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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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.

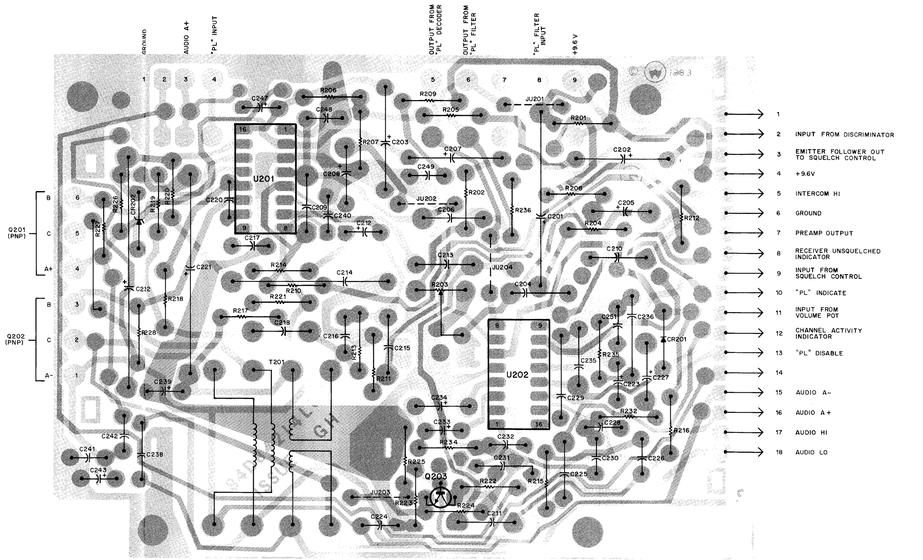
2.6.3 Squelch Output Circuit

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.



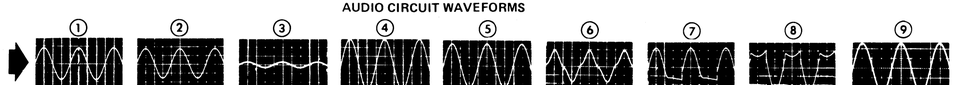
COMPONENT SIDE = 80-DEPS-41273-O SHOWN FROM SOLDER SIDE
SOLDER SIDE: 80-DEPS-41272-O
OL-DEPS-41274-O

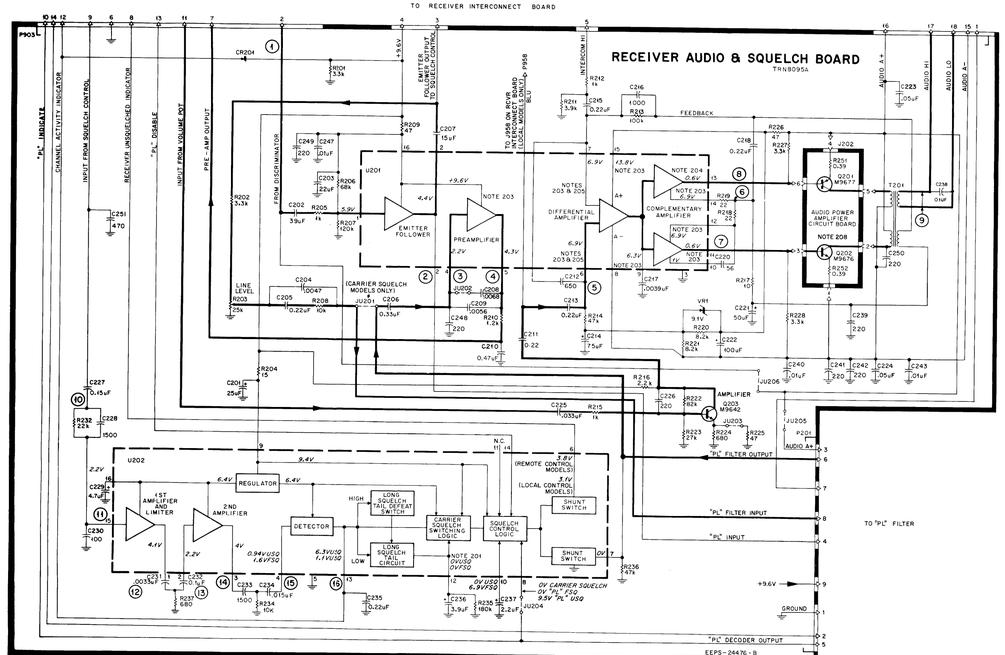
ALL AUDIO CIRCUIT OSCILLOSCOPE WAVEFORMS TAKEN UNDER THE FOLLOWING CONDITIONS:

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

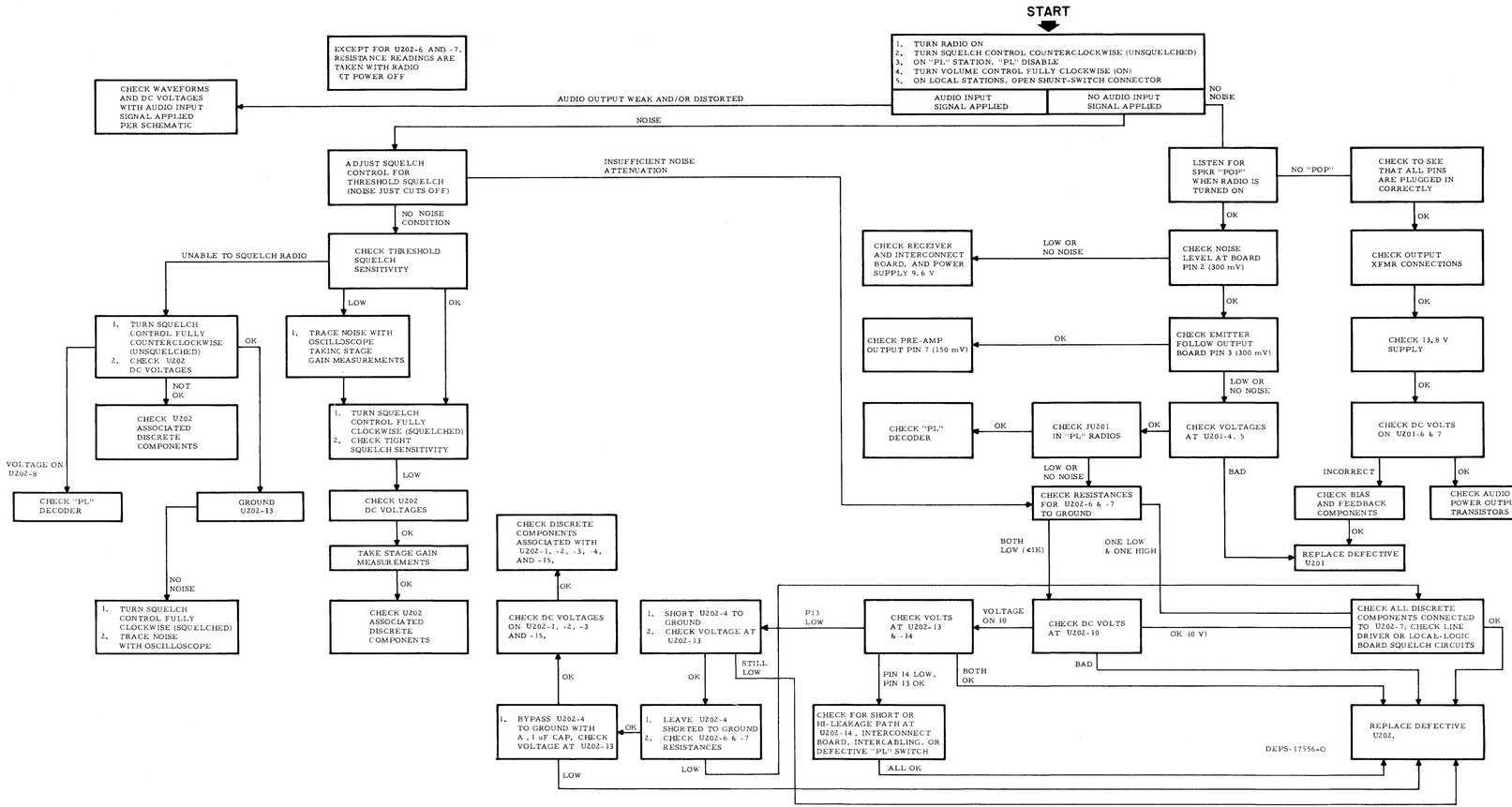
Motorola No. PEPS-24477-B
(Sheet 2 of 3)
5/30/85- UP

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.

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

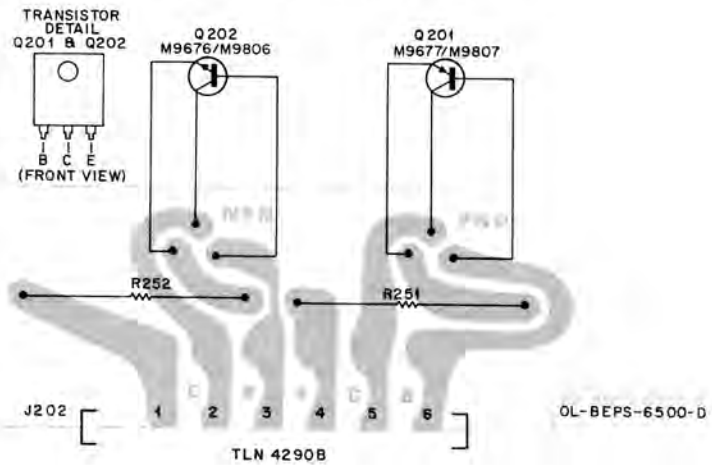
AUDIO POWER AMPLIFIER
MODEL TLN4290B

FUNCTION

— Provides up to 10 watts audio output.

