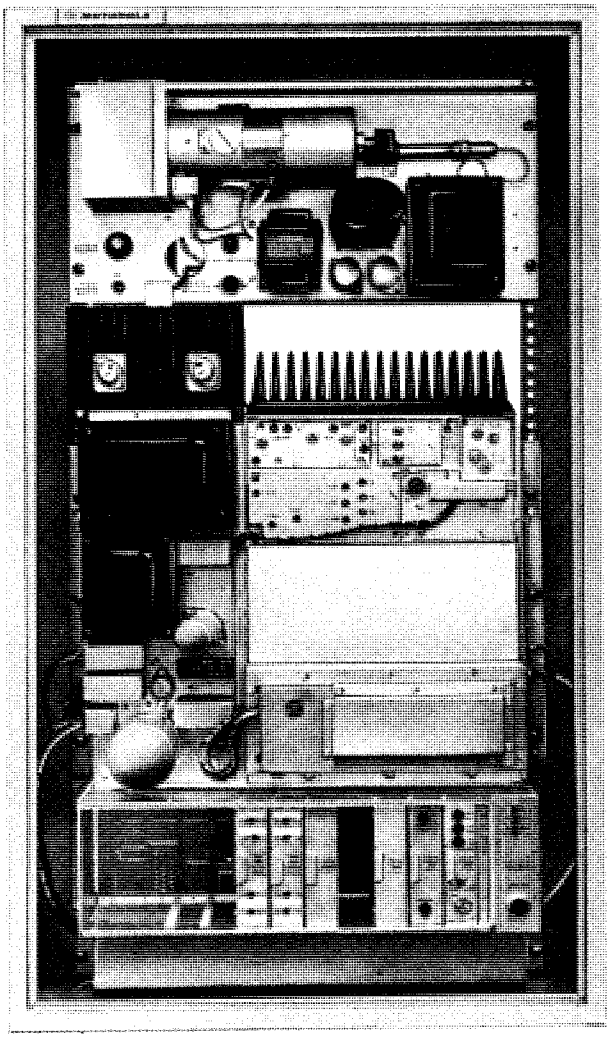
MOTOROLA

"COMPA-STATION"®
WITH "SENSITRON" RECEIVER
COMMUNITY REPEATER

450-470 MHz 90 W RF POWER
"PRIVATE-LINE" TONE-CODED SQUELCH
117 V AC 50/60 Hz



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THIS MANUAL HAS BEEN

DISCONTINUED

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

8/6/74-NPC

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Issue - C

GUARANTEED PERFORMANCE SPECIFICATIONS

GENERAL

AC INPUT POWER REQUIREMENTS	Receive: .8 amps Transmit: 5.0 amps @ 117 V ac 50/60 Hz
12 V DC DRAIN	Standby: 1.0 amp Receive: 2.0 amp Transmit: 9.0 amp
FREQUENCY RANGE	450-470 MHz
CABINET DIMENSIONS	22" wide x 38" high x 10" deep (56 cm x 98 cm x 25 cm) for standard indoor "Compa-Station" cabinet. 22" wide x 40" high x 16" deep (56 cm x 102 cm x 41 cm) for optional outdoor "Compa-Station" cabinet. 21-3/4" wide x 70" high x 20-1/4" deep (56 cm x 178 cm x 52 cm) for optional indoor upright cabinet. 23-1/4" wide x 70" high x 24-1/2" deep (59 cm x 178 cm x 63 cm) for optional outdoor upright cabinet; add 4-5/8" height (12 cm) to height for rainshield.
WEIGHT	185 lbs. shipping weight (83.9 kg) with standard indoor "Compa-Station" cabinet
METERING	Optional meter and switch with single 0-50 microampere meter can be used to measure all circuits essential to tuning and checking.
TRANSMITTER	
RF POWER OUTPUT	90 watts
OUTPUT IMPEDANCE	50 ohms
SPURIOUS & HARMONICS	More than 85 dB below carrier
FREQUENCY STABILITY	Temperature-compensated channel element maintains carrier within ±.0002% of assigned center frequency from -30°C to +60°C ambient (+25°C reference).
MODULATION	16F3: ±5 kHz for 100% at 1000 Hz
AUDIO SENSITIVITY	0.165 volt ±3 dB for 2/3 maximum deviation at 1000 Hz
FM NOISE	45 dB below 2/3 system deviation at 1000 Hz
AUDIO RESPONSE	+1, -3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
AUDIO DISTORTION	Less than 2% at 1000 Hz for 2/3 system deviation.
RECEIVER	
INPUT IMPEDANCE	50 ohms
CHANNEL SPACING	25 kHz
SELECTIVITY EIA SINAD	-90 dB
EIA SINAD INTERMODULATION	-80 dB
EIA MODULATION ACCEPTANCE	±7 kHz minimum
SENSITIVITY	Less than .5 microvolt for 20 dB quieting; less than .35 microvolt for EIA SINAD
FREQUENCY STABILITY	Temperature-compensated AFC channel element maintains oscillator frequency within ±.0002% of reference frequency from -30°C to +60°C ambient (+25°C reference).
SPURIOUS & IMAGE REJECTION	More than 100 dB
SQUELCH	Carrier Squelch: Noise compensated type, adjustable sensitivity, threshold sensitivity of 0.25 microvolt or less (Patent No. 2343115 other patents pending). "Private-Line" Tone-Coded Squelch: Also includes a tone-operated squelch circuit with a fixed sensitivity of 0.25 microvolt or less (Patent No. 2688059).
AUDIO OUTPUT	5 watts at 3.2 ohms; less than 5% distortion at 1000 Hz
AUDIO RESPONSE	+1, -8 dB of 6 dB/octave de-emphasis characteristic from 300-3000 Hz (ref. 1000 Hz)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC LICENSE DESIGNATION: CC4061C

EPS-15831-O

Note: Pages iii through v are omitted due to non-relevancy.

CONTENTS

SECTION NUMBER

SECTION NUMBER

OPTIONS

1. INTRODUCTION

The Motorola Model C74MSY-3101AY "Compa-Station" Community Repeater (RT) Station is a common repeater unit shared by several "Private-Line" Tone-Coded subscribers. Each subscriber has an exclusive "Private-Line" tone frequency. The "Private-Line" tone-coded signals used in the system are automatically decoded and retransmitted. The stations operate in the 450 to 470 MHz frequency range with an rf output of 90 watts.

Optional equipment is available for local metering, single-tone decoding, and emergency power reverting, where a lowered rf power output is available from a 12-volt battery supply in case of an ac power failure.

These stations employ completely transistorized receivers, exciters, power supplies and control units. Only the power amplifier stage in the transmitter uses a tube. The advantages of the transistor -- low current requirements, reliability, light weight, compact size and low maintenance requirements -- are fully utilized. Solid-state switching replaces all relays except the antenna relay and the emergency power reverting relay (optional). Current demands are low and unheated, temperature compensated, plug-in oscillator modules (channel elements) are used for frequency control. In addition, blowers and their related maintenance problems are eliminated by the use of heat sinks in the transmitter amplifier stages.

The station cabinets are of rugged steel construction with front and rear doors that are easily removed for servicing. The compact cabinet size permits shelf mounting in addition to the standard floor mounting.

The station is constructed so that all metering controls are accessible without interrupting communications. There is no interlock on the front door since there are no high voltages present on the front panels. Switches are provided for placing the station under local control while servicing.

2. C74MSY-3101AY AND C74MSY-3101BY MODEL COMPLEMENT

QTY	MODEL NO.	DESCRIPTION
1	TRE1150AB Series	Receiver
1	TTE1130AA Series	Transmitter
1	TPN1061AA	Power Supply
1	TCN1059A	Control Unit
1	TLE1060B	Power Amplifier
1	TLN1179A	Time-Out Timer
1	TLN1180A	Squelch Gate Module
1*	TLN1183A	Master Decoder Module
1*	TLN1177A	4-User Decoder Module
1**	TLN1684A	Master Decoder Module
1**	TLN1685A	4-User Decoder Module
1	TLN1173A	Station Logic Module
1	TLN8889A	Receiver Shield
1	TLN8810A	Junction Box
1	TLN8036A	Blank Chassis
1	TKN6365A	Antenna Cable
1	THN6082A	Indoor Cabinet
1	TLN8806A	Cabinet Accessories
1	TLN8805A	Tuning Tools
***	TLN8381A	"Vibrasponder" Resonant Reed
1	CER106B	Receiver Channel Element
1	TLN1190A	Transmitter Channel Element
1	TLN8799A	Service Board Kit

* Used with Model C74MSY-3101AY

** Used with Model C74MSY-3101BY

*** As required.

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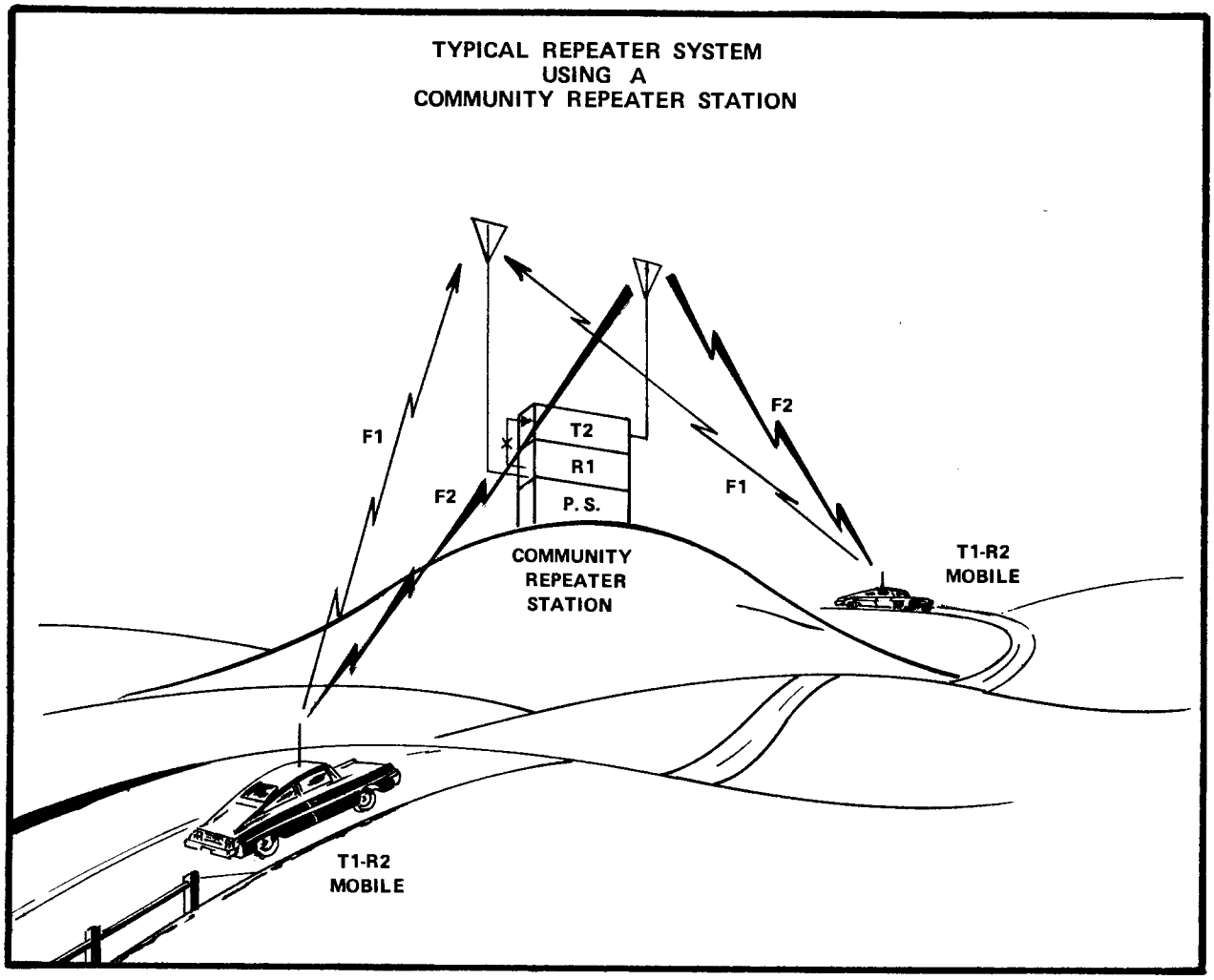

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3. APPLICATION

Motorola community repeater (RT) stations are for use in two-way FM radio communications systems where extended range operation is required or where natural or man-made limitations to direct communications are encountered. The station is used primarily for "mobile relay" repeater applications. Refer to the System Diagram for typical examples of this unique repeater circuit.

In a "mobile relay" circuit, signals as received by the repeater receiver from one mobile unit are rebroadcast to other mobiles by the repeater transmitter. Mobiles operating in a system of this type must employ a transmitter and receiver of different frequencies. The repeater transmitter and receiver will consequently be aligned on exactly the reverse frequencies of the transmitters and receivers of the mobile units.

The station functions automatically; i.e., all control functions for the station are initiated via the rf carrier. As a signal is received by the receiver, the transmitter is automatically actuated. The output of the receiver is fed to the transmitter modulator input circuit so that the received signal is rebroadcast at greatly increased power on the repeater transmitter frequency.

4. CONTROL FACILITIES

These stations contain a transistorized Control Unit which is used to provide the specific switching functions required for station operation.

5. DESCRIPTION OF ITEMS

a. Receiver

The completely transistorized receivers in these stations are crystal-controlled, dual

conversion models. They provide five watts of audio power at the local speaker. RF preselectors, and i-f crystal filter and a sealed, lifetime guaranteed "Permakay" ® filter in the i-f stages determine the excellent bandwidth and selectivity characteristics of the receivers. Temperature compensated, plug-in crystal oscillator modules (channel elements) provide excellent frequency stability without the use of crystal ovens. The channel elements are two-piece units in which the upper (resonator) portion plugs into the lower (oscillator) portion. The frequency can be changed by unplugging the resonator and replacing it with one of a different frequency.

b. Exciter-Transmitter

The exciter-transmitter is completely transistorized. Channel elements furnish the fundamental transmitter frequency. Modulation is effected by a varactor phase modulator and a low distortion "Instantaneous Deviation Control" circuit which provides modulation with a very low distortion level. The output frequency of the exciter-transmitter is 36 times the crystal frequency. A harmonic filter at the output of the exciter-transmitter attenuates all frequencies outside the 450 to 470 MHz band. The exciter-transmitter is used to drive the power amplifier.

c. Power Amplifier

The power amplifier is a one-tube tetrode amplifier which increases the rf output from the exciter-transmitter to the rated power output of the station. It is a separate unit, incorporating its own high voltage plate, screen, and grid bias supplies. A low-pass rf filter at the power amplifier output suppresses all frequencies above 470 MHz. A metering receptacle is also located on the power amplifier panel.

d. Power Supply

The power supply provides all the voltages necessary for operating the station, except the operating voltages for the power amplifier.

e. Control Unit

Transmitting, metering and monitoring controls are available on the Local Control Panel (part of the Remote Control Unit) for servicing and test purposes. All other operational circuits in the Control Unit are contained in plug-in modules inserted into the Control Unit Chassis. The basic community repeater (RT) station includes the following plug-in modules: Station Logic, Squelch Gate, Time-Out Timer, Four-User Control and Master Decoder.

f. Metering

A receptacle is provided on the Station Logic Module for connection of a Motorola S1056A-9A Series Portable Test Set or equivalent. The test set permits measurement and metering of the basic functions of the switching circuits.

Metering receptacles are also provided on the receiver, exciter-transmitter and power amplifier for tuning and alignment.

g. Station Logic

The Station Logic Module circuitry controls transmitter keying, receiver muting, and the local microphone ground output in response to the squelch gate module push-to-talk, R1 mute inhibit and transmitter key inhibit outputs.

h. Squelch Gate

The squelch gate module produces an output that activates the transmitter when a carrier signal is received that has a sufficiently high signal-to-noise ratio and a proper "PL" tone.

i. Time-Out Timer

This completely transistorized timer is used to turn off the transmitter after a predetermined transmission time for each message. It is adjustable in steps from 1/2 to 8 minutes.

j. Four-User Control

This module contains four "Private-Line" tone decoder circuits and the necessary logic circuits to combine their outputs. The defeat switch disables the individual tone circuits as desired. One module is supplied and up to three additional four-user control modules can be added for sixteen-tone maximum capability.

k. Master Decoder

This module splits the discriminator output into audio (above 300 Hz) and "Private-Line" (below 200 Hz) tone segments. The audio is routed through the audio gate (if a proper "PL" tone is simultaneously passed by a four-user control module) and applied to the exciter audio input. The "PL" tone is also applied to the exciter audio lead thus providing the required "PL" tone for retransmission.

l. Single-Tone Decoder (Optional)

The single-tone decoder output enables the individual "PL" tone outputs in the four-user control modules. The correct single-tone signal must be received before the "PL" tone can open the circuits for retransmission of the message.

m. Metering Kit (Optional)

The TLN8204A Metering Kit provides a convenient rack-mounted test meter with switching facilities, thereby eliminating the need for a portable test set. This chassis also contains a speaker for local monitoring of receiver audio; a convenience for testing and adjusting the station.

n. Power and Audio Line Junction Box

The junction box provides a convenient means of connecting the 117-volt ac line for operation of the station. An ac receptacle and the main station fuse are also located on this box.

o. Emergency Power Accessories

The following emergency power items are available as factory installed accessories in new stations. These accessories are normally used together. They allow the station to continue operation (with a reduction in transmitter rf power output) from a 12-volt battery if the 117-volt ac primary power fails.

(1) TLN1241A Emergency Reverting Kit (Option No. C28)

This kit includes a relay which bypasses the power amplifier and connects the exciter-transmitter directly to the antenna when operating from the battery. It also disconnects power from the filaments of the power amplifier tube to conserve battery life. Restoration of 117-volt ac primary power automatically returns the station to normal operation.

(2) TLN1235A Battery Protection and Alarm (Option No. C29)

This accessory provides the following functions:

- Audible alarm to alert the operator that the station is operating on emergency power.
- Completely disconnects the batteries when they are discharged to a predetermined level; thus preventing possible damage to the batteries from prolonged emergency power operation.
- Controls the charging rate for recharging the batteries after emergency power operation.
- Permits an equalizing charge to be applied to batteries to bring all cells to the same voltage.

The alarm signal is a short tone burst (approximately 1/4-second) that is repeated at a regular interval (approximately 2-1/2 seconds). The tone is heard in the station speaker except when the transmitter is keyed. The alarm turns off automatically upon restoration of 117-volt ac primary power.

The low voltage detector circuit provides battery protection by completely disconnecting the station from the battery when the battery voltage drops to a preset level. This prevents the battery from being completely discharged and possibly damaged. This action puts the station completely out of operation until another source of primary power can be provided, or the battery can be recharged by another power source.

The charging control circuits control the charging rate for recharging the batteries following emergency power operation. This circuit allows a rapid charge rate at first and reduces it as the battery approaches full charge.

An equalizing switch is provided to bring the voltage of all cells to one optimum level. Operation of the switch applies a charge voltage that is approximately 7% above the "float" voltage. This is normally done only to a fully charged battery to bring it to the ideal condition where the terminal voltages of all cells are equal (which prevents one cell from acting as a load on another one which has a slightly higher terminal voltage).

p. Optional Cabinets

The following optional cabinets are available as factory installed accessories:

(1) Option No. C27 40" Outdoor "Compa-Station" Cabinet

This option includes a Motorola Model THN6080A cabinet and TLN8813A Rain Shield Kit.

(2) Option No. C40 70" Indoor Upright Cabinet

This option includes a 70" tall cabinet (Motorola Model THN6057A), which allows space for adding a duplexer or other desired equipment within the cabinet, and built-in station metering (TLN4319A Meter Panel and TLN4288A Meter Switching Panel).

(3) Option No. C36 70" Outdoor Cabinet

This option includes a Motorola Model THN6058A Cabinet and TLN6892A Rain Shield for outdoor installation with space for adding a duplexer or other equipment within the cabinet.

6. FUNCTIONAL DESCRIPTION

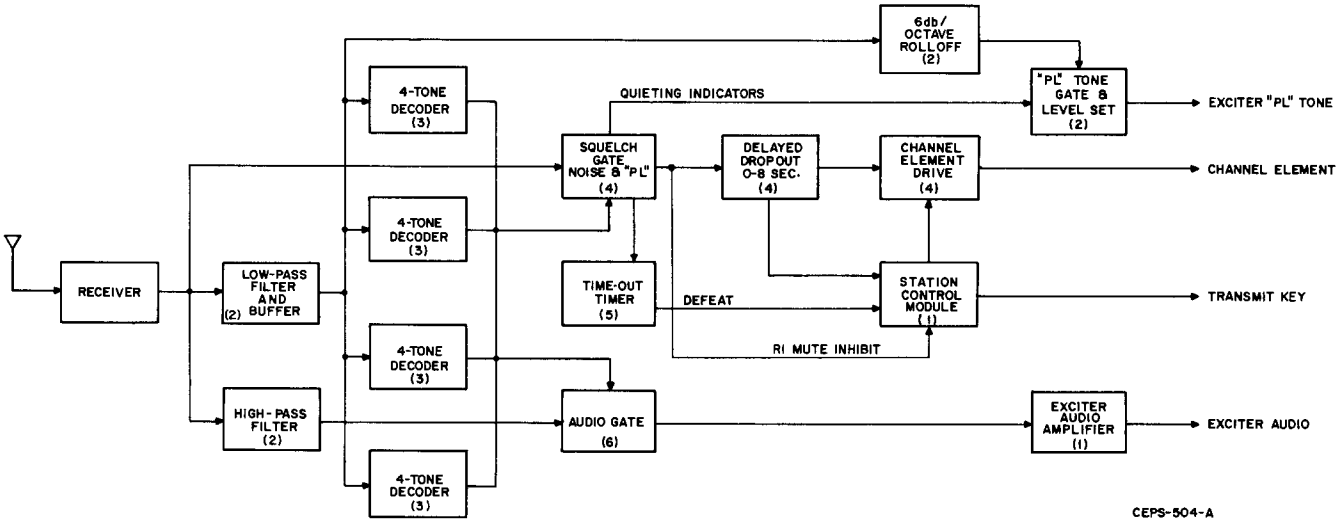
The basic function of a community repeater is to retransmit received signals from its subscribers. When the control circuitry detects a signal with the proper signal-to-noise ratio and one of the subscriber "PL" tones (and if so equipped, the proper single-tone frequency) it keys the transmitter and applies both the received audio and "PL" tone to the modulator.

The audio filter (high pass) allows the audio to reach the audio gate minus the received "PL" tone. The gate will prevent the audio from being passed to the exciter audio amplifier for retransmission until one of the "PL" tone outputs from the four-user module reaches the gate.

The tone filter (low pass) passes the "PL" tones to their respective circuits for opening the audio gate. The tone is also routed to the "PL" tone gate and level setting circuit. This circuit adjusts the "PL" tone to the proper level for retransmission and applies it to the exciter tone input lead.

The "PL" tone outputs from the four-user modules are simultaneously connected through the Master Decoder and Squelch Gate Modules to the time-out timer for initiating its cycle. The squelch gate has two outputs; one regulates the "PL" tone gate and level set output; the other activates the keying circuit in the Remote Control Unit. The transmitter keying circuit activates the power supply and turns on the transmitter. The received audio is then routed to the exciter modulator for retransmission.

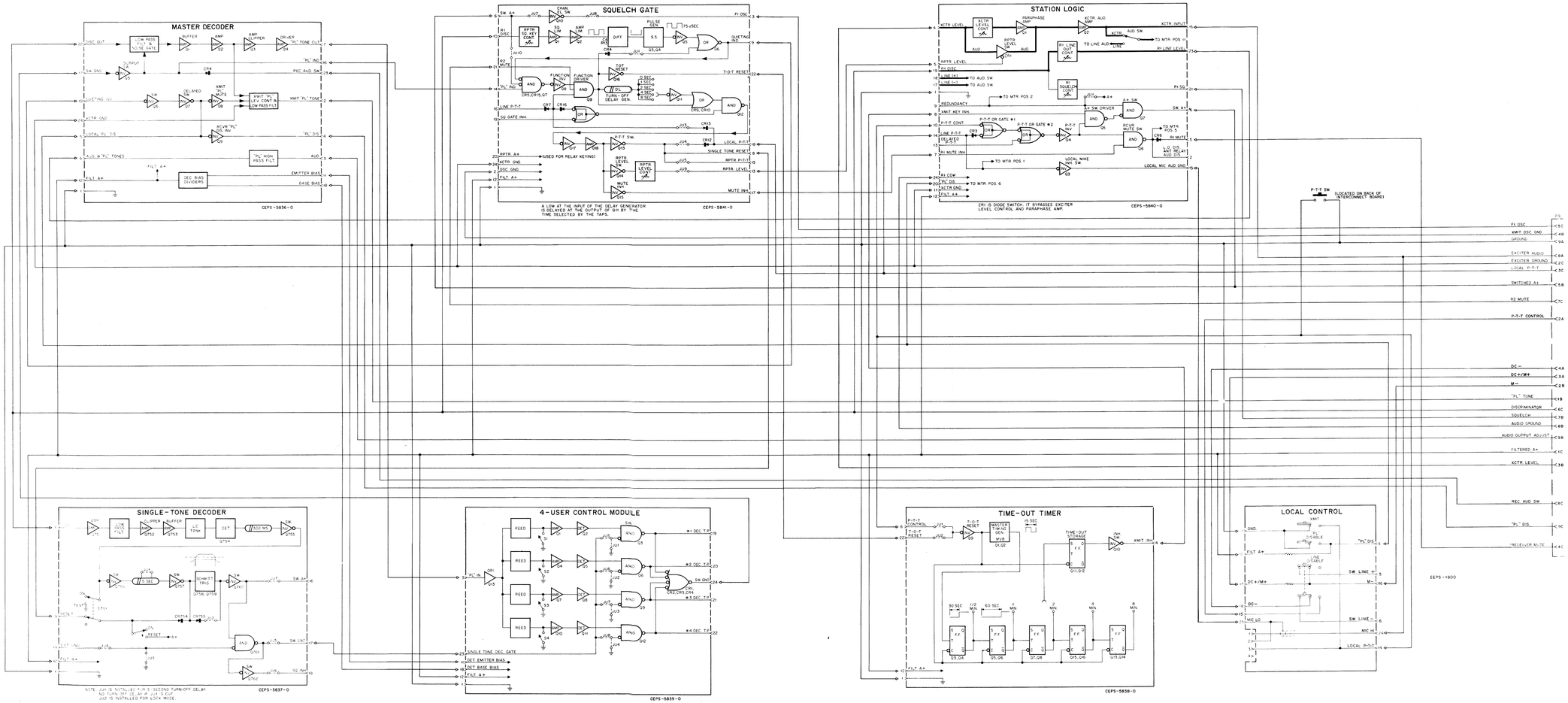
If the squelch gate loses its signal for a period of time longer than the adjusted drop-out time, the input to the transmitter keying circuit is removed, turning off the transmitter. If the squelch gate is on when the timer reaches the end of its cycle, an output from the time-out timer will interrupt operation of the transmitter keying circuit and turn off the transmitter.



