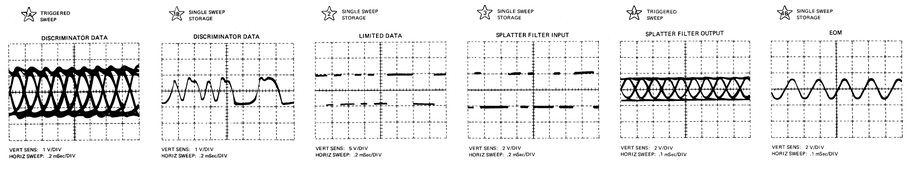
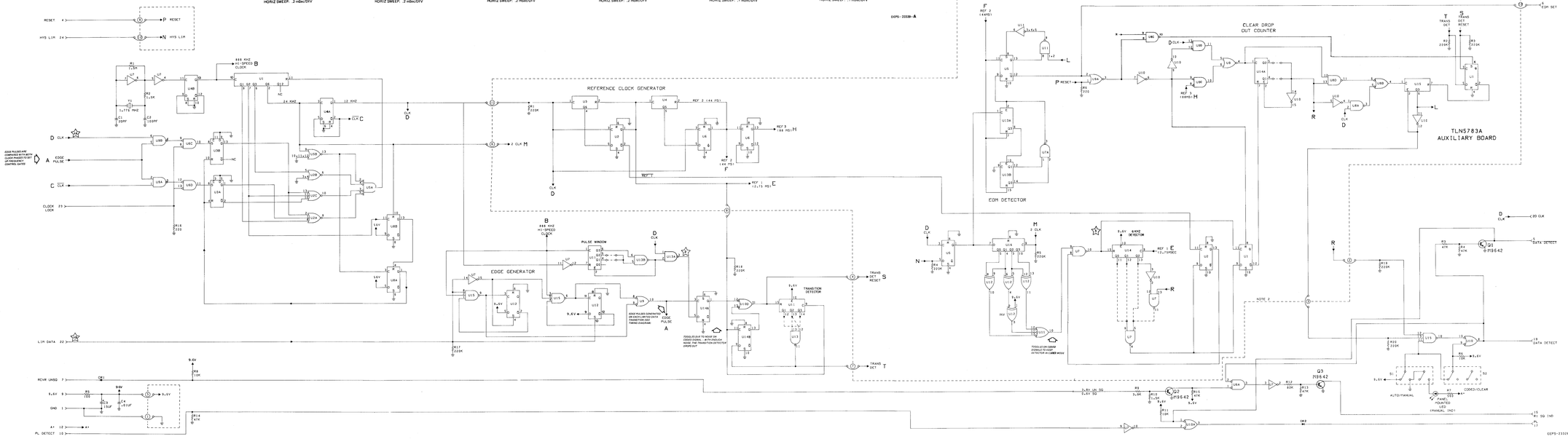
MODEL TLN5783A



COMPONENT SIDE ● BD-DEPS-23316-O
SOLDER SIDE BD-DEPS-23317-O
OL-DEPS-23318-O

SHOWN FROM COMPONENT SIDE





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PARTS LIST

TLN5974A Code Detector Module (Main Board) PL-5436-B

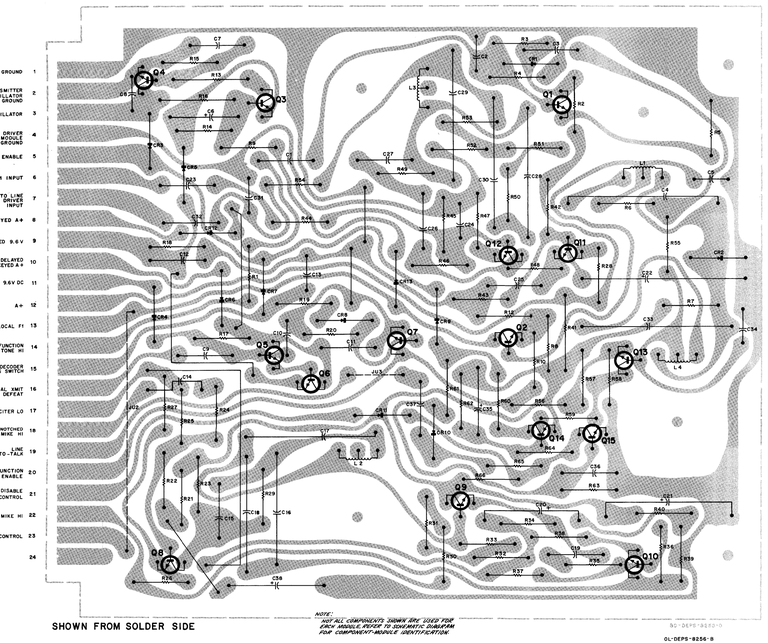
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed:
C1	21-82610C22	20 uF ±5%; 200 V
C2	21-82610C44	100 uF ±5%; 100 V
C3	23-82783B24	15 uF ±10%; 25 V
C4	21-82428B12	.01 uF +70-30%; 100 V
		DIODE: (SEE NOTE)
CR1, CR2	48-83654H01	silicon
		LIGHT EMITTING DIODE: (SEE NOTE)
DS1	48-88245C08	red
		TRANSISTOR: (SEE NOTE)
Q1,2,3	48-869642	NPN; type M9642
		RESISTORS: fixed, ±10%, 1/4W unless otherwise stated
R1	6-124B26	1.5 meg ±5%
R2	6-124A53	1.5k ±5%
R3,4	6-124C89	47k
R5	6-124C25	100
R6	6-124C73	10k
R7	6-124C43	560
R8	6-124C73	10k
R9	6-124C63	3.9k
R10	6-124C53	1.5k
R11	6-124C73	10k
R12	6-124C95	82k
R13,14,15	6-124C89	47k
R16 thru 20	6-124D06	220k
		SWITCH, slide:
S1,2	40-83204B01	dpdt
		INTEGRATED CIRCUIT: (SEE NOTE)
U1	51-83627M14	type CD4040
U2	51-82884L17	type CD4025
U3,4	51-82884L13	type CD4013
U5	51-82884L22	type 4002
U6	51-82884L04	type CD4001
U7	51-82884L02	type CD4049
U8	51-82884L13	type CD4013
U9	51-82884L05	type CD4011
U10	51-83627M17	type 74C00
U11	51-82884L07	type 14520
U12	51-82884L13	type CD4013
U13	51-82884L05	type CD4011
U14	51-82884L13	type CD4013
U15	51-82884L06	type CD4023
		CRYSTAL
Y1	48-83853F03	1.78 MHz
MECHANICAL PARTS		
	3-8022	SCREW, machine; 4-40 x 1/4"; 8 used
	4-7683	WASHER, lock: #4 int.; 8 used
	55-84413E01	HINGE, stand-off
	1-80795B23	PANEL ASSEMBLY includes: ref. items S1,2
	64-83365L01	PANEL
	1-80795B24	CIRCUIT BOARD ASSEMBLY includes:
	9-83011H01	RECEPTACLE, board mounting; 24 used
	43-84412E01	SPACER, threaded; 2 used
	45-83914G01	GUIDE, card; 2 used
	14-84583B02	INSULATOR

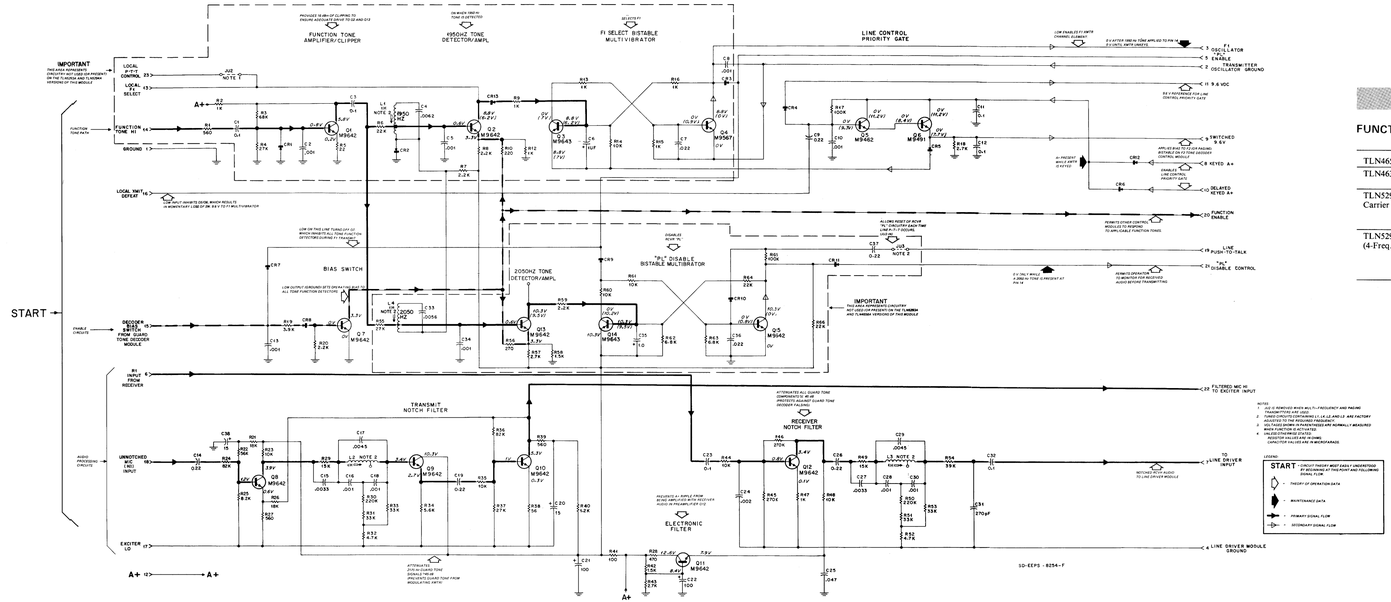
NOTE:
For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TLN5783A Code Detect Module (Auxiliary Board) PL-5434-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		RESISTORS, fixed:
R1 thru 6	6-124D06	220k ±10%; 1/4 W
		INTEGRATED CIRCUITS: (SEE NOTE)
U1,2	51-82884L13	type CD4013
U3,4	51-82884L19	type 4024
U5,6	51-82884L13	type CD4013
U7,8	51-82884L05	type CD4011
U9	51-82884L04	type CD4001
U10	51-82884L02	type CD4049
U11	51-82884L06	type CD4023
U12	51-82884L18	type CD4030
U13,14,15	51-82884L07	type 14520
U16	51-82884L16	type CD4015
MECHANICAL PARTS		
	30-82906L03	CABLE, flat; 12 conductor

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





F1 & F1-PL TONE DECODER MODULES

MODELS TLN4638A F1-PL
TLN4658A F1
TLN5293A F1 (4F)
TLN5294A F1-PL (4F)

FUNCTION

TLN4658A F1 Control	Keys XMTR on F1.
TLN4638A F1-PL Control	Keys XMTR on F1 and PL disables RCVR.
TLN5293A F1 Control (4-Freq. Carrier Squelch Station)	Provides receive and transmit notch filters. Frequency selected on separate 4-Freq. control module (TLN5292A).
TLN5294A F1-PL Control (4-Freq. PL Squelch Station)	Provides receive and transmit notch filters and PL disables RCVR. Frequency selected on separate 4-Freq. control module (TLN5292A)