AUDIO POWER AMPLIFIER

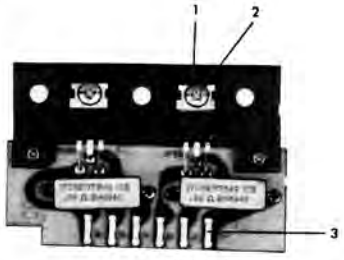
SHOWN FROM SOLDER SIDE



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

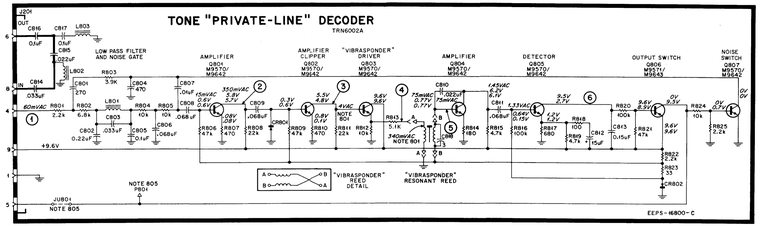
At resonance, the reed acts as a high Q transformer coupling energy from the primary to the secondary winding. At all other frequencies, the reed will not vibrate and no energy is coupled to the secondary winding.

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.

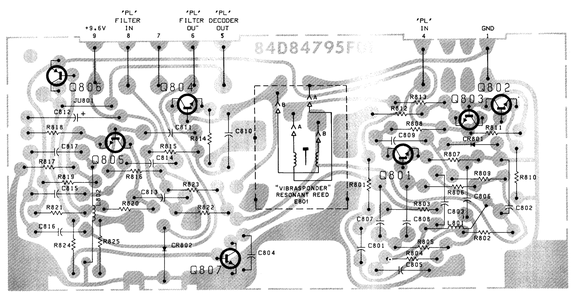
802. AC VOLTAGE READINGS ARE RMS VALUES WITH 60 MILLIVOLTS "PL" TONE INPUT, USE HIGH IMPEDANCE (10 MEGOHM) AC VOLTMETER. MEASUREMENT MADE WITH RESPECT TO CHASSIS GROUND.

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.

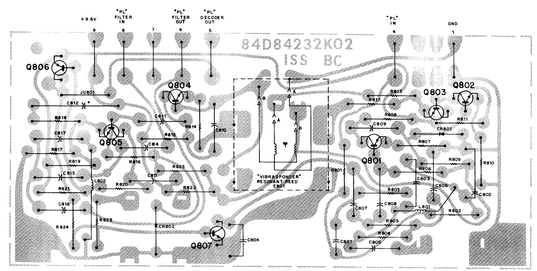
EARLIER VERSION



SHOWN FROM SOLDER SIDE

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

LATER VERSION



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

SHOWN FROM SOLDER SIDE

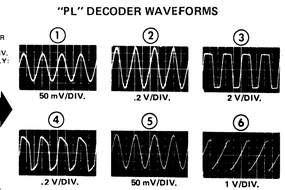
FUNCTION

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

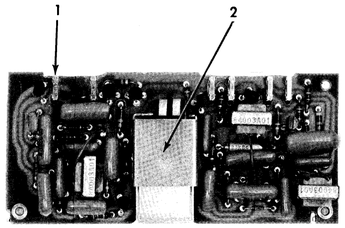
ELECTRICAL PARTS LIST

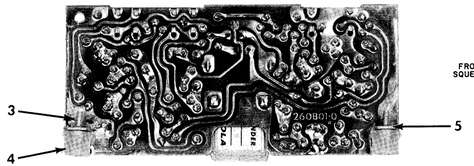
IMPORTANT

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

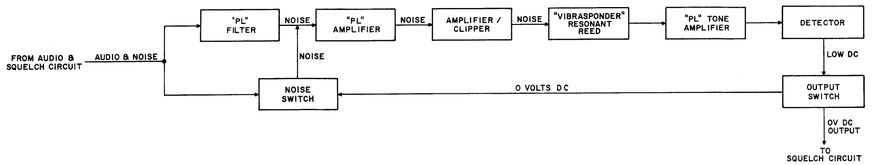
ITEM	MOTOROLA PART NO.	DESCRIPTION
1	9-83011H01	TERMINAL, pin: female; 6 req'd.
2	42-84116B01	SOCKET & CLAMP ASSY
3	3-136905	SCREW, lock: No. 4 x 5/16"; 2 req'd.
4	42-84284B01	RETAINER, Nylon: 2 req'd.
5	7-84223B01	BRACKET, retainer

NOTES:

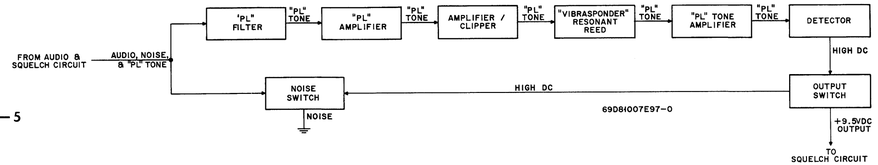
I. For optimum performance, replacement diodes and transistors must be ordered by Motorola part number.

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

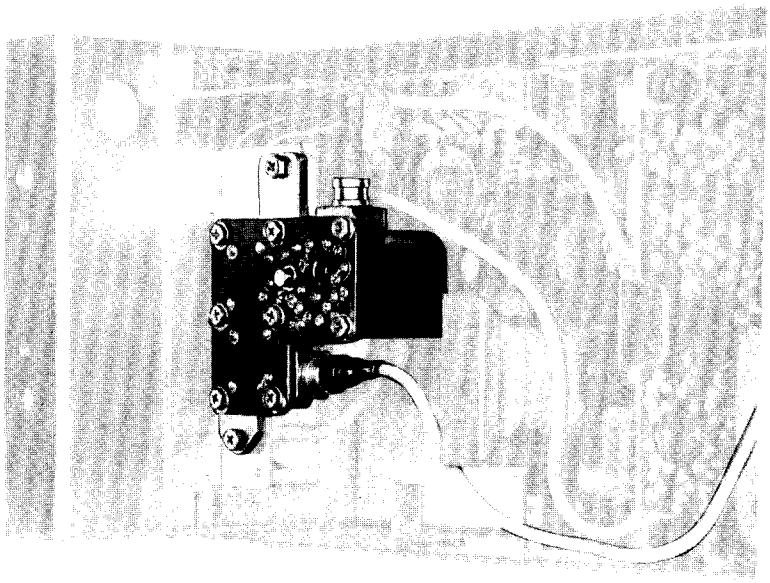
The PL decoder can be removed from its normal position in the receiver chassis and plugged on the front or circuitry side of the audio board. Parallel-connected pins have been provided for ease of servicing. Remove the audio board shield for access to these pins.

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.

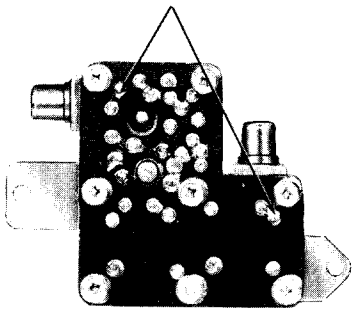
(3) Increase the signal generator output until the same reference point is obtained on the test set meter. Note the signal generator output level setting, it should be at least 3 times greater than the previous setting for a preamplifier gain of approximately 9-1/2 dB.

(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.



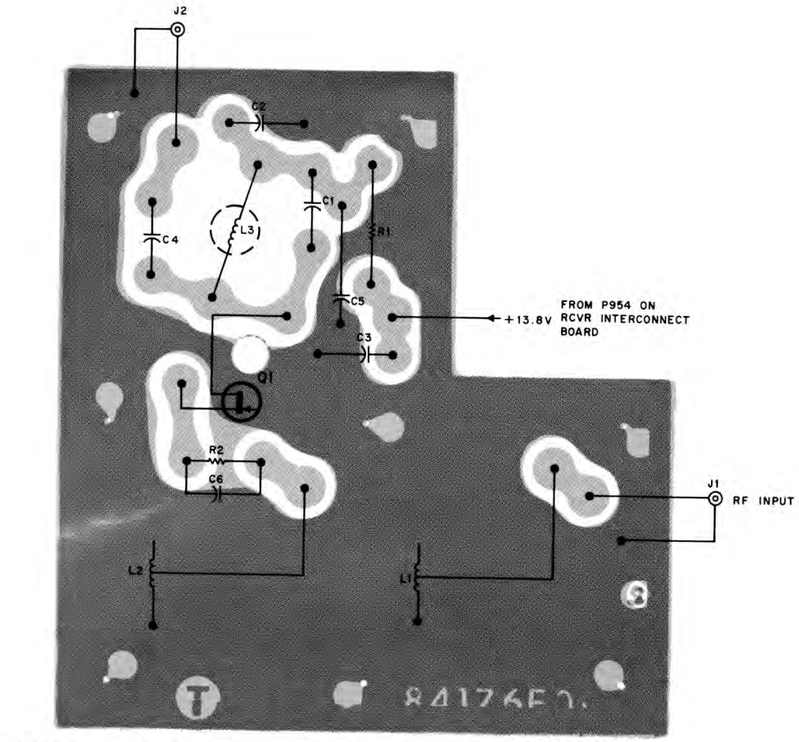
AEPS-8815-O

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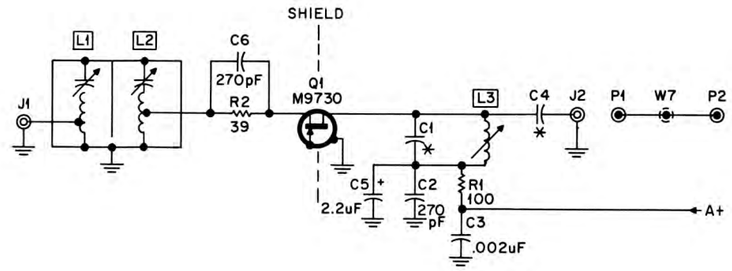
OL-BEPS-8822-A
BD-BEPS-7407-O