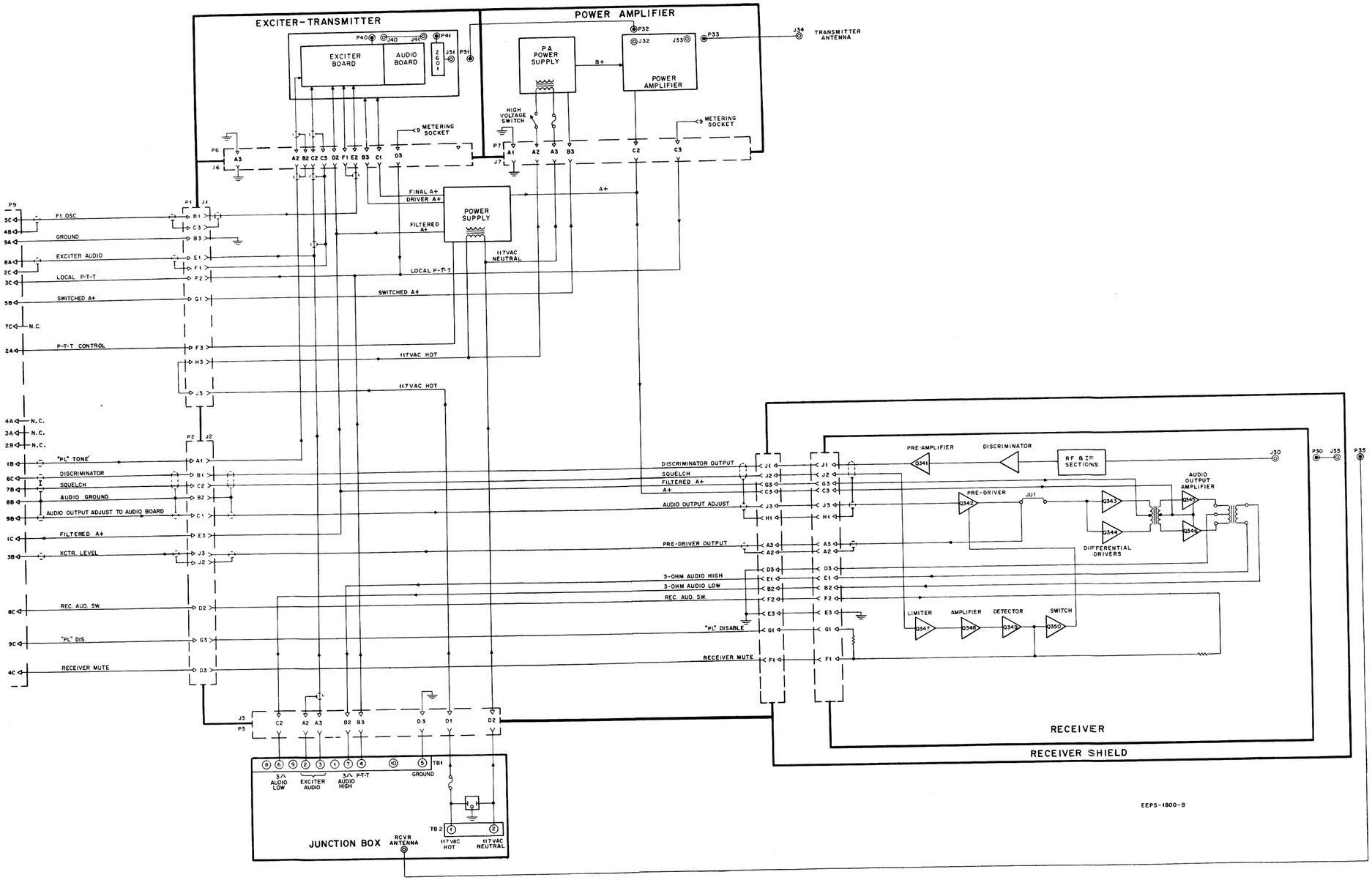
NOTE: NUMBERS IN BLOCKS INDICATE MODULE WHERE FUNCTION IS PERFORMED:
(1) STATION CONTROL MODULE
(2) MASTER DECODER MODULE
(3) FOUR-USER CONTROL MODULE (UP TO 4 MODULES MAY BE USED)
(4) SQUELCH GATE MODULE
(5) TIME-OUT TIMER MODULE
(6) RECEIVER AUDIO BOARD

Community Repeater Functional Block Diagram

(Pages 6 and 7 are blank)



Community Repeater
Detailed Functional Diagram
Motorola No. EEPS-1800-B
(Sheet 1 of 2)
8/6/74-NPC



DESCRIPTION

Community Repeater
Detailed Functional Diagram
Motorola No. EEPS-1800-B
(Sheet 2 of 2)
8/6/74-NPC

INSTALLATION AND OPERATION

IMPORTANT

FCC regulations state that:

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

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

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

REMEMBER

The efficiency of the equipment depends upon a good installation.

1. UNPACKING

a. "Compa-Station" Cabinet

(1) Remove the station from the shipping carton.

(2) Remove the keys taped to the front door; unlock and remove both doors. Remove all shipping tape from inside the cabinet.

(3) Remove the center bolt, the two #14 self-tapping screws and the speed nuts from the shipping bar assembly across the back of the station. Remove and discard the shipping bar.

(4) Remove the two flat washers from under the side rails and replace the speed nuts.

(5) Replace the two #14 self-tapping screws in the side rails and tighten.

b. Upright Cabinet

(1) Uncrate the station and remove the skid which is attached to the base.

(2) Remove the keys taped to the front door; unlock both doors. Remove all shipping tape from inside the cabinet.

2. INSPECTION

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

3. INSTALLATION OF CABINET

The cabinet should be located on a solid, level surface convenient to the 117-volt ac power source and the transmission line. Allow space for ventilation at the sides of the cabinet. The transmission line should be kept as short as possible to minimize line losses.

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

If the station is equipped with an optional cabinet (any cabinet other than 38" high indoor

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"Compa-Station" cabinet), refer to additional installation information in the appropriate cabinet section of this manual immediately after this "Installation and Operation" section.

4. VENTILATION

The radio equipment is operated without forced ventilation. The cabinets have vents which allow outside air to be drawn in through an opening in the rear door and expelled through an opening in the top. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the two openings in the cabinet be kept free of obstructions so the air flow will not be restricted.

5. CONNECTIONS

a. Antenna

Installation of the antennas and transmission lines should be made prior to installation of the station. The antennas and transmission lines are not supplied as part of the station equipment; therefore, antenna installation instructions are not included herein. Follow the instructions shipped with the antenna for the applicable antenna installation procedure.

In its primary application, the repeater station is used for communication with mobile stations and antennas exhibiting omni-directional characteristics. However, if the repeater station is located at the outer perimeter of a communications area or if it is to be used for communication with fixed stations, antennas with specific directional characteristics may be more suitable. Two antennas (or a duplexer) are required for this station, one for the receiver and the other for the transmitter. The receiver antenna input is in the junction box and the transmitter output is on the power amplifier panel.

If the station is equipped with an optional cabinet (any cabinet other than 38" high indoor "Compa-Station" cabinet), refer to additional installation information in the appropriate cabinet section of this manual immediately after this "Installation and Operation" section.

b. AC Power

(1) Power Requirements

All stations require a 15-ampere, 120 volt; 50/60 Hz ac power input. This circuit should be installed in accordance with local electrical codes.

The primary ac power line can be installed and terminated near the station site before installing the station cabinet. If the 3-wire line cord (supplied with the station) is used, the ac power line should be terminated with a 3-contact receptacle to accommodate the plug on the power cord. For outdoor installations where a permanent connection is desired, the ac power line can be terminated with fittings to accommodate 1/2" conduit or "BX" cable instead of the power cord. All three wires in the conduit or BX cable should be No. 12, type TW. Connection to the station can be made by routing the cable through the bottom or the side of the cabinet.

If the station is equipped with an optional cabinet (any cabinet other than 38" high indoor "Compa-Station" cabinet), refer to additional installation information in the appropriate cabinet section of this manual immediately after this "Installation and Operation" section.

(2) Power Connection

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

The station fuse controls all power to the station except ac power to the outlet in the junction box.

WARNING

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

c. Jumper Connections

Jumpers for community repeater operation are installed in the plug-in modules at the factory. In case of difficulty or when replacing modules, refer to the respective module section(s) of this manual for jumper connection information.

6. PRE-OPERATIONAL ADJUSTMENTS

a. Audio Level

(1) Connect transmitter to wattmeter and load.

(2) Connect a 3.2-ohm speaker or load to terminals TB1-6 and -7 in the junction box. Connect an audio (ac) voltmeter across the same terminals.

(3) Set the squelch gate for "carrier-squelch" operation ("PL" disabled), as follows:

NOTE

The "PL" DISABLE switch on the local control panel (on the control unit) does not affect the squelch gate module.

Disconnect JU1 (blue lead) and connect JU2 (black lead). The receiver is now "PL" disabled along with the squelch gate.

(4) Connect a signal generator to the receiver and inject a 1000 microvolt signal. Modulate the signal with a 1000 Hz tone at ±4 kHz deviation. Turn the R1 squelch control on the station logic module fully counterclockwise (CCW).

(5) Adjust the R#1 LINE OUTPUT control on the station logic module for 1.8 volts across the 3.2-ohm load.

(6) Adjust the XCTR LEVEL control for a voltage 3 dB greater than the modulator sensitivity at the exciter input (voltage stamped on exciter).

(7) Connect an audio voltmeter to pins 1 and 2 of the LOCAL MIKE receptacle on the LOCAL CONTROL panel, or between terminals TB1-2 and -3 in the junction box. Apply a 20 dB quieting signal to the receiver and adjust the REPEATER SQUELCH KEY control (on the squelch gate module) until the transmitter keys. (This is the operating threshold point that causes transmitter keying at the recommended 20 dB quieting level.)

(8) Return JU1 and JU2 on the squelch gate module to "PL" operation. Connect JU1 (blue lead) and disconnect JU2 (black lead).

(9) Set the drop-out delay generator for 4-second operation, by connecting the flexible red lead on the squelch gate circuit board to the 4 (seconds) terminal (also on the board).

b. "PL" Tone Output Level Adjustment

The "PL" audio level control on the master decoder is factory-adjusted and normally requires no further adjustment. However, in case of component replacement or other maintenance procedures, it may become necessary to readjust the transmit "PL" tone output level. The procedure is as follows:

(1) Adjust the master decoder only after all other modules have been adjusted.

(2) Set the squelch gate module for "carrier squelch" operation by disconnecting JU1 (blue lead) and connecting JU2 (black lead). Connecting JU2 simulates the "PL" indicator signal.

(3) Apply a 1000 microvolt carrier signal to the receiver with 150 Hz modulation at 1 kHz deviation. The transmitter should key.

(4) Adjust the "PL" tone output level potentiometer R38 (behind the front panel of the master decoder) for a transmitted tone deviation of 1 kHz.

(5) Reset the squelch gate for "PL" operation by connecting JU1 (blue lead) and disconnecting JU2 (black lead).

c. Timing Adjustments

The station is equipped with a Time-Out Timer Module that prevents unintentional continuous transmission. The timing jumper on the Time-Out Timer Module can be set for 1/2, 1-, 2-, 4-, or 8-minute operation.

The time-out timer will reset to its present timed interval each time a new input signal arrives at the radio whether or not the dropout delay generator has shut the transmitter off.

The dropout delay generator prevents the transmitter from shutting off during loss or excessive fade of input signal for the length of time preset.

The dropout delay generator can be set for 0, 1-, 2-, 4-, or 8-second operation.

PRE-OPERATIONAL AND ROUTINE CHECK LIST

UNIT	STEP	CHECK
RECEIVER	1	Compare meter readings with the minimum values in the RECEIVER section of this manual. Realign if necessary.
	2	Measure signal level required for 20 db quieting.
	3	Check that receiver squelch opens with each "PL" tone on carrier.
EXCITER-TRANSMITTER	4	Compare meter readings with minimum values in the EXCITER-TRANSMITTER section of this manual. Realign if necessary.
POWER AMPLIFIER	5	Tune and load to antenna.
SYSTEM ADJUSTMENTS	6	Measure power output of transmitter if required.
	7	Measure transmitter frequency and adjust if necessary.
	8	Measure tone deviation (equal input and output "PL" tone deviation)
	9	Measure transmitter voice channel for proper deviation. Adjust IDC if necessary.
	10	Measure exciter modulator sensitivity.
	11	Adjust receiver on frequency.
	12	Measure and adjust audio input to exciter.
	13	Check repeater operation.

BEFORE LEAVING STATION CHECK THE FOLLOWING

1. All external power switches ON.
2. Local speaker OFF.
3. Cabinet doors locked.
4. Vents in sides of cabinet unobstructed.

EPS-2038-O

7. OPERATING INSTRUCTIONS

a. Unattended Operation

Once power is applied and the station is properly adjusted, the repeater station operates entirely unattended. When the receiver rf input is of sufficient level, the transmitter is keyed and the signal is retransmitted.

b. Local Control

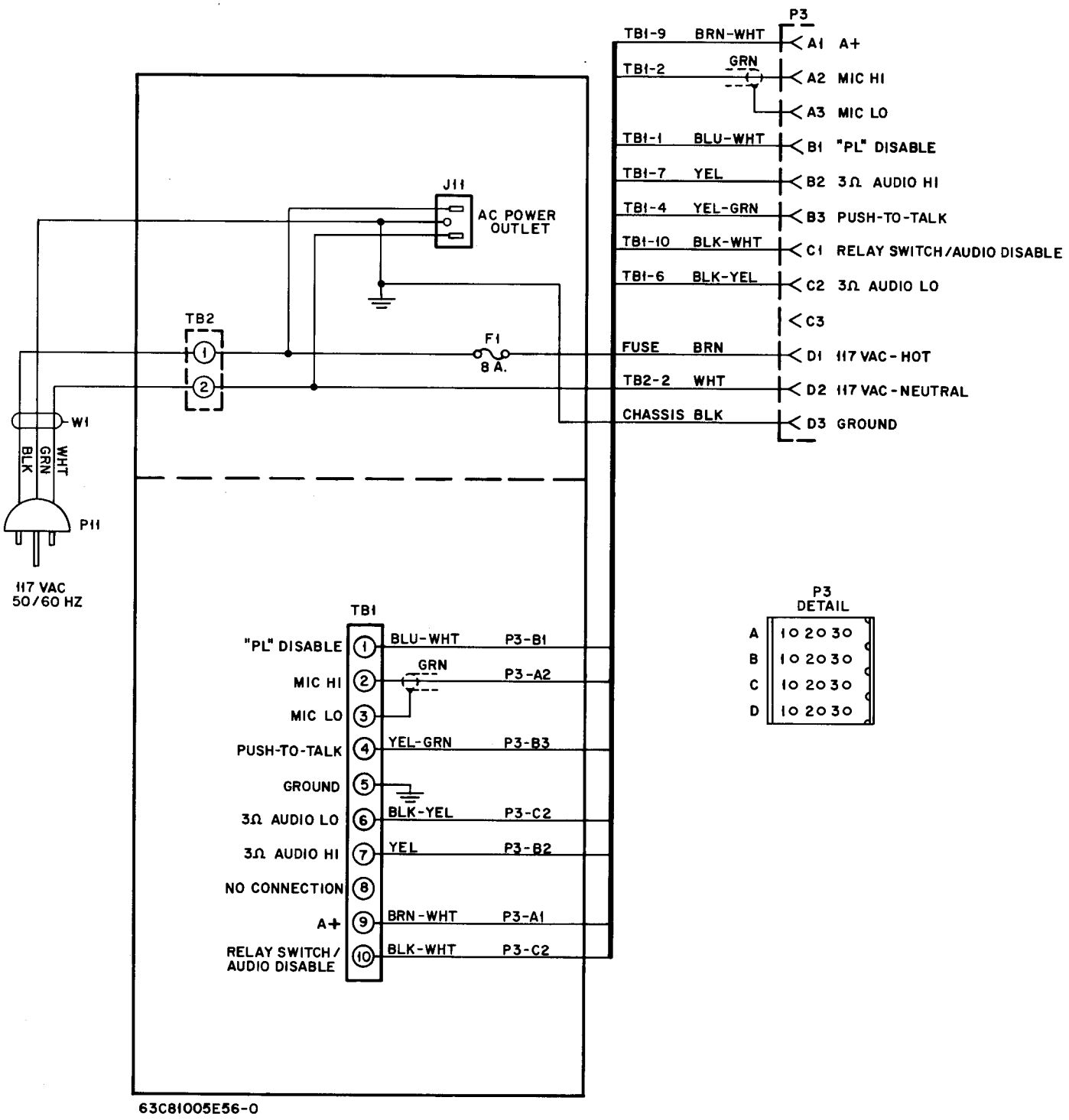
The station may be operated locally from the Control Unit for maintenance and testing by the following procedure:

(1) Connect a microphone (Motorola Model TMN6020A or equivalent with 4-prong connector) to the microphone receptacle on the Local Control Panel.

(2) Set the LOCAL SPKR switch to the ON position for stations that are equipped with a local speaker, or connect any 3-ohm 5-watt test speaker to TB1-6 and -7 of the junction box. This speaker will be used to monitor all received messages.

LOCAL CONTROL PANEL CONTROLS

CONTROL	POSITION	FUNCTIONS POSSIBLE
XMIT	Normal (Not Actuated)	Normal receive or standby mode of operation.
	Actuated (hold to right)	Turns on transmitter with no modulation. Use test microphone connected to Local Mike receptacle to modulate transmitter.
"PL" DISABLE"	Normal (Not Actuated)	Only "PL" tone-coded, on-frequency, signals accepted by receiver.
	Actuated (hold to right)	All on-frequency signals accepted by receiver.



63C81005E56-O

INSTALLATION & OPERATION

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Junction Box Connections
Schematic Diagram
Motorola No. 63C81005E56-O
8/6/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

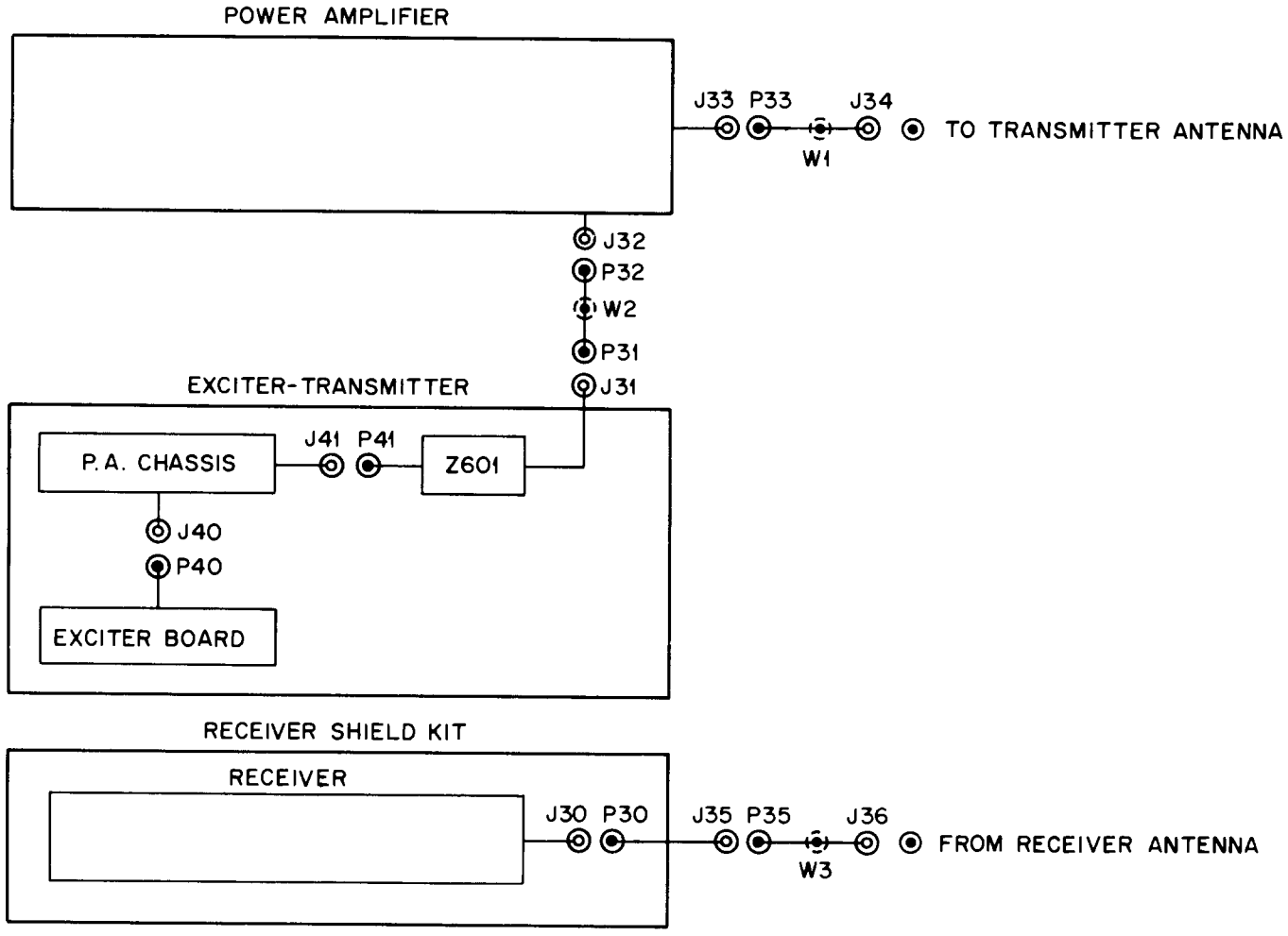
PARTS LIST

TLN8810A Junction Box — PL-414-O

J11	9C83238C01	CONNECTOR, receptacle: female; 3 contact
P3		CONNECTOR, plug: incl. 14C83783A05 BODY (12-hole), 29C82336A01 TERMINAL, contact: female, 15C83934A07 SHELL
P11		(p/o W1)
TB1	31B848187	TERMINAL BOARD: 10 screw terminals
TB2	31A50378	2 dual screw terminals
W1	1V80755A66	CABLE ASSEMBLY, power: c/o: 30C83211C01 CABLE ASSEMBLY: incl. 3-cond cable and a "molded-on" 3-cont male plug; conductors are No. 16 ga, str; length overall 9 ft. 29K845081 LUG, ring tongue; 3 req'd does not incl. 42B82018H01 RETAINER, cable
XF1	9C83122C01	FUSEHOLDER: standard screw-base type

p/o TLN8806A Cabinet Accessories Kit — PL-415-O

F1	65B83099A02	FUSE, plug: standard screw-base type; 8 A; 125 v



63C81002E39-A

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

RF Intercabling Diagram
Motorola No. 63C81002E39-A
8/6/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

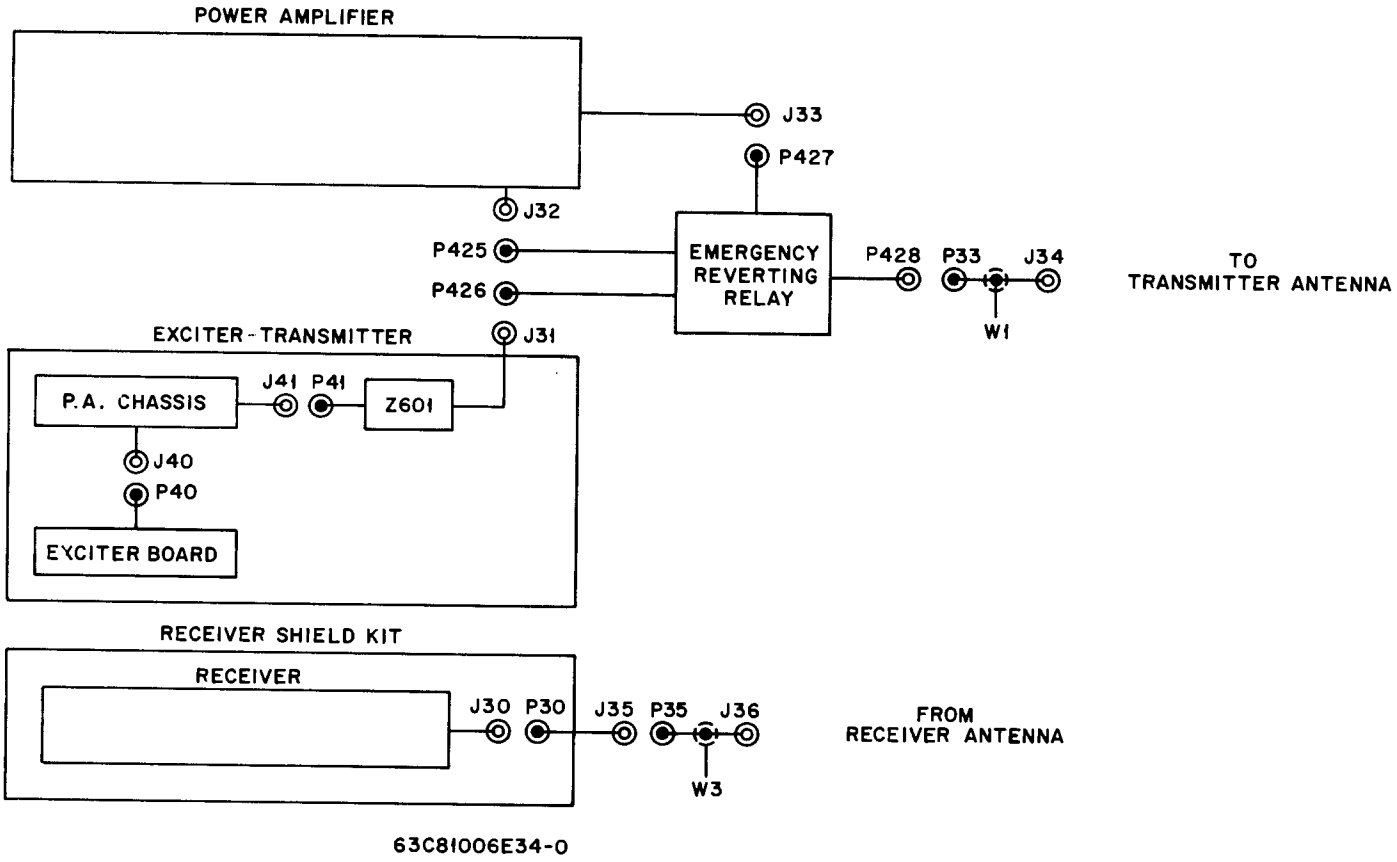
PARTS LIST

TKN6365A Antenna Cable Kit — PL-416-O

		CONNECTOR, receptacle: coaxial;
J34	9C82442E01	female; uhf type
J36	9C82442E06	female; uhf type
		CONNECTOR, plug: coaxial;
P33	28K852527	male; type "N"
P35	28B82331G01	male; miniature type
		LINE, RF transmission:
W1	1V80782A83	incl. J34, P33 and 30C82921H01 CABLE, RF: coaxial; 10" length req'd
W3	1V80782A84	incl. J36, P35 and 30C82921H01 CABLE, RF: coaxial; 24" length req'd

p/o TLE6292A Power Amplifier — PL-417-O

		CONNECTOR, plug: coaxial;
P31, 32	28B82331G01	male; miniature type
		LINE, RF transmission:
W2	1V80701B81	incl. P31, P32 and 30C82921H01 CABLE, RF: coaxial; 35" length req'd



RF Intercabling Diagram with
Emergency Power Reverting
Motorola No. 63C81006E34-O
8/6/74-NPC

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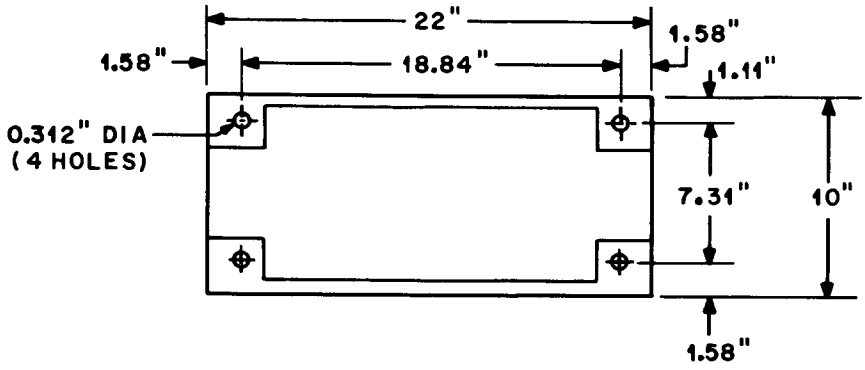
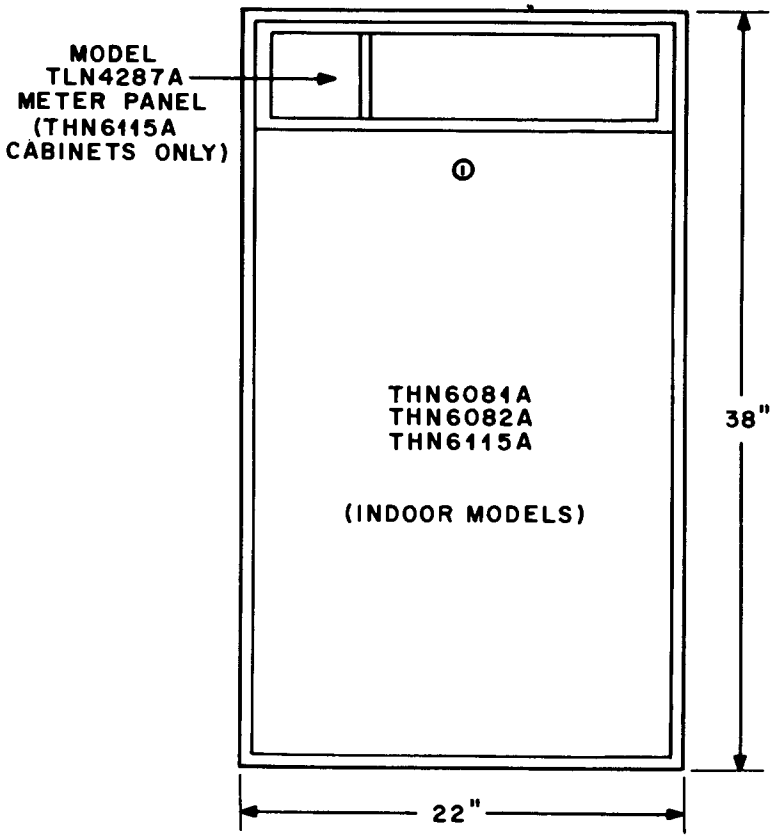
TOP VIEW
(OF BOTTOM OF CABINET)



FRONT VIEW



NOTE:
ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.