PARTS LIST SHOWN ON BACK OF THIS PAGE

68P81016E19-N

10/5/82 - V & G

parts list

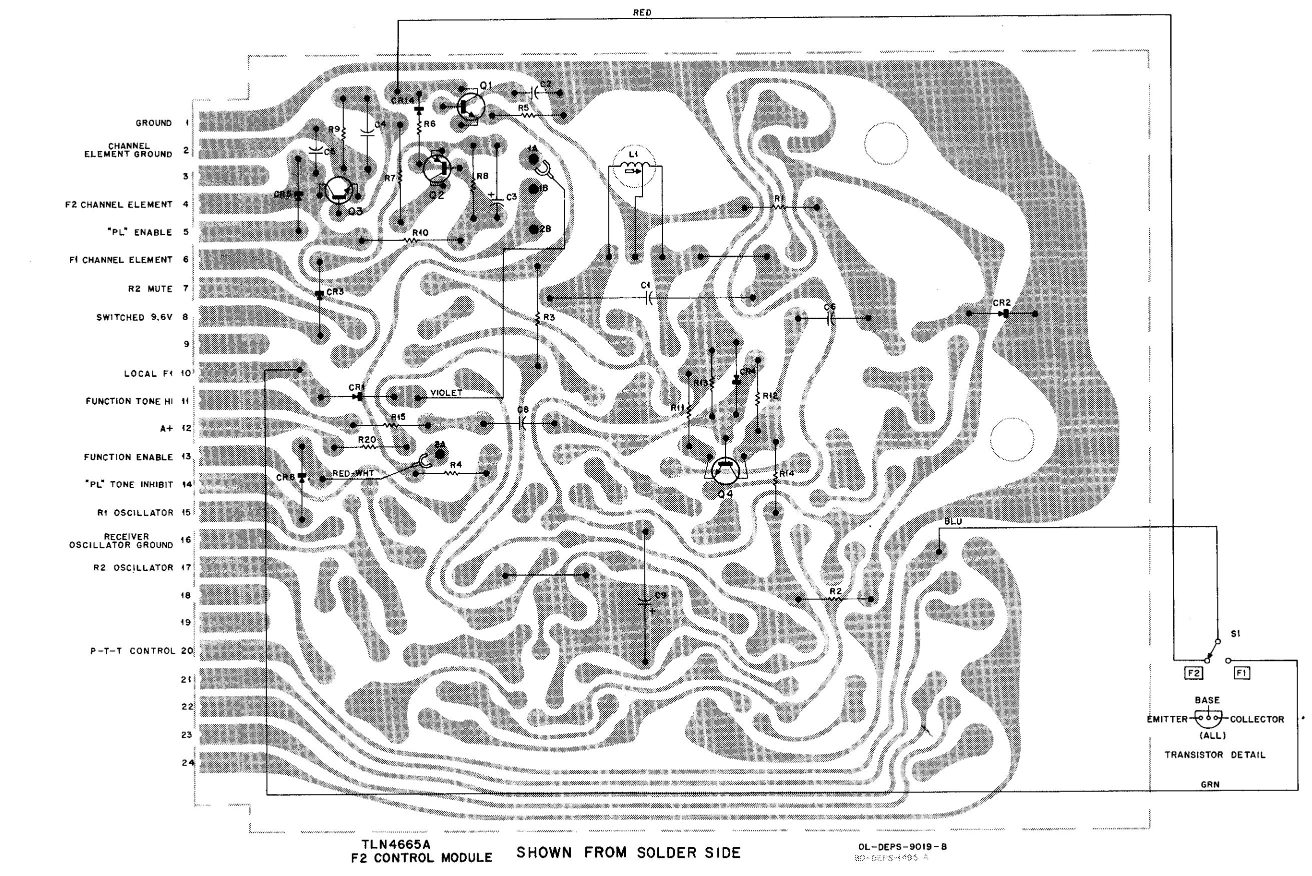
TLN4658A F1 Control Module
TLN4638A F1 *Private-Line* Control Module
TLN5293A F1 Control Module
TLN5294A F1 *Private-Line* Control Module PL-1798-G

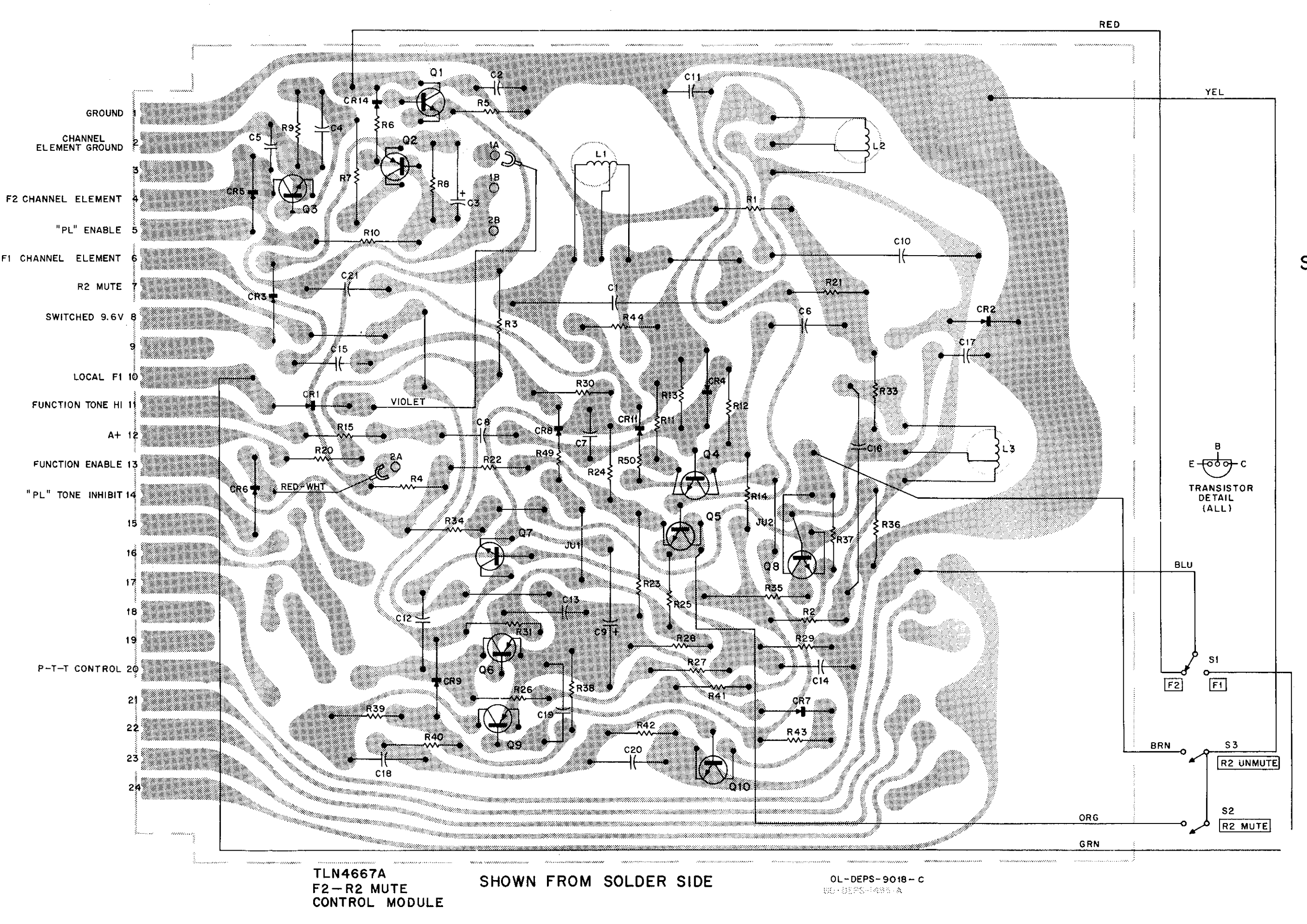
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V unless otherwise stated:
C1	8-82905G07	0.1
C2	21-82187B29	.001; 100 V
C3	8-82905G07	0.
C4	8-84326A14	.006 ± 2%
C5	21-82187B29	.001; 100 V
C6	23-82783B08	1 ± 20%; 35 V
C7	8-82905G02	.022
C8	21-82187B29	.001; 100 V
C9	8-82905G11	0.22
C10	21-82187B29	.001; 100 V
C11, 12	8-82905G07	0.1
C13, 14	21-82187B29	.001; 100 V
C15	8-82905G25	.0033
C16	8-82284C01	.001
C17	8-84326A30	.0045 ± 1%
C18	8-82284C01	.001
C19	8-82905G11	0.22
C20	23-865136	15 ± 20%; 25 V
C21	23-84669A19	100 + 150-10%; 20 V
C22	23-82601A25	100 + 150-10%; 20 V
C23	8-82905G07	0.1
C24	21-82187B27	.002; 100 V
C25	8-82905G03	.047
C26	8-82905G11	0.22
C27	8-82905G25	.0033
C28	8-82284C01	.001
C29	8-84326A30	.0045 ± 1%
C30	8-82284C01	.001
C31	21-82187B22	270 pF; 200 V
C32	8-82905G07	0.1
C33	8-84326A13	.0056 ± 2%
C34	21-82187B29	.001; 100 V
C35	23-82783B08	1 ± 20%; 35 V
C36	8-82905G02	.022
C37	8-82905G11	0.22
C38	23-865136	15 ± 20%; 25 V
		semiconductor device, diode (see note)
CR1 thru 13	48-83654H01	silicon
		reactor:
L1 thru 4	1V80702B11	(factory-adjusted) res. 40 ohms ± 10%; includes grounding clip
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
Q3	48-869643	PNP; type M9643
Q4	48-869567	NPN; type M9567
Q5	48-869642	NPN; type M9642
Q6	48-869491	NPN; type M9491
Q7, 8, 9, 10, 11, 12, 13	48-869642	NPN; type M9642
Q14	48-869643	PNP; type M9643
Q15	48-869642	NPN; type M9642
		resistor, fixed; ± 5%; 1/4 W; unless otherwise stated:
R1	6-11009C43	560
R2	6-11009C49	1k
R3	6-11009C93	68k
R4	6-11009C83	27k
R5, 6	6-11009C81	22k
R7, 8	6-11009C57	2.2k
R9	6-11009C49	1k
R10	6-11009C33	220
R11		NOT USED
R12	6-11009C49	1k
R13	6-124A49	1k; 1/2 W
R14	6-11009C73	10k
R15	6-11009C49	1k
R16	6-124A49	1k; 1/2 W
R17	6-11009C97	100k
R18	6-11009C59	2.7k
R19	6-11009C63	3.9k
R20	6-11009C57	2.2k
R21	6-11009C79	18k
R22	6-11009C91	56k
R23	6-11009C73	10k
R24	6-11009C95	82k
R25	6-11009C71	8.2k
R26	6-11009C79	18k
R27	6-11009C43	560
R28	6-11009C41	470
R29	6-11009C77	15k
R30	6-11009D06	220k
R31	6-11009C85	33k
R32	6-11009C65	4.7k
R33	6-11009C85	33k
R34	6-11009C67	5.6k
R35	6-11009C73	10k
R36	6-11009C95	82k
R37	6-11009C83	27k
R38	6-11009C19	56
R39	6-11009C43	560
R40	6-11009C51	1.2k
R41	6-124A25	100; 1/2 W
R42	6-11009C53	1.5k
R43	6-11009C59	2.7k
R44	6-11009C73	10k
R45	6-11009D08	270k
R46	6-124B08	270k ± 5%
R47	6-11009C49	1k
R48	6-11009C73	10k
R49	6-11009C77	15k
R50	6-11009D06	220k
R51	6-11009C85	33k
R52	6-11009C65	4.7k
R53	6-11009C85	33k
R54	6-11009C87	39k
R55	6-11009C83	27k
R56	6-11009C35	270
R57	6-11009C59	2.7k
R58	6-11009C53	1.5k
R59	6-11009C57	2.2k
R60, 61	6-11009C73	10k
R62, 63	6-11009C69	6.8k
R64	6-11009C81	22k
R65	6-11009C97	100k
R66	6-11009C81	22k

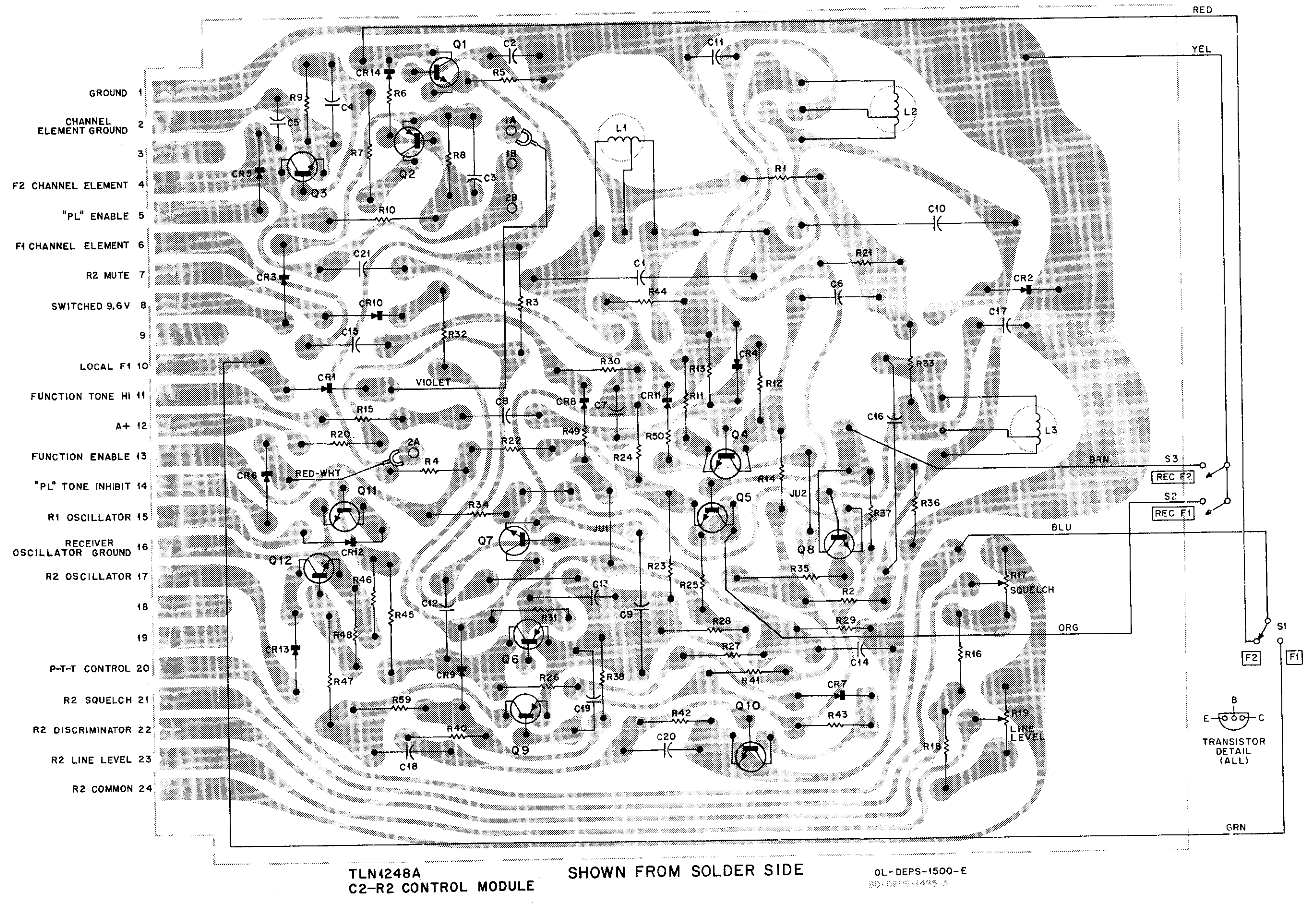
note: Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