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

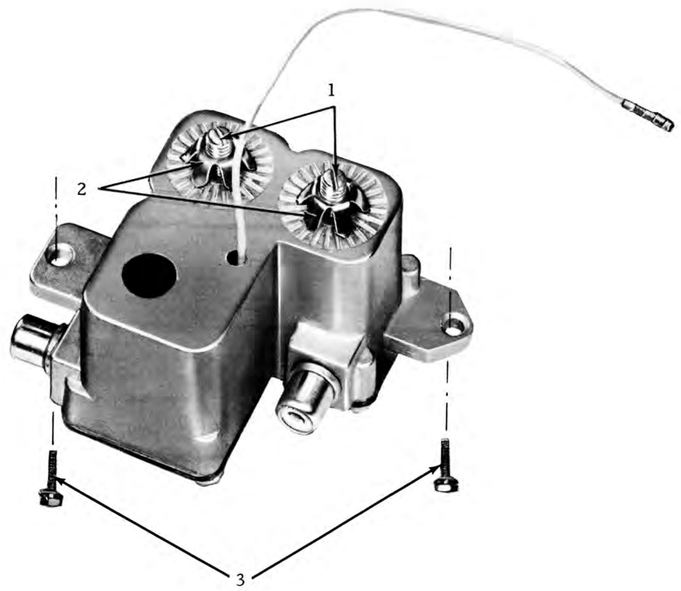
LEGEND:
L = 132-150.8 MHz
H = 150.8-174 MHz

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

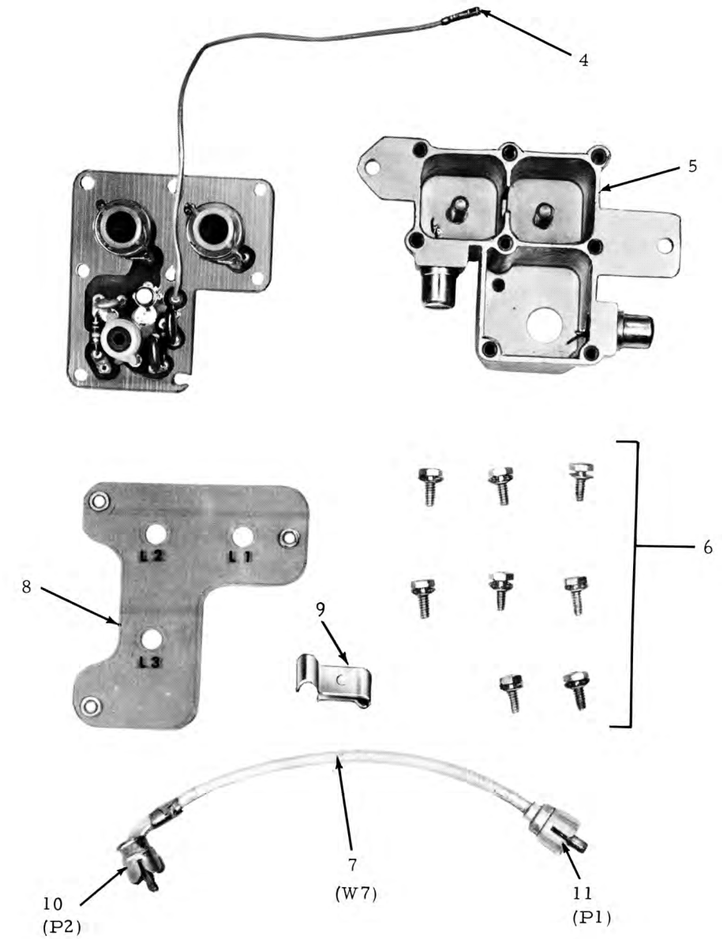
TLD8421B and TLD8422B RF Preamplifier
TLD8421A and TLD8422A RF Preamplifier PL-1035-G

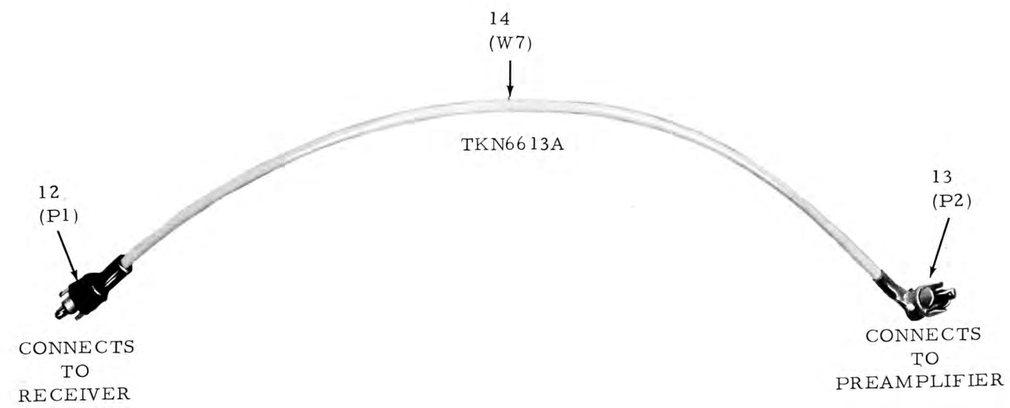
CODE	MOTOROLA PART NO.	DESCRIPTION
1	3S136923	SET SCREW, No. 10-32 x 1"; slotted head; 2 req'd
2	2B83677G01	LOCK NUT: 2 req'd
3	3S134268	LOCKSCREW, tapping: No. 4-40 x 7/16" "Phillips" hex head; 2 req'd
4	39S10184A24	CONNECTOR, receptacle: female
5	15D84416B01	HOUSING, preamplifier
6	3S136926	LOCKSCREW: 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

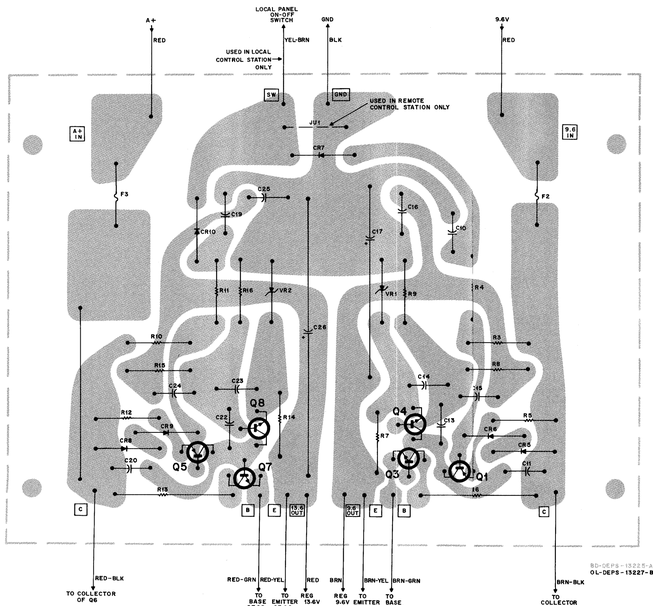
parts list

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

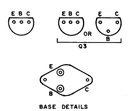
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2-119913	NUT, 8-32 x 11/32 x 1/8"; 3 used
	2-82360B07	NUT, speed, 1/4-14"; 18 used
	2-84410P04	NUT, stamped: 1/4-14"; 18 used
	3-122777	SCREW, machine: 8-32 x 1/2"; 3 used
	3-134268	SCREW, tapping: 4-40 x 7/16"; 2 used
	3-135038	SCREW, tapping: 14-14 x 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