BEPS-3826-A

INSTALLATION & OPERATION

Models THN6082A and THN6115A
"Compa-Station" Base Radio
Cabinet Dimensional Detail
Motorola No. BEPS-3826-A
8/6/74-NPC

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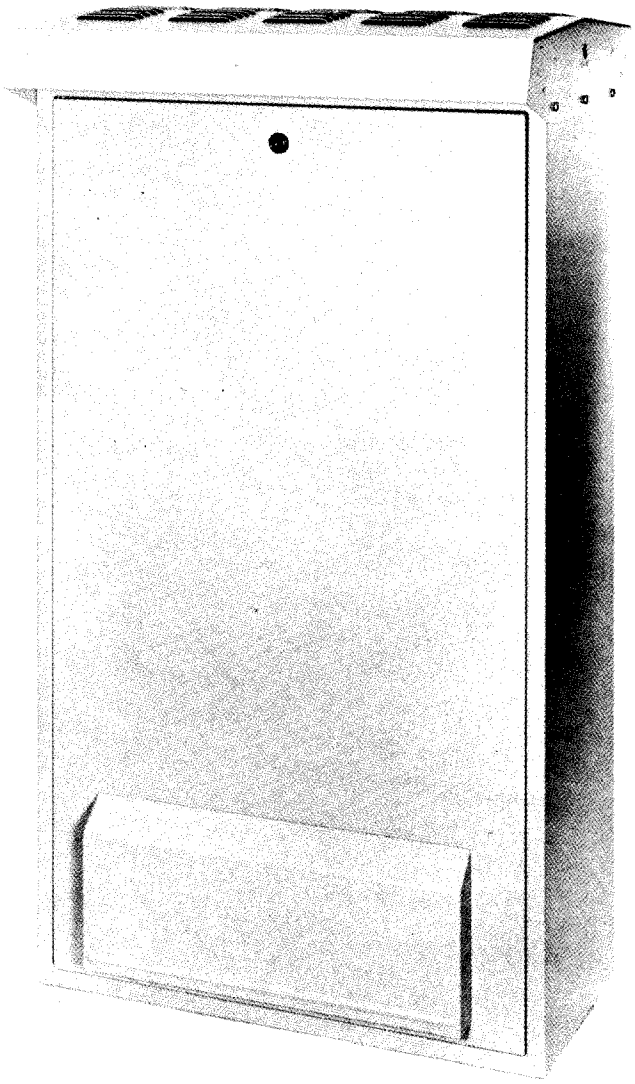
40" OUTDOOR CABINET

MODEL THN6080A

WITH TLN8813A RAIN SHIELD KIT



1. GENERAL

The outdoor cabinet may be installed in any convenient location (indoors or outdoors) which provides space to open the front and rear doors. If the cabinet is installed outdoors, the Rain Shield Kit should be installed as described in this section. The rain hood is designed to cover the air vent in the top of the cabinet, and the vent shields to cover the louvered openings in the doors. With these installed, the equipment is protected against all normally encountered elements such as rain, snow, or sleet.

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

Although the cabinet is built to be installed outdoors, maintenance of equipment in an exposed location is not easily accomplished during inclement weather. It is therefore recommended that the equipment be installed inside of an enclosure which will protect the serviceman and the test equipment he may be using. A suggested enclosure would be an elevator penthouse or a small building no less than six feet square and eight feet tall as measured on the inside.

a. Installation of Rain Hood -- Install the main section (largest fabricated assembly) over the top of the cabinet using the six sheet metal screws provided.

b. Installation of Vent Shields -- Mount the awning-shaped vent shields over the louvered openings on the outside of the front and rear doors using the sixteen hex-head sheet-metal screws provided for each vent shield.

2. VENTILATION

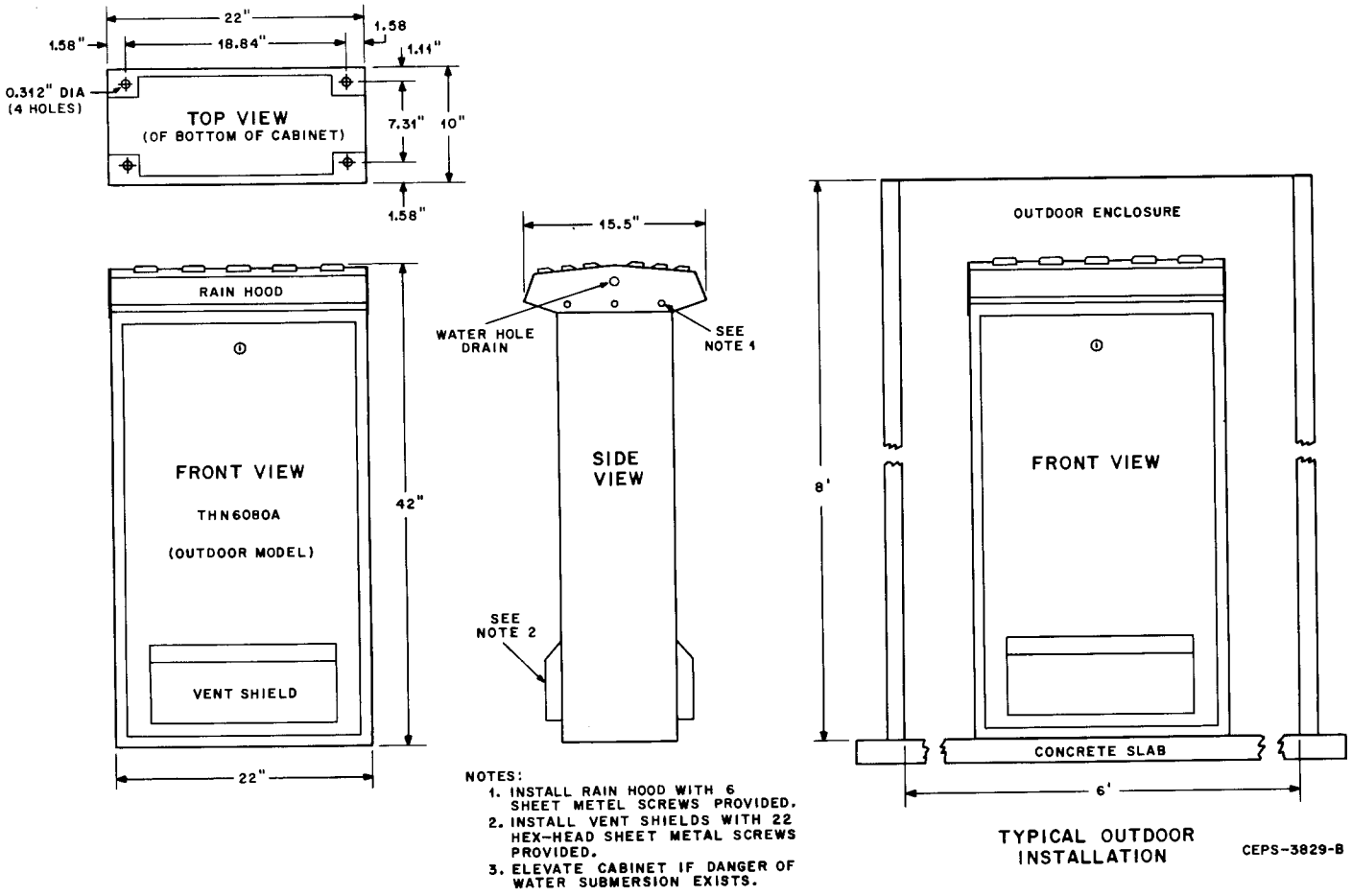
The radio equipment is operated without forced ventilation. The vents allow outside air to be drawn in through the openings in the doors and expelled through the opening in the top. The heated air rising

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

in the cabinet causes a natural draft. Therefore, it is essential that the openings in the cabinet be kept free of obstructions so the air flow will not be restricted.

3. EXTERNAL CONNECTIONS

External power, antenna and control cables connected to the radio equipment should be brought into the cabinet either through the two knockout-sealed access holes located on the lower right-hand side of the cabinet or through a hole drilled in the cabinet in a more convenient location. In either case, the entrance point(s) must be sealed and made as weatherproof as possible.

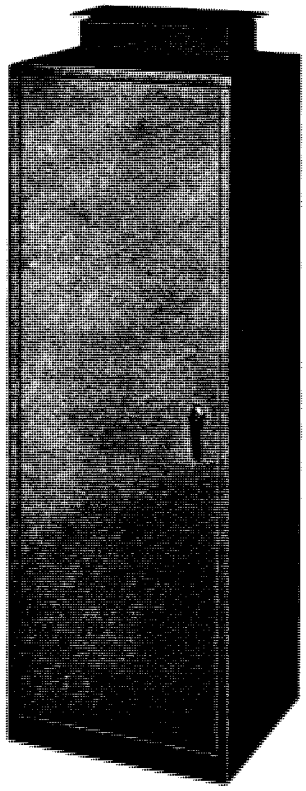


Outdoor Cabinet Dimensional Detail

70" OUTDOOR CABINET

MODEL THN6058A

WITH TLN6892A RAIN SHIELD KIT



1. GENERAL

The outdoor cabinet may be installed in any convenient location (indoors or outdoors) which provides space to open the front and rear doors. If the cabinet is installed outdoors, the Rain Shield Kit should be installed as described in this section. The rain hood is designed to cover the air vent in the top of the cabinet, and the vent shield to cover the opening in the rear door. With these installed, the equipment is protected against all normally encountered elements such as rain, snow, or sleet.

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

Although the cabinet is built to be installed outdoors, maintenance of equipment in an exposed location is not easily accomplished during inclement weather. It is therefore recommended that the equipment be installed inside of an enclosure which will protect the serviceman and the test equipment he may be using. A suggested enclosure would be an elevator penthouse or a small building no less than six feet square and eight feet tall as measured on the inside.

a. Installation of Rain Hood

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

(2) Mount the smaller of the two rectangular covers inside the main section using the machine screws provided.

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

b. Installation of Vent Shield

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

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

2. VENTILATION

The radio equipment is operated without forced ventilation. The cabinets have vents which allow outside air to be drawn in through an opening in the rear door and expelled through an opening in the top. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the two openings in the cabinet be kept free of obstructions so that the air flow will not be restricted.

3. EXTERNAL CONNECTIONS

a. Antenna Cable

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

NOTE

Do not substitute connectors or cables for the ones supplied. The supplied material is for use at the high temperatures which may be encountered in the operation of the equipment when located in bright sunlight in a warm climate.

Install the connector as follows:

(1) Determine the location.

(2) Use a center punch to mark the location.

(3) Drill a 1/4-inch pilot hole.

(4) Using a 3/4-inch hole saw to enlarge the pilot hole to the proper size.

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

(6) Center punch and drill three holes with a 7/32-inch drill.

(7) Place the gasket (supplied) over the longest stud of the connector.

(8) Insert the connector from the outside so the gasket is against the outside cabinet wall.

(9) Secure the connector in place with the three screws, lockwasher and nuts supplied. The nuts should be on the inside of the cabinet.

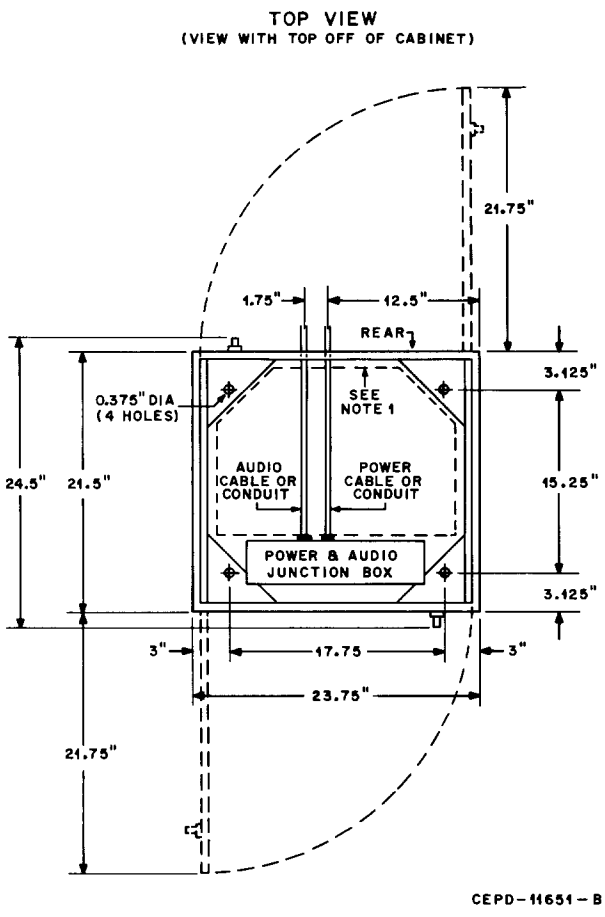
(10) Measure and cut the loose end of the 6-foot coaxial cable attached to the equipment so that it will reach the bulkhead fitting without any sharp bends. This cable should be made as short as possible to keep power loss to a minimum.

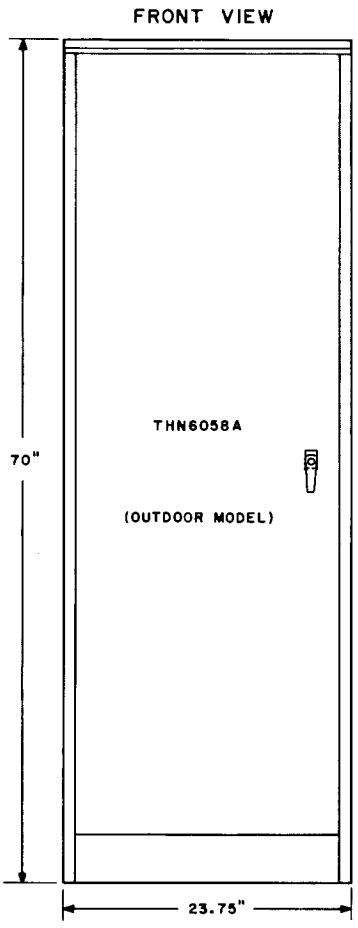
(11) Install the connector and adapter (supplied) to the end of the cable and connect to the bulkhead fitting.

b. Power

For rear cable entry, two punch marks are located on the rear panel of the cabinet base. Using these as centers, drill holes in the cable net with a 3/4-inch hole saw. When facing the rear of the cabinet, the left hand hole is intended for the entrance of ac power and the right hand hole is intended for the entrance of control lines. The holes are in line with holes in the junction box so that 1/2-inch thinwall or rigid conduit may be installed through the base and directly to the junction box. Install the conduit, or if conduit is not used, install rubber grommets in the holes to protect the cables. Seal the entry to make the opening as weatherproof as possible. Make power connections as described in your instruction manual for the comparable indoor station and inside the station junction box cover. The green wire shown is an earth ground to reduce shock hazard. It is not connected to the ac supply, but it may be an extra wire in the cable, conduit, or raceway that houses the current carrying wire from the main service entrance. It may also be connected to the conduit or raceway itself as this is connected to earth ground at the main service entrance.

For bottom cable entry, power and control cables may be brought in at almost any desired point through the bottom of the cabinet. Refer to the Outdoor Cabinet Dimensional Detail for specific limitations. Measure and center punch the desired cable entry locations. Using the center punch mark as the center of the holes, drill 3/4-inch holes with a hole saw. Install conduit, or if conduit is not used, install rubber grommets in the holes to protect the cables. Make power connections as described in the previous paragraph. Seal the entry to make the opening as weatherproof as possible.





NOTES:

1. IF ENTRANCE OF POWER AND AUDIO CABLES THROUGH BOTTOM OF CABINET IS DESIRED, AREAS ENCLOSED BY DOTTED LINES MAY BE USED.
2. FRONT AND REAR DOORS CAN BE REVERSED FROM RIGHT OPENING TO LEFT HAND OPENING.
3. ON REAR DOOR, OPENING OPPOSITE AIR DUCT MUST BE UNCOVERED AND UNUSED OPENING COVERED.
4. ELEVATE CABINET IF DANGER OF WATER SUBMERSION EXISTS.

Outdoor Cabinet Dimensional Detail
Motorola No. CEPD-11651-B
8/6/74-NPC

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70" INDOOR CABINET

MODEL THN6057A

1. GENERAL

The indoor cabinet may be installed in any location convenient for servicing where it is not exposed to the elements of weather.

2. REMOVAL AND REVERSING OF DOORS

Both front and rear doors are removable by simply unhooking the arm of the door stop from the door and pulling down on the upper hinge pin.

If desired, both front and rear doors may be reversed from right hand opening to left hand opening as follows:

(1) Remove the door and unbolt the hinge brackets from the cabinet.

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

(3) Turn the door upside down and re-insert the hinge pins in the brackets.

(4) Remove the latch bar from the rear of the door lock and re-install it 180° from its original position.

CAUTION

On the rear door, the blank cover plate must be removed and re-installed over the unused (bottom) ventilation opening. The opening opposite the air duct must be uncovered to admit air for proper cooling of the equipment. The unused opening must be covered to prevent dust from entering the cabinet.

3. REMOVAL OF SIDE PANELS

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

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

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

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

4. REPLACEMENT OF SIDE PANELS

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

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

(3) The locking screw should be replaced for security reasons.

5. VENTILATION

The radio equipment is operated without forced ventilation. The cabinets have vents

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which allow outside air to be drawn in through an opening in the rear door and expelled through an opening in the top. The heated air rising in the cabinet causes a natural draft. Therefore, it is essential that the two openings in the cabinet be kept free of obstructions so the air flow will not be restricted.

6. EXTERNAL CONNECTIONS

a. Antenna Cable

Six knockouts in three sizes are provided on the cabinet top for ease of installation. Refer to Figure 1 for proper hole usage and to Figure 2 for typical installation details. Determine the type of cable entry required and select the most convenient knockout if antenna cable entry through the side of the cabinet is preferred.

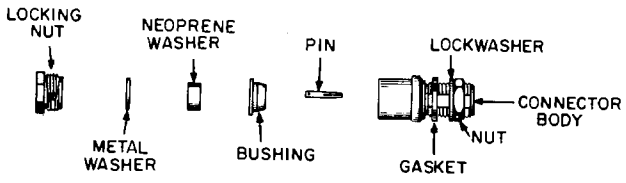
(1) Transmission Lines Terminated in Female UHF Connector

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

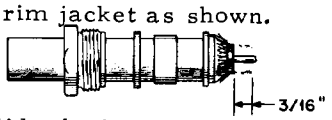
(b) Measure and cut coaxial cable so that it will reach from the equipment to the connector in the cabinet top.

(c) Install the connector and adapter on the end of the cable and connect it to the transmission line.

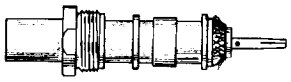
RF CONNECTOR ASSEMBLY DETAILS
0.405" O.D. CABLE



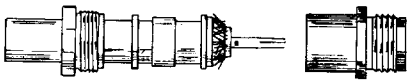
Step 1 -- Trim jacket as shown.



Step 2 -- Slide the locking nut, metal washer, neoprene washer, and bushing over the cable. Trim the shield braid and center conductor as shown.

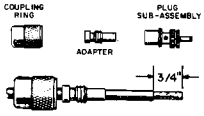


Step 3 -- Tin the center conductor and pin. Heat the pin using a minimum amount of heat and solder the pin on the center conductor.



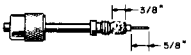
Step 4 -- Slide the connector body into place. Push in the locking nut and tighten the assembly using pliers.

0.195" O.D. CABLE

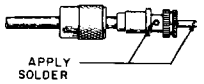


Step 1 -- Trim the jacket and slide the coupling ring and adapter onto the cable as shown.

Step 2 -- Fold the braid over the jacket as shown.

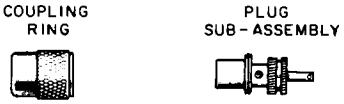


Step 3 -- Slide the adapter under the braid. Trim the braid and center conductor as shown.

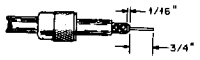


Step 4 -- Slide the plug sub-assembly onto the cable and push in and tighten the adapter coupling ring using pliers. Apply solder where shown.

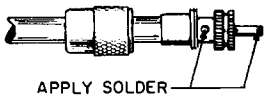
0.405" O.D. CABLE



Step 1 -- Trim the jacket as shown.



Step 2 -- Trim the shield braid and center conductor as shown. Slide the coupling ring over the cable.



Step 3 -- Slide the plug sub-assembly onto the cable and solder as shown.

(2) Transmission Lines Terminated in Flange Type Connector

(a) Install the flange type connector in the cabinet top using the appropriate knockout.

(b) Measure and cut coaxial cable so that it will reach the connector in the cabinet top without any sharp bends.

(c) Install the connector and adapter on the end of the cable and attach it to the flange type connector.

(3) Externally Terminated Transmission Line

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

(a) Punch out the 7/8-inch knockout in the cabinet top.

(b) Install the rubber grommet (supplied) in the hole.

(c) Route the coaxial cable attached to the equipment through the hole in the grommet.

(d) Install the connector and adapter on the loose end of the cable and attach it to the termination on the transmission line.

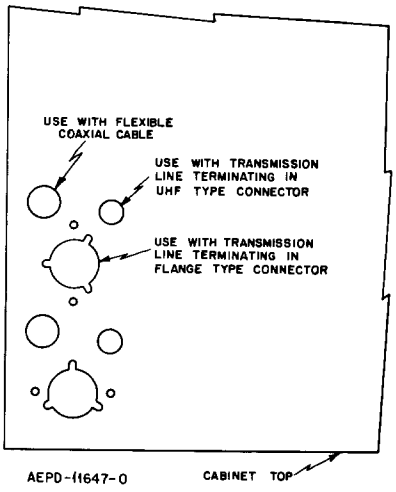


Figure 1.
Cabinet Knockout Detail

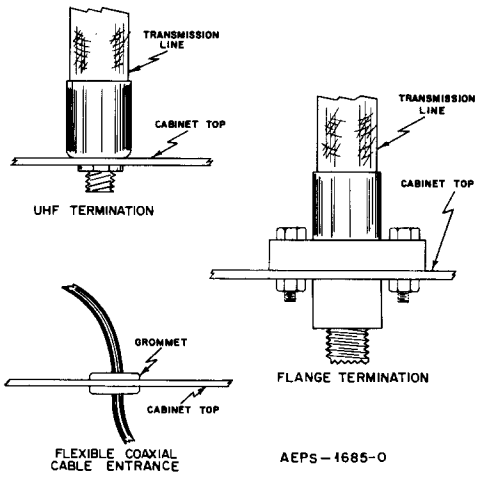


Figure 2.
Indoor Cabinet Antenna Cable Installation

b. AC Power

(1) Power Requirements

Stations rated at 200 watts or more rf power output require a 20-ampere, 120-volt ac power source. Stations rated at less than 200 watts rf power require a similar 15-ampere power source. These circuits should be installed in accordance with local electrical codes.

The primary ac power line may be installed prior to installation of the cabinet and terminated near the location chosen for the station. Connection from the termination to the station may be through the rear or bottom of the base station cabinet. The connection can be made with 1/2-inch conduit, flexible BX cable, or heavy duty 3-conductor line cord. The recommended wire for conduit or BX is three number 12 TW type wires. A line cord is supplied if that type of installation is desired and does not violate local electrical codes.

WARNING

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

(2) Power Connection

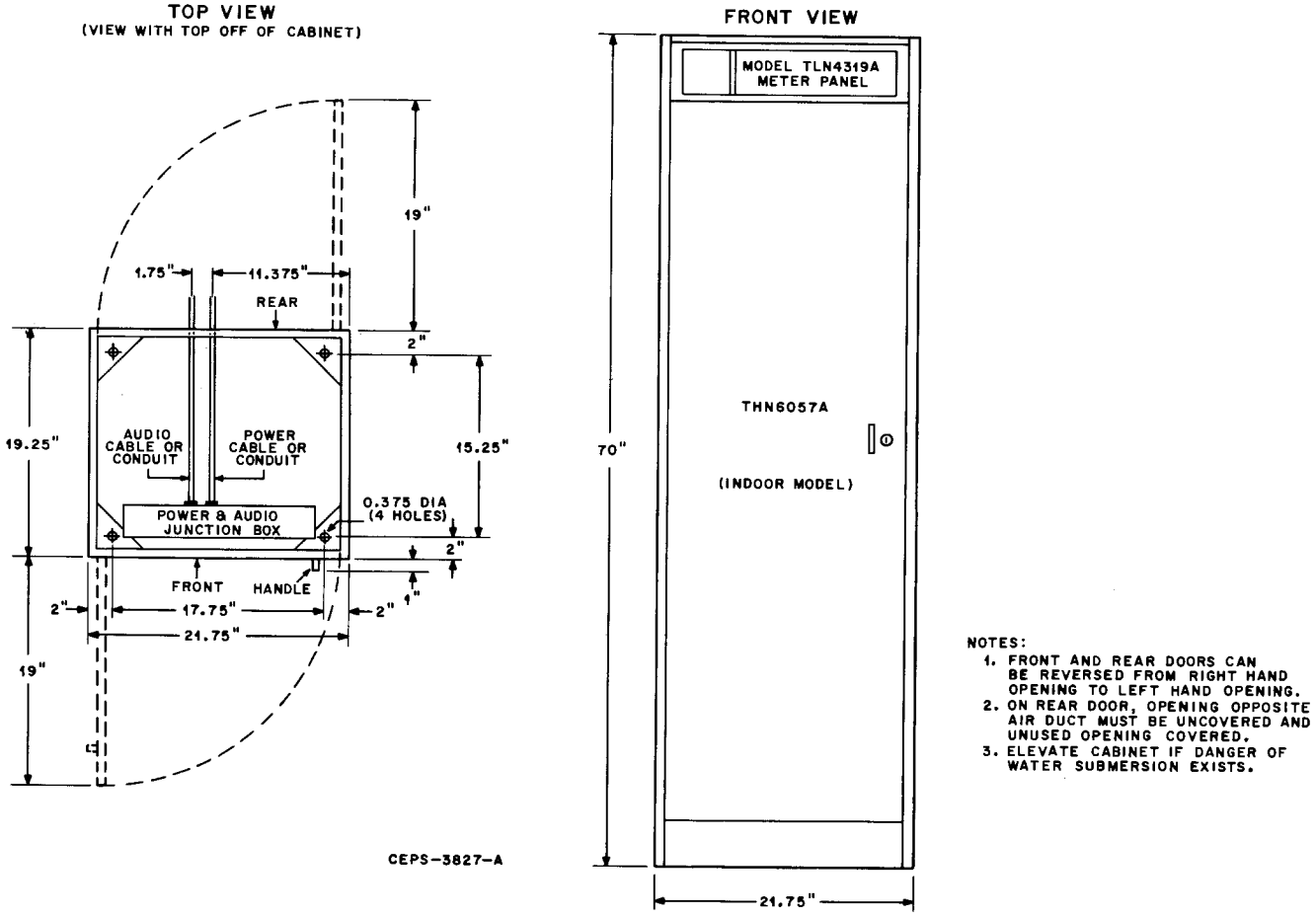
(Refer to Indoor Cabinet Dimensional Detail.)