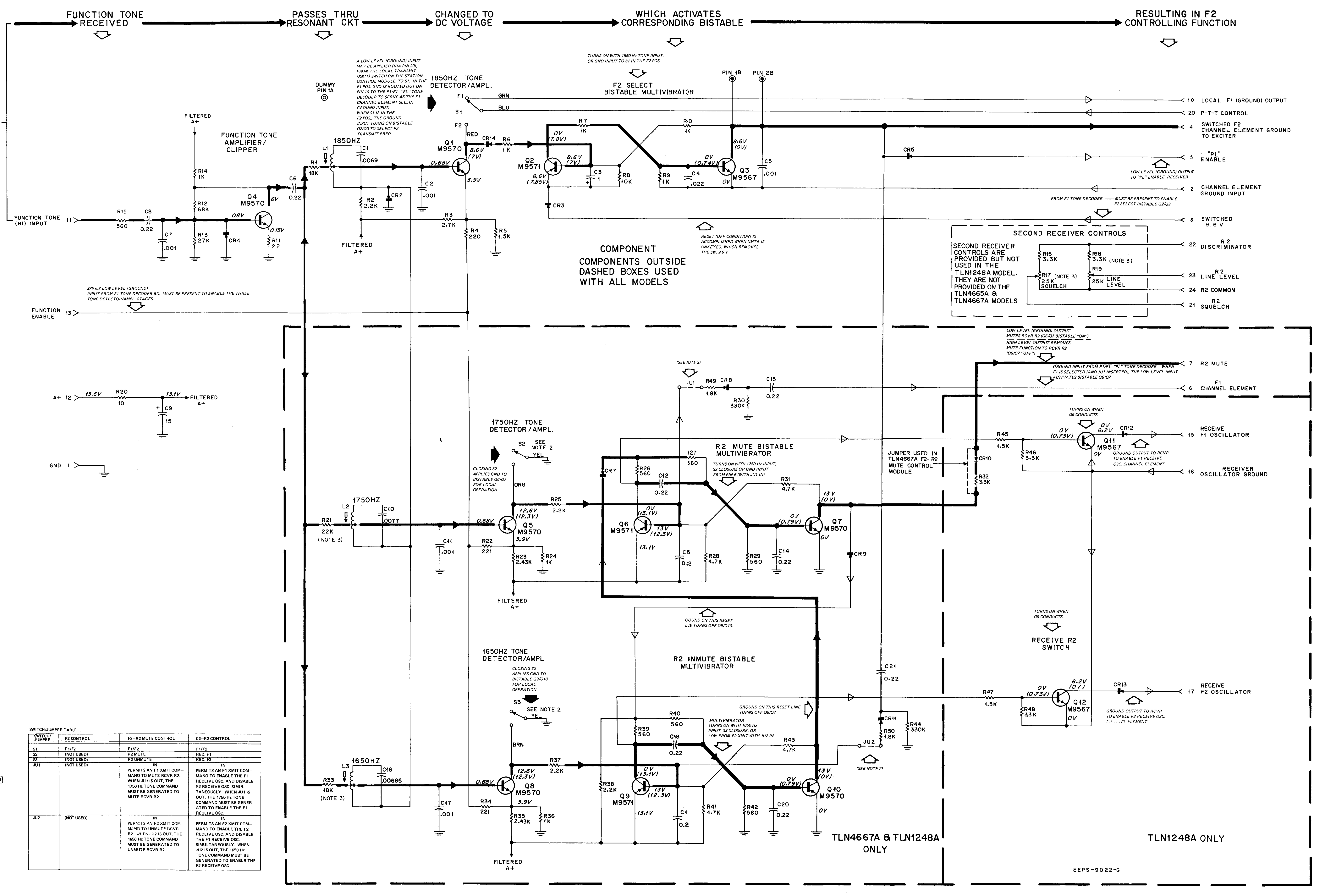
F2 TONE DECODER MODULES

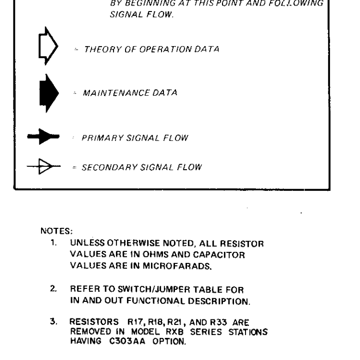
MODEL TLN4665A F2 CONTROL
MODEL TLN4667A F2-R2 MUTE CONTROL
MODEL TLN1248A C2-R2 CONTROL
(MODEL TLN1253A PAGING CONTROL
SHOWN ON SHEET 2)











FUNCTION

TLN4665A F2 Control	1850 Hz Function Tone Keys XMTR On F2
TLN4667A F2-R2 Mute Control	1. 1850 Hz Function Tone Keys XMTR on F2 2. 1750 Hz Function Tone Mutes RCVR R2 3. 1650 Hz Function Tone Unmutes RCVR R2
TLN1248A C2-R2 Control	1. 1850 Hz Function Tone Keys XMTR on F2 2. 1750 Hz Function Tone selects F1 Receive Osc. 3. 1650 Hz Function Tone selects F2 Receive Osc.

MODEL COMPLEMENT

Model	Version	Board	Version	Panel	Version
TLN1248A		TLN4048A		TLN4049A	
TLN1253A		TLN4044A		TLN4056A	
TLN4665A		—	—	—	—
TLN4667A		—	—	—	—

PARTS LIST SHOWN ON BACK
68P81016E39-J
(Sheet 1 of 2)
7/15/83-PHI

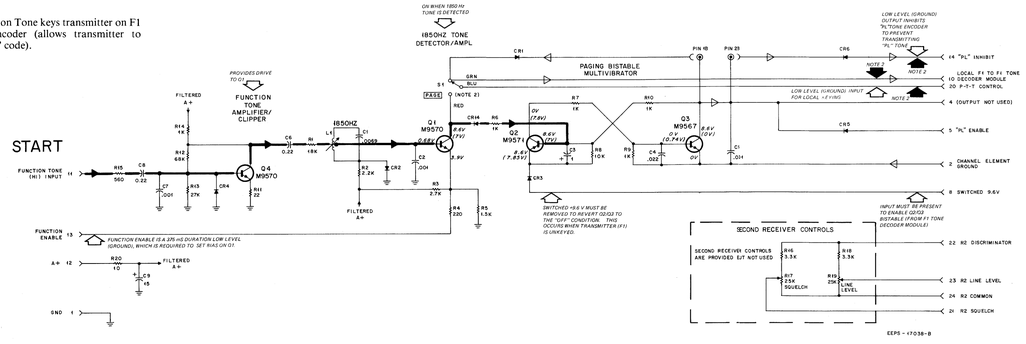
F2 TONE DECODER MODULES

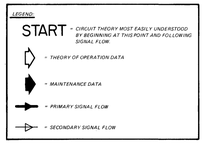
F2 TONE DECODER MODULE

MODEL TLN1253A PAGING CONTROL

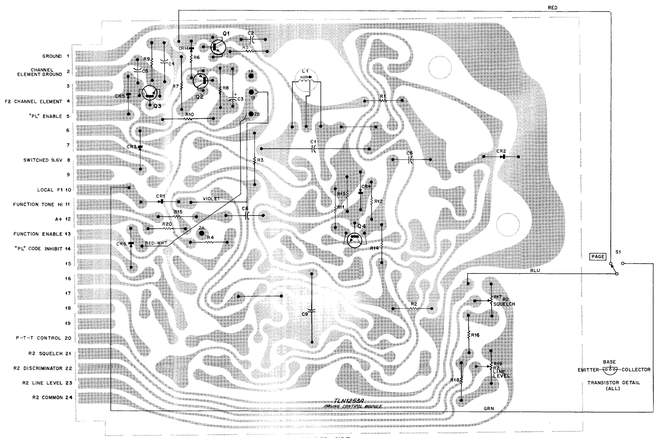
FUNCTION

Received 1850 Hz Function Tone keys transmitter on F1 and disables "PL" encoder (allows transmitter to transmit without a "PL" code).





WHENEVER THIS MODULE IS USED, A XMIT "PL" LEAD MUST BE ADDED FROM THE TRANSMITTER INTERCONNECT BOARD TO THE "PL" ENCODER. REFER TO THE TRANSMITTER INTERCONNECT BOARD DIAGRAM FOR SPECIFIC CONNECTION POINTS.



SHOWN FROM SOLDER SIDE

OL-DEPS-1562-K

parts list

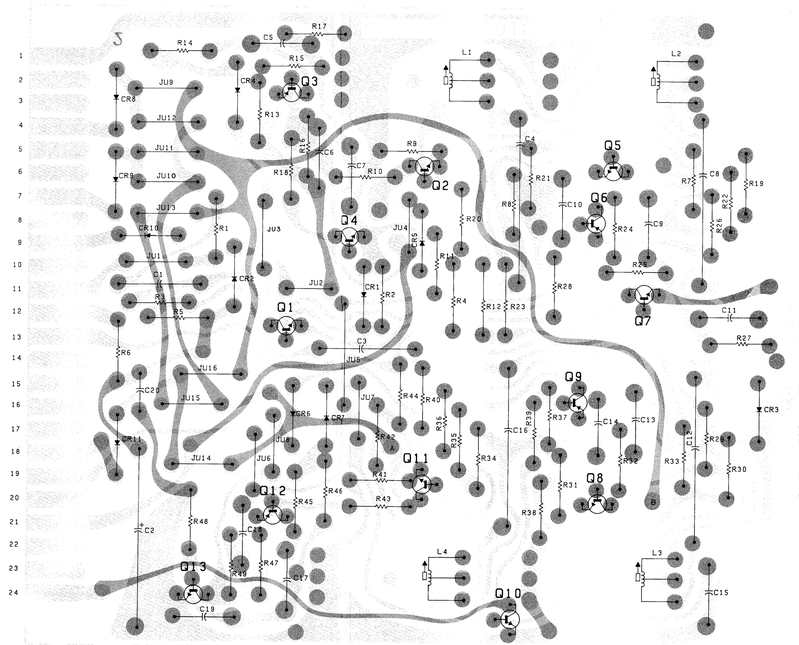
CONTROL MODULES
TLN1248A CR2-R2
TLN1253A Paging
TLN4665A F2
TLN4667A F2-R2 Mute

PL-1796-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C1	8-84326A15	.0069 ± 2%
C2	21-82187B29	.001; 100 V
C3	23-82783B08	1 ± 20%; 35 V
C4	8-82905G02	.022
C5	21-82187B29	.001; 100 V
C6	8-82905G11	0.22
C7	21-82187B29	.001; 100 V
C8	8-82905G11	0.22
C9	23-865136	15 ± 20%; 25 V
C10	8-84326A16	.0077 ± 2%
C11	21-82187B29	.001; 100 V
C12 thru 15	8-82905G11	0.22
C16	8-84326A17	.00865 ± 2%
C17	21-82187B29	.001; 100 V
C18 thru 21	8-82905G11	0.22
		semiconductor device, diode: (see note)
CR1 thru 14	48-82392B03	silicon
		coil assembly, inductor:
L1 thru 3	1-80702B11	1H; incl. ground clip
		transistor: (see note)
Q1	48-869570	NPN; type M9570
Q2	48-869571	PNP; type M9571
Q3	48-869567	NPN; type M9567
Q4, 5	48-869570	NPN; type M9570
Q6	48-869571	PNP; type M9571
Q7, 8	48-869570	NPN; type M9570
Q9	48-869571	NPN; type M9571
Q10	48-869570	NPN; type M9570
Q11, 12	48-869567	NPN; type M9567
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C79	18k
R2	6-11009C57	2.2k
R3	6-5652	2.7k; 1/2 W
R4	6-11009C33	220
R5	6-11009C53	1.5k
R6	6-11009C49	1k
R7	6-6229	1k; 1/2 W
R8	6-11009C73	10k
R9	6-11009C49	1k
R10	6-6229	1k; 1/2 W
R11	6-11009C09	22
R12	6-11009C93	68k
R13	6-11009C83	27k
R14	6-11009C49	1k
R15	6-11009C43	560
R16	6-11009C61	3.3k
R17	18-83083G03	var: 25k
R18	6-11009C61	3.3k
R19	18-83083G03	var: 25k
R20	6-11009C01	10
R21	6-129667	22k
R22	6-84444A07	221 ± 1%
R23	6-84444A09	2.43 ± 1%
R24	6-11009C49	1k
R25	6-11009C57	2.2k
R26, 27	6-11009C43	560
R28	6-11009C65	4.7k
R29	6-11009C43	560
R30	6-11009D10	330k
R31	6-11009C65	4.7k
R32	6-11009C61	3.3k
R33	6-11009C79	18k
R34	6-84444A07	221 ± 1%
R35	6-84444A06	2.21k ± 1%
R36	6-11009C49	1k
R37, 38	6-11009C57	2.2k
R39, 40	6-11009C43	560
R41	6-11009C65	4.7k
R42	6-11009C43	560
R43	6-11009C65	4.7k
R44	6-11009D10	330k
R45	6-6038	1.5k; 1/2 W
R46	6-11009C61	3.3k
R47	6-6038	1.5k; 1/2 W
R48	6-11009C61	3.3k
		switch, slide:
S1	40-83204B01	spdt
S2, 3	40-83486E01	dpst
		non-referenced items
	1-80729B37	PANEL ASSY., incl. ref. parts S1, S2 & S3 (Model TLN4667A)
	1-80728B43	PANEL ASSY., incl. ref. part S1 (Model TLN4665A)