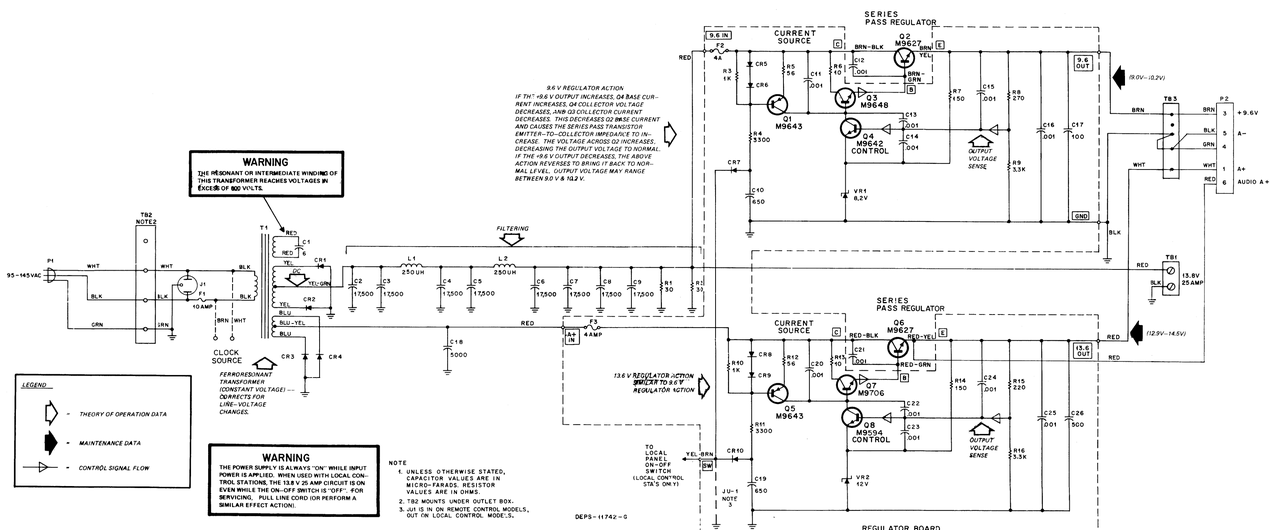
POWER SUPPLY

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

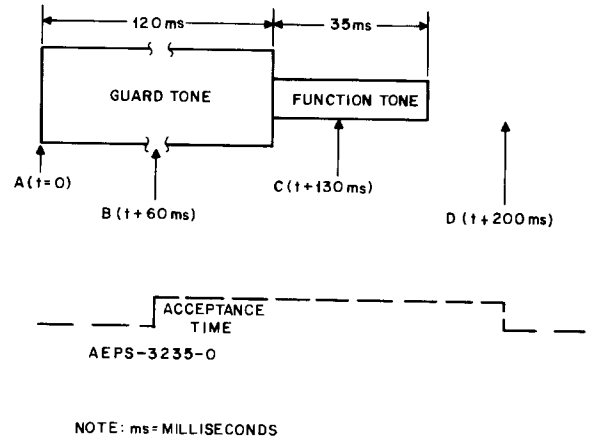


Figure 1. Tone Control Format, Non-Transmit Command

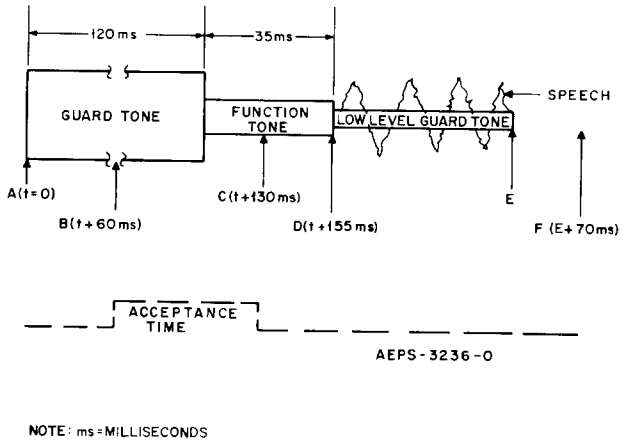


Figure 2. Tone Control Format, Transmit Command

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:

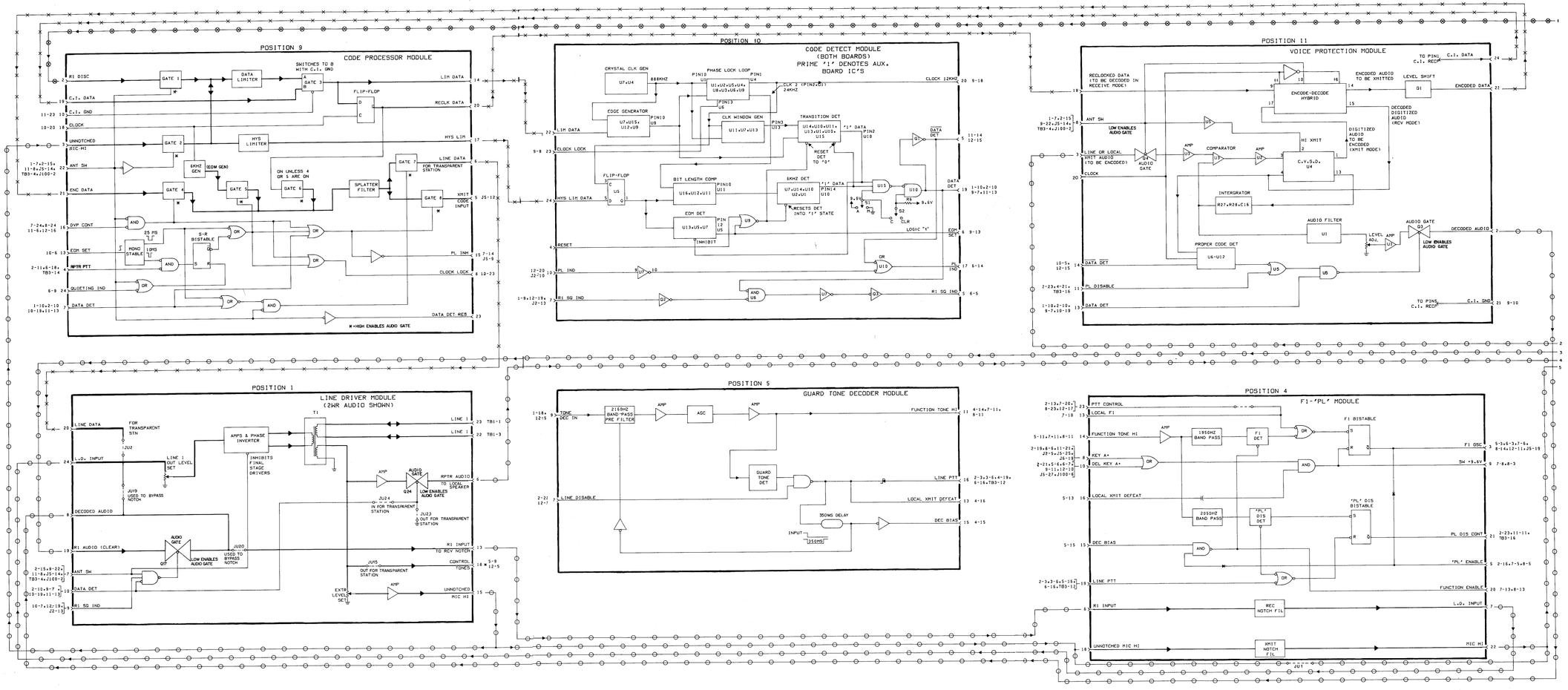
- R1 audio from J2-14 is routed to pin 17 of the squelch gate, through the audio gate, RPTR LEVEL control, amplifier and out on pin 11 to the transmitter.

4.9 REPEAT CODED AUDIO

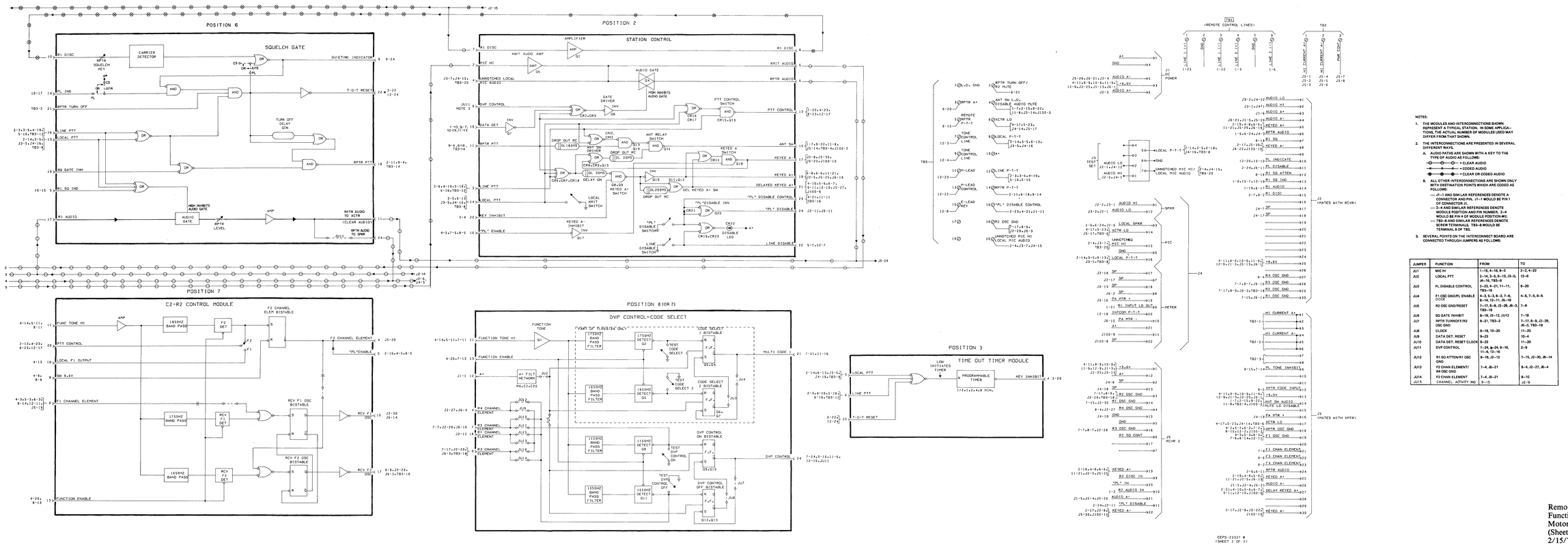
If the received audio is coded, it will be reshaped and reclocked before being re-transmitted. The audio path is as follows:

- 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.