Two knockouts are provided on the rear panel of the cabinet base for rear entrance of

power and control lines. When facing the rear of the cabinet, the left hand knockout is intended for the entrance of ac power. The knockouts are in line with holes in the junction box so that 1/2-inch thinwall tubing or rigid conduit may be installed through the base and directly to the junction box if desired. Punch out the knockout and install the conduit, or if conduit is not used, install a 7/8-inch rubber grommet in the hole to protect the cable. Make power connections as shown in the Power and Control Line Connection Detail or inside the junction box cover.

The green wire shown is an earth ground to reduce shock hazard. It is not connected to the ac supply, but it may be an extra wire in the cable, conduit, or raceway that houses the current carrying wires from the main service. It may also be connected to the conduit or raceway itself as this is connected to earth ground at the main service entrance.

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



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

Model THN6057A
Indoor Cabinet Dimensional Detail

MODEL TABLE

MODEL	FREQUENCY RANGE	APPLICATION
TTE1133AA TTE1134AA	450-460 MHz 460-470 MHz	Standard
TTE1313AA TTE1314AA	450-460 MHz 460-470 MHz	With Optional Transmitter Shield

1. DESCRIPTION

The exciter-transmitter is a completely solid-state unit. It provides a phase-modulated, crystal-controlled rf output in the 450 to 470 MHz range with a nominal power output of 12 watts. The Transmitter Block Diagram (Figure 1) shows the stage-by-stage signal flow and operating frequencies.

2. CIRCUIT DESCRIPTION

a. 1st Audio Amplifier, Clipper, and 2nd Audio/IDC Stage

The audio input from the line transformer or microphone amplifier enters a pre-emphasis network before being coupled to the audio amplifiers. The output from 1st audio amplifier Q181 is fed through a coupling capacitor to the clipper, where audio peaks in excess of a specific level are removed from the signal. The output of the clipper passes through a "splatter filter" before being applied to the 2nd Audio Amplifier and IDC Circuit (Q182).

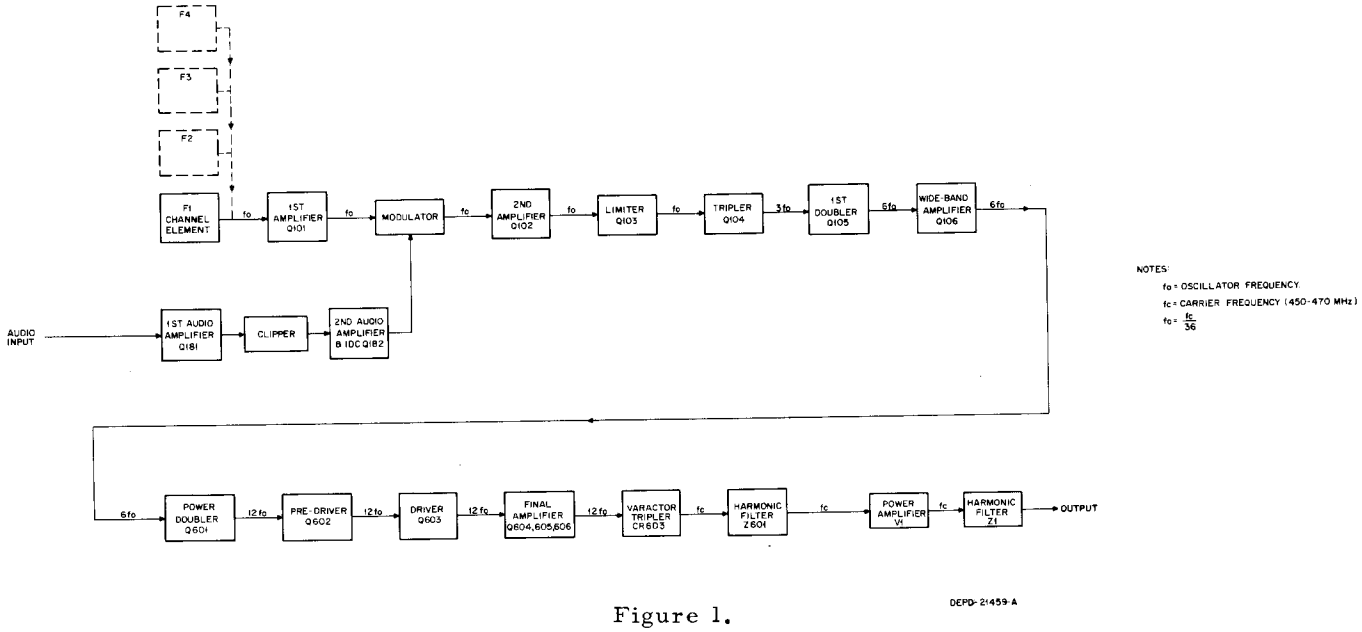


Figure 1.
Transmitter Block Diagram

The clipper/filter limits the slope (steepness) of the audio signals which pass through it, as illustrated in Figure 2. The "shaped" audio signal is amplified by emitter-follower Q182 whose output is adjusted by "instantaneous deviation control" (IDC) potentiometer R119. The IDC control, the clipper stage, the pre-emphasis and de-emphasis circuits, and the two audio amplifiers comprise a "deviation limiting circuit".

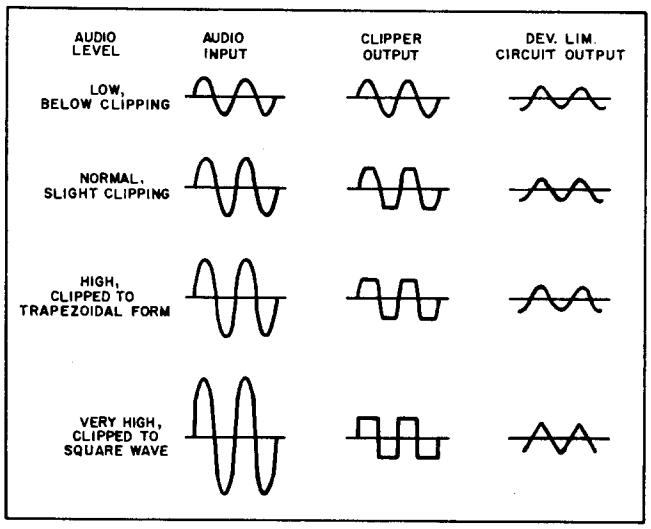


Figure 2.
Deviation Limiting Circuit Waveforms

b. Oscillator (Channel Element)

The plug-in channel element consists of a transistorized oscillator circuit and a crystal. The crystal is unheated and the oscillator circuit is compensated for frequency stability over the entire temperature range. For multi-frequency operation, additional channel elements are used. A variable "warp" capacitor is mounted in the base of each channel element, and is accessible through a hole in the exciter circuit board. Each oscillator operates on a specific frequency in the 12.5 to 13.055 MHz range.

c. First RF Amplifier

First Amplifier Stage Q101 provides a constant load for the oscillator and amplifies the channel element output to the proper rf level for the modulator. The series-resonant network in the emitter circuit of this amplifier offers negligible impedance over the range of crystal frequencies from 12.5 to 13.055 MHz.

d. Modulator

The audio output of the deviation limiting circuit is applied to the modulator which phase-modulates the output of the 1st amplifier. The tuning elements of the modulator tank circuits are varactors (CR101, CR102 and CR104). The capacitance of these special back-biased diodes is a function of the potential across them. The audio signal applied to the varactors changes the potential at an audio rate and consequently varies the capacitance in the modulator tank circuit. This changes the phase angle of the rf signal, producing modulation.

e. Multipliers and Amplifiers

From the modulator, the rf signal is amplified (Q102), limited (Q103), and applied to Q104 where its frequency is tripled. It is then applied to Q105 where the rf frequency is doubled, and then amplified by wide-band amplifier Q106. All of the rf circuitry up to this point is contained on the exciter board. All stages are conventional common-emitter circuits, with the exception of the 2nd amplifier (Q102) which is a field effect transistor (FET). The rf output of the exciter board is at a frequency of 75 to 78.33 MHz, with a nominal power output of 400 milliwatts. This rf output (from Q106) is applied as the input signal to the doubler-driver circuit board.

f. Doubler-Driver Board

The doubler-driver board contains three stages: Power Doubler Q601, Pre-Driver Q602 and Driver Q603. The input rf signal is applied to the Power Doubler where it is amplified and doubled in frequency. The signal is then amplified in the pre-driver and driver stages to produce an rf signal of sufficient power to drive the final amplifier. The pre-driver and driver stages are protected by the driver current limiter in the main power supply.

g. Final Amplifier Board

The final rf amplifier is comprised of three power transistors (Q604, Q605 and Q606) connected in parallel. The output is LC coupled through C107 and L625 to the varactor tripler stage. The final amplifier transistors are also protected by the final current limiter located in the main power supply.

h. Varactor Tripler

The varactor tripler multiplies the signal to the desired carrier frequency in the 450-470 MHz range. The circuitry associated with the tripler and the varactor diode (CR603) is contained in the varactor housing. The output of the varactor tripler is then passed through a bandpass harmonic filter (Z601). Nominal rf power output at this

point is 12 watts. This signal is applied via a short length of coaxial cable to the power amplifier.

3. TROUBLESHOOTING

a. Alignment

Many transmitter troubles are due to incorrect alignment (tune-up and loading). Transmitter alignment therefore becomes a logical part of transmitter troubleshooting. A complete transmitter alignment is also a necessary final step after transmitter repairs have been completed to assure that the transmitter is again being correctly loaded at the output frequencies.

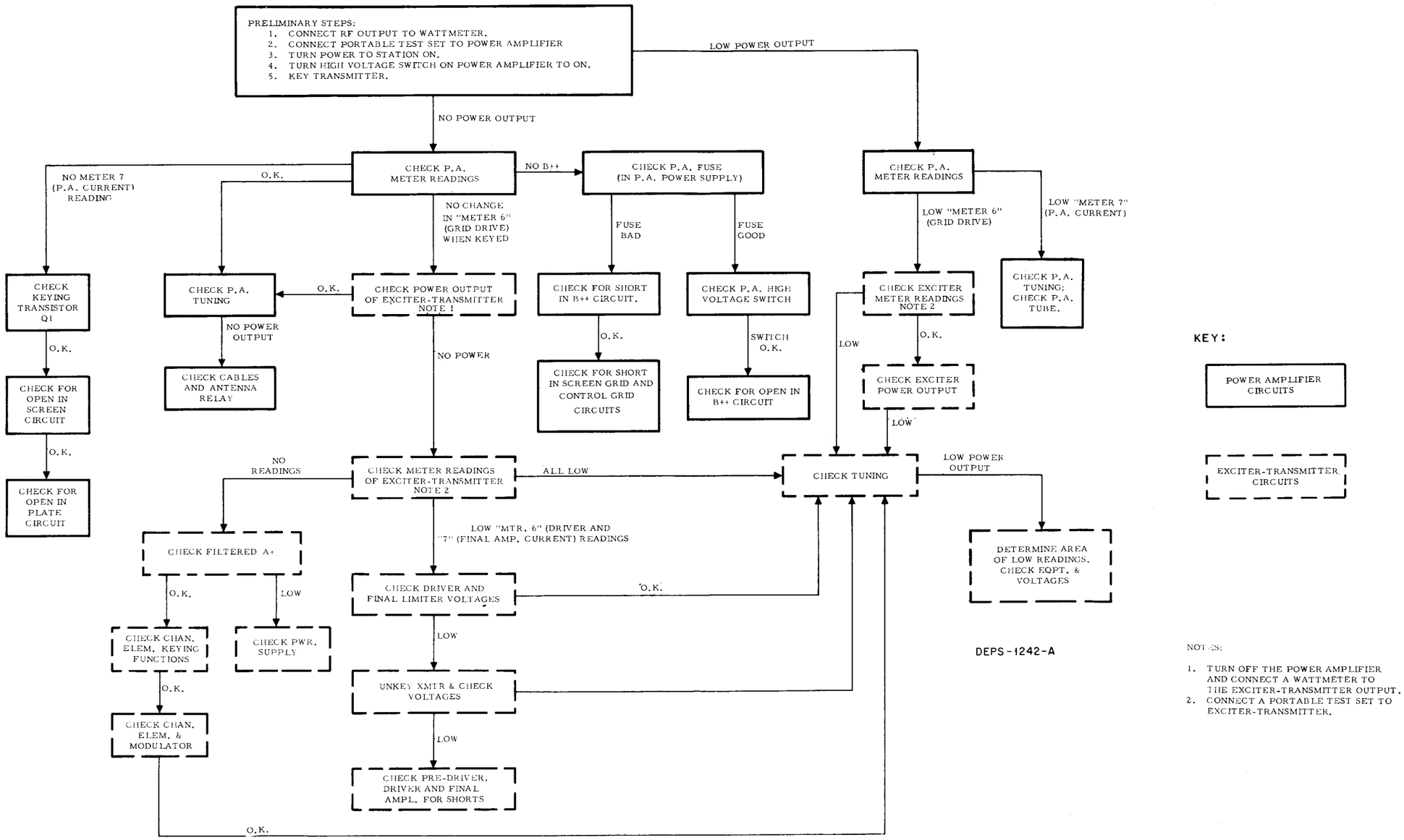
In the course of troubleshooting the transmitter, it may be necessary to disturb alignment adjustments. It is important that the transmitter be completely tuned after such procedures. Peak tuning of individual stages is not adequate. The entire procedure must be followed to obtain correct alignment of the transmitter.

b. Fault Location

A general procedure for localizing faults is given in "flow chart" form in the Transmitter Troubleshooting Chart.

(Page 4 is blank)

TRANSMITTER TROUBLESHOOTING CHART



DEPS-1242-A

NOTES:

1. TURN OFF THE POWER AMPLIFIER AND CONNECT A WATTMETER TO THE EXCITER-TRANSMITTER OUTPUT.
2. CONNECT A PORTABLE TEST SET TO EXCITER-TRANSMITTER.

(Page 6 is blank)

4. SERVICE AIDS

a. General

The following paragraphs describe proper methods and procedures for servicing the exciter-transmitter chassis. Observe standard servicing practices, such as tagging leads and identification of connecting points. Do not remove any transistor until it has been definitely established that it is damaged or causing a malfunction.

To gain access to the exciter board, remove the front exciter board shield. Removal of the rear shield permits access to the component side of the exciter board, the doubler-driver board, and the final amplifier board. The varactor tripler is accessible after removal of the rear shield and varactor cover. Refer to the Exciter-Transmitter Parts Location Detail for locations of the printed circuit boards and other significant parts in the exciter-transmitter.

b. Audio Board Removal

If the audio board is to be removed, the rear shield must be removed first. Remove the F1 channel element. Then slide the two clips on the top corners of the board to the outside. Pull straight out to remove the board.

c. Power Doubler, Pre-Driver and Driver Transistor Removal

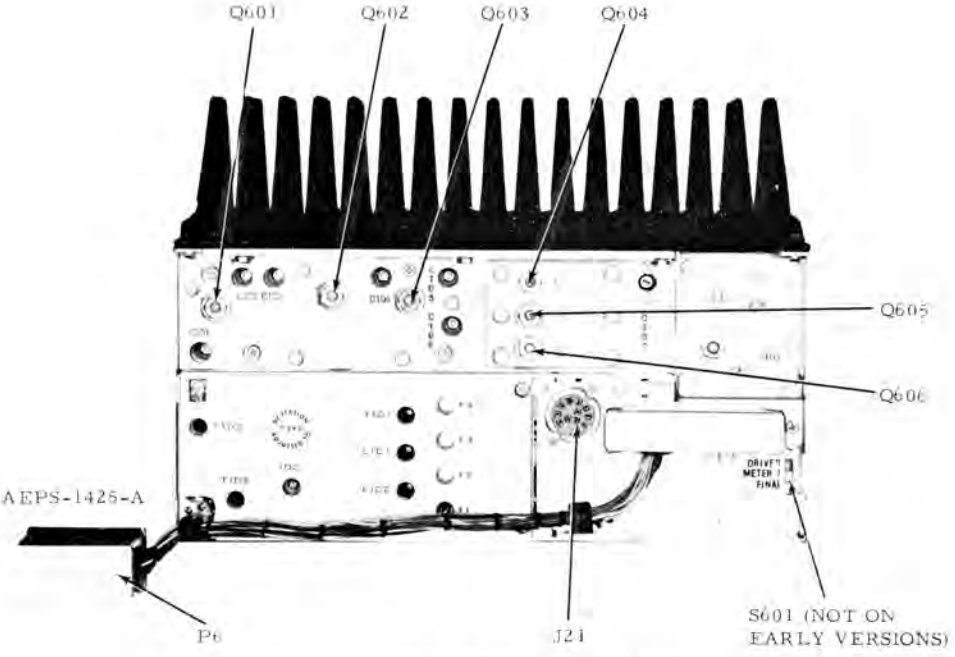
The power doubler, pre-driver or driver transistors (Q601, Q602 or Q603) are removed by the same procedure due to a common heat sink. The rear shield must be removed first and then the heat sink on the front of the chassis. After removal of the heat sink, any of the transistors can be unsoldered and removed from the front. When replacing these transistors, secure the emitter stud to the heat sink and secure the heat sink to the chassis before soldering any of the transistor leads to the circuit board.

d. Final Amplifier Transistor Removal

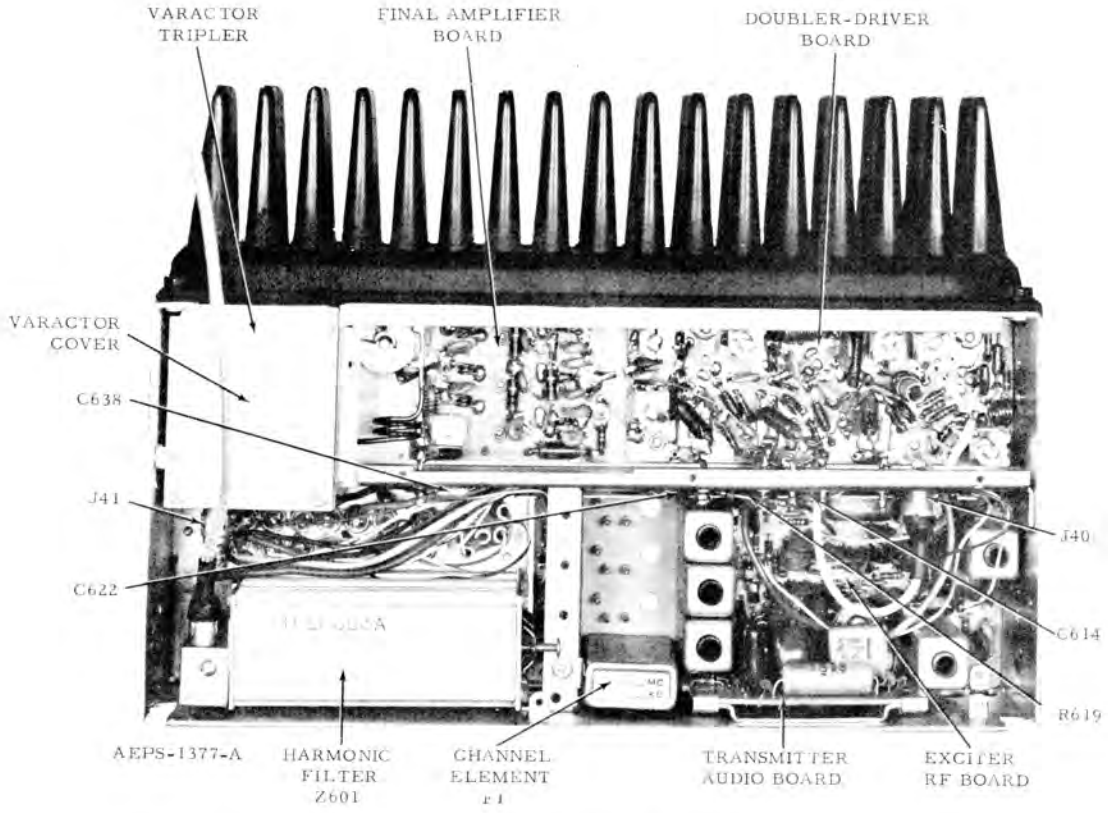
The three final amplifier transistors (Q604, Q605 or Q606) can be replaced in the same manner as previously described for the power doubler, pre-driver or driver transistors. Use the same precautions.

e. Varactor Tripler

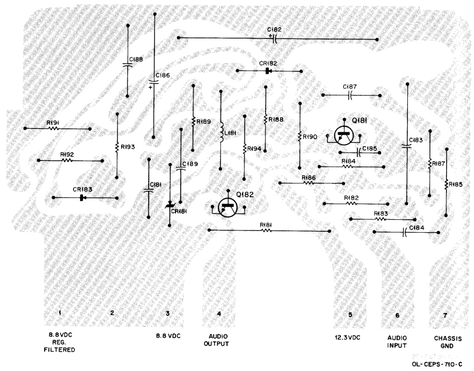
Replacement of the varactor or coils can easily be accomplished from the rear after removal of the varactor cover. If the variable capacitors must be replaced, it may be easier to remove the housing. To remove the housing, first remove the tripler input coil and the 3 screws holding the housing in the chassis. Next, remove the harmonic filter; then slide the housing down and out.



Parts Location Detail (Front View)



Parts Location Detail (Rear View)

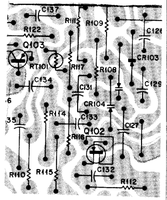


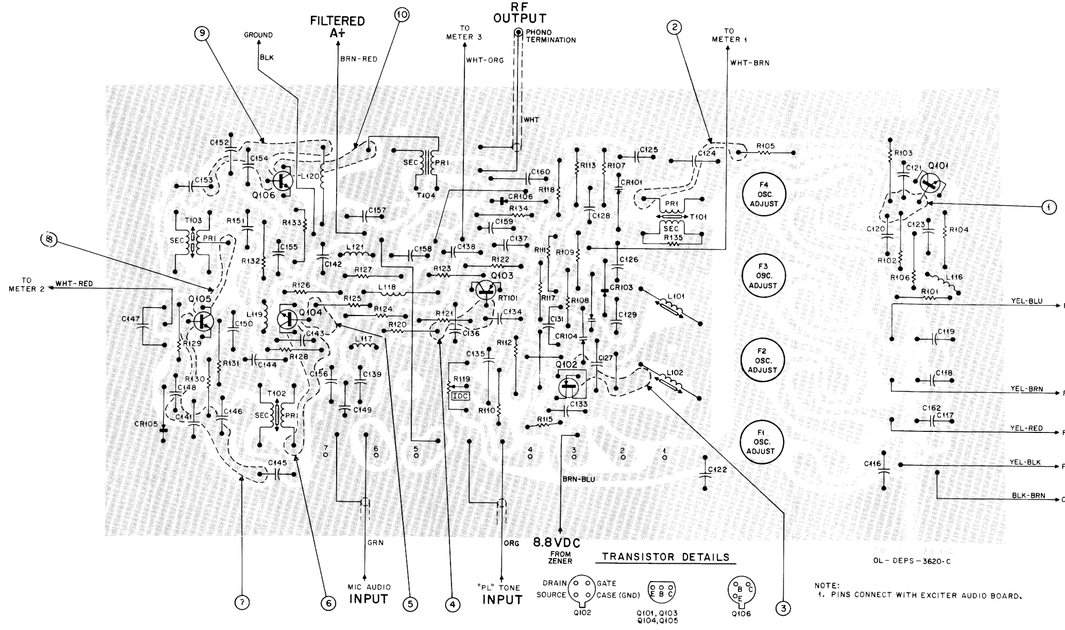
Transmitter Audio Board TLN8956A

REVISIONS

PEPS-3621-H

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE6392A-4	C125, 131	FROM 21D82187B18, 1500 pF TO 21D84226B63, 1500 pF	2ND AMPL.
	C127	FROM 21D82187B11, 1500 pF TO 21D84226B63, 1500 pF	
	C126	FROM 21K868935, 3 pF TO 21D83496D65, 5 pF	
	C130	FROM 21D82133G40, 3.9 pF TO 21D8204B26, 2.2 pF	
	C132	REMOVED 21C82372C04, .05 uF	
	R114	REMOVED 6S129235, 1.2k	
	R112	FROM 6S129806, 330 TO 6S129804, 2.2k	
	R122	FROM 6S127801, 470 TO 6S129804, 2.2k	
	R135	FROM 6S127687, 6.8k TO 6S127804, 4.7k	
	R115	FROM 6S129753, 100; 1/4 W TO 6S185B67, 100; 1/8 W	
	R116	REMOVED 6S129236, 15k	
	RT101	REMOVED 6B82696B01 10k	
	CR101, 102, 104	FROM 48D82190H08, MV1662 TO 48D82190H17, SMV489	
		CIRCUIT WAS AS SHOWN BELOW:	





Exciter RF Board TLE6392A-4

FOR MODELS TLE6392A-1 & 2
AND TLN8956A WITH NO SUFFIX,
REFER TO CIRCUIT BOARD DETAIL
PEPS-714.

EPS-3628-A

EXCITER-TRANSMITTER

Exciter RF Board TLE 6392A &
Transmitter Audio Board TLN8956A
Circuit Board Details
Motorola No. PEPS-3621-H
6/5/74-NPC

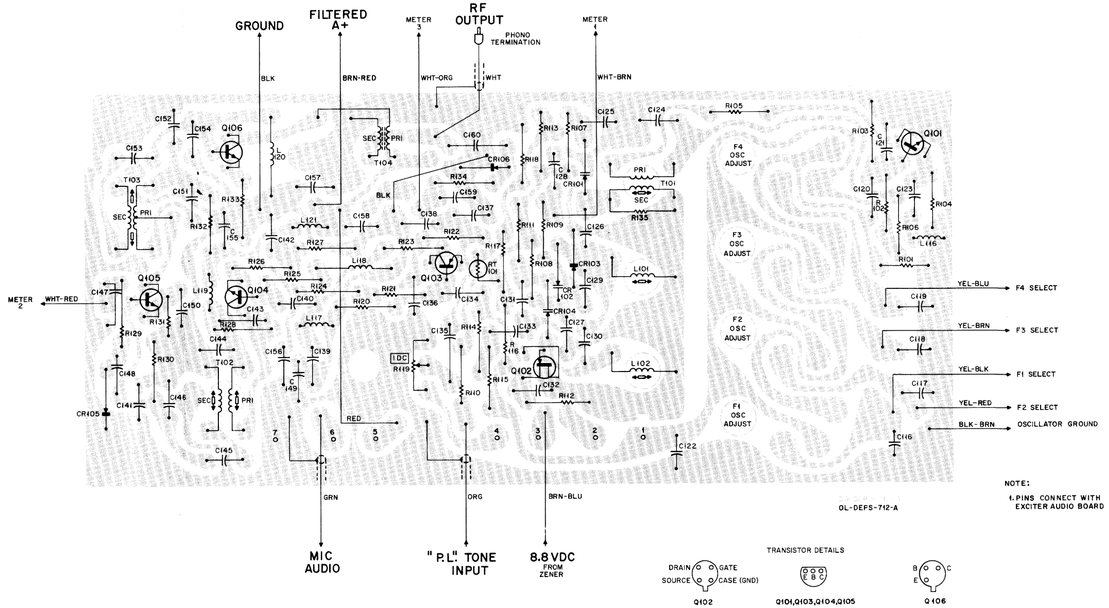
REVISIONS

PEPS-714-H

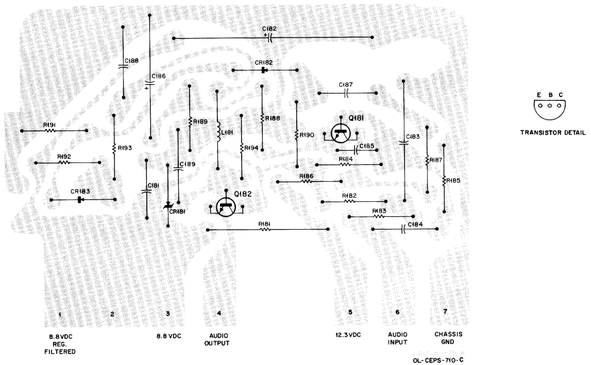
BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE6392A	Q104	WAS 48R869322 TYPE M9322	TRIPLER
	R123	WAS 6S129708; 1.2K	
	R125	WAS 6S129806; 330	
	R126	WAS 6S124857; 3.3	
TLE6392A-1 TLE6392A-2	R135	ADDED; 6S128687 6.8K	T101 SECONDARY
TLE6392A-3 TLN8956A-1		PRINTED CIRCUIT BOARD PLATING REVISED.	REFER TO PEPS-3621

FOR MODELS TLE6392A-3 AND TLN8956A SUFFIX -1 OR LATER, REFER TO CIRCUIT BOARD DETAIL PEPS-3621.