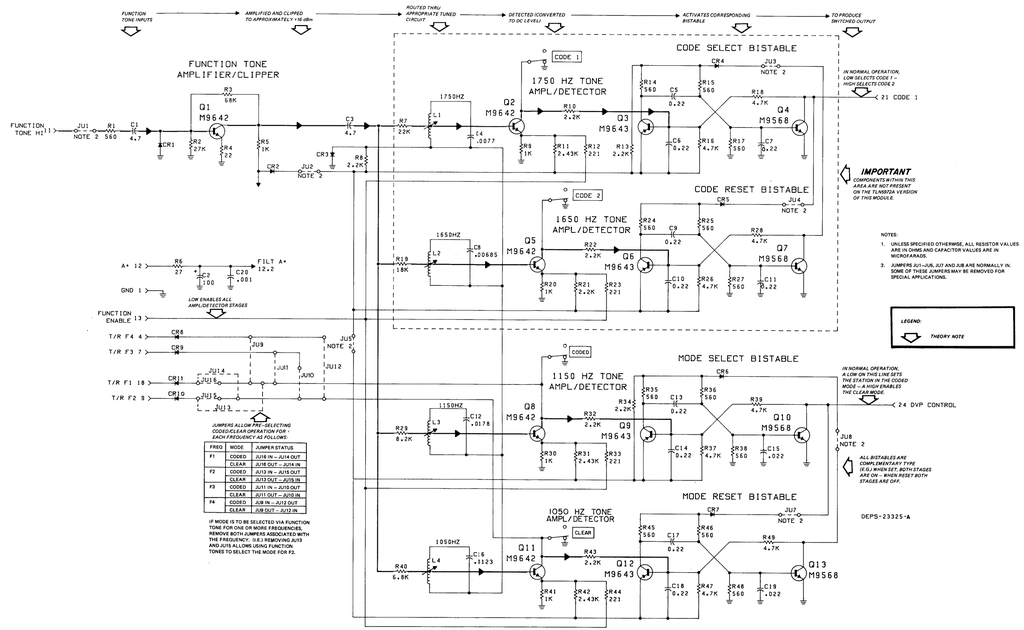
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80702B25	PANEL ASSY., incl. ref. part S1 (Model TLN1253A)
	1-80703B19	PANEL ASSY., incl. ref. parts S1, S2 and S3 (Model TLN1248A)
	45-83914G01	GUIDE, card; 2 req'd.
	46-84703E01	SHROUD

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



SHOWN FROM SOLDER SIDE

COMPONENT SIDE - BD-DEPS-23313-D
SOLDER SIDE - BD-DEPS-23314-D
OL-DEPS-23312-A



DVP CONTROL MODULE

MODEL TLN5972A

CODE SELECT MODULE

MODEL TLN5978A

FUNCTION

TLN5972A DVP Control Module -- converts control tones to a switched output used to set the station in the coded or clear mode.

--1150 Hz selects the coded mode
--1050 Hz selects the clear mode

TLN5978A Code Select Module -- in addition to the functions provided by the TLN5972A version, this module provides code selection capability as follows:

--1750 Hz selects code 1
--1650 Hz selects code 2

PARTS LIST SHOWN ON BACK
68P81035E61-A
2/15/78-UP

DVP CONTROL & CODE SELECT MODULE

PARTS LIST

TLN5972A DVP Control Module
TLN5978A Code Select Module

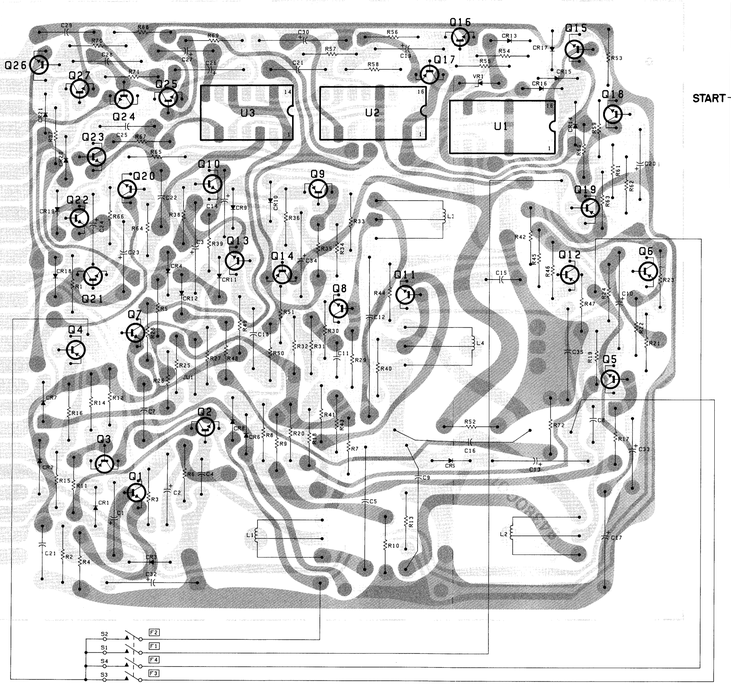
PL-5439-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed: uF ±10%; 50 V; unless otherwise stated
C1	23-865137	4.7 ±20%; 25 V
C2	23-82601A25	100 +150-10%; 20 V
C3	23-865137	4.7 ±20%; 25 V
C4	8-84326A16	.0077 ±2% (TLN5978A only)
C5,6,7	8-82905G11	.22 (TLN5978A only)
C8	8-84326A17	.00865 ±2% (TLN5978A only)
C9,10,11	8-82905G11	.22 (TLN5978A only)
C12	8-84326A22	.0178 ±2%
C13,14	8-82905G11	.22
C15	8-82905G02	.022
C16	8-84326H23	.0213 ±2%
C17,18	8-82905G11	.22
C19	8-8295G02	.022
C20	21-82187B29	1000; 100 V
		DIODES: (SEE NOTE)
CR1,2,3	48-83654H01	silicon
CR4,5	48-83654H01	silicon (TLN5978A only)
CR6 thru 11	48-83654H01	silicon
		COILS, variable
L1,2	24-84200A01	1.005 uH (TLN5978A only)
L3,4	24-84200A01	1.005 uH
		TRANSISTORS: (SEE NOTE)
Q1	48-869642	NPN; type M9642
Q2	48-869642	NPN; type M9642 (TLN5978A only)
Q3	48-869643	PNP; type M9643 (TLN5978A only)
Q4	48-869568	NPN; type M9568 (TLN5978A only)
Q5	48-869642	NPN; type M9642 (TLN5978A only)
Q6	48-869643	PNP; type M9643 (TLN5978A only)
Q7	48-869568	NPN; type M9568 (TLN5978A only)
Q8	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10	48-869568	NPN; type M9568
Q11	48-869642	NPN; type M9642
Q12	48-869643	PNP; type M9643
Q13	48-869568	NPN; type M9568
		RESISTORS: fixed; ±10%; 1/4 W unless otherwise stated
R1	6-124C43	560
R2	6-124C83	27k
R3	6-124C93	68k
R4	6-124A09	22 ±5%
R5	6-124A49	1k ±5%
R6	6-124C11	27
R7	6-124C57	2.2k (TLN5978A only)
R8	6-124C57	2.2k
R9	6-124A49	1k ±5% (TLN5978A only)
R10	6-124C57	2.2k
R11	6-84444A09	2.43k ±1% (TLN5978A only)
R12	6-84444A07	221 ±1% (TLN5978A only)
R13	6-124C57	2.2k (TLN5978A only)
R14,15	6-124C43	560 (TLN5978A only)
R16	6-124C65	4.7k (TLN5978A only)
R17	6-124C43	560 (TLN5978A only)
R18	6-124C65	4.7k (TLN5978A only)
R19	6-124A79	18k ±5% (TLN5978A only)
R20	6-124A49	1k ±5% (TLN5978A only)
R21	6-84444A08	2.21k ±1% (TLN5978A only)
R22	6-124C57	2.2 (TLN5978A only)
R23	6-84444A07	221 ±1% (TLN5978A only)
R24,25	6-124C43	560 (TLN5978A only)
R26	6-124C65	4.7k (TLN5978A only)
R27	6-124C43	560 (TLN5978A only)
R28	6-124C65	4.7k (TLN5978A only)
R29	6-124A71	8.2k ±5%
R30	6-124A49	1k ±5%
R31	6-84444A09	2.43k ±1%
R32	6-124C57	2.2k
R33	6-84444A07	221 ±1%
R34	6-124C57	22k
R35,36	6-124C43	560
R37	6-124C65	4.7k
R38	6-124C43	560
R39	6-124C65	4.7k
R40	6-124A69	6.8k ±5%
R41	6-124A49	1k ±5%
R42	6-84444A09	2.43k ±1%
R43	6-124C57	2.2k
R44	6-84444A07	221 ±1%
R45,46	6-124C43	560
R47	6-124C65	4.7k
R48	6-124C43	560
R49	6-124C65	4.7k
		SWITCHES, slide
S1 thru 4	40-83204B01	dpdt
		MECHANICAL PARTS
	1-80702B11	INDUCTOR ASSEMBLY: 2 or 4 used includes: reference items L1-L4
	42-84315A01	CLIP, grounding
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock #4 int.; 2 used
	45-83914G01	GUIDE, card; 2 used
	1-80795B27	CIRCUIT BOARD ASSEMBLY includes:
	9-83011H11	RECEPTACLE, board mounting; 24 used
	43-865080	BUSHING, threaded; 2 used
	1-80795B28	PANEL ASSEMBLY includes: ref. items S1 thru S4

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

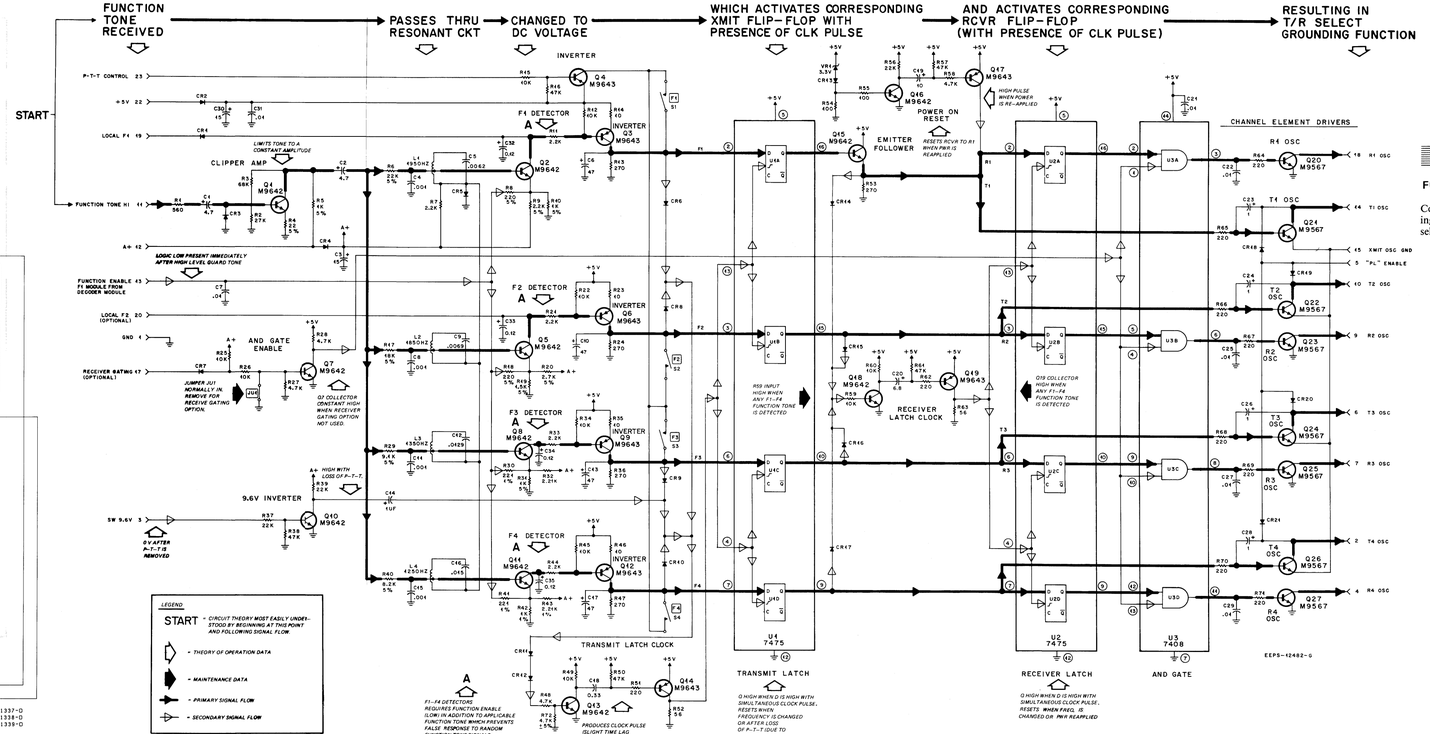
FOUR FREQUENCY CONTROL MODULE

MODEL TLN5292A



SHOWN FROM SOLDER SIDE

SOLDER SIDE 80-DEPS-21337-D
COMPONENT SIDE 80-DEPS-21338-D
OL-DEPS-21339-D



FUNCTION

Converts function tones from remote source to grounding functions for transmit and receive channel element selection.