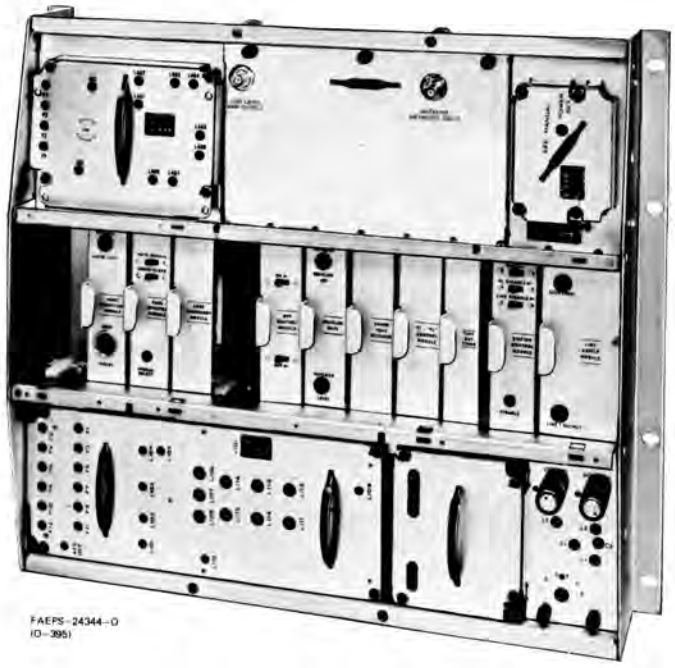
Remote Control Chassis
Functional Interconnect Diagram
Motorola No. PEPS-24349-A
(Sheet 1 of 2)
2/15/78-UP



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.

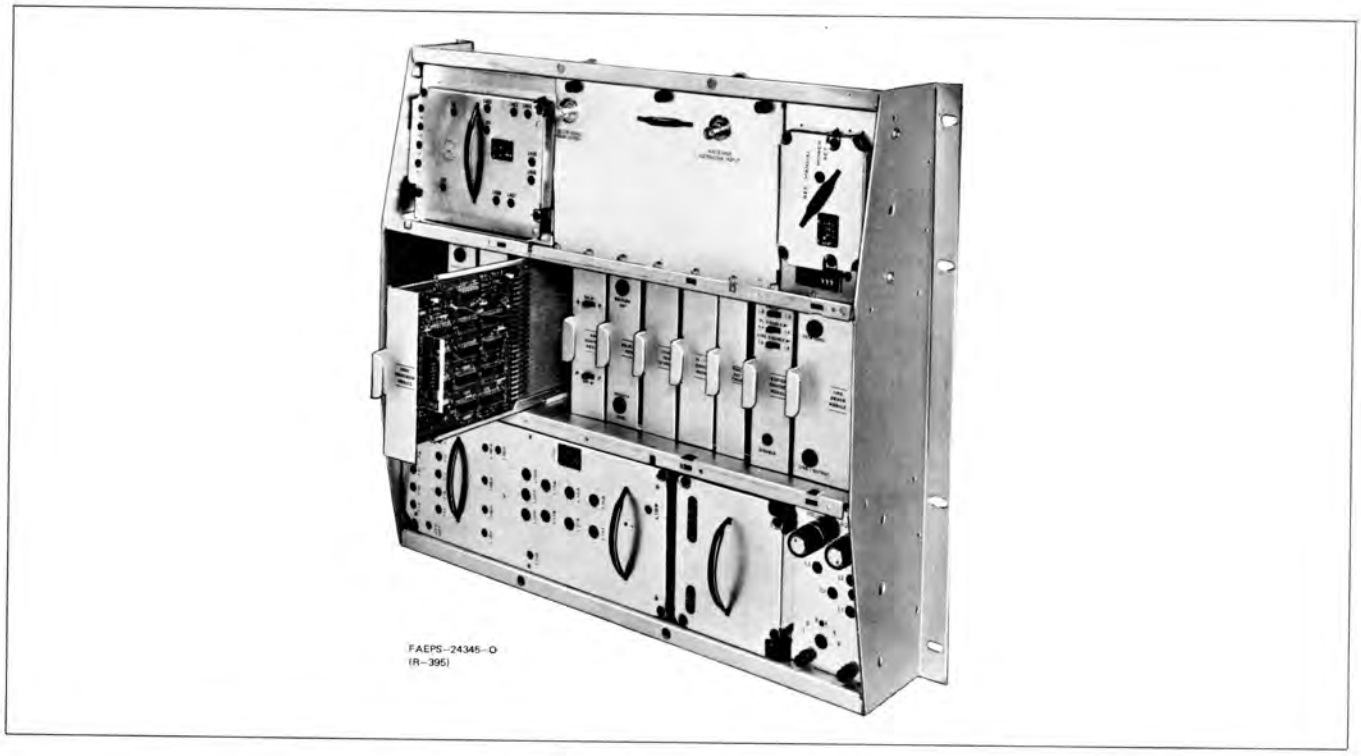


Figure 1. Typical In-Circuit Module Servicing

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%

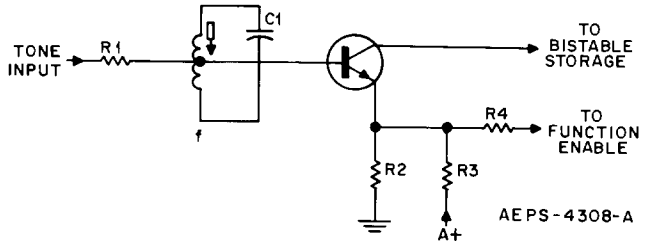


Figure 3. Typical Function Tone Detector

	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	MIC HI	LINE DISABLE	CONTROL TONES TO GUARD TONE DECODER	REPEATER PTT	R1 DISC	RPTR AUDIO	R1 AUDIO
1 LINE DRIVER	1	12										15*					24	13*									18*			6*	19
2 STATION CONTROL	1	12		20	14*	3	19*	13*			21*		23*						16						2	22*		11	8*		
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*	22*						
GUARD TONE DECODER	1 17	12				16*			2	23	6			3		13*						11*	15*			7	9				
6 SQUELCH GATE	1 23	12	22*		13	16	6		2		7			3*														18*	10	24*	17
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													4			
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											7	5*				
13 JUMPERS					2							1	3	4					4						1						
14 J1 POWER SUPPLY	4*	1*													3*																
15 J2 RCVR	23 26	24					5								25															6	14*
16 J3 TEST SET METER	6				5																										
17 J4 METERING	5	21			16*					14																				3	
18 J5 XMTR	20	28					25		18*	17*	27*			19	13																
19 J6 2ND RCVR	5 15	12					19								1																
20 TB1 REMOTE CONTROL																															
21 TB2 HIGH CURRENT																															
22 TB3 EXTERNAL	1	10			8	12				6			16															14			
23 INDIVIDUAL PINS J100	4 5	1 7							3		6																				

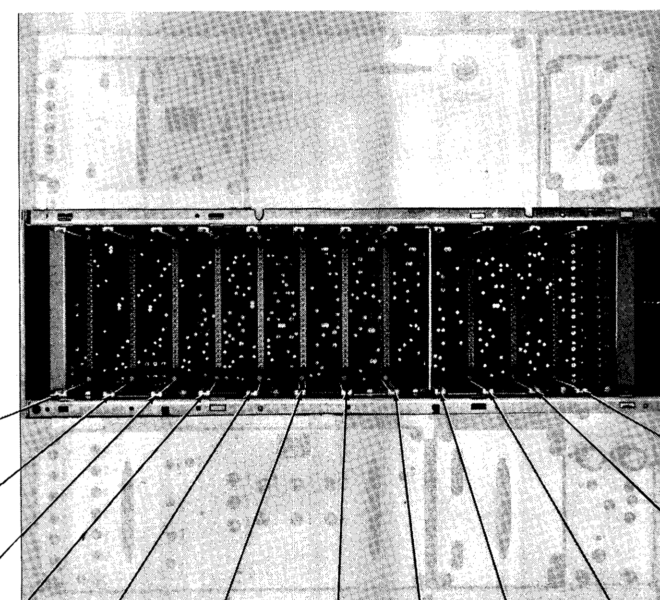
	R1 SQUELCH INDICATE	RPTR AUDIO TO LOCAL SPEAKER	ADL OUTPUT	"PL" OR "DD" INDICATOR/SW A+	XMTR CODE INPUT	REPEATER TURN-OFF/R2 MUTE	12 W PA MTR +	REPEATER A+	REMOTE REPEATER PTT	E LEAD KEY	TONE CONTROL LINE	TONE CONTROL LINE	"PL" INDICATE	R1 SQUELCH IND. TO SQ. GATE	DVP CONTROL 1 (EOM-T)	$\overline{\text{DATA DETECT}}$	STATUS TONE OUT	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
1 LINE DRIVER	9																11								10				7			20	2	21	8			
2 STATION CONTROL		6*																				7		4	10	5*		17*	15*	24*								
3 TIME OUT TIMER																																						
4 F1/F1-PL																																						
GUARD TONE DECODER																																						
6 SQUELCH GATE		11*		14		21		20*	15*					5																								
7 F2/DVP CONTROL															24*																							
8 OPTIONS/4 FREQ/ DVP CONTROL															24*																							
9 CODE PROCESSOR					5*										16							2			7				22			6						
10 CODE DETECT	7			17*									10	15*		5*									19*													
11 VOICE PROTECTION (OPTIONAL CODE DET)															6	14									13	3			8						2*			
12 LINE INTERFACE	19									8	3	4	20		16	15	21*	23*	22*		6*		18															
13 JUMPERS						7									11						2																	
14 J1 POWER SUPPLY																																						
15 J2 RCVR	13*												10*									15*						8		11						2*	1*	
16 J3 TEST SET METER																								7*												1	2	
17 J4 METERING							19													10			20*	15*			18				8			9		1	12	11
18 J5 XMTR		24	7,8*		12		16													15								30	14									
19 J6 2ND RCVR																											13	22		11	2		10*					
20 TB1 REMOTE CONTROL																																						
21 TB2 HIGH CURRENT			3																																			
22 TB3 EXTERNAL						2		3	5	15	7	9						11	13					20					4									
23 INDIVIDUAL PINS J100																												10	2									9