EPS-3627-A

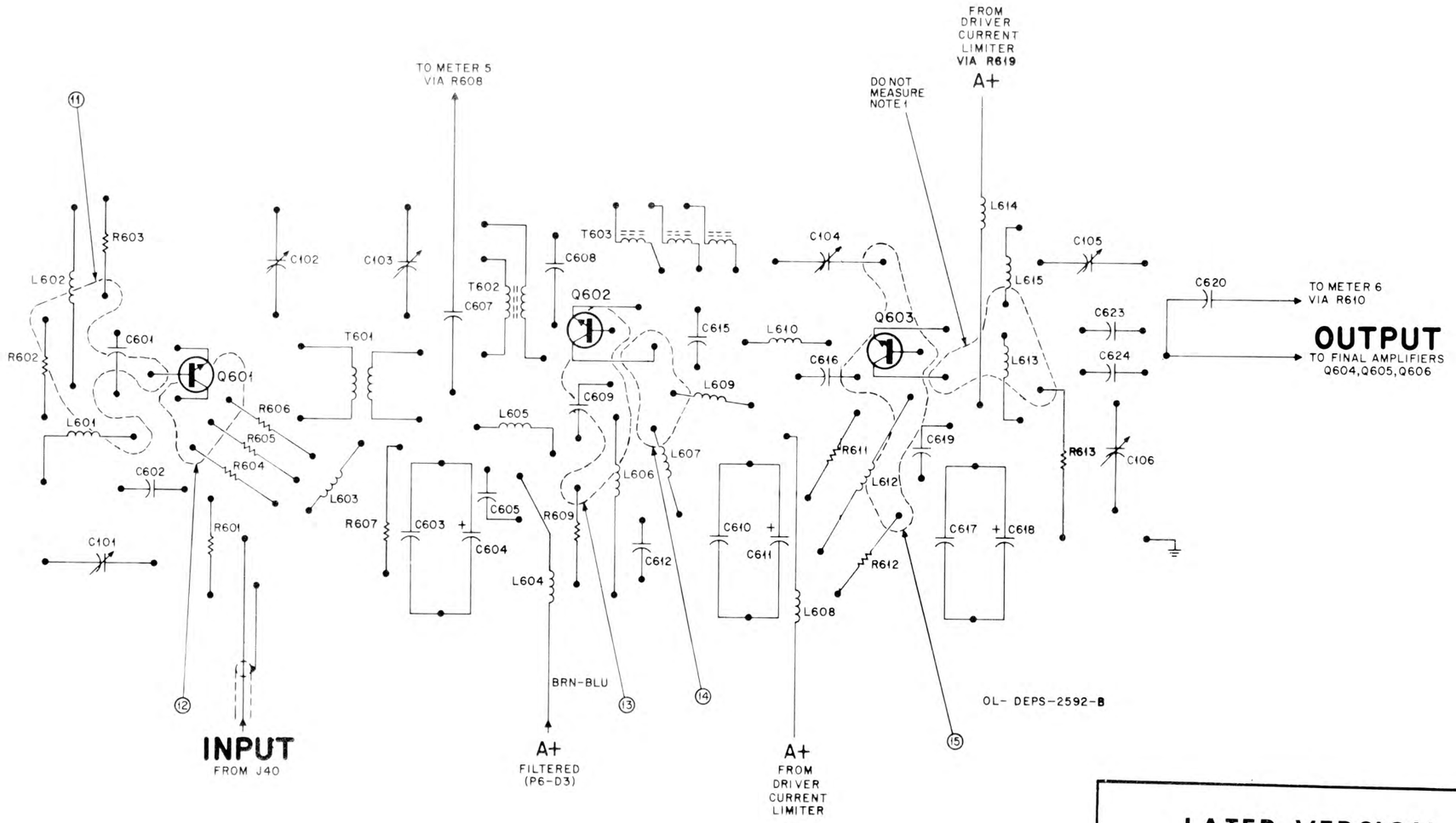


Exciter RF Board TLE6392A



Transmitter Audio Board TLN8956A

Exciter RF Board TLE6392A &
Transmitter Audio Board TLN8956A
Circuit Board Details
Motorola No. PEPS-714-H
6/5/74-NPC



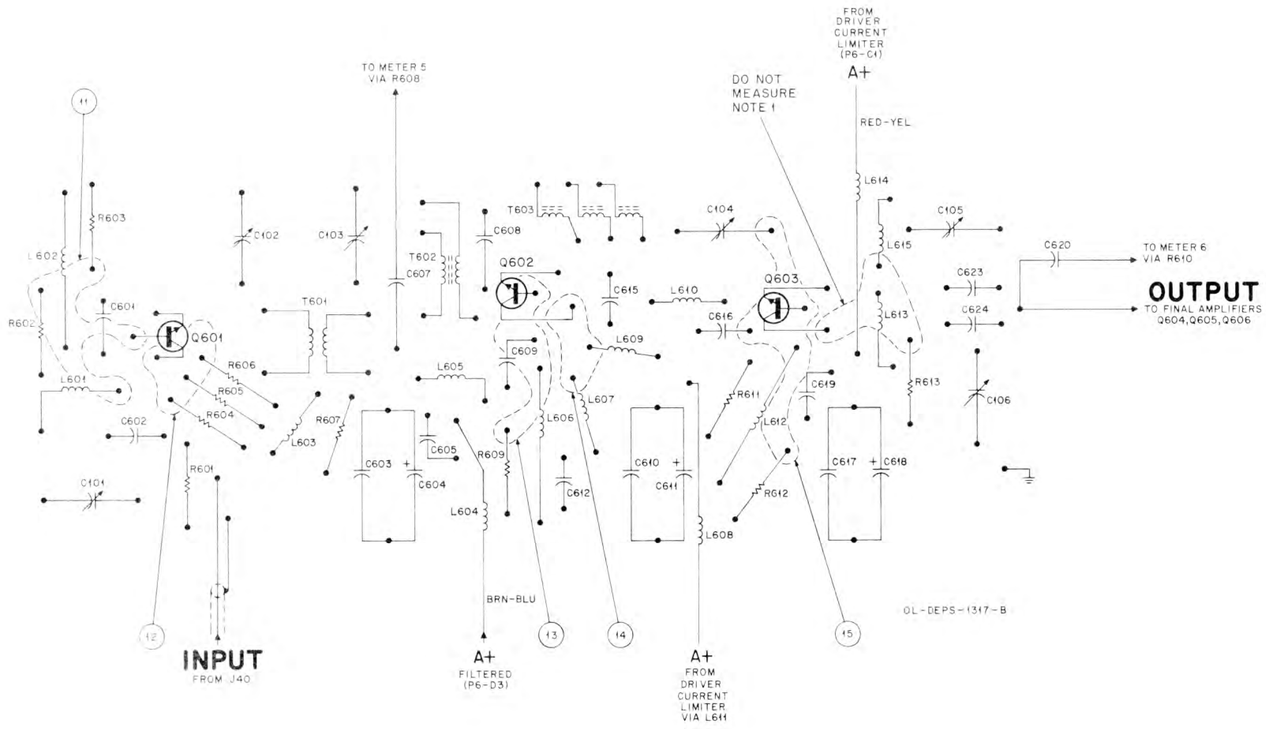
LATER VERSION

FOR EARLY VERSION UNITS, REFER
TO 1V80701B33 DOUBLER-DRIVER

EXCITER-TRANSMITTER

EPS-14690-O

TLN4220A Double-Driver
Circuit Board Detail
Motorola No. PEPS-2593-D
6/5/74-NPC

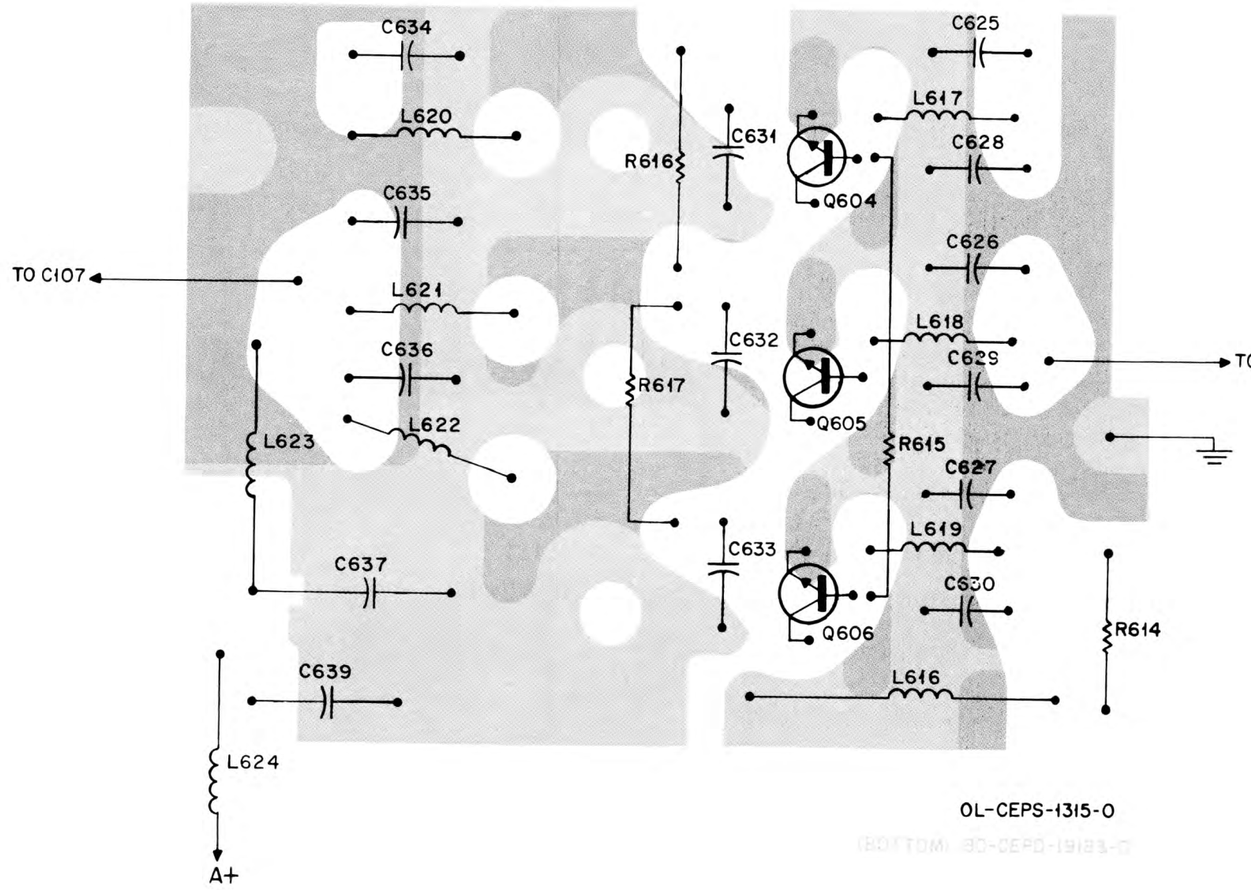


EARLY VERSION

FOR LATER VERSION UNITS, REFER
TO TLN4220A DOUBLER-DRIVER

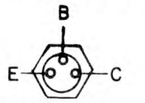
EPS-14691-O

1V80701B33 Double-Driver
Circuit Board Detail
Motorola No. PEPS-1319-F
6/5/74-NPC



OL-CEPS-1315-O

TRANSISTOR DETAIL



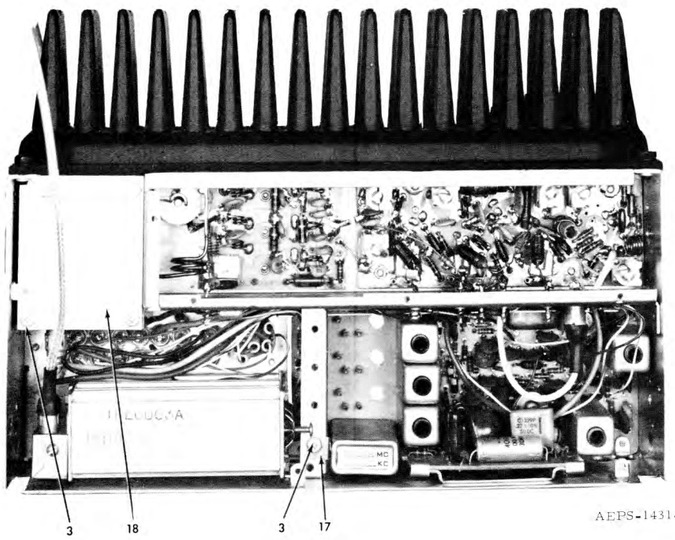
(TOP VIEW)

B = BASE
E = EMITTER
C = CATHODE

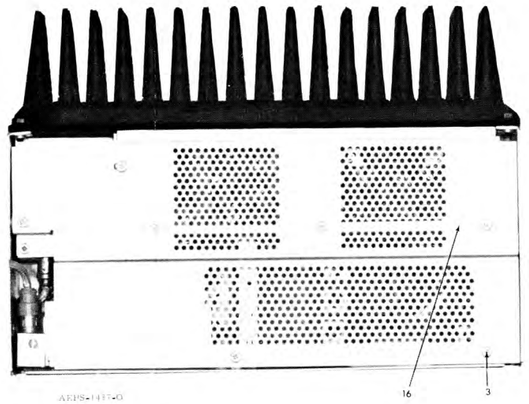
EXCITER-TRANSMITTER

1V80701B35 Power Amplifier
Circuit Board Detail
Motorola No. PEPS-1316-D
6/5/74-NFC

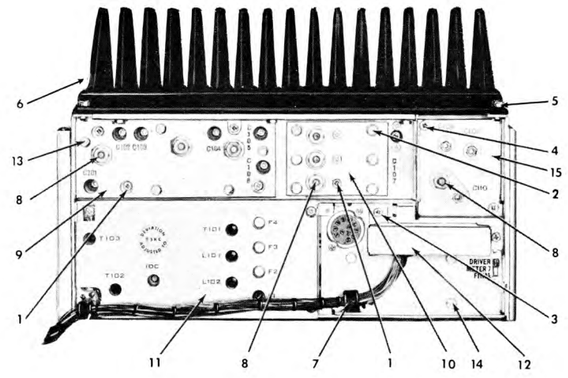
CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION	QTY.
1	3A82227A02	Screw 4-40 x 7/16"	7
2	3S134269	Tapping Screw, locking plain hex	6
3	3S134169	Screw 4-40 x 1/4"	17
4	3S134186	Screw 6-32 x 5/16" "Phillips" hex	3
5	3S135049	Screw 10-32 x 3/8" Plain hex	4
6	26D83027D01	Heat Sink	1
7	42A881156	Cable Clamp	2
8	2S8370	Nut 10-32 x 3/8" hex	6
9	64B84084B01	Heat Sink	1
10	64B83197D01	Heat Sink	1
11	15B84006A01	Exciter Board Cover	1
12	15B83036H01	Cable Cover	1
13	3S135839	Screw 6-32, locking plain hex	5
14	3S134136	Tapping Screw 6-32 x 5/16" "Phillips" hex locking	4
15	1V80781A44	Varactor Housing Assy	1
16	15C83005H01	Rear Cover	1
17	41A82114E01	Channel Element Clip	1 to 4
18	64B83007H01	Varactor Cover	1



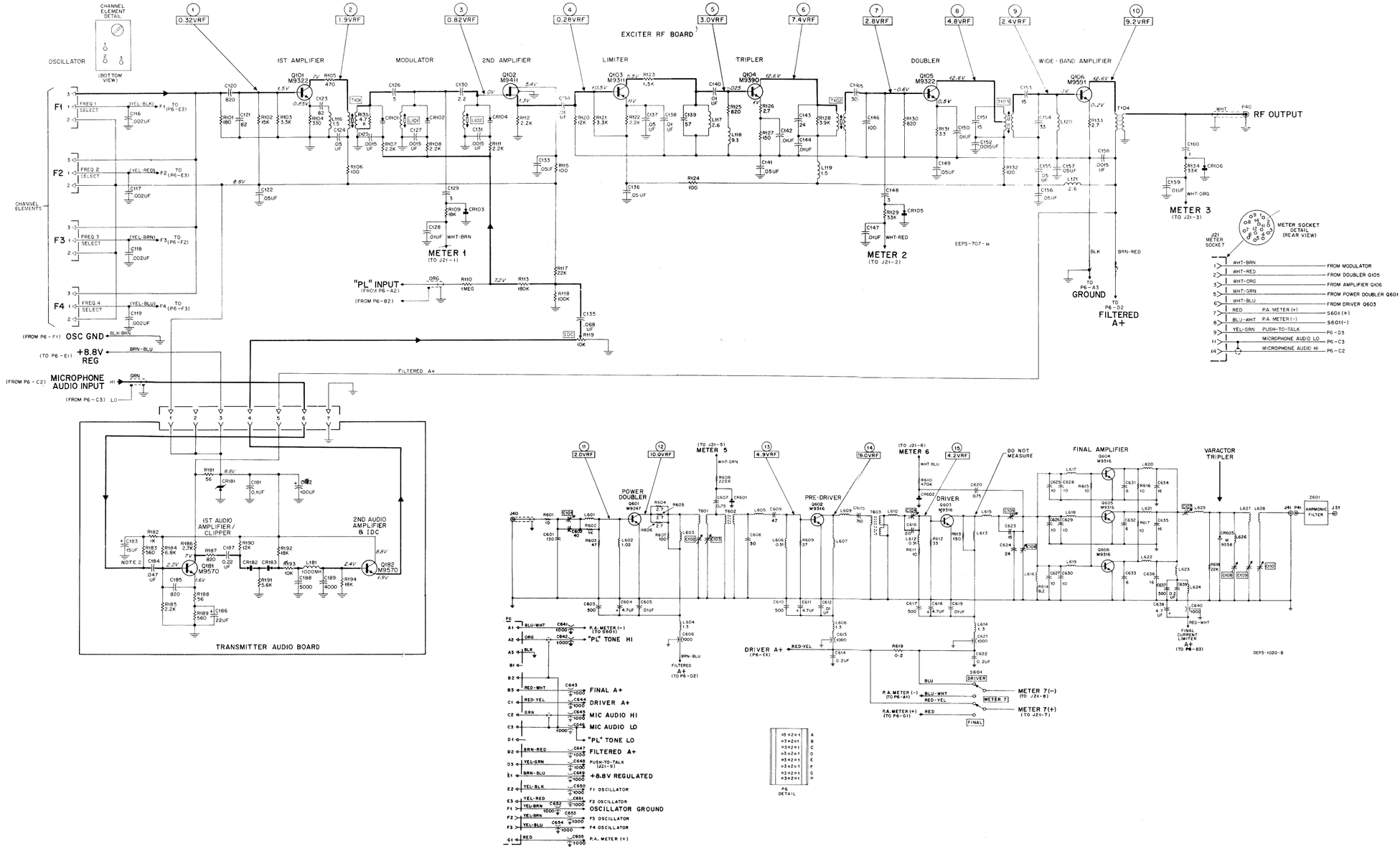
AEPS-1431-O



AEPS-1431-O



AEPS-1430-A



NOTES:

1. UNLESS OTHERWISE STATED: RESISTOR VALUES ARE IN OHMS (K = 1000). CAPACITOR VALUES ARE IN PICOFARADS. INDUCTOR VALUES ARE IN MICROHENRIES.
2. R183 USED ONLY IN LOCAL CONTROL MODELS WITHOUT MONITOR INTERCOM OPTION.
3. COMPONENT REFERENCES WITHIN RECTANGLES ARE MARKED ON THE EQUIPMENT.
4. ALL DC VOLTAGES ARE MEASURED WITH A MOTOROLA TRANSISTORIZED DC MULTIMETER OR EQUIVALENT WITH 11 MEGOHMS INPUT RESISTANCE. VOLTAGES SHOWN ARE WITH TRANSMITTER IN KEYED POSITION.

EPD-21324-B

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

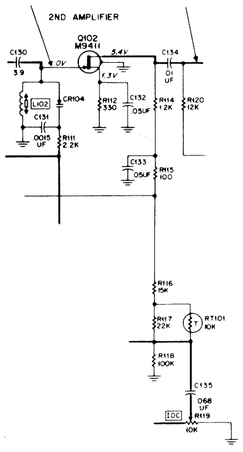
Exciter-Transmitter
Schematic Diagram and Parts List
Motorola No. 63P81057A02-L
6/5/74-NPC

EXCITER-TRANSMITTER

REVISIONS

63P81057A02-L

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLE6392A	Q104	WAS TYPE M9322	EXCITER RF BOARD	EXCITER BD. PEPS-714
	R123	WAS 1.2K; ±5%; 1/4 W		
	R125	WAS 330; ±5%; 1/4 W		
	R126	WAS 3.3; ±5%; 1/4 W		
TLE6392A-1 TTE1170AA TTE1133AA TTE1134AA		CONTAINED TLE6412A TRANSMITTER CHASSIS KIT WHICH INCLUDED 1V80701D33 DOUBLER-DRIVER CIRCUIT BD.	Q602 AND METER 7 CIRCUITS	EXCITER BD. PEPS-1319
TTE1170AA-1 TTE1133AA-1 TTE1134AA-1		CHANGED TO TLE6512A TRANSMITTER CHASSIS KIT AND TLN4220A DOUBLER-DRIVER CIRCUIT BOARD		PEPS-2593
TLE6392A-2	R135	ADDED	T101 SECONDARY	EXCITER BD. PEPS-714
TLE6392A-3 TLN8956A-1		REVISED PRINTED CIRCUIT BOARD PLATING		EXCITER BD. PEPS-3621-C
TLE6392A-4		CIRCUIT WAS AS SHOWN BELOW:	2ND AMPL.	EXCITER BD. PEPS-3621-D



TLE6392A-5	Q106	FROM 48R869552, M9552 TO 48R869591, M9591	W-B AMPL.	NONE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLE6412A Transmitter Chassis Kit PL-370-B

		CAPACITOR, fixed: pF; ±5%; 500 V; unl. stated
C107	19C83221D01	var: 2.93-13.5; 850 V peak
C108, 109	19C83444C04	var: 1.3-5.2; 1100 V peak
C110	19C83444C02	var: 1.74-6.57; 750 V peak
C606, 613 621, 640 thru 655	21K861219	feed-thru type; 1000 +100-0%; coded RED
C614, 622	21C82372C05	0.2 uF +80-20%; 25 V
C638	23K865137	4.7 uF ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR601, 602	48C82139G01	germanium
CR603	48R869558	silicon; varactor; type M9558
		CONNECTOR, receptacle:
J21	9C857358	female; 12-contact
J40	9B82323G01	female; min; coaxial
J41	9C83663C01	female; min; coaxial
		COIL, RF:
L611	24K832590	choke; 1.3 uH
L625	24C84095A01	2 turns
L626	24A83450C01	2 turns
L627	24A83002H01	1/2 turn
L628	24A83003H01	1/2 turn
P6		CONNECTOR, plug: c/o: 14C82337A09 BODY: 24-contact type 29C82335A02 TERMINAL, contact: male (specify quantity) 29C82336A02 TERMINAL, contact: female (specify) 15D83934A01 SHELL
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R608	6S124B06	220K ±5%
R610	6S129149	470K ±5%
R618	6S128685	22K

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLE6512A Transmitter Chassis Kit PL-660-B

		CAPACITOR, fixed: pF; ±5%; 500 V; unl. stated
C107	19C83221D01	var: 2.93-13.5; 850 V peak
C108, 109	19C83444C04	var: 1.3-5.2; 1100 V peak
C110	19C83444C02	var: 1.74-6.57; 750 V peak
C606, 613 621, 640 thru 655	21K861219	feed-thru type; 1000 +100-0%; coded RED
C614, 622	21C82372C05	0.2 uF +80-20%; 25 V
C638	23K865137	4.7 uF ±20%; 25 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR601, 602	48C82139G01	germanium
CR603	48R869558	silicon; varactor; type M9558
		CONNECTOR, receptacle:
J21	9C83478E01	female; 12-contact
J40	9B82323G01	female; min; coaxial
J41	9C83663C01	female; min; coaxial
		COIL, RF:
L625	24C84095A01	2 turns
L626	24A83450C01	2 turns
L627	24A83002H01	1/2 turn
L628	24A83003H01	1/2 turn
P6		CONNECTOR, plug: includes: 14C82337A09 BODY: 24-contact type; 29C82335A01 TERMINAL, contact male; 29C82336A01 TERMINAL, contact female; 29C82335A02 TERMINAL, contact: male (specify quantity); 29C82336A02 TERMINAL, contact: female (specify); 15D83934A01 SHELL
		RESISTOR, fixed: 1/4 W unl. stated
R608	6S124B06	220K ±5%
R610	6S129149	470K ±5%
R618	6S128685	22K ±10%
R619	17C82586H01	0.2; ±5%; 5 W
S601	40B83204B01	SWITCH, slide: dpdt
NON-REFERENCED ITEMS		
	64B83007H01	COVER
	15B84006A03	COVER, exciter; includes legend

Harmonic Filter PL-371-O

	TFE6003A or TFE6004A	FILTER, RF: 450-460 MHz FILTER, RF: 460-470 MHz

Channel Element PL-658-O

	TLN1190A	Transmitter control

TLE6392A Exciter Board PL-368-G

		CAPACITOR, fixed:
C116, 117, 118, 119	21D82428B25	.002 uF ±20%; 500 v
C120	21D82187B17	820 pF ±10%; 500 v
C121, 123	21D82610C20	82 pF ±5%; 200 v; NP0
C122, 124, 133, 136, 137, 149, 155, 156, 157	21C82372C04	.05 uF +80-20%; 25 v
C125, 127, 131	21D84426B63	1500 pF ±5%; 500 v
C126	21D83406D65	5 pF ±5%; 500 v; NP0
C128, 134, 138, 140, 141, 142, 144, 147, 150, 159	21D82428B59	.01 uF +80-20%; 200 v
C129, 148	21K868935	3 pF ±0.25 pF; 2000 v; NP0
C130	21D82204B26	2.2 pF ±0.1 pF; 500 v; NP0
C135	8C82095G04	.068 uF ±10%; 200 v
C139	21D82610C47	57 pF ±5%; 100 v; N220
C143	21D82133G74	24 pF ±5%; 500 v; N150
C145	21D82610C14	30 pF ±5%; 200 v; N150
C146	21D82610C44	100 pF ±5%; 100 v; N220
C151, 153	21S114535	15 pF ±5%; 500 v; N150
C152, 158	21D82187B18	1500 pF ±10%; 100 v
C154	21K855809	33 pF ±5%; 250 v; N150
C160	21K864518	1 pF ±10%; 500 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 104	48D82190H17	silicon; varicap; type SMV489
CR103, 105, 106	48C82139G01	germanium
		COIL, RF:
L101, 102	24D83377H01	coded RED; incl. 76B83377H01 CORE, tuning
L116, 119	24C82835G04	choke; 1.5 uH
L117, 121	24C82835G03	choke; 2.6 uH
L118	24C82835G20	choke; 9.3 uH
L120	24B83977B01	incl. ferrite body
P40	28B82331G01	CONNECTOR, plug: male; coaxial; min; "cinch" type
		TRANSISTOR: (SEE NOTE)
Q101, 105	48R869322	N-P-N; type M9322
Q102	48R869411	field-effect; type M9411
Q103	48R869311	P-N-P; type M9311
Q104	48R869390	N-P-N; type M9390
Q106	48R869591	N-P-N; type M9591; does not incl. 26B83379H01 HEAT SINK
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R101	6S129662	180
R102	6S127805	15K
R103, 121	6S129231	3.3K
R104	6S129775	330
R105, I32	6S127801	470
R106, 124,	6S129753	100
R107, 108, 111	6S128689	2.2K
R109	6S128904	18K
R110	6S129189	1 meg ±5%
R112, 122	6S129804	2.2K ±5%
R113	6S124B04	180K ±5%
R115	6S185B67	100; 1/8 w
R117	6S129667	22K ±5%
R118	6S124A97	100K ±5%
R119	18D82238D15	var: 10K
R120	6S129230	12K
R123	6S129681	..5K ±5%
R125	6S129818	820 ±5%
R126, 133	6S124B55	2.7 ±5%
R127	6S129862	150
R128	6S129819	3.9K ±5%
R129, 134	6S127807	33K
R130	6S129432	820
R131	6S129754	33
R135	6S127804	4.7K