FUNCTION TABLE

FUNCTION TONE	FREQUENCY SELECTED
1950 Hz	F1: TRANSMITTER KEYS ON FREQUENCY T1. RECEIVER OPERATES IN STANDBY MODE ON FREQUENCY R1.
1850 Hz	F2: TRANSMITTER KEYS ON FREQUENCY T2. RECEIVER OPERATES IN STANDBY MODE ON FREQUENCY R2.
1350 Hz	F3: TRANSMITTER KEYS ON FREQUENCY T3. RECEIVER OPERATES IN STANDBY MODE ON FREQUENCY R3.
1250 Hz	F4: TRANSMITTER KEYS ON FREQUENCY T4. RECEIVER OPERATES IN STANDBY MODE ON FREQUENCY R4.

NOTES:

1. RECEIPT OF A NEW FUNCTION TONE RESETS ANY SELECTION PREVIOUSLY MADE.
2. RECEIVER REMAINS LATCHED ONTO RESPECTIVE FREQUENCY UNTIL RESET BY A NEW FREQUENCY SELECTION. TRANSMITTER FREQUENCY IS RESET WITH LOSS OF SWITCHED B+.
3. TRANSMITTER KEYS ONLY MOMENTARILY WHEN THE FREQUENCY IS SELECTED.
4. TRANSMITTER REMAINS KEYED DURING A VOICE TRANSMISSION UNTIL THE PUSH-TO-TALK COMMAND IS INTERRUPTED.

LOCAL OPERATION

WARNING

ALWAYS LINE DISABLE THIS STATION BEFORE PERFORMING MAINTENANCE TO PREVENT UNEXPECTED KEYING OF THE STATION BY REMOTE CONTROL. ACTUATION OF THE FREQUENCY SELECT SWITCH MOMENTARILY KEYS THE STATION EVEN WITHOUT OPERATING THE MICROPHONE PUSH-TO-TALK SWITCH.

WHEN LOCAL KEYING OF THE STATION IS DESIRED THE FOLLOWING STEPS ARE NECESSARY.

STEP 1. LINE DISABLE THE STATION.

STEP 2. HOLD THE XMIT SWITCH, ON THE STATION CONTROL MODULE, TO THE RIGHT.

STEP 3. SELECT THE DESIRED FREQUENCY F1, F2, F3 OR F4 ON THE MODULE AND ACTUATE SWITCH MOMENTARILY.

STEP 4. AFTER TESTING ALWAYS RETURN LINE DISABLE SWITCH TO NORMAL POSITION.

NOTE

THE STATION TRANSMITTER IS NOT "ON-THE-AIR" UNTIL STEP 3 IS COMPLETED. THE FREQUENCY SELECT SWITCH MUST BE RELEASED BEFORE UNKEYING.

PARTS LIST SHOWN ON BACK

68P81022E04-J
5/30/85- UP

parts list

TLN5292A 4-Frequency Control Module — PL-2581-G

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±20%; 50 V: unless otherwise stated
C1, 2	23-865137	4.7; 25 V
C3	23-865136	15; 25 V
C4	21-82187B29	.001 ±10%; 100 V
C5	8-84326A14	.0062 ±2%
C6	23-868446	47; 6 V
C7	8-82905G01	.01 ±10%; 50 V
C8	21-82187B29	.001; 100 V
C9	8-84326A15	.0069 ±2%; 50 V
C10	23-868446	47; 6 V
C11	21-82187B29	.001 ±10%; 100 V
C12	8-84326A20	.0129 ±2%
C13	23-868446	47; 6 V
C14	23-82783B08	1; 35 V
C15	21-82187B29	.001 ±10%; 100 V
C16	8-84326A21	.015 ±2%
C17	23-868446	47; 6 V
C18	8-82906G42	0.33 ±10%
C19	23-84762H03	10; 20 V
C20	23-83214C21	6.8; 20 V
C21, 22	8-82905G01	.01 ±10%
C23, 24	23-82783B08	1; 35 V
C25	8-82905G01	.01 ±10%
C26	23-82783B08	1; 35 V
C27	8-82905G01	.01 ±10%
C28	23-82783B08	1; 35 V
C29	8-82905G01	.01 ±10%
C30	23-865136	15; 25 V
C31	8-82905G01	0.1 ±10%
C32 thru 35	23-83214C23	0.12; 20 V
		semiconductor device, diode: (see note)
CR1	48-83654H01	silicon
CR2	48-82466H13	silicon
CR3 thru 21	48-83654H01	silicon
		coil, audio freq:
L1 thru 4	24-84200A01	1.005H ±2%
		transistor: (see note)
Q1, 2	48-869642	NPN; type M9642
Q3, 4	48-869643	PNP; type M9643
Q5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q7, 8	48-869642	NPN; type M9642
Q9	48-869643	PNP; type M9643
Q10, 11	48-869642	NPN; type M9642
Q12	48-869643	PNP; type M9643
Q13	48-869642	NPN; type M9642
Q14	48-869643	PNP; type M9643
Q15, 16	48-869642	NPN; type M9642
Q17	48-869643	PNP; type M9643
Q18	48-869642	NPN; type M9642
Q19	48-869643	PNP; type M9643
Q20 thru 27	48-869567	NPN; type M9567
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-11009C43	560
R2	6-11009C83	27k
R3	6-11009C93	68k
R4	6-10401A09	22
R5	6-10401A49	1k
R6	6-10401A81	22k
R7	6-11009C57	2.2k
R8	6-10401A33	220
R9	6-10401A57	2.2k
R10	6-10401A49	1k
R11	6-11009C57	2.2k
R12	6-11009C73	10k
R13	6-11009C35	270
R14	6-11009C01	10
R15	6-11009C73	10k
R16	6-11009C89	47k
R17	6-10401A79	18k
R18	6-10401A33	220
R19	6-10401A53	1.5k
R20	6-10401A59	2.7k
R21	6-11009C57	2.2k
R22	6-11009C73	10k
R23	6-11009C01	10
R24	6-11009C35	270
R25, 26	6-11009C73	10k
R27, 28	6-11009C65	4.7k
R29	6-10401A72	9.1k
R30	6-84444A07	221
R31	6-10401A49	1k
R32	6-84444A08	2.21k ±1%
R33	6-11009C57	2.2k
R34	6-11009C73	10k
R35	6-11009C01	10
R36	6-11009C35	270
R37	6-11009C81	22k
R38	6-11009C89	47k
R39	6-11009C81	22k
R40	6-10401A71	8.2
R41	6-84444A07	221 ±1%
R42	6-10401A49	1k
R43	6-84444A08	2.21k ±1%
R44	6-11009C57	2.2k
R45	6-11009C73	10k
R46	6-11009C01	10
R47	6-11009C35	270 ±10%
R48	6-124C65	4.7k
R49	6-10401C73	270 ±10
R50	6-11009C89	47k
R51	6-11009C33	220
R52	6-11009C19	56
R53	6-11009C35	270
R54, 55	6-11009C25	100
R56	6-11009C81	22k
R57	6-11009C89	47k
R58	6-11009C65	4.7k
R59, 60	6-11009C73	10k
R61	6-11009C89	47k
R62	6-11009C33	220
R63	6-11009C19	56
R64 thru 71	6-11009C33	220
R72	6-124A65	4.7
		switch, slide:
S1 thru 4	40-83468E01	spdt
		integrated circuit: (see note)
U1, 2	51-84371K25	type 7475
U3	51-84371K09	type 7408
		semiconductor device, diode: (see note)
VR1	48-82256C26	Zener
		non-referenced items
	45-83914G01	GUIDE, card; 2 req'd.
	64-83931G01	PANEL, screened
	42-84315A01	CLIP, grounding
	46-84703E01	SHROUD

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

REVISIONS

68P81022E04-H

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN5292A-1	C32 THRU 35, R72	ADDED	PARTS LIST
TLN5292A-2		PLATING CHANGE	
TLN5292A-3	R48	FROM 6-10401C73, 10k TO 6-124C65, 4.7k	TRANSMIT LATCH CLOCK
	U1,2	FROM 51-48084D36, TYPE 7475 TO 51-84371K25, TYPE M7475	TRANSMIT AND RECEIVE LATCH
	U3	FROM 51-84084D20, TYPE 7408 TO 51-84371K09, TYPE 7408	AND GATE

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K = 1000)
   CAPACITOR VALUES ARE IN MICROFARADS
2. RELAY KIT IS AN OPTIONAL ACCESSORY ITEM. REFER TO RELAY APPLICATION CHART FOR CR1S, JU8 AND JU9 USAGE WITH RELAY.
3. USE OF THIS RESISTOR AND CAPACITOR IS DETERMINED AT FACTORY.
4. REFER TO JUMPER TABLE

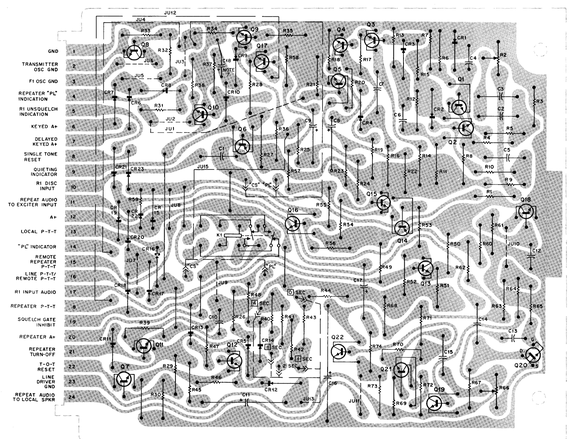
JUMPER TABLE

APPLICATION	JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11	JU12	JU13	JU14	JU15
LINE CONTROL BASE	OUT	OUT	IN	OUT	OUT	OUT	IN	IN	IN	OUT	OUT	OUT	SELECTED DELAY	IN	OUT
REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	OUT	OUT	IN	IN "PL"	IN	IN	IN	IN	IN	IN	IN	IN	SELECTED DELAY	IN "CS"	IN "PL"
REPEATER (RT) STATION WITH WIRE LINE CONTROL	OUT	OUT	IN	IN "PL"	NOTE 6	NOTE 6	IN	IN	IN	IN	OUT	IN	SELECTED DELAY	IN "CS"	IN "PL"
BASE (RA) STATION	IN	OUT	IN	IN "PL"	IN	IN	#	#	#	OUT	OUT	OUT	SELECTED DELAY	IN "CS"	IN "PL"
REPEATER (RA) STATION	OUT	OUT	IN	IN "PL"	IN	IN	OUT	#	#	OUT	OUT	OUT	SELECTED DELAY	IN "CS"	IN "PL"
COMMUNITY REPEATER (RT) STATION	OUT	OUT	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	SELECTED DELAY	OUT	IN

5. VOLTAGE READINGS SHOWN ARE FOR TWO CONDITIONS:
   USO = UNSQUELCHED
   FSO = FULLY SQUELCHED
6. JUMPERS JU5 & JU6 ARE USED IN DC-CONTROLLED "PL" REPEATER STATIONS WHEN SUCH STATIONS ARE EQUIPPED WITH DC TRANSFER MODULE.
7. CAPACITOR C18 IS 01 µF IN STANDARD APPLICATIONS. CAPACITOR C18 IS CHANGED TO 10 µF WHEN THE CY45 TAC ENCODER OPTION IS INSTALLED.