	LINE 1	LINE 1	LINE 2	LINE 2	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	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	23*	22*	3*	4*																																							
2 STATION CONTROL																																									9		
3 TIME OUT TIMER																																											
4 F1/F1-PL																																											
GUARD TONE DECODER																																											
6 SQUELCH GATE																																	9										
7 F2/DVP CONTROL						21												4*			7				14*						15*	17*		18	9								
8 OPTIONS/4 FREQ/ DVP CONTROL					19	21								22	20*		18	10*		6	7*	2	4*									9*										10	
9 CODE PROCESSOR									20	18	21	10	19												15*	8	14	23*	17	13			24										
10 CODE DETECT										20*																23	22		24	6*										4			
11 VOICE PROTECTION (OPTIONAL CODE DET)						16			19		22*	23*	24*																										20				
12 LINE INTERFACE																																											
13 JUMPERS										8					3		12 6	13 14					13		15			9,10			12	7 5		6	5				8 10	9	11	14	15
14 J1 POWER SUPPLY																																				6*	5*						
15 J2 RCVR					7*												12		17		28		27	18							30	29				3	4						9
16 J3 TEST SET METER																																											
17 J4 METERING																22			7					17																			
18 J5 XMTR							1,2,3	4,5,6										21		22		23			9												26						
19 J6 2ND RCVR																					16		4								14	3					21						
20 TB1 REMOTE CONTROL	1	3	4	6																																							
21 TB2 HIGH CURRENT							1*	2*																																			
22 TB3 EXTERNAL																																18											
23 INDIVIDUAL PINS J100																8																											

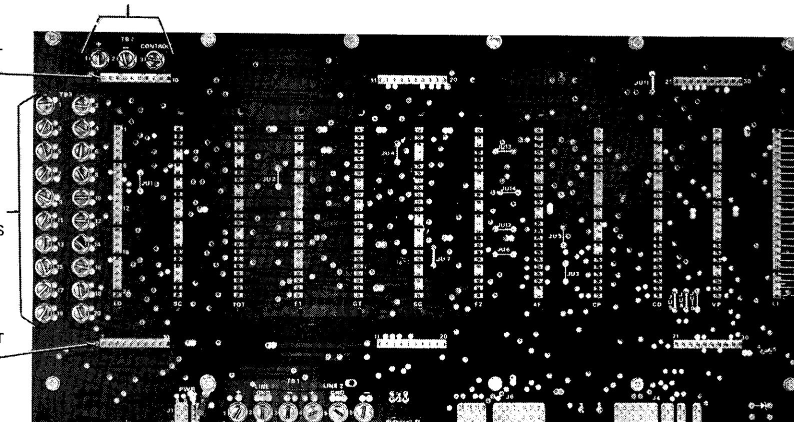
* = SIGNAL SOURCE

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

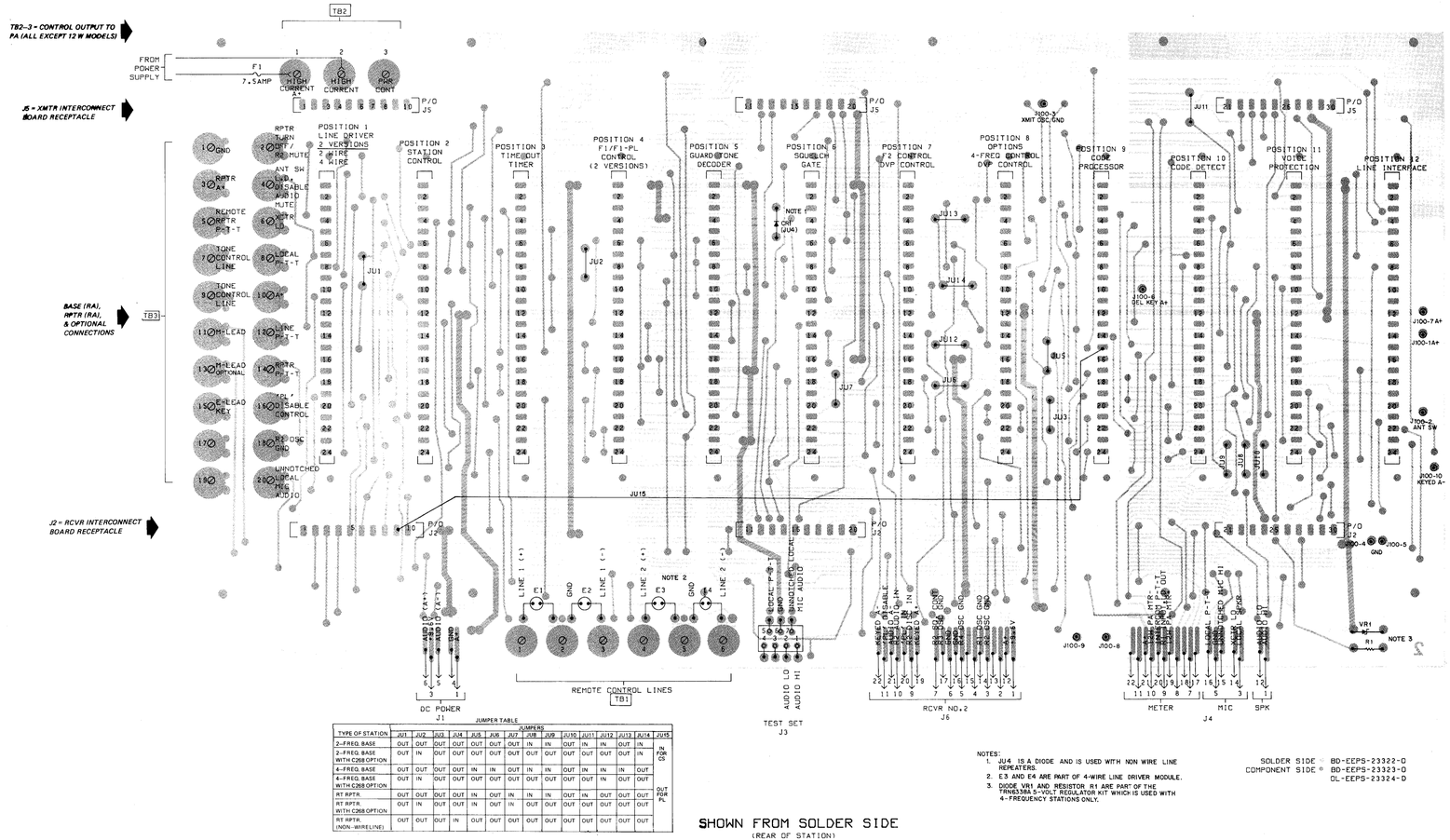
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C921, 922	21-82372C07	.05 uF; 25 V
		connector, plug:
P1002		includes:
	15-83498F04	housing, connector:
	29-83499F01	contact, connector; 3 req'd.
	46-84549F01	plug, polarizing
		transistor: (see note)
Q902	48-869701	PNP; type M9701
		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

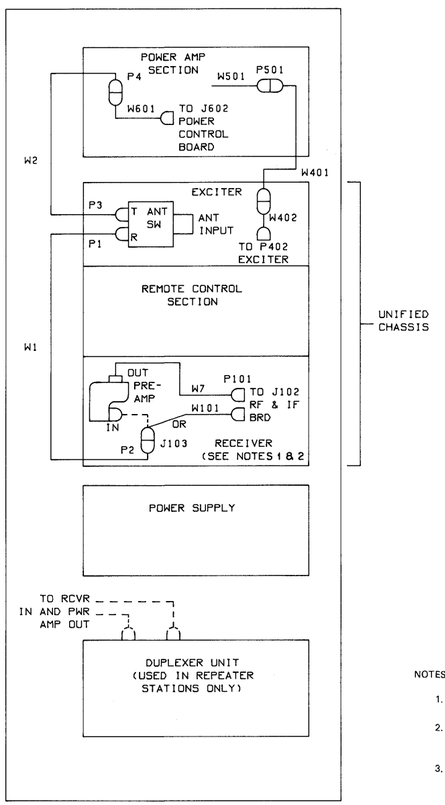
SHOWN FROM SOLDER SIDE
(REAR OF STATION)

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

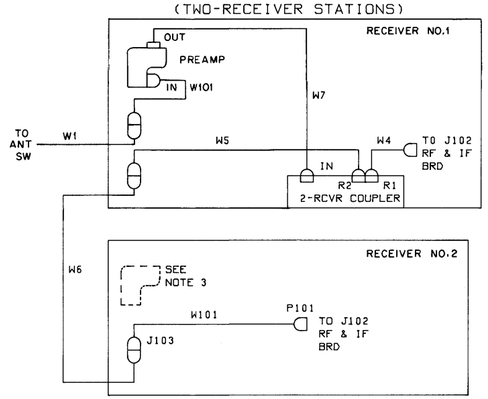
(CONTINUOUS DUTY STATIONS
WITH UNIFIED CONTROL CHASSIS)

SINGLE RECEIVER STATIONS

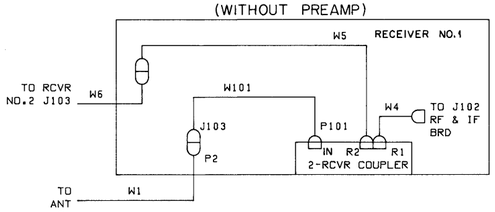


REAR VIEW

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.