T101	24D83377H02	TRANSFORMER, RF: coded BRN; incl. 76B83382H01 CORE, tuning
T102	24D83377H05	coded ORG; incl. 76B83382H03 CORE, tuning
T103	24D83377H03	coded YEL; incl. 76B83382H02 CORE, tuning (2 cores req'd)
T116	24C83380H01	bifilar winding
NON-REFERENCED ITEMS		
	1V80737A35	SHIELD, coil: used with L101, L102, T101, T102, T103
	26A84000A01	SHIELD, coil: used with T116

TLN8956A Transmitter Audio Board PL-369-O

		CAPACITOR, fixed:
C181	21C82372C01	0.1 uF +80-20%; 25 v
C182	23D82601A25	100 uF +150-10%; 20 v
C183	23D83214C02	15 uF ±20%; 25 v
C184	8D82905G03	.047 uF ±10%; 50 v
C185	21D82187B17	820 pF ±10%; 500 v
C186	23D83214C07	22 uF ±20%; 15 v
C187	8D83293B02	0.22 uF ±10%; 50 v
C188	21K863298	5000 pF ±1%; 500 v
C189	21K863396	4000 pF ±1%; 500 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR181	48D82256C56	silicon; zener type
CR182, 183	48C82392B03	silicon
		REACTOR:
L181	25D82113H02	a-f choke; 1000 mH
		TRANSISTOR: (SEE NOTE)
Q181, 182	48R869570	N-P-N; type M9570
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R181	6S2037	56
R182	6S127802	1K
R183, 189	6S129620	560
R184	6S128687	6.8K
R185	6S128689	2.2K
R186	6S128688	2.7K
R187	6S129432	820
R188	6S129860	56
R190	6S129887	12K ±5%
R191	6S129982	5.6K ±5%
R192, 194	6S131526	18K ±5%
R193	6S129668	10K ±5%

TLN4220A Doubler Driver Board PL-659-O

		CAPACITOR, fixed: pF; ±5%; 500 V; unl. stated
C101, 104, 105, 106	19C83491E04	var: 2.2-21.9; 500 V ac
C102, 103	19C83491E05	var: 1-9
C601	21K865444	130 ±3%
C602	21D82610C45	40; 100 V; NP0
C603, 610, 617	21D82880E19	500 ±10%
C604, 611, 618	23K865137	4.7 uF ±20%; 25 V
C605, 612, 619	21K832501	.01 uF +60-40%; 250 V
C607, 620	21C82450B06	0.75 ±10%
C608	21D82355B07	30; N330
C609	21R132265	47; NP0
C615	21D82355B11	30; NP0
C623	21K82989E33	15 ±2.5%; NP0
C624	21K840365	24; NP0
C616	21D82610C22	20; NP0
		COIL, RF:
L601	24C84154A01	4-1/4 turns
L602	24K890687	choke; 1.02 uH
L603, 607, 613	24C84153A01	2-1/4 turns
L604, 608, 614	24K832590	choke; 1.3 uH
L605, 609, 610, 615	24C84152A01	1-1/4 turns
L606, 612	24K800484	choke; 0.31 uH
		TRANSISTOR: (SEE NOTE)
Q601	48R869247	N-P-N; type M9247; does not incl. 14A83211B01 INSULATOR mtg
Q602, 603	48R869316	N-P-N; type M9316; does not incl. 14A83211B01 INSULATOR mtg
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R601, 611	6S129755	10
R602	6S127802	1K
R603	6S129233	47
R604, 605, 606	6S124B55	2.7 ±5%
R607	6S6326	100; 1/2 W
R609	6S131594	27
R612	6S129754	33
R613	6S6373	150; 1/2 W
		TRANSFORMER, RF:
T601	24C84151A01	pri: 4-1/2 turns sec: 4-1/2 turns (windings spaced apart)
T602	24C84149A01	(bifilar winding); pri; coded RED sec: coded GRN
T603	24C84150A01	(bifilar winding)

1V80701B33 Doubler-Driver Board (P/O TLE6412A) PL-678-O

		CAPACITOR, fixed: pF; ±5%; 500 V; unl. stated
C101, 104 105, 106	19C83491E04	var: 2.2-21.9; 500 V ac
C102, 103	19C83491E05	var: 1-9
C601	21K859941	130
C602	21D82610C45	40; 100 V; NP0
C603, 610 617	21K82880E19	500 ±10%
C604, 611 618	23K865137	4.7 uF ±20%; 25 V
C605, 612 619	21K832501	.01 uF +60-40%; 250 V
C607, 620	21C82450B06	0.75 ±10%
C608	21K852185	36; NP0
C609	21D83406D06	39; N220
C615	21D82355B11	30; NP0
C616, 624	21K840365	24; NP0
C623	21K82989E33	15 ±2.5%; NP0
		COIL, RF:
L601	24C84154A01	4-1/4 turns
L602	24K890687	choke; 1.02 uH
L603, 607 613	24C84153A01	2-1/4 turns
L604, 608 614	24K832590	choke; 1.3 uH
L605, 609 610, 615	24C84152A01	1-1/4 turns
L606, 612	24K800484	choke; 0.31 uH
		TRANSISTOR (SEE NOTE)
Q601, 602	48R869247	N-P-N; type M9247; does not incl. 14A83211B01 INSULATOR mtg.
Q603	48R869316	N-P-N; type M9316; does not incl. 14A83211B01 INSULATOR mtg.
		RESISTOR, fixed: ±10%; 1/4 W; unl. stated
R601, 611	6S129755	10
R602	6S127802	1K
R603	6S129233	47
R604, 605	6S124B55	2.7 ±5%
R607	6S129753	100
R612	6S129754	33
R613	6S129862	150
		TRANSFORMER: RF:
T601	24C84151A01	pri: 4-1/2 turns sec: 4-1/2 turns (windings spaced apart)
T602	24C84149A01	(bifilar winding); pri: coded RED sec: coded GRN
T603	24C84150A01	(bifilar winding)

1V80701B35 Power Amplifier (P/O TLE6512A) PL-676-O

		CAPACITOR fixed: pF; 500 V; unl. stated
C625 thru 630	21D82355B26	10 ±0.25 pF; NP0
C631 thru 633	21D82204B03	6 ±0.5 pF; NP0
C634 thru 636	21K848525	16 ±5%; NP0
C637	21D82880E19	500 ±10%
C639	21C82372C05	0.2 uF +80-20%; 25 V
		COIL, RF:
L616	24V80900A86	choke; 1.02 uH; sleeved; code BRN, V10
L617 thru 619	24B83656E01	1 turn
L620 thru 622	24B83656E02	2 turns
L623	24C82000E26	choke; sleeved; coded ORG
L624	24C82000E25	choke; sleeved; coded BLU
		TRANSISTOR, N-P-N: (SEE NOTE)
Q604 thru 606	48R869316	type M9316; does not incl. 14A83211B01 INSULATOR mtg.
		RESISTOR, fixed:
R614	6S124B67	8.2 ±5%; 1/4 W
R615 thru 617	6S5621	10 ±10%; 1/2 W

NOTE:

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

PARTS LIST CONTINUED

"IDC" ADJUSTMENT

1. INTRODUCTION

Accuracy of test equipment is of prime importance to any user of radio communications equipment; but of equal importance is a knowledge of the characteristics of the measuring equipment under various conditions.

The Motorola S1327A Service Monitor provides a highly accurate means of measuring frequency deviation directly from the rf output of the transmitter. The peak-reading deviation meter used in this unit has the high sensitivity necessary for measuring the low deviation of split-channel transmitters.

2. PROCEDURE WITH PEAK-READING DEVIATION MONITOR

a. Test Equipment Required

(1) Motorola S1327A Service Monitor.

(2) Motorola Transistorized AC Voltmeter (or equivalent).

(3) Motorola Model TEK-1A Transistorized Tone Generator.

b. Setting Up Test Equipment

Set up the test equipment as instructed in the test equipment instruction manual for deviation measurement.

c. Measurement and Setting of Transmitter Deviation

(1) Key the transmitter with no audio input and check "Private-Line" tone deviation ("Private-Line" models only). The tone deviation reading should be 0.5 to 1 kHz.

(2) Apply a 1-volt, 1000-Hz input signal to terminals 2 and 3 on the top terminal strip (TB1) at the rear of the junction box.

(3) With this input signal level, adjust the IDC control (R119) on the transmitter to provide a deviation reading of ±5 kHz on the deviation meter.

(4) Reduce the 1000-Hz input signal to obtain a deviation reading of 3.3 kHz on the meter. The 1000-Hz signal level necessary to obtain the 3.3 kHz 2/3 deviation should be 0.165 (± 070) volt for optimum performance. A higher reading could indicate a weak audio stage.

3. EMERGENCY MEASUREMENT OF DEVIATION

If an audio oscillator is not available, a loud sustained whistle of approximately 1000 cycles can be used for a rough measurement of deviation. If this rough check indicates the need for resetting deviation, do so only under controlled conditions, using a 1000-Hz tone as previously indicated.

4. OTHER MEANS FOR MEASUREMENT OF DEVIATION

Another accurate means of measuring transmitter deviation is to use the Motorola S1325A Digital Frequency and Deviation Meter and the Motorola S1058A or S1059A Test Set (with deviation meter) for measuring deviation. These units, properly used, permit the accurate measurement and setting of transmitter deviation from a peak-reading meter, which is unaffected by waveform. With these devices, the transmitter deviation can be measured accurately even with voice modulation.

5. DEVIATION CONSIDERATIONS

The foregoing procedures will insure that the transmitter will comply with FCC requirements for maximum deviation.

The importance of the correct deviation setting cannot be overemphasized. Optimum system performance demands accurate deviation setting, both from the standpoint that overdeviation will interfere with the user on the adjacent channel, and underdeviation may reduce system range.

TRANSMITTER PRE-ALIGNMENT NOTES

A. EXCERPTS FROM FCC REGULATIONS

FCC Regulations state that:

1. Radio transmitters may be tuned or adjusted only by persons holding a 1st or 2nd class commercial radiotelephone operator's license or by personnel working under their immediate supervision.
2. The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and the local conditions.
3. Frequency and deviation of a transmitter must be checked before it is placed in service and re-checked once each year thereafter.

B. TEST EQUIPMENT REQUIRED

1. Built-in metering facilities or Motorola Model S1056A-9A Portable Test Set with a Motorola Model TKN6025A Adapter Cable (available on separate order). A 0-50 microampere meter with 20,000 ohms equivalent series resistance may be used if a test set is not available.
2. Motorola Model TLN8805A Tuning Tool Kit.
3. Motorola Model T1012A RF Load Resistor (or equivalent) and Model 43 Bird "Thruline" Wattmeter with 100-watt element (or equivalent).
4. Digital Frequency Meter S1324A or Digital Frequency and Deviation Meter S1325A.

C. HOW TO SET UP THE S1056A-9A PORTABLE TEST SET

1. Set function selector switch to XMTR position.
2. Place the oscillator and meter reversing switch in the OFF position.
3. Connect the 20-pin meter cable plug to the test set; connect the adapter cable to the cable coming from the test set; connect the other end of the adapter cable to the transmitter metering socket. When the test set is not being used, disconnect the 20-pin metering cable to conserve internal battery life. The plug on the cable acts as an on-off switch completing the battery circuit.

D. HOW TO KEY THE TRANSMITTER

1. Connect the load resistor and "Thruline" wattmeter to the exciter-transmitter output.
2. Key the transmitter with the microphone push-to-talk switch or the KEY XMTR switch on the test set.

CAUTION

Do not key the transmitter for more than a few seconds at a time until it is properly tuned. Current is excessive in untuned stages and may cause damage. Turn on the transmitter for brief periods while reading the meter and making the adjustments.

E. FREQUENCY CALCULATIONS

xtal freq. in MHz $\longrightarrow f_o = \frac{f_c}{36} \longleftarrow$ carrier freq. in MHz

F. "IDC" CONTROL SETTING
(Transmitter Deviation)

Refer to the separate IDC Adjustment Procedure for setting of the IDC control.

G. PRE-ALIGNMENT STATION SWITCH POSITION CHART

CHASSIS	CONTROL	POSITION
RF Power Amplifier	HIGH VOLTAGE SWITCH	Off
	SCREEN VOLTAGE	Fully Counterclockwise
	PLATE TUNING SCREW	Fully Clockwise
	GRID TUNING KNOB	Fully Counterclockwise

H. TRANSMITTER ALIGNMENT PROCEDURE

NOTE

(a) This tuning procedure must be followed exactly whenever tuning is required. When the power amplifier tube is replaced, set station switch to positions as given in the Pre-Alignment Station Switch Position Chart and follow steps 25 through 37 only.

(b) Before making any adjustments on the P.A., loosen the two screws on the plate tuning knob retaining clip and the set screw on the collar of the grid tuning adjustment.

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
1	PA High Voltage Switch and exciter METER 7 switch	None	Turn power amplifier high voltage switch off. Output cable from exciter-transmitter must be connected to wattmeter and load, not to power amplifier. Reclamp the tube per Step 7 in the Power Amplifier Tube Removal Procedure. (Refer to Service Aids in the Power Amplifier Section.) Place the METER 7 switch on the exciter in the FINAL position if exciter is equipped with this switch.
2	C109, C108, C102, C106	None	Using blade end of tuning tool A, turn C108 and C109 counterclockwise to stop. Use screwdriver end of tuning tool B; turn C102 and C106 counterclockwise to stop.
3	T101, L101, L102, T102	None	Use hex end of tuning tool B. Slugs should be set at lower end ("printed circuit board end") of coil form.
4	T103 Primary	None	Use hex end of tuning tool B. Lower tuning slug should be set at lower end of coilform near printed circuit board.
5	T103 Secondary	None	Use hex end of tuning tool A. Upper tuning slug should be set at upper end of coil form near top of can.
6	---	None	OSCILLATOR - FCC regulations require a periodic frequency check. If the check is due at this time, follow the IDC Adjustment Procedure; OTHERWISE NO ADJUSTMENT SHOULD BE MADE.
7	---	None	Select lowest operating frequency.
8	T101, L101	1	FIRST AMPLIFIER OUTPUT - MODULATOR - Use hex end of tuning tool. Tune T101, L101, T101 in that order for maximum reading. Only a small meter indication (approximately .5 ua) will be observed when tuning T101. Choose first peak for tuning (slug nearest printed circuit board).
9	L102	1	2ND AMPLIFIER INPUT - Use hex end of tuning tool. Tune for minimum reading. Choose first dip (slug nearest printed circuit board).
10	T102	2	TRIPLER OUTPUT - Use hex end of tuning tool. Tune for maximum reading. Slug should be approximately in center of coil form.
11	T103 Primary	2	DOUBLER OUTPUT - Use hex end of tuning tool. Tune for minimum reading. Choose first dip (slug nearest printed circuit board).

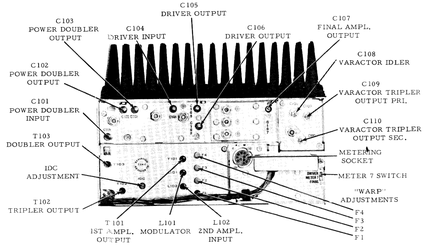


Figure 1.
Exciter-Transmitter Alignment Detail

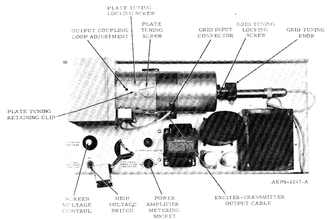


Figure 2.
Power Amplifier Alignment Detail

H. TRANSMITTER ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
28	Screen Voltage	PA	Turn the screen voltage control clockwise until PA meter reads 25 ua.
29	Grid Tuning Knob, Plate Tuning Screw, Output Coupling Loop	Wattmeter	Alternately tune the Grid Tuning Knob, the Plate Tuning Screw, and the Output Coupling Loop, in that order, for a maximum reading. Repeat until power output does not increase with retuning.
30	Screen Voltage	PA B+	CAUTION: The PA power input must be maintained within safe limits at all times. Refer to "PRECAUTIONS CONCERNING DC POWER INPUT FOR 90-WATT PA" before adjusting the screen voltage for proper power input. Note the plate voltage (B+ meter). Increase or decrease the screen voltage until (PA Meter reading) x 10,000 = Table 1 value of I_{cp}.
31	Screen Voltage	PA B+	If the plate voltage has changed from that noted in Step 30, repeat Step 30 using the new value of plate voltage.
32			Repeat Steps 29, 30 and 31.
33	C110, C109, C108, C107	6 on PA	Tune C110, C109, C108 and C107 in that order on the exciter-transmitter for maximum reading.
34	C107	PA (METER 7 switch in FINAL)	Replace metering cable in exciter-transmitter metering socket. Turn C107 such that PA meter READING DECREASES 3 ua from the initial reading. If after reducing current 3 ua, current is still greater than 40 ua, reduce to 40 ua.
35	T103	3	Use hex end of tuning tool. Tune primary and secondary slugs for maximum reading.
36	C106	PA (METER 7 switch in DRIVER)	If exciter has a METER 7 switch, place in DRIVER position. If meter reads above 15 ua, turn C106 counterclockwise for a 15 ua reading.
37	Grid Tuning Knob	Wattmeter	Adjust grid tuning knob for maximum power output.
38			Carefully tighten the plate tuning knob retaining clip screws and the set screw on the grid tuning adjustment collar of P.A. DO NOT apply excessive force to the screws. C54 and C74 alignment is complete.

H. TRANSMITTER ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
12	T103 Secondary	3	DOUBLER OUTPUT - Use hex end of tuning tool A. Tune for maximum reading. Choose first peak (slug farthest from printed circuit board).
13	T103 Primary	3	DOUBLER OUTPUT - Use hex end of tuning tool. Tune for maximum reading.
14	C103, C101	5	POWER DOUBLER OUTPUT & INPUT - Use screwdriver end of tuning tool. Tune C103 and C101 in that order, for maximum reading.
15	C103, C102	5	POWER DOUBLER OUTPUT - Use screwdriver end of tuning tool. Tune C103 and C102 (turning C102 clockwise) in that order for a maximum reading. Repeak C103 and C102 in that order for maximum reading.
16	C105, C106	6	DRIVER OUTPUT - Use screwdriver end of tuning tool. Tune C105 and C106 in that order for maximum reading. (Turning C106 clockwise.) If at any time while tuning, a meter reading drops abruptly, due to the current limiter protection circuits, it may be necessary to rekey the transmitter while varying the tuning control.
17	C104	6	DRIVER INPUT - Use screwdriver end of tuning tool. Tune C104 for a minimum reading without being an abrupt dip.
18	C107	PA	FINAL AMPLIFIER OUTPUT - Use screwdriver end of tuning tool. Tune for minimum reading without being an abrupt dip.
19	C109	Wattmeter	VARACTOR TRIPLER OUTPUT PRIMARY - Using tuning tool A, turn C109 clockwise for maximum reading.
20	C110	Wattmeter	VARACTOR TRIPLER OUTPUT SECONDARY - Tune for maximum reading.
21	C104, C105, C106, C107	Wattmeter	Tune C104, C105, C106 and C107 in that order for maximum reading.
22	C109	Wattmeter	Tune for maximum reading.
23	C108	Wattmeter	VARACTOR IDLER - Rotate C108 fully clockwise and return counterclockwise for a maximum reading.
24	---	---	Remove metering plug from exciter-transmitter metering socket, and plug it into the power amplifier metering socket. Connect exciter-transmitter output cable to the power amplifier grid. (See Figure 2.) Connect wattmeter to the power amplifier output. Use a 5-1/2" cable to connect the wattmeter to the power amplifier.
25	PA Grid Tuning Knob	6 on PA	Tune the PA grid tuning knob for maximum reading with high voltage switch OFF.
26	Plate Tuning Screw	Wattmeter	Turn the high voltage switch to the "on" position and turn the plate tuning screw for a maximum reading.
27	Output Coupling Loop	Wattmeter	CAUTION: DO NOT INSERT METAL SCREWDRIVER INTO OUTPUT COUPLING LOOP HOLE. Insert the longer screwdriver end of tuning tool C into the plate cavity and adjust the output coupling loop for a maximum reading.

ALIGNMENT CONTINUED ON REVERSE SIDE

TABLE 1.
POWER INPUT

*180 WATT DC POWER INPUT
(For 90-Watt Models)

PLATE VOLTAGE (B+ Meter)	PLATE CURRENT (PA Meter 7 x 10,000)
600 V	300 mA
625 V	288 mA
650 V	277 mA
675 V	267 mA
700 V	257 mA
725 V	250 mA
750 V	240 mA
775 V	232 mA
800 V	225 mA
825 V	218 mA
850 V	212 mA
875 V	206 mA
900 V	200 mA

120 WATT DC POWER INPUT
(For 60-Watt Models)

PLATE VOLTAGE	PLATE CURRENT (PA Meter 7 x 10,000)
440 V	272 mA
460 V	261 mA
480 V	250 mA
500 V	240 mA
520 V	230 mA
540 V	222 mA
560 V	214 mA

PRECAUTIONS CONCERNING DC POWER INPUT FOR 90-WATT PA
(Refer to STEP 30 in this alignment procedure)

Proper setting of PA power input depends on the expected line voltage variation in your area. If your line voltage, whether nominal, low or high, is relatively constant, set power input to 180 watts. If your line voltage is known to change for extended periods, set the power input to 180 watts at the highest expected line voltage. If, at the time of tune-up, the line voltage is less than the expected maximum, reduce the power input 4 watts per line volt below the expected maximum.

I. FINAL METER READINGS

1. Each time a transmitter is aligned or tested, final meter readings should be made and entered in a logbook.
2. All readings given in the tables below are minimum except FINAL AMPLIFIER CURRENT, DRIVER CURRENT and PA CURRENT which are maximum. DO NOT exceed the value given for the PA current. Multiply the microampere scale reading by 1/10 to obtain actual FINAL AMPLIFIER COLLECTOR current and DRIVER CURRENT in amperes. Multiply the microampere scale reading by 10 to obtain PA current in milliamperes.
3. Readings 1, 2, 3, 5, and 6 in the exciter-transmitter chart are purely relative and do not give actual current or voltage measurement.

EXCITER-TRANSMITTER FINAL METER READINGS
(Test Set cable inserted into J21 on Exciter-Transmitter)

CIRCUIT METERED	Modulator 1st Amp.	Tripler	Doubler	Power Doubler	Driver	Final Amp. Current	Driver Current
SWITCH POSITION	1	2	3	5	6	7	7
METER READING	16	20	20	10	15	40	15

POWER AMPLIFIER FINAL METER READINGS
(Test Set cable inserted into J22 on Power Amplifier)

CIRCUIT METERED	Grid Drive	PA Current
SWITCH POSITION	6	7
METER READING	13	30

J. OSCILLATOR FREQUENCY ADJUSTMENT

1. TEMPERATURE COMPENSATED OSCILLATOR FREQUENCY

The channel element oscillator is pre-adjusted at the factory to operate within ±0.0002% of the assigned channel frequency from -30°C (-22°F) to +60°C (140°F). The reference point is 25°C (77°F) at which the transmitter oscillator frequency is set exactly on the assigned channel frequency. AT TEMPERATURES OTHER THAN 25°C THE OSCILLATOR WILL NOT OPERATE EXACTLY ON THE ASSIGNED FREQUENCY. The Channel Element Oscillator Temperature Correction Curve (Figure 3) gives the frequency offset required for a given channel element at a given temperature.

For example, if the temperature of the channel element is +40°C, an oscillator with a "C" channel element should be warped down 0.6 parts per million (ppm) or 280 Hz from the assigned center frequency; at +10°C it should be warped up 0.3 ppm or 140 Hz from the assigned frequency. The letter of the channel element is stamped on the edge of the housing. The amount of correction required at a given temperature is expressed both in ppm and in Hz (at 460 MHz) on the correction curve. This correction in Hz can be used for any carrier frequency in the 450-470 MHz range. A correction of 280 Hz is expressed in MHz as 280 x 0.000001 = 0.000280 MHz. Thus, if the curve shows that the oscillator should be warped down 0.6 ppm and the assigned frequency is 465.025 MHz, the oscillator should operate at 465.02500 MHz less 0.000279 MHz or 465.02472 MHz. THE OSCILLATOR MUST BE SET ON THE FREQUENCY SPECIFIED BY THE CORRECTION CURVE FOR A GIVEN TEMPERATURE IN ORDER TO BE WITHIN FCC FREQUENCY SPECIFICATIONS OVER THE ENTIRE TEMPERATURE RANGE.

NOTE

The best accuracy in setting frequency is obtained with channel element temperature near 25°C. In any case the frequency should not be adjusted if the temperature of the channel element is not between +10°C (50°F) and +40°C (104°F).

The channel element temperature can be determined by measuring with a surface-type thermometer placed on the rear shield next to the channel element. A sufficient time must be allowed for the module temperature to stabilize after the station cabinet doors are opened. Stabilization of the channel element temperature (as indicated by the thermometer reading remaining constat) will usually take place in 15-30 minutes or less depending on the particular installation. The temperature to use with Figure 3 will be the channel element temperature plus 1°C (or 2°F).

2. CHANNEL ELEMENT OSCILLATOR FREQUENCY ADJUSTMENT

NOTE

DO NOT ADJUST CHANNEL ELEMENT UNTIL PROPER FREQUENCY HAS BEEN DETERMINED AS DESCRIBED IN THE PRECEDING PARAGRAPHS.

a. Connect the heterodyne OUTPUT to the Model S1075B INPUT, using the short coaxial cable provided.
b. Set the heterodyne selector switch to the 405-475 MHz range.
c. Set the frequency meter selector switch to either the 100 Hz or the 10 Hz position. With 10 Hz resolution, the first digit of the frequency readout will not appear on the display.
d. Attach the antenna provided with the frequency meter to the appropriate 405-475 MHz input on the heterodyne unit, depending on the rf output of the transmitter under test.
e. Read the frequency indication displayed on the digital readout. In multi-frequency models, make certain that the frequency selector switch is in the desired position.
f. Adjust the appropriate channel element frequency warp adjustment (see Figure 1) until the Digital Meter reads the proper frequency as determined in the preceding explanation of the temperature compensated oscillator frequency.