RELAY APPLICATION CHART

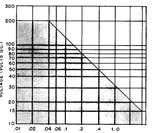
TLN4151A RELAY KIT	DIODE CR1S	JU8
NOT USED	OUT	IN
USED	IN	OUT



SHOWN FROM SOLDER SIDE

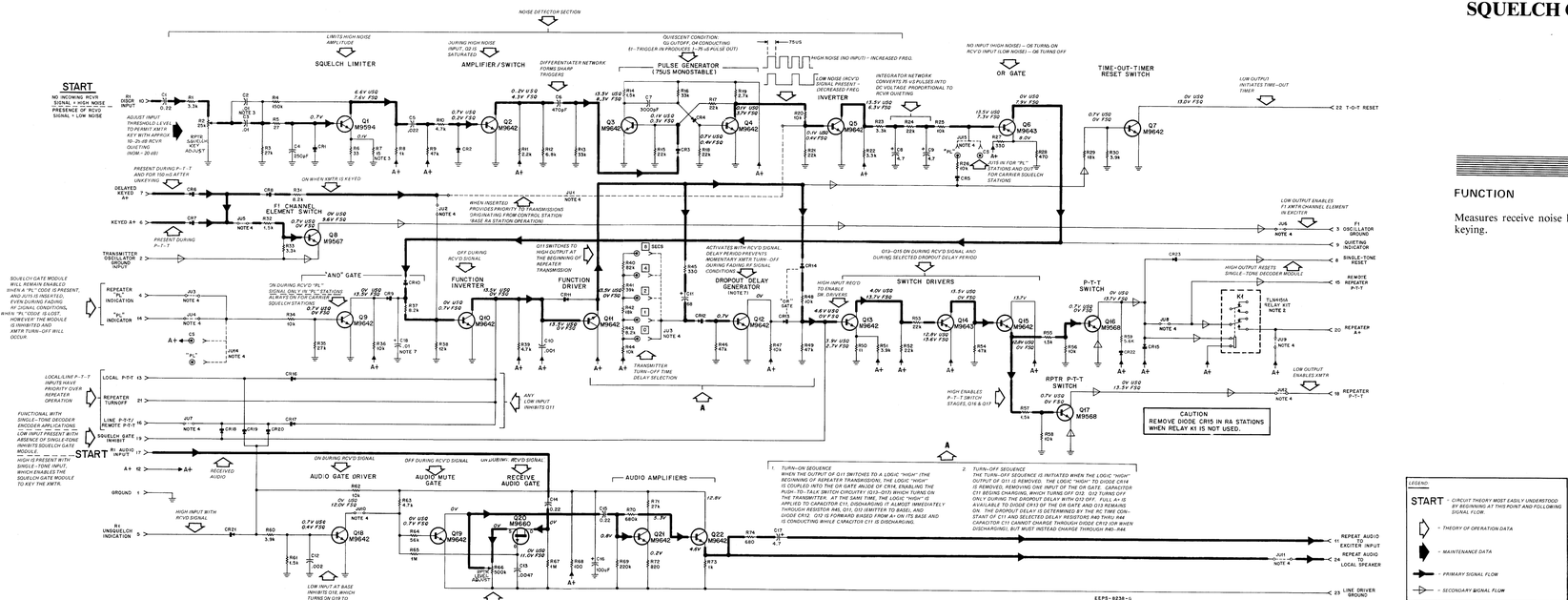
SQ-DEPS-8255-G

OL-DEPS-8240-A



LOAD MUST BE IN SHADED AREA

TLN4151A RELAY KIT RELAY CONTACT RATING



LEGEND:

START — CIRCUIT THEORY MOST EASILY UNDERSTOOD BY BEGINNING AT THIS POINT AND FOLLOWING SIGNAL FLOW.

= THEORY OF OPERATION DATA

= MAINTENANCE DATA

= PRIMARY SIGNAL FLOW

= SECONDARY SIGNAL FLOW

SQUELCH GATE MODULE

MODEL TLN4662A

FUNCTION

Measures receive noise levels and controls transmitter keying.

PARTS LIST SHOWN ON BACK
68P81015E33-L
7/15/83- PHI

SQUELCH GATE MODULE

parts list

TLN4662A Squelch Gate Module — PL-1697-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 10%; 50 V: unless otherwise stated
C1	8-82905G11	0.22 uF
C2, 3	8-82905G01	.01 uF
C4	21-859943	250 ± 5%; 500 V
C5	8-82905G02	.022 uF
C6	21-850510	470; 300 V
C7	21-850994	3000 ± 5%; 500 V
C8, 9	23-82783B25	4.7 uF; 25 V
C10	21-82187B29	.001 uF; 100 V
C11	23-865594	68 uF; 15 V
C12	21-82428B25	.002 uF ± 20%; 500 V
C13	21-83596E23	.0047 uF; 200 V
C14, 15	8-82905G11	0.22 uF
C16	23-82783B04	100 uF ± 20%; 25 V
C17	23-82783B25	4.7 uF; 25 V
C18	21-82428B62	.01 uF
		semiconductor device, diode: (see note)
CR1, 2	48-82392B03	silicon
CR3	48-83654H01	silicon
CR4 thru 8	48-82392B03	silicon
CR9, 10	48-83654H01	silicon
CR11 thru 21	48-82392B03	silicon
CR22, 23	48-83654H01	silicon
		transistor: (see note)
Q1	48-869594	NPN; type M9594
Q2 thru 5	48-869642	NPN; type M9642
Q6	48-869643	PNP; type M9643
Q7	48-869642	NPN; type M9642
Q8	48-869567	NPN; type M9567
Q9 thru 13	48-869642	NPN; type M9642
Q14	48-869643	PNP; type M9643
Q15	48-869642	NPN; type M9642
Q16, 17	48-869568	NPN; type M9568
Q18, 19	48-869642	NPN; type M9642
Q20	48-869660	field-effect; type M9660
Q21, 22	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C61	3.3k
R2	18-83083G03	variable: 25k ± 30%
R3	6-11009C83	27k
R4	6-11009D02	150k
R5	6-11009C11	27
R6	6-11009C13	33
R7	6-11009C05	15
R8	6-11009C49	1k
R9	6-11009C89	47k
R10	6-11009C65	4.7k
R11	6-11009C57	2.2k
R12	6-11009C69	6.8k
R13	6-11009C85	33k
R14	6-11009C53	1.5k
R15	6-11009C81	22k
R16	6-11009C85	33k
R17, 18	6-11009C81	22k
R19	6-11009C59	2.7k
R20	6-11009C73	10k
R21	6-11009C81	22k
R22, 23	6-11009C61	3.3k
R24	6-11009C81	22k
R25, 26	6-11009C73	10k
R27	6-11009C37	330
R28	6-11009C41	470
R29	6-11009C79	18k
R30	6-11009C63	3.9k
R31	6-11009C71	8.2k
R32	6-11009C53	1.5k
R33	6-11009C61	3.3k
R34	6-11009C73	10k
R35	6-11009C83	27k
R36	6-11009C73	10k
R37	6-11009C71	8.2k
R38	6-11009C75	12k
R39	6-11009C65	4.7k
R40	6-11009C95	82k
R41	6-11009C87	39k
R42	6-11009C79	18k
R43	6-11009C71	8.2k
R44	6-11009C73	10k
R45	6-11009C37	330
R46	6-11009C89	47k
R47, 48	6-11009C73	10k
R49	6-11009C89	47k
R50	6-11009C49	1k
R51	6-11009C63	3.9k
R52, 53	6-11009C81	22k
R54	6-11009C89	47k
R55	6-11009C53	1.5k
R56	6-11009C73	10k
R57	6-11009C53	1.5k
R58	6-11009C73	10k
R59	6-11009C67	5.6k
R60	6-11009C63	3.9k
R61	6-11009C53	1.5k
R62	6-11009C73	10k
R63	6-11009C65	4.7k
R64	6-11009C91	56k
R65	6-11009D22	1 meg
R66	18-83083G02	variable; 500k ± 30%
R67	6-11009D22	1 meg
R68	6-11009C25	100
R69	6-11009D06	220k
R70	6-11009D18	680k
R71	6-11009C83	27k
R72	6-11009C47	820
R73	6-11009C49	1k
R74	6-11009C45	680

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

TLN4055A "Wild Card" Module Panel — PL-474-B

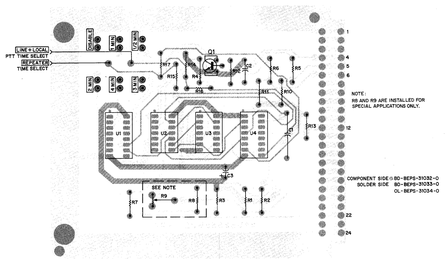
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		switch, slide:
S1 thru 4	40-83468E01	spdt
		non-referenced items
	1-80702B24	PANEL ASSEMBLY, includes
	64-84321A01	PANEL, switches S1 thru S4
	3-8022	SCREW, machine: 4-40 × 1/4"; 2 req'd.
	45-83914G01	GUIDE, card; 2 req'd.
	4-7683	WASHER, lock #4 (internal tooth); 2 req'd.

TLN4151A Relay Kit — PL-455-A

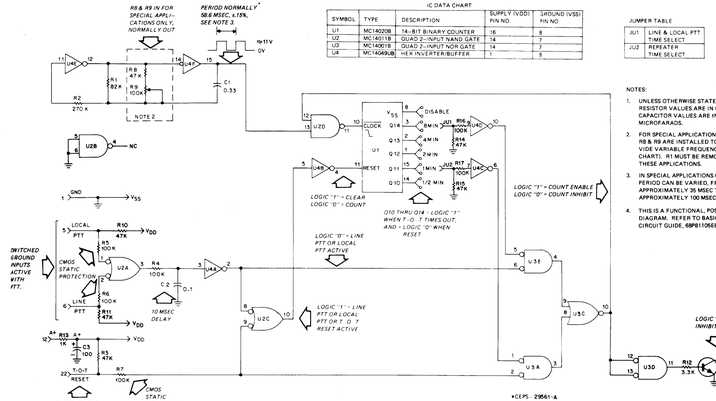
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		diode:
CR11	48-82392B03	silicon
		relay, armature:
K1	80-84201A01	2 form "C", coil res. 200 ohms
		non-referenced items
	43-84920H01	SPACER, relay

REVISIONS 68P81015E33-L

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4662A-1	CR22, 23	ADDED 48-83654H01	P-T-T SWITCH CIRCUIT
TLN4662A-2	CR9, 10	FROM 48-82392B03, TO 48-83654H01	GATE CIRCUIT Q9
	C18	ADDED 21-82428B62, .01 uF	



SHOWN FROM COMPONENT SIDE



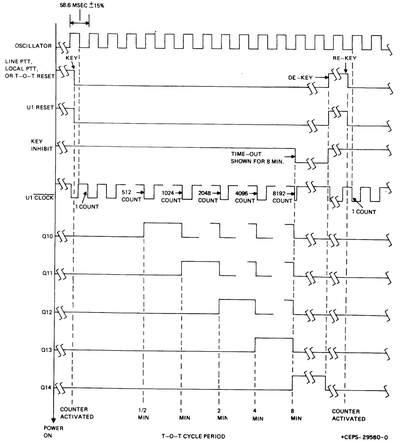
IC DATA CHART

SYMBOL	TYPE	DESCRIPTION	SUPPLY (VDD) PIN NO.	GROUND (VSS) PIN NO.
U1	MC14020B	14-BIT BINARY COUNTER	16	8
U2	MC14011B	QUAD 2-INPUT NAND GATE	14	7
U3	MC14001B	QUAD 2-INPUT NOR GATE	14	7
U4	MC14049UB	HEX INVERTER/BUFFER	1	8

JUMPER TABLE

JU1	LINE & LOCAL PTT TIME SELECT
JU2	REPEATER TIME SELECT

NOTES:
1. UNLESS OTHERWISE STATED: RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS.
2. FOR SPECIAL APPLICATIONS ONLY, R8 & R9 ARE INSTALLED TO PROVIDE VARIABLE FREQUENCY (SEE CHART). R1 MUST BE REMOVED IN THESE APPLICATIONS.
3. IN SPECIAL APPLICATIONS ONLY: PERIOD CAN BE VARIED, FROM APPROXIMATELY 35 MSEC TO APPROXIMATELY 100 MSEC.
4. THIS IS A FUNCTIONAL, POSITIVE LOGIC DIAGRAM. REFER TO BASIC LOGIC CIRCUIT GUIDE, 68P81105E88.



VARIABLE TIMING CHART (SPECIAL APPLICATIONS ONLY)

FACTORY FIXED (±15%)		58.6 MSEC OR 17.1 HZ	Q10 1/2 MIN.	Q11 1 MIN.	Q12 2 MIN.	Q13 4 MIN.	Q14 8 MIN.	DISABLE INFINITY
VARIABLE	MAXIMUM	99.6 MSEC OR 10.0 HZ	51 SEC OR 0.85 MIN	102 SEC OR 1.7 MIN	204 SEC OR 3.4 MIN	408 SEC OR 6.8 MIN	816 SEC OR 13.6 MIN	INFINITY
	MINIMUM	35.2 MSEC OR 28.4 HZ	18 SEC OR 0.3 MIN	36 SEC OR 0.6 MIN	72 SEC OR 1.2 MIN	144 SEC OR 2.4 MIN	288 SEC OR 4.8 MIN	INFINITY

GENERAL FORMULA: $F = (1/(10)^{N-1})$; WHERE F IS THE DESIRED TIME-OUT TIME IN SECONDS, N IS THE CHOSEN Q-OUTPUT NUMBER, AND F IS THE REQUIRED OSCILLATOR FREQUENCY IN HERTZ.