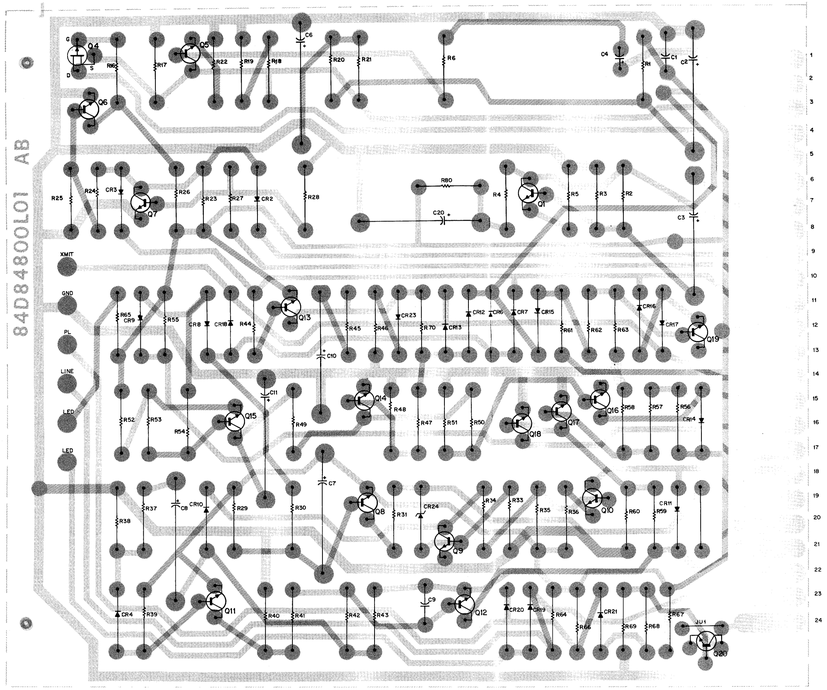
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

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)

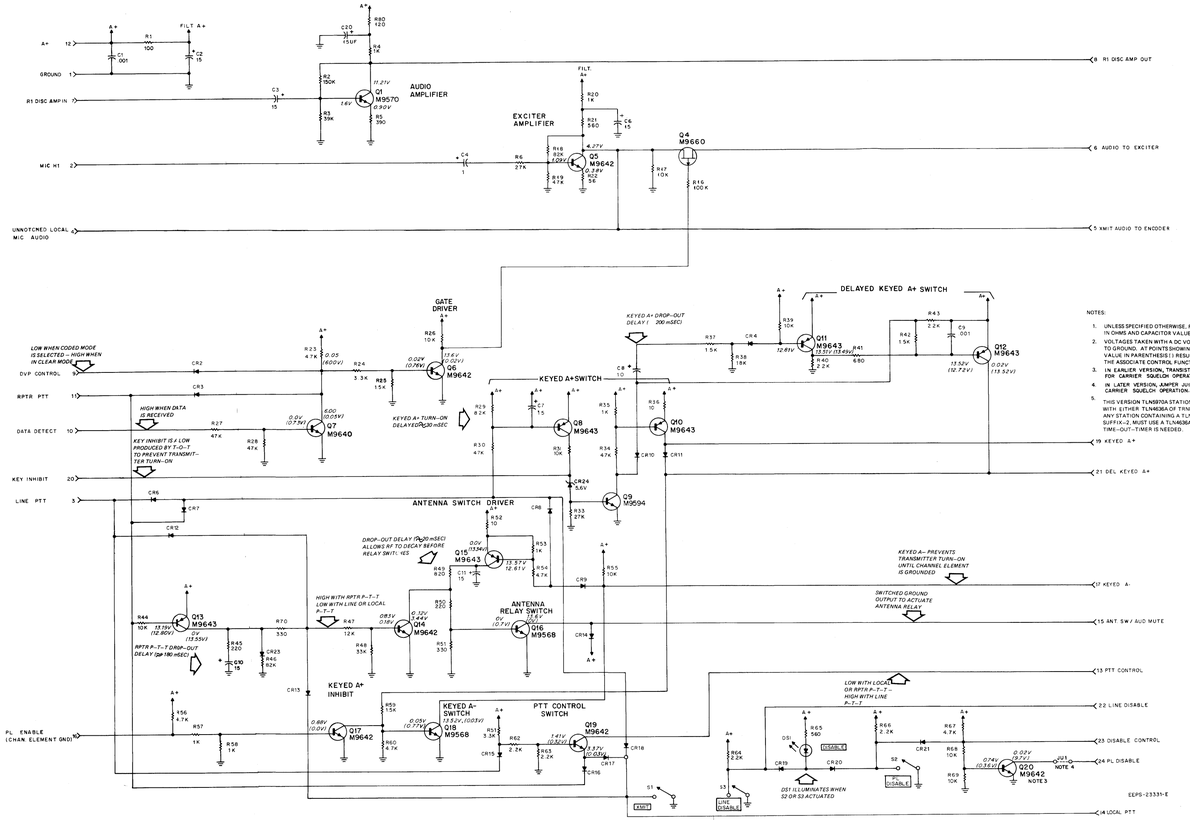
LATER VERSION

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

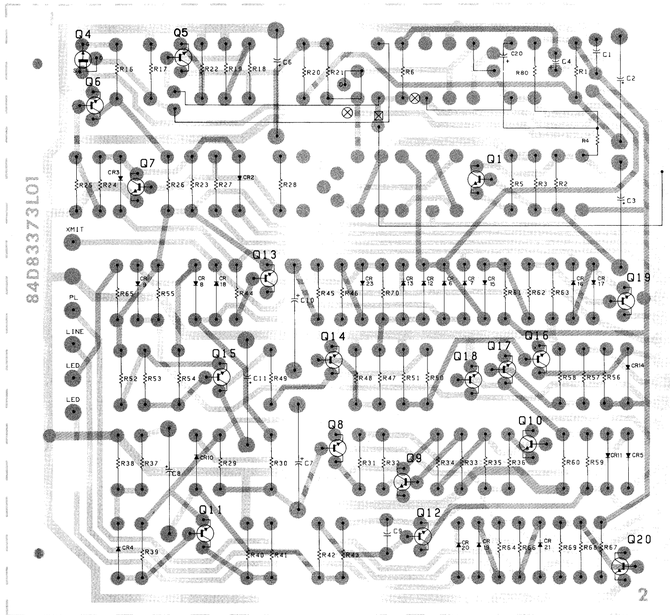
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITORS, fixed:
C1,9	21-83596E01	.001 uF ±10%; 500 V
C2,3	23-82783B13	15 uF ±5%; 25 V
C4,12	23-84538G14	1.0 uF ±10%; 35 V
C6,7	23-82783B13	15 uF ±5%; 25 V
C8	23-82783B27	10 uF ±10%; 25 V
C9	21-83596E01	.001 uF ±10%; 500 V
C10,11	23-82783B13	15 uF ±15%; 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.

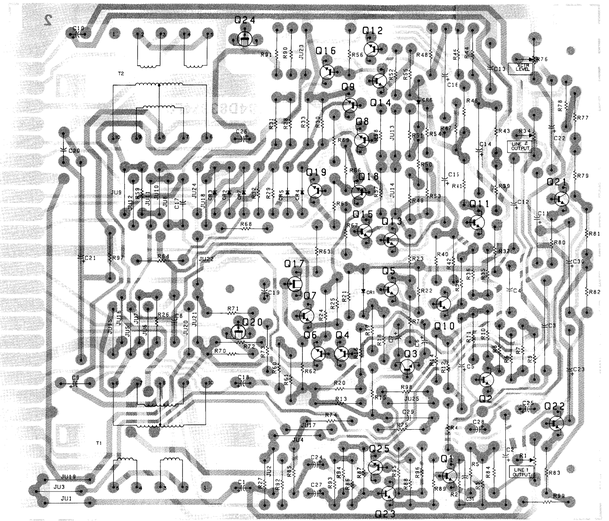
Receiver audio enters the module on pin 19 and passes through audio gate Q17 if R1 squelch indicate, pin 19, is high (about 4.0 volts dc) or if data detect, pin 10, is low. If JU18 is installed, antenna switch, pin 7, will inhibit audio gate Q17 when in a low state. After passing through the audio gate, 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.