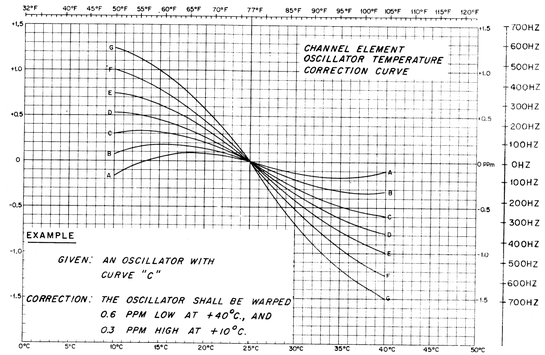
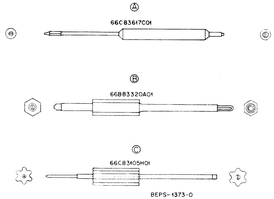
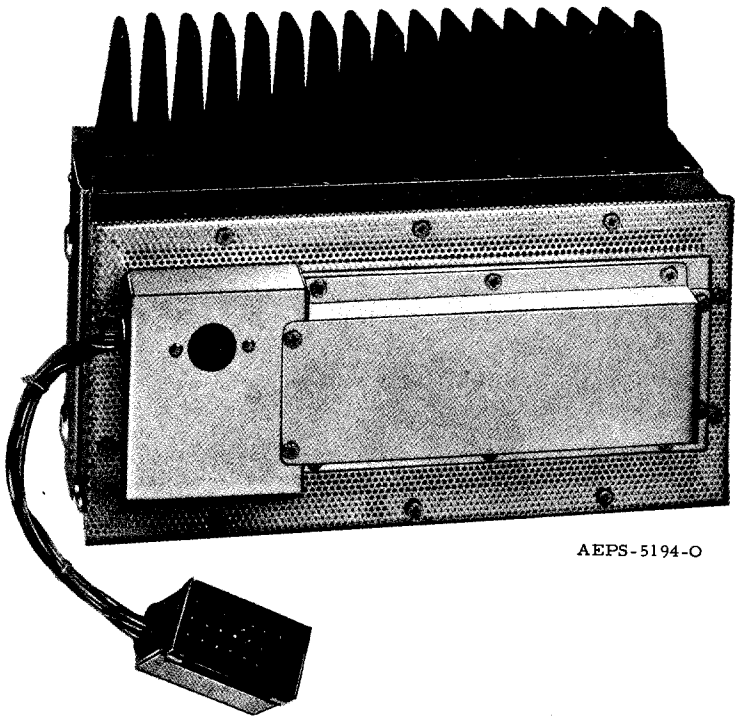


Figure 3.
Oscillator Temperature Correction Curve
(TLN1190A Channel Element)

TRANSMITTER ALIGNMENT TOOLS



TRANSMITTER SHIELD
MODEL TLN8888B



AEPS-5194-O

Front View of Transmitter With
Shield Kit Installed

1. DESCRIPTION

This kit provides additional shielding for the transmitter, and helps to minimize intermodulation effects between stations operating in close proximity to each other.

2. TRANSMITTER ALIGNMENT

The front and rear shield covers can be removed to gain access to the transmitter for alignment. The power and rf cables can be left connected normally during alignment.

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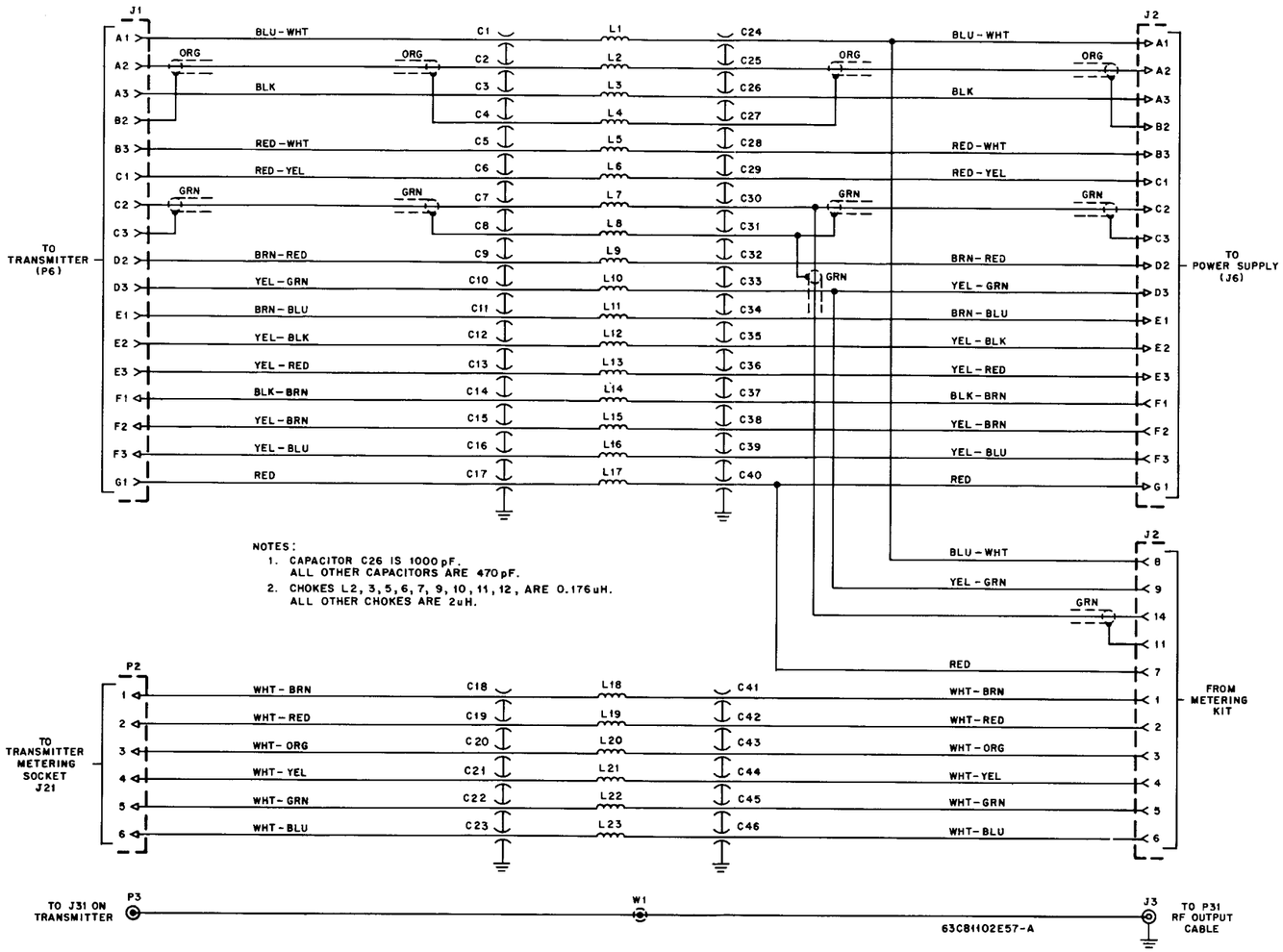
PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN8888B Transmitter Shield Kit PL-1241-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1 thru 25, 27 thru 46	21K821474	470 pF ±20%; 500 V; coded YEL-VIO-BRN
C26	21K861219	1000 pF +100-0%; 500 V
		CONNECTOR, receptacle:
J1	1V80783A26	includes: 14C83783A03 BODY; 24-contact type; 29C82336A01 TERMINAL, contact; female 29C82335A01 TERMINAL, contact; male
J2	9C83478E01	female; 12-contact
J3	9C82323G01	female; coaxial; miniature type
		COIL, RF: choke;
L1	24A890687	2 uH
L4	24A890687	2 uH
L8	24A890687	2 uH
L12 thru 23	24A890687	2 uH
L2	24K858989	0.176 uH
L3	24K858989	0.176 uH
L5	24K858989	0.176 uH
L6	24K858989	0.176 uH
L7	24K858989	0.176 uH
L9	24K858989	0.176 uH
L10	24K858989	0.176 uH
L11	24K858989	0.176 uH
		CONNECTOR, plug:
P1	1V80783A27	includes: 14C82337A09 BODY; 24-contact type; 29C82335A01 TERMINAL, contact; male 29C82336A01 TERMINAL, contact; female
		LINE, RF transmission:
W1	1V80783A31	includes reference part P3 and 30B859004 CABLE, RF; coaxial; type RG-188/U; 6" length req'd; 11S134371 TUBING, heat-shrinkable; 3/4" length req'd
		NON-REFERENCED ITEMS
	1V80718B75	HOUSING ASSEMBLY: includes reference parts J3, P3, W1
	15D84651C01	COVER, bottom
	15B83190D01	PLATE, inner shield (for doubler, driver and power amplifier stages)
	15C84649C01	COVER, rear
	15C84648C01	COVER, front
	1V80719B31	FILTER ASSEMBLY; includes filtering components, connectors, cables and 37K103664 GROMMET
	15C83094H01	COVER, filter



TRANSMITTER SHIELD

TLN8888B Transmitter Shield
Schematic Diagram
Motorola No. 63C81102E57-A
8/6/74-NPC

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POWER AMPLIFIER

MODEL TLE1060A
TLE1240A

MODEL TABLE

MODEL SERIES	APPLICATION
TLE1060A	Extended Local Control Stations, Remote Control Stations, Repeaters
TLE1240A	Local Control Stations

1. DESCRIPTION

This unit is an rf power amplifier for the 450 MHz to 470 MHz band, employing a vacuum tube with an integral cavity-type tuned circuit. This unit supplies final power amplification for the 60-watt and 90-watt station transmitters. It is fully temperature-compensated and capable of continuous-duty operation.

The power amplifier includes a self-contained power supply for plate, screen, and control grid bias voltages. RF power outputs of either 60 or 90 watts are obtained by using the appropriate plate voltage provided (+500 or +700 volts). Filament voltage is provided by the main station power supply.

The rf output of the amplifier is fed through a harmonic filter to the antenna relay which is mounted on the rear of the power amplifier chassis.

2. CIRCUIT DESCRIPTION

(Refer to Power Amplifier Schematic Diagram.)

a. Amplifier

The input 450 MHz signal to this amplifier is applied through the RF DRIVE coaxial connector (J32) protruding from the side of the amplifier cavity. Approximately 12 watts of rf power is applied to the amplifier grid through a tuned cavity which is tuned to resonance by adjusting the GRID TUNING knob extending from the right-hand end of the amplifier.

Tuning of the plate cavity is accomplished by turning the PLATE TUNING control, a slotted, threaded cap in the wall of the cavity. The amplified rf power in the plate circuit of the power amplifier is coupled from the plate cavity via the output coupling loop to harmonic filter Z1. Z1 attenuates all frequencies above the 450 MHz to 470 MHz band; at the same time, it passes the desired signal to the contacts of antenna relay K1 and through connector J34 to the antenna.

b. Power Supply

The self-contained power supply in the power amplifier contains a plate supply, a "keyed" screen supply, and a grid bias supply.

(1) Plate Supply

The plate supply uses the high-voltage secondary winding of power transformer T1 in a full-wave bridge rectifier circuit with a capacitor-input LC filter. The dc output voltage of this circuit is applied through rf choke L5 to the "plate line" inside the plate cavity.

(a) In 90-watt rf stations, the full high-voltage secondary winding of T1 (portion between red leads) is used. In these models, the output voltage of the plate supply is approximately 700 volts.

(b) In 60-watt rf stations, only the portion of the high-voltage secondary winding between the blue leads is in use, developing a lower plate voltage for the power amplifier. In these models, the output voltage of the plate supply is approximately 500 volts.

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(2) Keyed Screen Supply Circuit

As long as keying transistor Q1 is turned on (saturated), the low-voltage secondary winding of power transformer T1 and diodes CR1 and CR2 provide pulsed driving power to the primary of transformer T2 (grounds the center tap on the T2 primary). Whenever the transmitter is keyed, Q1 is turned on by a positive voltage (approximately 12 volts) at pin B3 of connector P7. With both ends of the T2 secondary connected through diodes to the gate lead of SCR1, positive pulses are supplied at a rate of 120 Hz to the SCR gate. Conduction of the SCR completes the dc path for the full-wave screen supply, and this develops a positive voltage of approximately 390 v across capacitor C2. The voltage across C2 is divided across screen voltage potentiometer R6 and resistor R7. The voltage on the tap of R6 is applied through R8 and rf choke L4 to the screen of power amplifier V1. Resistor R3 is shorted out in 60-watt stations to provide the proper screen voltage.

When the transmitter is unkeyed, a zero-volt signal at P7-B3 keeps Q1 cut off causing an open circuit between the center tap of the T2 primary and ground. With the center tap ungrounded, no current can flow in the primary of T2 due to the presence of blocking diodes CR1 and CR2 (on either alternation, one of the two diodes is reverse-biased, preventing current flow). With no primary current in T2, there is no voltage induced in its secondary, and the source of gate pulses for SCR1 is lost. SCR1 is therefore non-conductive, cutting off the screen voltage to power amplifier V1.

(3) Grid Bias Supply

The voltage across one half of the low-voltage secondary winding of T1 is rectified by diode CR9 and filtered by C3 and R9 producing approximately 25 volts of negative bias for the control grid of V1. This fixed bias is applied through rf choke L2 to the control grid of V1.

In addition to fixed bias, the power amplifier also develops its own "excitation" (grid-leak) bias across resistor R10. This occurs when the rf grid voltage exceeds the fixed bias voltage causing the control grid to become positive and draw grid current.

Approximately 45 volts of grid bias (total) is developed across R10 with a normal full rf drive of approximately 12 watts present at input connector J32 (note that R10 also serves as a bleeder resistor across the fixed bias supply).

R15 is a metering resistor for measuring the grid bias voltage at pin 6 of metering socket J22. C4 and C7 are bypass capacitors to prevent any stray rf voltage on the grid lead from being coupled back through the power supply.

3. TROUBLESHOOTING

(Refer to the Transmitter Troubleshooting Chart in the EXCITER/TRANSMITTER section of this manual.)

If the troubleshooting sequence indicates that the fault is in the final (power amplifier) stage of the transmitter, proceed to check, service, and repair (as needed) the power amplifier.

4. ALIGNMENT PROCEDURE

The power amplifier alignment instructions are included in the Transmitter Alignment Procedure in the EXCITER-TRANSMITTER section of this manual. The alignment tool used for the power amplifier is the long end of tuning tool C (detail shown with alignment procedure).

5. SERVICE AIDS

The following items are provided to aid in servicing the power amplifier:

a. Tube removal procedure including two illustrations (Detail A and Detail B).

b. Front and rear illustrations showing locations of component parts including alignment adjustments.

c. Exploded view and parts list for cavity assembly.

d. A rectifier and control circuit board detail showing locations of all component parts and conductive paths on the board.

e. Power amplifier schematic diagram.

POWER AMPLIFIER TUBE REMOVAL

WARNING

Before proceeding, turn off power ON-OFF switch at lower left-hand side of the power amplifier chassis and OFF-VOLUME switch on the control panel of local control stations.

If the power amplifier cavity is hot, proceed with caution.

Refer to Power Amplifier Tube Removal Details A and B.

1. Disengage clamps at top and bottom of cavity and fold them back to the left so they will be out of the way.

2. With left hand, insert the blade of 1/4-inch screwdriver through lower hole in plate cavity (see Tube Removal Detail A). Keeping blade approximately perpendicular to cavity wall, continue to insert it until it strikes locking mechanism inside cavity. Rotate screwdriver slowly to right or left until its blade engages locking mechanism.

3. Grasp screwdriver handle firmly and rotate it either to right or left while exerting a right-hand pull on grid cavity with right hand. At high point of screwdriver rotation, lock will release and grid cavity will begin to separate from plate cavity. After right half of cavity separates from left half, continue pulling straight to the right until top of "lighthouse" amplifier tube clears the left half of the cavity.

4. Rotate screwdriver back to its original position and remove it from hole in cavity.

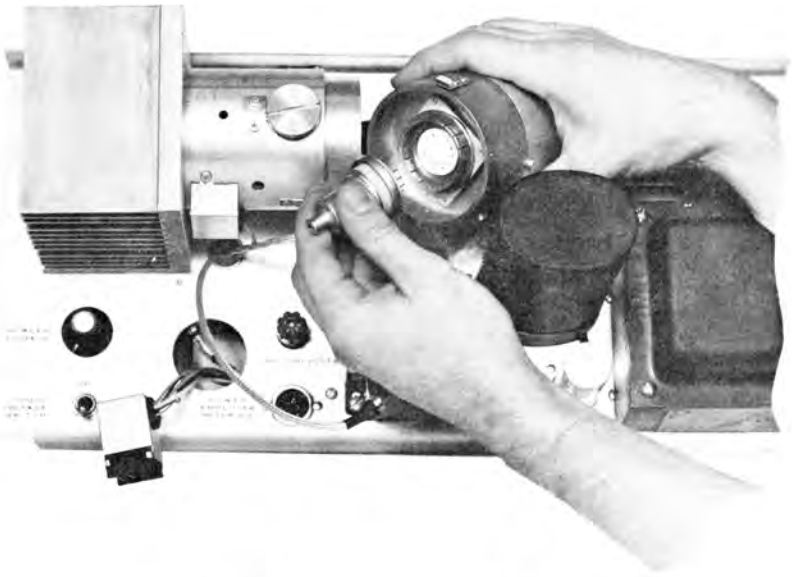
5. Grasp grid cavity firmly with one hand and amplifier tube with other hand as shown in Tube Removal Detail B. Rock tube gently back and forth while pulling to help free it from socket.

6. Replace power amplifier tube in opposite sequence.

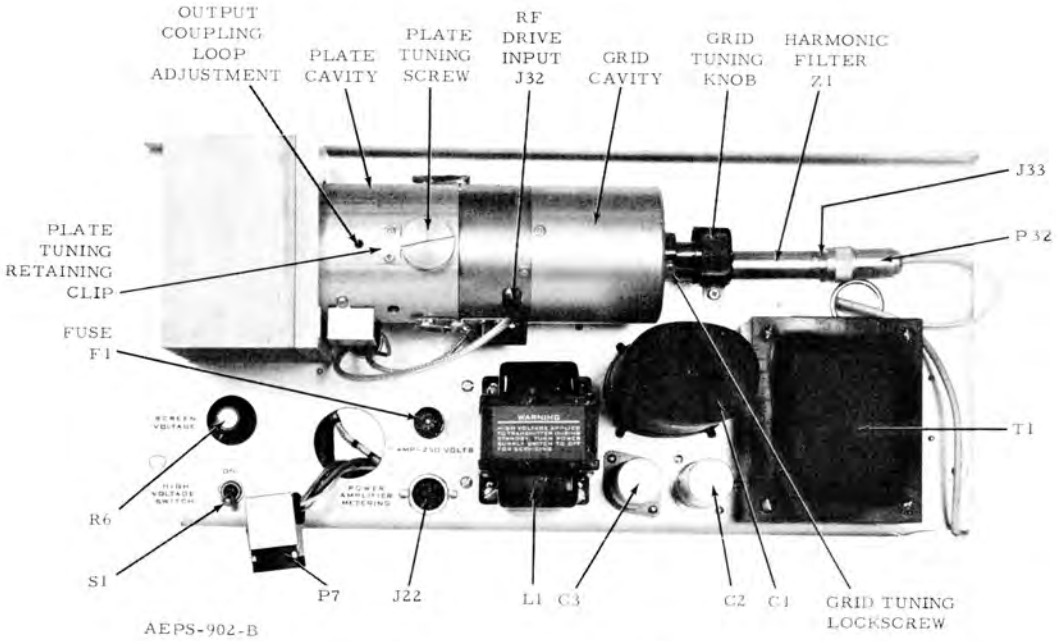
7. After power amplifier is completely reassembled, insert screwdriver again and rotate it to operate locking mechanism. Grasp grid cavity firmly with right hand and rotate it slightly clockwise until clamps prevent any further movement.

8. Remove screwdriver and refer to the Power Amplifier Alignment Procedure.

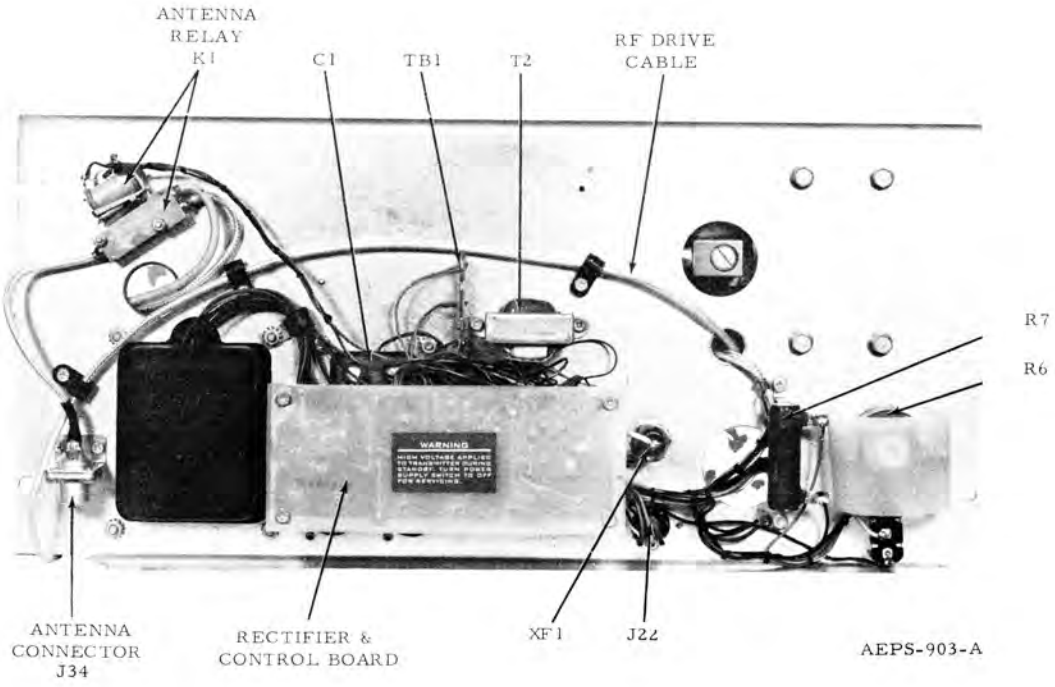
Power Amplifier Tube Removal
Detail A



Power Amplifier Tube Removal
Detail B



Power Amplifier (Front View)
Alignment and Parts Location Detail



Power Amplifier (Rear View)
Alignment and Parts Location Detail

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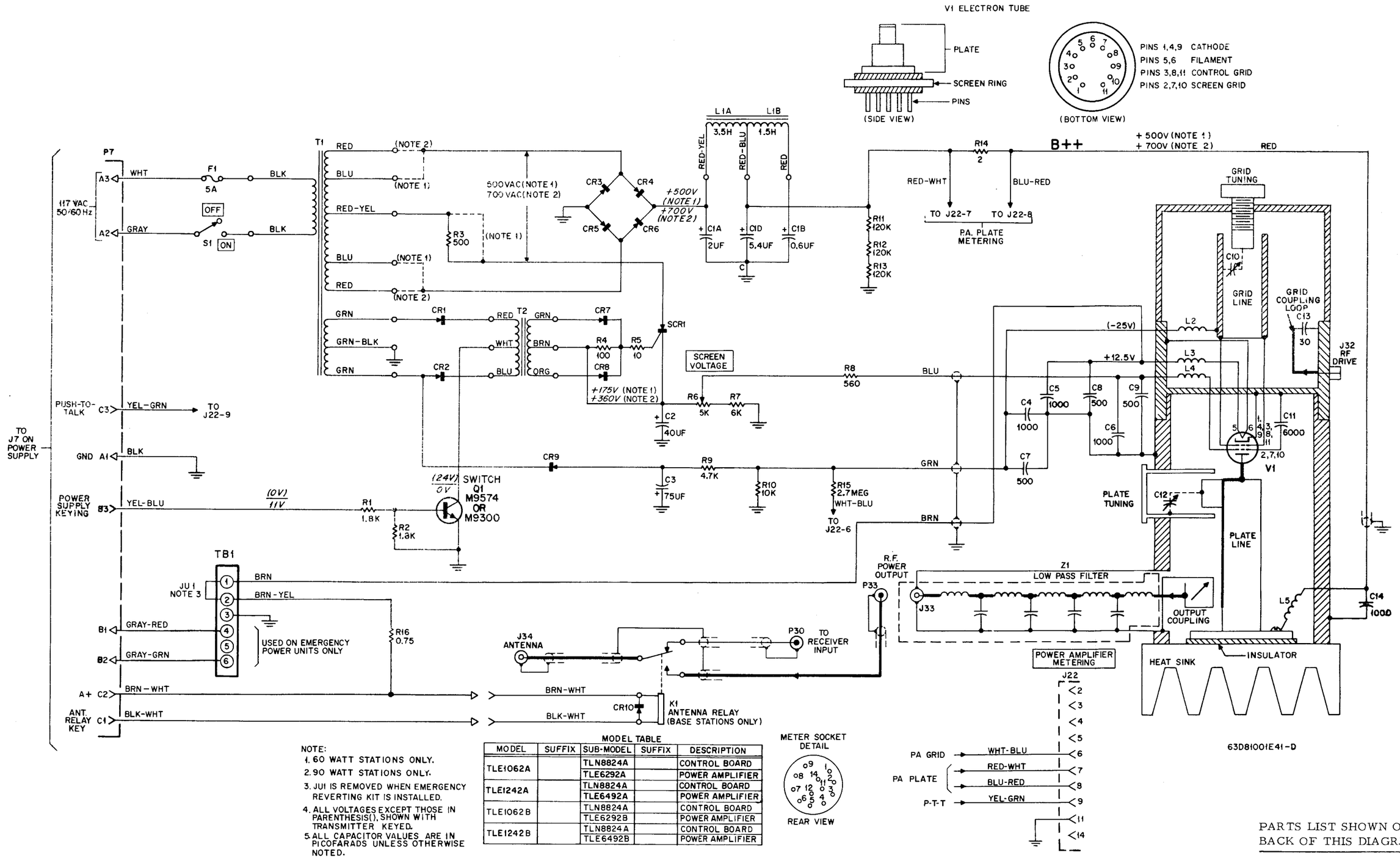


NOTE:

1. 60 WATT STATIONS ONLY.
2. 90 WATT STATIONS ONLY.
3. JU1 IS REMOVED WHEN EMERGENCY REVERTING KIT IS INSTALLED.
4. ALL VOLTAGES EXCEPT THOSE IN PARENTHESIS(), SHOWN WITH TRANSMITTER KEYED.
5. ALL CAPACITOR VALUES ARE IN PICOFARADS UNLESS OTHERWISE NOTED.