FOR EXAMPLE: TO CALCULATE THE OSCILLATOR FREQUENCY NEEDED TO PRODUCE A 3 MINUTE T-O-T PERIOD, FIRST DETERMINE FROM THE ABOVE CHART WHICH OUTPUT MUST BE USED – Q12. SECOND, INSERT THE KNOWNS INTO THE GENERAL FORMULA, AND CALCULATE THE REQUIRED FREQUENCY:

$F = (1/1)\ X\ (2^{N-1}) = (1/(3\ X\ 60))\ X\ (2^{12-1}) = (1/180)\ X\ (2048) = 11.4\ HZ$

FOR A 5 MINUTE T.O.T. PERIOD, $F = (1/1)\ X\ (2^{N-1}) = (1/(5\ X\ 60))\ X\ (2^{13-1}) = 13.7\ HZ$

*8EPS-27258-A

CMOS TIME-OUT-TIMER

MODEL TRN8684B

FUNCTION

Limits the period of time the transmitter may be keyed.

parts list

TRN8684B CMOS Time-Out-Timer — PL-6821-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	8-83813H29	0.33 uF ± 10%; 50 V
C2	21-82372C01	0.1 uF + 80-20%; 25 V
C3	23-84665F03	100 uF + 100-10%; 25 V
		transistor: (see note)
Q1	48-869642	NPN; silicon
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C95	82k
R2	6-11009D08	270k
R3	6-11009C89	47k
R4,7	6-11009C97	100k
R8	6-11009C89	47k (used for special applications only)
R9	18-84944C07	var. 100k ± 20%; 0.1 W (used for special applications only)
R10, 11	6-11009C89	47k
R12	6-11009C81	3.3k
R13	6-11009C40	1k
R14, 15	6-11009C89	47k
R16, 17	6-11009C97	100k
		integrated circuit: (see note)
U1	51-82884L42	type MC14020B (14-bit binary counter)
U2	51-82884L05	type MC14011B (Quad, 2-input NAND gate)
U3	51-82884L04	type MC14001B (Quad, 2-input NOR gate)
U4	51-82884L02	type MC14049UB (HEX inverter/buffer)
		non-referenced items
	29-83167C01	TERMINAL, strain relief; 2 used
	39-10184A24	CONTACT, receptacle; 2 used
	9-83011H01	RECEPTACLE, board mounting; 9 used
	39-10184A10	CONTACT, plug; 12 used
	43-865080	BUSHING, threaded; 2 used
	3-134212	SCREW, tapping; 4-40 x 5/16"; 2 used
	45-83914G01	GUIDE, card; 2 used
	64-83125L01	PANEL, screened
	46-84703E01	GUIDE, circuit board

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

revisions

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TRN8684B-2	C1	FROM 8-82096J21, 0.33 uF ± 10%; 250 V TO 8-83813H29, 0.33 uF ± 10%; 50 V	BETWEEN U4F AND R9
	C3	FROM 21-83250Z, 0.1 uF + 80%, -20%; 250 V TO 23-84665F02, 100 uF + 100-10%; 25 V	BETWEEN PIN 12 AND R3
	R12	FROM 6-5173, 10k ± 5%; 1/4 W TO 6-124A81, 3.3k ± 5%; 1/4 W	BASE OF Q1
	R13	ADDED 6-124C49, 1k ± 10%;1/4 W	PIN 12 A + AND C3
	R14	ADDED 6-124C89, 47k ± 10%; 1/4 W	U4D-9 AND U1-14
	R16	ADDED 6-124C97 100k ± 10%; 1/4 W	
	R15	ADDED 6-124C89 47k ± 10%; 1/4 W	U4?-7 AND U1-15
	R17	ADDED 6-124C97 100k ± 10%; 1/4 W	
		FROM 84-83655M01 CIRCUIT BOARD TO 84-83655M02	

GENERAL

The time-out-timer (T-O-T) module is standard in all repeater (RT) models and is an optional accessory for base station models. It limits the period of time the transmitter can be keyed. It can be set to limit transmission time from line controlled operation, and to limit the transmission time of individual repeater users. The timing period of each is independent of the other. The unit can be preset for 1/2, 1, 2, 4, or 8 minutes or unlimited continuous keying by jumper selection.

CIRCUIT DESCRIPTION

The initial condition of the time-out-timer module is: local PTT, line PTT and T-O-T reset at a high (logic "1") level, with A + applied to the module.

The high local and line PTT inputs to U2A cause its output to be low. This low is inverted by U4A producing a high input to U2C-8. This high input, plus the high T-O-T reset input to U2C-9, forces the output at U2C-10 low. This low is inverted by U4B, producing a high at counter U1 reset input. The high reset input clears the counter by forcing and holding all of the outputs low.

Jumpers JU1 and JU2 connect two low outputs of U1 to the inputs of U4D and U4C, respectively. A local or line PTT input (base station) executes the T-O-T timing function via JU1. A T-O-T reset input (repeater PTT) executes the T-O-T timing function via JU2.

The low outputs of U1 are inverted by U4D and U4C, producing high inputs at U3B-5 and U3A-1, respectively. These high inputs, plus the highs from the T-O-T reset input and U4A-2, cause the outputs of U3B and U3A to be low. These low inputs are applied to U3C and cause its output to be high. This high is applied to U2D, enabling it, and to U3D, resulting in a high at the key inhibit output of the module. This high output allows the station transmitter to operate if keyed.

The timing function is started by a low line PTT, a low local PTT, or a low T-O-T reset signal from the squelch gate module. A low on the local PTT or the line PTT input causes the output of U2A to be high. This high is delayed by R4, C2 and is inverted by U4A producing a low input to U2C-8. This low input, or a low T-O-T reset input to U2C-9, causes the output of U2C to be high which is inverted by U4B. The resulting low enables counter U1. The oscillator output passes through U2D to the clock input of U1. For every negative-going transition at the clock input of counter U1, the counter is advanced by one count.

Due to the period of the oscillator: 512 counts corresponds to 30 seconds (Q10 output); 1024 counts corresponds to 1 minute (Q11 output); 2048 counts corresponds to 2 minutes (Q12 output); 4096 counts corresponds to 4 minutes (Q13 output); and 8192 counts corresponds to 8 minutes (Q14 output). (See timing diagram.)

Assume that both time select jumpers are connected to the Q10 outputs of U1. The Q10 output goes high at the end of the 30 second timing period. This high is inverted by U4D and U4C, producing low inputs at U3B-5 and U3A-1, respectively. These low inputs, plus either the low from the T-O-T reset input or the low output of U4A-2, cause the output of U3A or U3B, respectively, to go high. The high output of either U3A or U3B causes the output of U3C to go low. This low is applied to U2D, which disables it and prevents any further transitions from reaching the clock input of U1.

The low U3C output is also applied to U3D, which functions as an inverter and causes Q1 to turn on. This results in a low at the key inhibit output of the module which inhibits the station transmitter.

The transmitter will remain inhibited until the switched ground start signal is removed from the module input. At that time, the module returns to its initial condition, which results in the counter being held in reset (all outputs low) and the station transmitter being uninhibited. When a start signal is again applied, another timing cycle begins.

If line and local PTT time select jumper JU1 is connected to the 30 second output, and repeater time select jumper JU2 is connected to the 2 minute output; then a start signal (switched ground) on either the line PTT or the local PTT input will inhibit the transmitter after 30 seconds, or a start signal on the T-O-T reset input will inhibit the transmitter after 2 minutes.

If either or both of the time select jumpers are connected to the DISABLE (ground) output of U1, the corresponding start signal input(s) will not inhibit the transmitter and unlimited continuous transmission is possible.

In special applications, it may be desirable to obtain a T-O-T cycle period other than those normally available. To vary the oscillator period, remove R1 and insert R8 and R9. Connect a + 13.8 V dc power supply between pin 12 and ground, pin 1. Monitor the oscillator output at U4F-15, with respect to ground.

Then, using the variable timing chart, choose an appropriate output and connect both time select jumpers to that output. Adjust R9 for the desired (calculated) period. An audio frequency counter or an oscilloscope may be used to monitor the oscillator output.

MAINTENANCE & TROUBLESHOOTING

This module may be serviced either while connected to the station or while connected to external test equipment as described in the Control Chassis section of this manual. The following check-out procedure is intended for out-of-station servicing but is functionally applicable to in-station servicing also.

CAUTION

This module uses CMOS integrated circuits which can be damaged by excessive static charges. Handle module by edges only.

Step 1. Remove the module from the chassis.

Step 2. Connect a 13.5 V dc power supply to the module so ground (-) is connected to pin 1 and the positive (+) terminal is connected to pin 12. Turn the power supply on.

Step 3. Connect a 5k ohm resistor between module pins 4 and 12.

Step 4. Connect time selection jumpers JU1 & JU2 to the "DISABLE" output (ground).

Step 5. Check the oscillator frequency with a counter connected between pin 15 of U4 and ground. The frequency should be 17.1 Hz ± 2.5 Hz. An oscilloscope may be used in place of the audio frequency counter. The oscillator period should be 58.6 msec, ± 9 msec.

Step 6. Connect a temporary jumper between module pins 5 and 1.

Step 7. Refer to the schematic and timing diagram and note the desired timing cycle for different outputs of the module. Use a stop-watch to compare the desired timing of highs and lows on a VTVM. Timing should be accurate to within ± 15%.

Step 8. Move the temporary jumper to pins 6 and 1 and repeat Step 7.

Step 9. Move the temporary jumper to pins 22 and 1 and repeat Step 7.

Step 10. Connect both time selection jumpers to "1/2 MIN" output. Module pin 4 should go low after 1/2 minute (± 4.5 sec.).

Step 11. If a defective output is not located, check connections and continuity of plating for opens and shorts.

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7/15/83-PHI

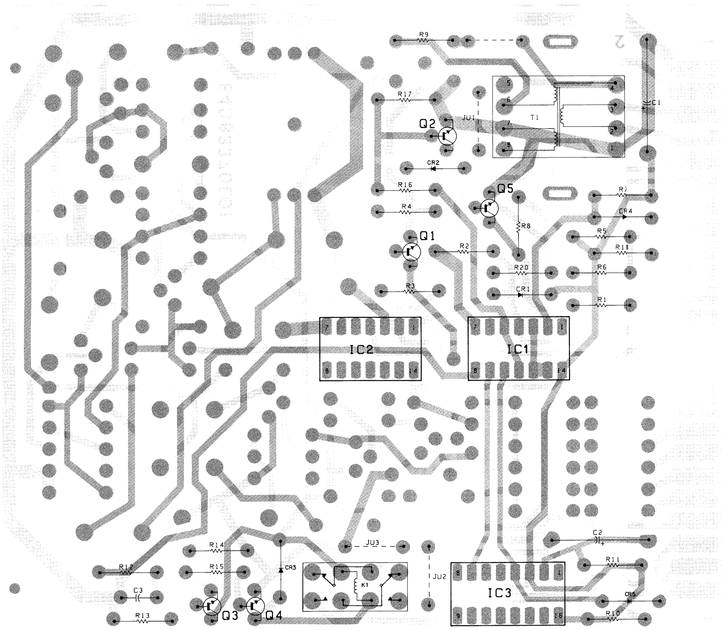
LINE INTERFACE MODULE
MODEL TLN5975A

PARTS LIST

TLN5975A Line Interface Module — PL-5438-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed:
C1	23-83214C07	22 uF ±20%; 35 V
C2	23-84538G04	15 uF ±10%; 20 V
C3	21-83596E01	.001 uF ±10%; 500 V
		DIODE: (SEE NOTE)
CR1	48-83654H01	silicon
CR4,5,6	48-83654H01	silicon
CR7	48-82466H13	silicon
		RELAY, crystal can
K1	80-84201A01	2 form "C", dpdt; 16 V
		TRANSISTOR: (SEE NOTE)
Q1	48-869567	NPN; type M9567
Q2,3	48-869642	NPN; type M9642
Q4	48-869568	NPN; type M9568
Q5	48-869642	NPN; type M9642
		RESISTOR, fixed: ±10%, 1/4 W unless otherwise stated
R1	6-124C65	4.7k
R2	6-124C89	47k
R3	6-124C51	1.2k
R4	6-124C89	47k
R5	6-124C73	10k
R6	6-124C85	33k
R7	6-124C73	10k
R8	6-125C85	33k; 1/2 W
R9	6-124C51	12k
R10	6-124C73	10k
R11	6-124A73	10k ±5%
R12	6-124C61	3.3k
R13	6-124C73	10k
R14	6-124C49	1k
R15	6-124C43	560
R16	6-124C79	18k
R17	6-124C89	47k
R18	6-124C23	82
R20	6-124C89	47k
		TRANSFORMER
T1	25-84202A02	prl, resist, 600 ohms sec, resist, #1 1200 ohms sec, resist, #2 600 ohms
		INTEGRATED CIRCUIT: (SEE NOTE)
U1	51-83627M17	type 74C00
U2	51-83627M18	type 74C74
U3	51-82884L53	type 14538
		MECHANICAL PARTS
	1-80795B29	CIRCUIT BOARD, eyeleted includes:
	43-865080	BUSHING, threaded; 2 used
	9-8301 1H01	RECEPTACLE, board mounting; 24 used
	43-84920H01	SPACER, relay
	45-83914G01	GUIDE, card
	80-83029H01	SPARK GAP
	64-83358L02	PANEL, screened
	64-83113L01	PANEL
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock: #4 int.; 2 used