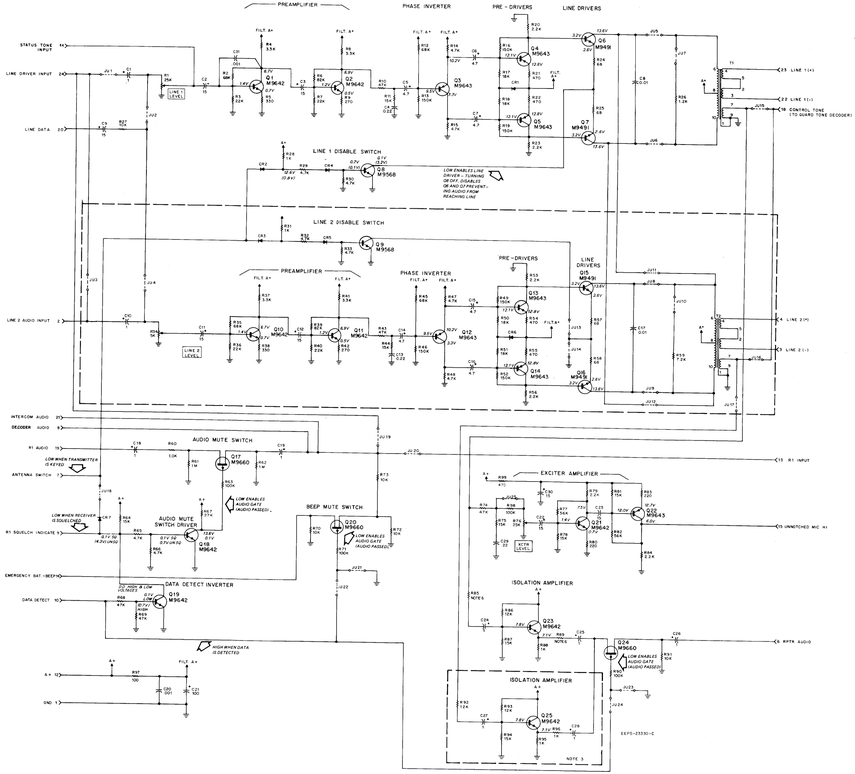
Local speaker audio which is taken from pin 7 of T1 and routed through the isolation amplifier Q23, audio gate Q24, and exits on pin 6. One an encode/decode station, Q24 is forced into a conducting mode at all times by installing JU23. This allows the local speaker to monitor clear and decoded audio 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.

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 PARENTHESES ( ) RESULTS FROM ACTIVATING THE LINE DISABLE SWITCH.
3. VOLTAGES SHOWN ON THE LINE 2 AMPLIFIER CIRCUIT ARE APPLICABLE FOR THE LINE 2 AMPLIFIER ALSO.
4. CIRCUITRY INSIDE DASHED LINES IS PRESENT ONLY ON MODEL TLN5977A LINE DRIVERS (4-WIRE).
5. LINE DRIVER JUMPERS VARY WITH THE MODEL AND APPLICATION. REFER TO THE JUMPER CHART FOR STATUS OPTIONS.
6. VALUES FOR RESISTORS R8 AND R86 DIFFER BETWEEN THE TWO MODELS. REFER TO PARTS LIST FOR INFORMATION.
7. THESE TWO MODULES CAN BE USED IN EITHER TRANSPARENT OR ENCODE/DECODE TYPE STATIONS. REFER TO THE JUMPER TABLE FOR APPROPRIATE CONNECTIONS.

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

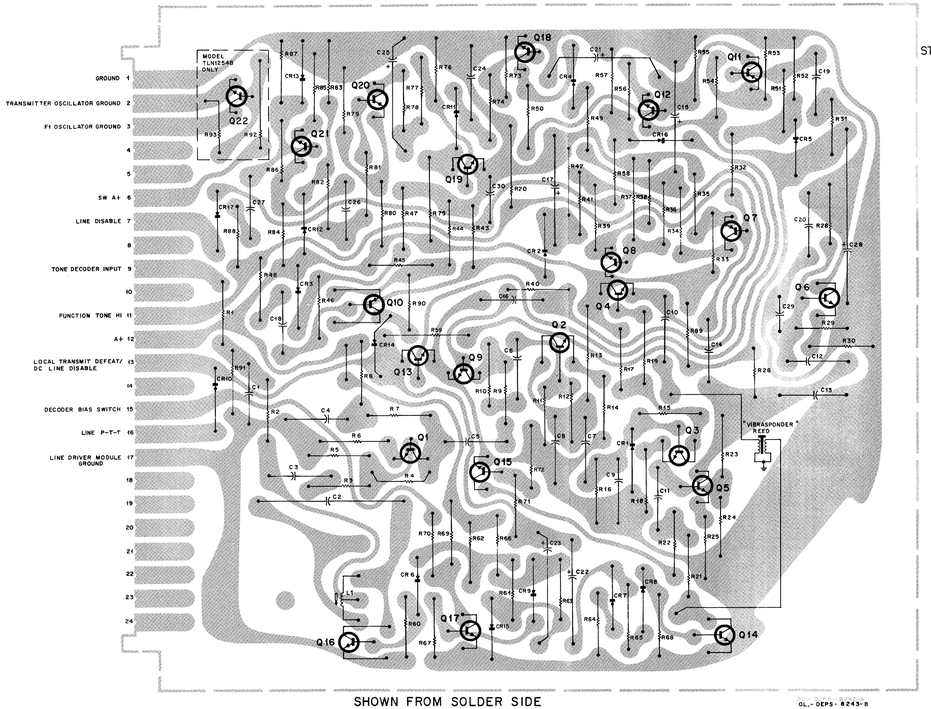
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R29,30	6-124C65	4.7k
R31	6-124C49	1k (TLN5977A only)
R32,33	6-124C65	4.7k (TLN5977A only)
R34	18-83083G03	var. 25k (TLN5977A only)
R35	6-124C93	68k (TLN5977A only)
R36	6-124C81	22k (TLN5977A only)
R37	6-124C61	3.3k (TLN5977A only)
R38	6-124C37	330 (TLN5977A 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

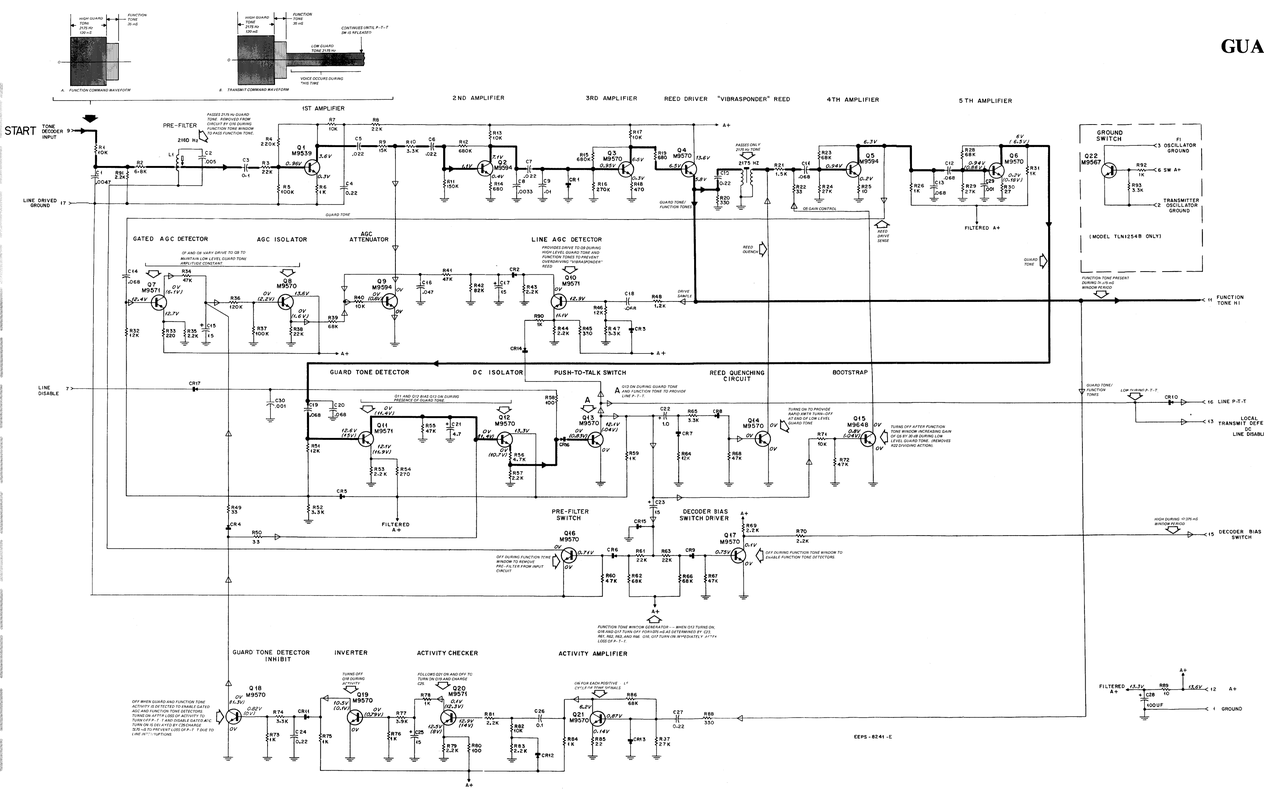
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-8022	SCREW, machine: 4-40 x 1/4"; 2 used
	3-134168	SCREW, tapping: 4-40 x 1/4"; 2 used
	4-7683	WASHER, lock #4 int.; 2 used
	7-82613K01	BRACKET, circuit board
	43-82721C01	BUSHING, snap; 3 used
	45-83914G01	GUIDE, card; 2 used
	64-83361L02	PANEL
	80-83029H01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