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



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COMPONENT SIDE @ BD-DEPS-23249-D
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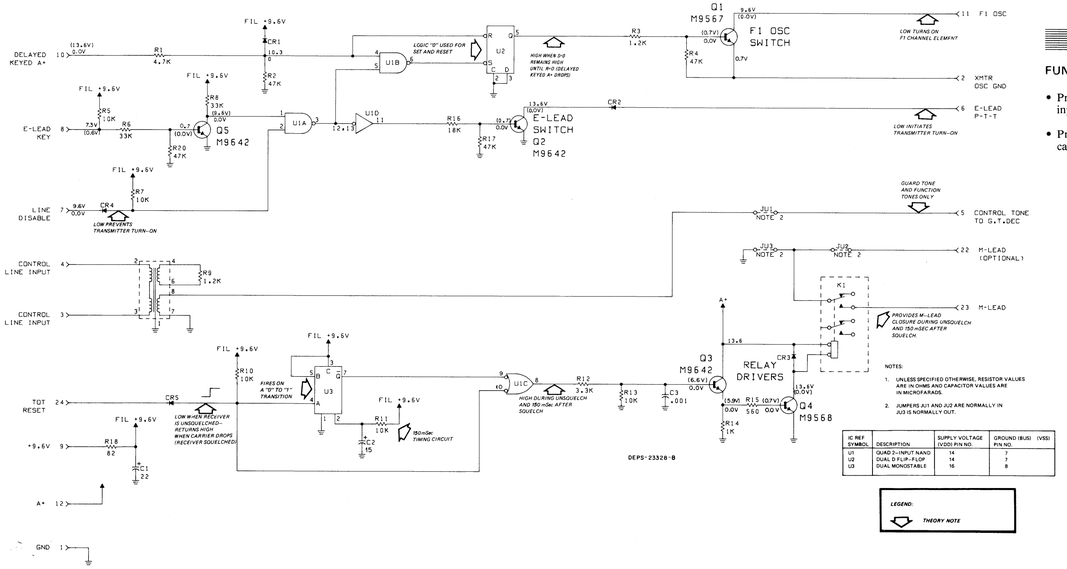
DL-DEPS-23251-D



NOTES:
1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS.
2. JUMPERS JU1 AND JU2 ARE NORMALLY IN. JU3 IS NORMALLY OUT.

IC REF SYMBOL	DESCRIPTION	SUPPLY VOLTAGE (VDD) PIN NO.	GROUND (BUS) (VSS) PIN NO.
U1	QUAD 2-INPUT NAND	14	7
U2	DUAL D FLIP-FLOP	14	7
U3	DUAL MONOSTABLE	16	8

LEGEND: THEORY NOTE

FUNCTION

- Provides additional line termination for control line input.
- Provides MUX interface (E & M lead signaling) capability.

OPTIONS DECODER MODULES

MODEL TLN1249A SQUELCH CONTROL
MODEL TLN1250A REPEATER CONTROL
MODEL TLN1251A "PRIVATE-LINE" CONTROL

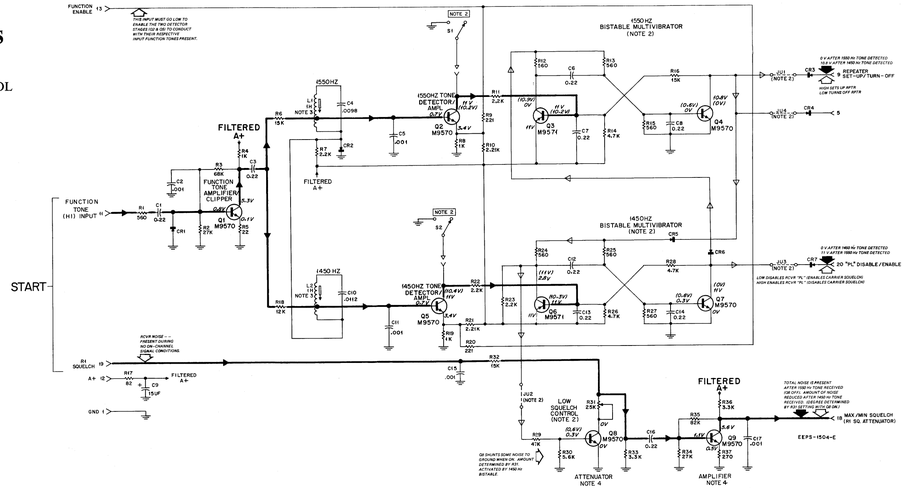
FUNCTION

Selects one of two modes of operation in response to 1450 Hz and 1550 Hz function tones as follows:

Function Tone (Hz)	TLN1249A	Repeater Turn-Off	PL Operation
1450	Threshold Squelch	Repeater Setup	Carrier Squelch Operation

MODEL COMPLEMENT

MODEL	VERSION	BOARD	VERSION	PANEL	VERSION
TLN1249A				TLN4051A	
TLN1250A		TLN4050A	-2	TLN4052A	
TLN1251A				TLN4053A	



OPTIONS CONTROL MODULES

(THREE VERSIONS)

MODEL/FUNCTION TABLE

FUNCTION TONE FREQUENCY	TLN1249A SQUELCH CONTROL	TLN1250A REPEATER CONTROL	TLN1251A "PRIVATE-LINE" CONTROL
1550 Hz	MAXIMUM SQUELCH OPERATION	REPEATER TURN-OFF OPERATION	"PRIVATE-LINE" TONE-CODED SQUELCH OPERATION
1450 Hz	THRESHOLD SQUELCH OPERATION	REPEATER SETUP OPERATION	CARRIER SQUELCH OPERATION

"FUNCTION" -- SELECTS DESIRED MODE OF OPERATION BY DECODING REMOTE-GENERATED 1450 AND 1550 Hz FUNCTION TONES

APPLICATION TABLE

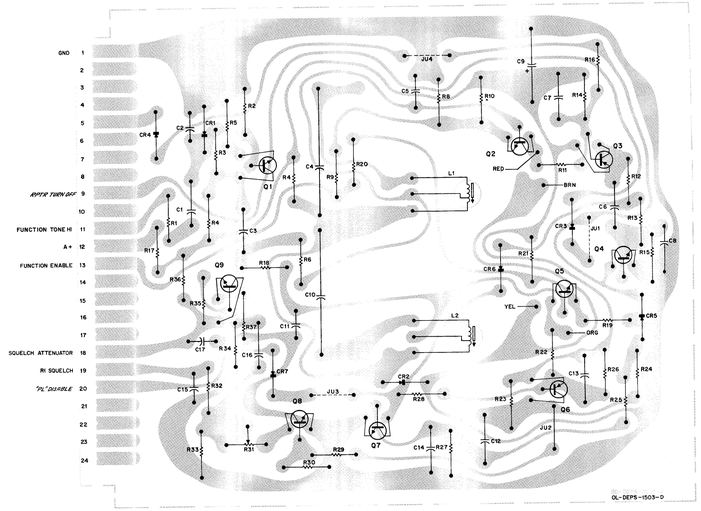
	SQUELCH CONTROL MODULE	"PRIVATE-LINE" CONTROL MODULE	REPEATER CONTROL MODULE
ST	MAX. SQ.	OPERATE "PL"	RPTR KNOCKDOWN
SF	MIN. SQ.	OPERATE CARRIER SQUELCH	RPTR SETUP
QSTOP	OPERATE MAXIMUM SQUELCH	OPERATE "PL"	REPEATER TURN-OFF
QRUP	OPERATE THRESHOLD SQUELCH	OPERATE CARRIER SQUELCH	REPEATER SETUP
PLT	TURN-ON/LOW SQUELCH CONTROL	(NOT USED)	(NOT USED)
OUT	OUT	OUT	IN
AB	IN	OUT	OUT
AB	OUT	IN	OUT
CM	OUT	OUT	OUT

NOTES:
1. VOLTAGES IN PARENTHESES ARE FOR ACTIVE STATE.
2. REFER TO TABLE FOR APPLICATION AND/OR DESCRIPTION.
3. FACTORY ADJUSTED TO REQUIRED FREQUENCY.
4. USED IN SQUELCH CONTROL MODULE ONLY.

LEGEND

START — CIRCUIT THEORY MUST EXIST UNDER CONDITIONS SPECIFIED AT THIS POINT AND FOLLOWING

- ENTRY OF OPERATION DATA
- MAINTENANCE DATA
- PRIMARY SIGNAL FLOW
- SECONDARY SIGNAL FLOW



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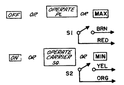

68P81005E01-K
8/15/77-NPC

END OF DOCUMENT

PARTS LIST

TLN4050A Control Board — PL-431-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1, 3, 6, 7, 8, 12, 13, 14, 16	8D82905G11	CAPACITOR, fixed: 0.22 uF ±10%, 50 V
C2, 5, 11, 15, 17	21D82187B29	.001 uF ±10%, 100 V
C4	8D84326A18	.0098 uF ±2%, 50 V
C9	23K865136	15 uF ±20%, 25 V
C10	8D84326A19	.0112 uF ±2%, 50 V
CR1 thru 7	48C82392B03	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon
L1, 2	1V80702B11	REACTOR: AF bandpass; (preset at factory); res 140 ohms ±10%; incl, grounding clip 42-84315A01
Q1, 2, 4, 5, 7, 8, 9	48R869570	TRANSISTOR: (SEE NOTE) N-P-N; type M9570
Q3, 6	48R869571	P-N-P; type M9571
R1, 12, 13, 15, 24, 25, 27	6S129620	RESISTOR, fixed: ±10%; 1/4 W; unl, stated 560
R2	6S129886	27K ±5%
R3	6S129299	68K ±5%
R4, 8, 19	6S129805	1K ±5%
R5	6S124A09	22 ±5%
R6	6S129236	15K ±5%
R7, 11, 22, 23	6S128689	2.2K
R9, 20	6D84444A07	221 ±1%
R10, 21	6D84444A08	2.21K ±1%
R14, 26, 28	6S127804	4.7K
R16, 32	6S127805	15K
R17	6S129224	82
R18	6S129887	12K ±5%
R29	6S128902	47K
R30	6S129433	5.6K
R31	18C83083G03	var: 25K ±30%
R33	6S129231	3.3K
R34	6S127806	27K
R35	6S129145	82K
R36	6S129981	3.3K
	NON-REFERENCED ITEMS	
	1-80702B19	CIRCUIT BOARD ASSEMBLY, includes:
	9-830111H01	CONTACT, female; 9 req'd.
	43-865080	BUSHING, threaded; 2 req'd.

TLN4052A Repeater Control Panel — PL-433-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
	NON-REFERENCED ITEM	
	1-80702B21	PANEL ASSEMBLY, includes:
	64-84198A03	PANEL SWITCHES S1 & S2
	3-8022	SCREW, machine; 4-40 x 1/4"; 2 req'd.
	4-7683	WASHER, lock: #4 (internal tooth); 2 req'd.
	45B83914C01	GUIDE RAIL (slide-mount for circuit board); 2 req'd.

TLN4051A Squelch Control Panel — PL-432-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
	NON-REFERENCED ITEM	
	1-80702B20	PANEL ASSEMBLY, includes:
	64-84198A02	PANEL SWITCHES S1 & S2
	3-8022	SCREW, machine; 4-40 x 1/4"; 2 req'd.
	4-7683	WASHER, lock: #4 (internal tooth); 2 req'd.
	45B83914C01	GUIDE RAIL (slide-mount for circuit board); 2 req'd.

TLN4053A "PL" Control Panel — PL-434-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S1, 2	40B83468E01	SWITCH, slide: spdt; spring return
	NON-REFERENCED ITEM	
	1-80702B22	PANEL ASSEMBLY, includes:
	64-84198A01	PANEL SWITCHES S1 & S2
	3-8022	SCREW, machine; 4-40 x 1/4"; 2 req'd.
	4-7683	WASHER, lock: #4 (internal tooth); 2 req'd.
	45B83914C01	GUIDE RAIL (slide-mount for circuit board); 2 req'd.

REVISIONS — 63P81005E01-K

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4050A	R6	WAS 6S133526, 18k	L1 TAP
	R7	WERE 6S133575, 220	Q5 EMITTER
	R10		Q6 EMITTER
	R11		Q5 EMITTER
	R19	WAS 6S129236, 15k	L2 TAP
TLN4050A-1	C7, 8, 13, 14	WERE 8D82905G02 .022 uF	BASE OF Q5, Q6, Q7
TLN4050A-2			