MODEL TABLE

MODEL	SUFFIX	SUB-MODEL	SUFFIX	DESCRIPTION
TLE1062A		TLN8824A		CONTROL BOARD
		TLE6292A		POWER AMPLIFIER
TLE1242A		TLN8824A		CONTROL BOARD
		TLE6492A		POWER AMPLIFIER
TLE1062B		TLN8824A		CONTROL BOARD
		TLE6292B		POWER AMPLIFIER
TLE1242B		TLN8824A		CONTROL BOARD
		TLE6492B		POWER AMPLIFIER

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Amplifier
Schematic Diagram
Motorola No. 63D81001E41-D
6/5/74-NPC

TLE1060A POWER AMPLIFIER

PARTS LIST

TLE6292B Power Amplifier
TLE6492B Power Amplifier
TLE6492A Power Amplifier
TLE6292A Power Amplifier — PL-374-C

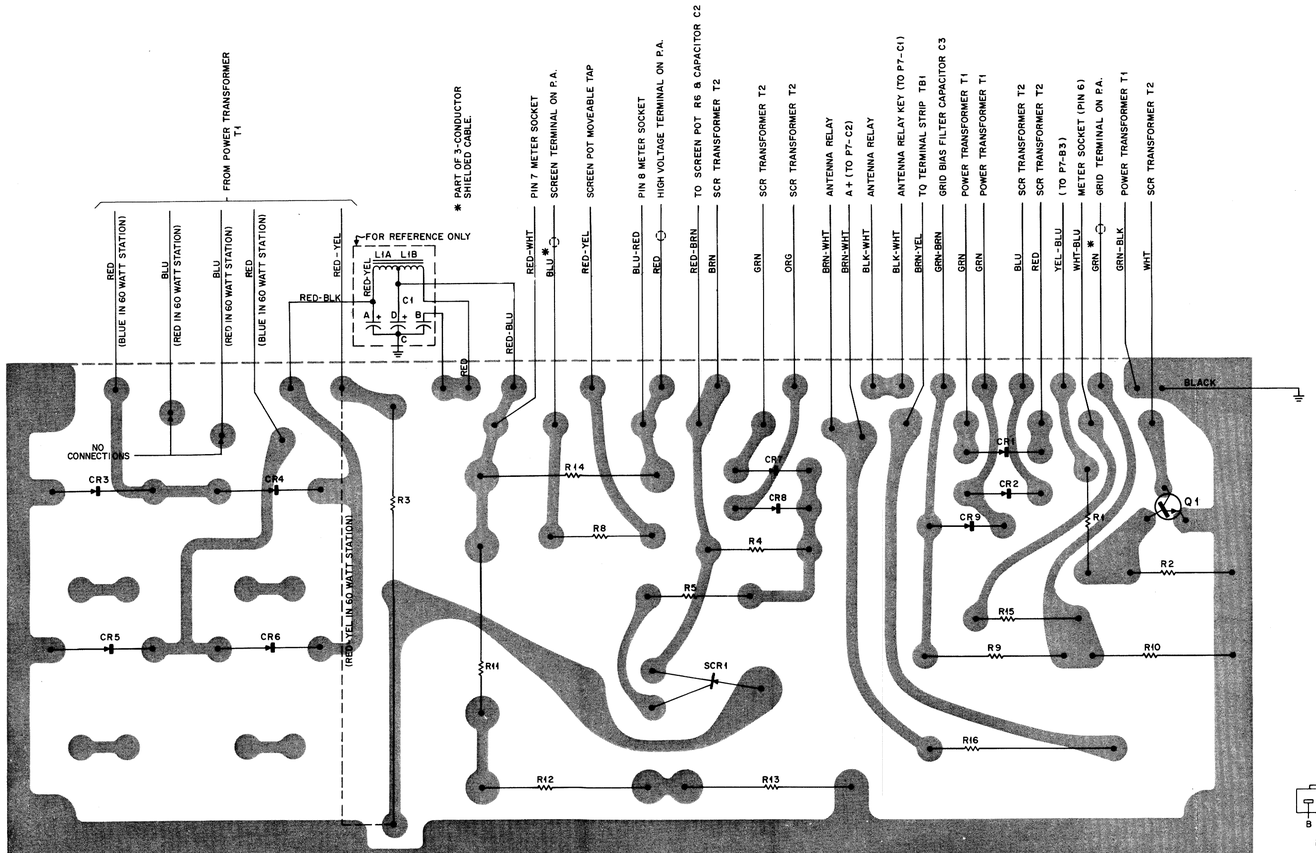
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	8C84195A01	3 sect; c/o:
C1A		2 uF +20-10%; 1200 v
C1B		0.6 uF ±10%; 1200 v
C1D		5.4 uF +20-10%; 1200 v
		NOTE "C" denotes common connection.
C2	23D83093G06	40 uF +150-10%; 450 v
C3	23D82304B28	75 uF +100-10%; 250 v
C4 thru 9		(replaceable as an assembly only): order 1V80781A71 CAPACITOR ASSEMBLY
C10		(for reference only; inherent capacitance in grid circuit)
C11	21C84636A01	6000 pF ±1000 pF; 500 v
C12		tuning capacitance; c/o the following items: 1V80783A56 PLATE TUNING SCREW ASSY (adjustable), 36A83984G01 SLUG, metallic: (stationary; mounts on plate line)
C13		(for replacement, order 1V80784A17 CAPACITOR & CLAMP ASSY)
C14	21K868902	1000 pF ±20%; 3000 v
		FUSE, cartridge: 1-1/4" x 1/4":
F1	65R52293	5 a; 250 v
		CONNECTOR, receptacle:
J22	9C82201E01	female; 12 cont
J32		female; coaxial; (for reference only; field-replacement not recommended)
J33		female; coaxial; (for reference only; field-replacement not recommended)
		REACTOR:
L1	25C83962A01	2 sect; c/o:
L1A		3.5 H; res 48 ohms ±10%
L1B		1.5 H; res 80 ohms ±10%
		COIL, RF: choke;
L2, 4, 5	24C82542E08	.039 uH
L3	24C84346A01	6 turns
		CONNECTOR, plug:
P7		c/o: 14C82337A03 BODY, 29C82335A01 TERMINAL, cont; male (specify qty), 29C82336A01 TERMINAL, cont; female (specify qty) 15C83934A07 COVER
		RESISTOR, variable:
R6	18C82782H01	5K ±10%; 25 w; does not incl. 14B83143H01 INS, mtg, and 36B83764G01 KNOB, control
		RESISTOR, fixed:
R7	17K804758	6K ±10%; 25 w
		SWITCH, toggle:
S1	40B858304	spst
		TRANSFORMER, power: 117 v; 60 Hz:
T1	25D84124A01	pri: BLK, BLK; res 0.873 ohm ±20% sec No. 1: RED, RED w/RED-YEL center tap (680 volts, no load); incl. intermediate BLU taps (500 volts no load); total res 25.72 ohms ±20% sec No. 2: BLU, BLU; (res not stated); sec No. 3: GRN, GRN w/GRN-BLK center tap; res 7.2 ohms ±20%
T2	25C83023H01	TRANSFORMER, control: 25 v ac; 60 Hz: pri: RED, BLU w/WHT center tap; sec: GRN, ORG w/BRN center tap
V1	65C83999G01	ELECTRON TUBE: 11 cont base
XF1	9C82083C01	FUSEHOLDER: extractor post type
Z1	1V80781A75	FILTER, RF: low-pass; "harmonic filter"; field repair and/or adjustment not recommended (replace entire unit only)
		NON-REFERENCED ITEMS
	31S121227	TERMINAL BOARD: wafer type; 6 soldering terminals (5 insulated and 1 mtg)
	64A851940	PLATE, capacitor mtg; (for C2)
	64A10844	PLATE, capacitor mtg; ins. (for C3)
	1V80702B78 (TLE6292A & TLE6492A)	PLATE LINE & CAVITY ASSY, incl. ref part C12, C14, L5 and the following: 26B83909G01 HEATSINK, 58D83985G01 CAVITY, plate tuning, 14B83906G01 INSULATOR, plate line mtg, 1V80783A57 PLATE LINE & CLAMP ASSY, 4B82345A11 WASHER, insulating; shoulder type (3 req'd) 43B82413A01 "PLUNGER" (metallic); friction stop for plate tuning screw, 41A83877E01 SPRING, compression (for plunger), 7B83900G01 BRACKET, plunger retainer, 55A879705 CATCH, draw-pull: (secures TUBE SOCKET & GRID LINE ASSY in place; 2 catches req'd, 36A83984G02 KNOB, plate-line
	or 1V80706B73 (TLE6292B & TLE6492B)	PLATE LINE & CAVITY ASS'Y, incl. ref part C12, C14, L5 and the following: 1V80706B72 PLATE LINE CLAMP ASS'Y (secures tube socket & grid line ass'y in place; 2 catches req'd) 7B83900G01 BRACKET, plunger retainer, 41A83877E01 SPRING, plunger compression 43B84213A01 "PLUNGER" (metallic); friction stop for plate tuning screw, 4B82345A11 WASHER, shoulder: insulating (3 req'd), 14B83906G01 INSULATOR, plate line mtg (NOTE: This item may be replaced, but careful alignment of the assembly is req'd.)
	55A83990G01	STRIKE, draw-pull: 2 req'd (companion piece to draw-pull catch)
	1V80701B81	GRID DRIVE CABLE ASSY
	1V80781A68	TUBE SOCKET & GRID LINE ASSY: incl. the following replaceable parts and sub-assemblies: Ref. Part C11, 24B83987G01 GRID COUPLING LOOP, 1V80784A17 CAPACITOR & CLAMP ASSEMBLY, 1V80781A73 GRID TUNING SCREW ASSEMBLY 1V80781A74 GRID CAVITY & NUT ASSEMBLY
		47B83910G01 "PLUNGER" (nylon); friction stop for grid tuning screw, 41B83901G01 SPRING, plunger compressor 36B82632H07 KNOB, control (grid tuning), 47B83989G01 GRID LINE, 1V80781A71 CAPACITORS & BRACKET ASSEMBLY: incl. C4 thru C9
		NOTE Do not attempt to replace any parts of 1V80781A68 TUBE SOCKET & GRID LINE ASS'Y or 1V80702B78 and 1V80706B73 PLATE LINE & CAVITY ASS'Y unless they appear in the above listing. Instead, order a new replacement assembly.
	1V80701B79	PANEL ASS'Y (riveted) used with TLE6292A and TLE6292B
	1V80704B44	PANEL ASS'Y (riveted) used with TLE6492A and TLE6492B

TLN8804A Antenna Relay — PL-375-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR10	48C82466H01	silicon
		RELAY, armature: coaxial;
K1	80D83796C03	13.5 v dc; 1 form "C"; incl. attached coaxial connecting leads
		CONNECTOR, receptacle: coaxial;
J34	9C82442E05	female; uhf type; does not incl. 15A483599 SHIELD
		CONNECTOR, plug: coaxial;
P30	28B82133G02	male; min. ("Cinch" type)
P33	28K852527	male; type "N"

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.
II. Do not attempt to replace any parts of the TUBE SOCKET & GRID LINE ASSEMBLY and/or the PLATE LINE & CAVITY ASSEMBLY unless the parts appear in the listing for these assemblies. If the part to be replaced is not listed, order the entire assembly.



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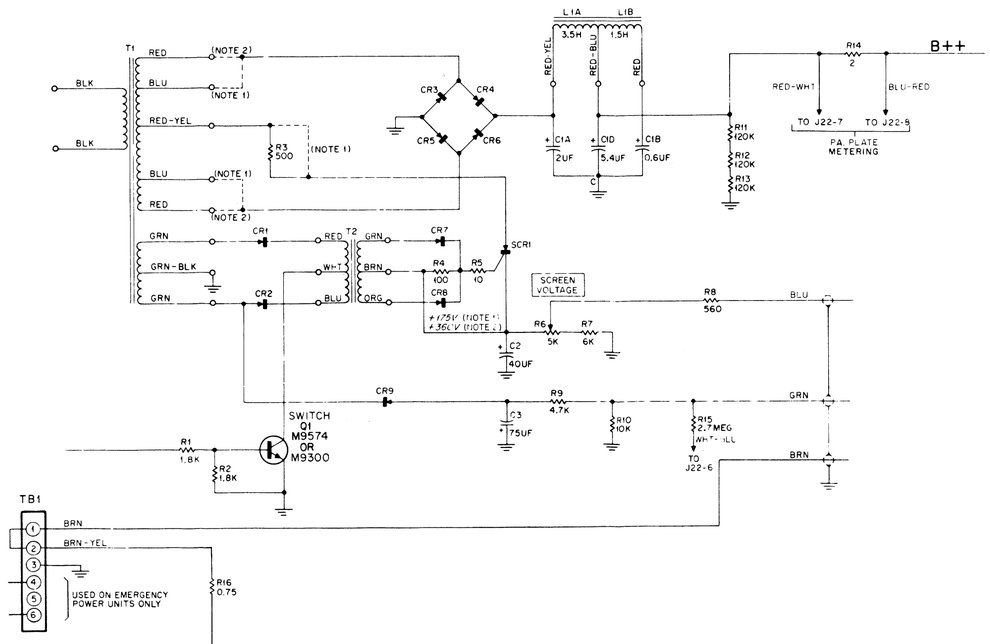
M9574

TRANSISTOR DETAIL (PIN SIDE VIEW)



REFER TO COMPLETE SCHEMATIC DIAGRAM FOR NOTE REFERENCES

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN8824A Rectifier & Control Circuit Board Detail
Motorola No. PEPS-1244-B
6/5/74-NPC

PARTS LIST

TLN8824A Control Board — PL-373-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 9	48C82466H04	silicon
CR3, 4, 5, 6	48C83024H01	silicon
CR7, 8	48C82466H01	silicon
		TRANSISTOR: (SEE NOTE)
Q1	48R869574	N-P-N; type M9574
	or48R869300	N-P-N; type M9300
		RESISTOR, fixed: ±10%; 1/2 w unl. stated
R1, 2	6S2089	1.8K
R3	17D83027H02	500 ±5%; 5 w
R4	6S6326	100
R5	6S5621	10
R8	6S6291	560
R9	6S5576	4.7K; 1 w
R10	6S6430	10K; 1 w
R11, 12, 13	6S5781	120K; 2 w
R14	17K847359	2 ±2%; 1 w
R15	6S488186	2.7 meg ±5%
R16	17D83027H01	0.75 ±5%; 5 w
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
SCR1	48R869349	controlled type

NOTE:

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

PARTS LIST

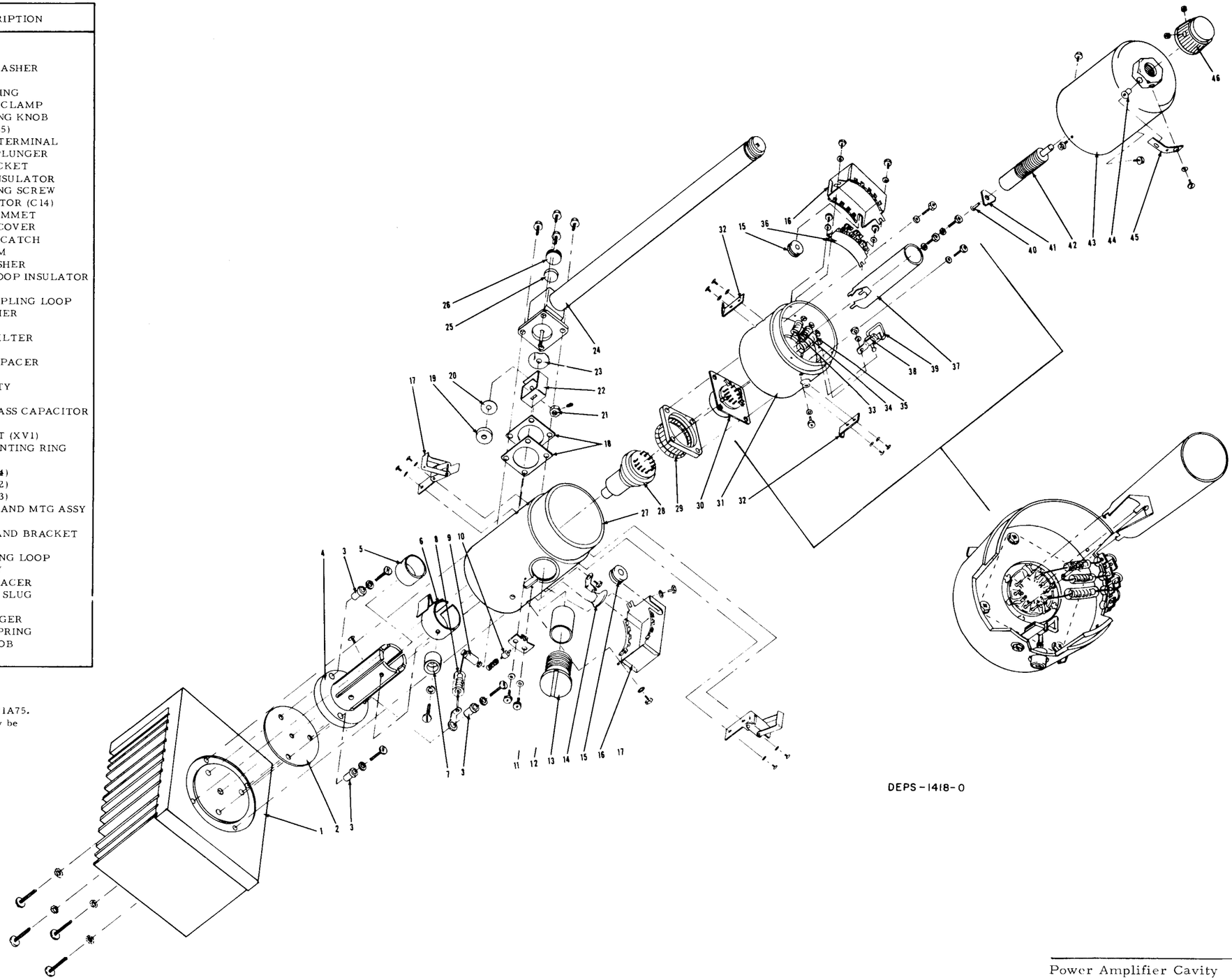
EPS-1426-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	26B83909G01	HEAT SINK
2	14B83906G01	INSULATOR
3	4B82345A11	SHOULDER WASHER
4	*	PLATE LINE
5	42B83270H01	COLLET SPRING
6	42B83986G01	PLATE LINE CLAMP
7	36A83984G02	PLATE TUNING KNOB
8	*	RF CHOKE (L5)
9	29B83988G01	FEED THRU TERMINAL
10	43B84213A01	ALUMINUM PLUNGER
11	7B83900G01	TUNING BRACKET
12	37A83173H01	"TEFLON" INSULATOR
13	3B83908G01	PLATE TUNING SCREW
14	*	DISC CAPACITOR (C14)
15	37C82633B09	RUBBER GROMMET
16	15B83992G01	FEED-THRU COVER
17	55A879705	DRAW-PULL CATCH
18	32A83384H01	HOUSING SHIM
19	**4A84401A01	SPECIAL WASHER
20	**14A84400A01	COUPLING LOOP INSULATOR
21	**2A83383H01	NUT
22	**24B83996G01	OUTPUT COUPLING LOOP
23	**4C82414E06	SPRING WASHER
24	**15B83997G01 **47A82427E03 **47C83028H01	HARMONIC FILTER
25	**14A83191H01	INSULATOR SPACER
*26	3A83907G01	PLUG SCREW
27	58D83985G01	PLATE CAVITY
28	*	TUBE (V1)
29	*	SCREEN BYPASS CAPACITOR (C11)
30	*	TUBE SOCKET (XV1)
31	42D83995G01	SOCKET MOUNTING RING
32	55A83990G01	STRIKE
33	*	RF CHOKE (L4)
34	*	RF CHOKE (L2)
35	*	RF CHOKE (L3)
36	1V80781A71	CAPACITORS AND MTG ASSY
37	47B83989G01	GRID LINE
38	21D82785H16 42A82765C03	CAPACITOR AND BRACKET (C-13)
39	24B83987G01	GRID COUPLING LOOP
40	3S8154	DRIVE SCREW
41	43B83904G01	"TEFLON" SPACER
42	76A83905G01	GRID TUNING SLUG
43	58B83993G01	GRID CAVITY
44	47B83910G01	NYLON PLUNGER
45	41B83901G01	RETAINING SPRING
46	36B83579B01	CONTROL KNOB

NOTES:

*See Electrical Parts List

**Part of Harmonic Filter Assembly, 1V80781A75. It is recommended that the entire assembly be replaced.



DEPS-1418-0

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POWER AMPLIFIER

MODEL TLE1060B
TLE1240B

MODEL TABLE

MODEL SERIES	APPLICATION
TLE1060B	Extended Local Control Stations, Remote Control Stations, Repeaters
TLE1240B	Local Control Stations

1. DESCRIPTION

This unit is an rf power amplifier for the 450 MHz to 470 MHz band, employing a vacuum tube with an integral cavity-type tuned circuit. This unit supplies final power amplification for the 60-watt and 90-watt station transmitters. It is fully temperature-compensated and capable of continuous-duty operation.

The power amplifier includes a self-contained power supply for plate, screen, and control grid bias voltages. RF power outputs of either 60 or 90 watts are obtained by using the appropriate plate voltage provided (+500 or +700 Volts). Filament voltage is provided by the main station power supply.

The rf output of the amplifier is fed through a harmonic filter to the antenna relay which is mounted on the rear of the power amplifier chassis.

2. CIRCUIT DESCRIPTION

(Refer to Power Amplifier Schematic Diagram.)

a. Amplifier

The input 450 MHz signal to this amplifier is applied through the RF DRIVE coaxial connector (J32) protruding from the side of the amplifier cavity. Approximately 12 watts of rf power is applied to the amplifier grid through a tuned cavity which is tuned to resonance by adjusting the GRID TUNING knob extending from the right-hand end of the amplifier.

Tuning of the plate cavity is accomplished by turning the PLATE TUNING control, a slotted, threaded cap in the wall of the cavity. The amplified rf power in the plate circuit of the power amplifier is coupled from the plate cavity via the output coupling loop to harmonic filter Z1. Z1 attenuates all frequencies above the 450 MHz to 470 MHz band; at the same time, it passes the desired signal to the contacts of antenna relay K1 and through connector J34 to the antenna.

b. Power Supply

The self-contained power supply in the power amplifier contains a plate supply, a "keyed" screen supply, and a grid bias supply.

(1) Plate Supply

The plate supply uses the high-voltage secondary winding of power transformer T1 in a full-wave bridge rectifier circuit with a capacitor-input LC filter. The dc output voltage of this circuit is applied through rf choke L5 to the "plate line" inside the plate cavity.

(a) In 90-watt rf stations, the full high-voltage secondary winding of T1 (portion between red leads) is used. In these models, the output voltage of the plate supply is approximately 700 Volts.

(b) In 60-watt rf stations, only the portion of the high-voltage secondary winding between the blue leads is in use developing a lower plate voltage for the power amplifier. In these models, the output voltage of the plate supply is approximately 500 Volts.

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(2) Keyed Screen Supply Circuit

As long as keying transistor Q1 is turned on (saturated), the low-voltage secondary winding of power transformer T1 and diodes CR1 and CR2 provide pulsed driving power to the primary of transformer T2 (grounds the center tap on the T2 primary). Whenever the transmitter is keyed, Q1 is turned on by a positive voltage (approximately 12 Volts at pin B3 of connector P7. With both ends of the T2 secondary connected through diodes to the gate lead of SCR1, positive pulses are supplied at a rate of 120 Hz to the SCR gate. Conduction of the SCR completes the dc path for the full-wave screen supply, and this develops a positive voltage of approximately 390 V across capacitor C2. The voltage across C2 is divided across screen voltage potentiometer R6 and resistor R7. The voltage on the tap of R6 is applied through R8 and rf choke L4 to the screen of power amplifier V1. Resistor R3 is shorted out in 60-watt stations to provide the proper screen voltage.

When the transmitter is unkeyed, a zero-volt signal at P7-B3 keeps Q1 cut off causing an open circuit between the center tap of the T2 primary and ground. With the center tap ungrounded, no current can flow in the primary of T2 due to the presence of blocking diodes CR1 and CR2 (on either alternation, one of the two diodes is reverse-biased, preventing current flow). With no primary current in T2, there is no voltage induced in its secondary, and the source of gate pulses for SCR1 is lost. SCR1 is therefore non-conductive, cutting off the screen voltage to power amplifier V1.

(3) Grid Bias Supply

The voltage across one half of the low-voltage secondary winding of T1 is rectified by diode CR9 and filtered by C3 and R9 producing approximately 25 Volts of negative bias for the control grid of V1. This fixed bias is applied through rf choke L2 to the control grid of V1.

In addition to fixed bias, the power amplifier also develops its own "excitation" (grid-leak) bias across resistor R10. This occurs when the rf grid voltage exceeds the fixed bias voltage causing the control grid to become positive and draw grid current.

Approximately 45 Volts of grid bias (total) is developed across R10 with a normal full rf drive of approximately 12 watts present at input connector J32 (note that R10 also serves as a bleeder resistor across the fixed bias supply).

R15 is a metering resistor for measuring the grid bias voltage at pin 6 of metering socket J22. C4 and C7 are bypass capacitors to prevent any stray rf voltage on the grid lead from being coupled back through the power supply.

3. TROUBLESHOOTING

(Refer to the Transmitter Troubleshooting Chart in the EXCITER/TRANSMITTER section of this manual.)

If the troubleshooting sequence indicates that the fault is in the final (power amplifier) stage of the transmitter, proceed to check, service, and repair (as needed) the power amplifier.

4. ALIGNMENT PROCEDURE

The power amplifier alignment instructions are included in the Transmitter Alignment Procedure in the EXCITER/TRANSMITTER section of this manual. The alignment tool used for the power amplifier is the long end of tuning tool C (detail shown with alignment procedure).

5. SERVICE AIDS

The following items are provided to aid in servicing the power amplifier:

a. Tube removal procedure including two illustrations (Detail A and Detail B).

b. Front and rear illustrations showing locations of component parts including alignment adjustments.

c. Exploded view and parts list for cavity assembly.

d. A rectifier and control circuit board detail showing locations of all component parts and conductive paths on the board.

e. Power amplifier schematic diagram.

POWER AMPLIFIER TUBE REMOVAL

WARNING

Before proceeding, turn off power ON-OFF switch at lower left-hand side of the power amplifier chassis and OFF-VOLUME switch on the control panel of local control stations.

If the power amplifier cavity is hot, proceed with caution.

Refer to Power Amplifier Tube Removal Details A and B.

(1) Disengage the clamps at the top and bottom of the cavity and fold them back to the left so they will be out of the way.

(2) Insert a "Phillips" screwdriver through the hole in the plate cavity (see Tube Removal Detail A) until it engages the screw head inside the cavity. Loosen the clamp by turning the screw counterclockwise.

(3) By exerting a right hand pull on the grid cavity, the clamp will release and the grid cavity will begin to separate from the plate cavity. After the right half of the cavity separates from the left half, continue pulling straight to the right until the top of the "lighthouse" amplifier tube clears the left half of the cavity.

(4) Remove the screwdriver from the hole in the cavity.

(5) Grasp the grid cavity firmly with one hand and the amplifier tube with the other hand as shown in Tube Removal Detail B. Rock the tube gently back and forth while pulling to help free it from the socket.

(6) Replace the power amplifier tube in the opposite sequence.

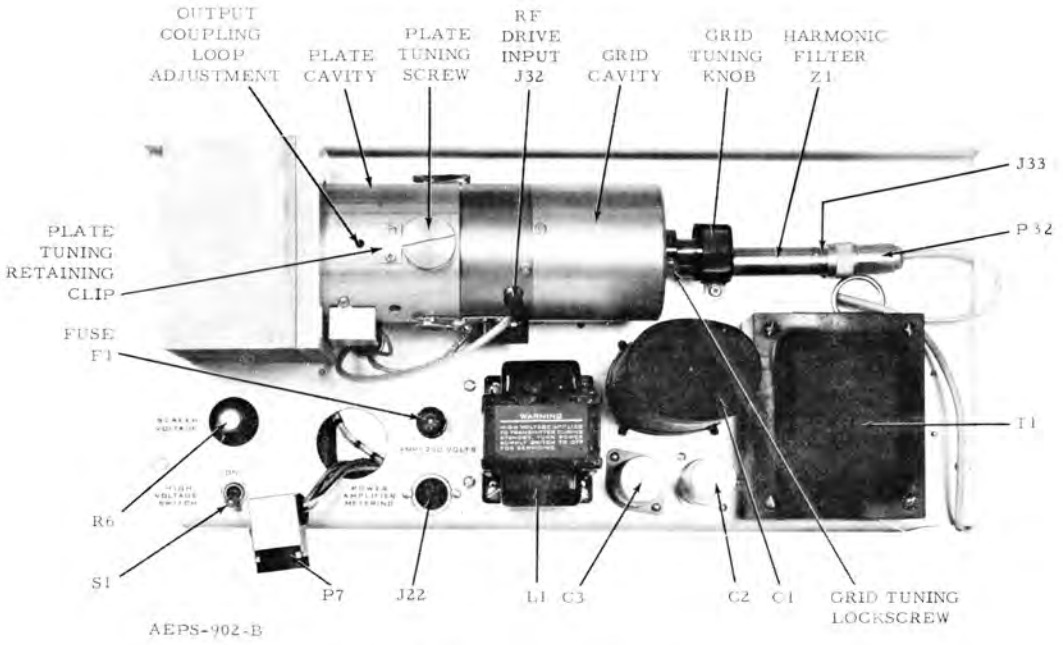
(7) After the power amplifier is completely reassembled, insert the screwdriver again and turn it clockwise to tighten the clamp.

WARNING

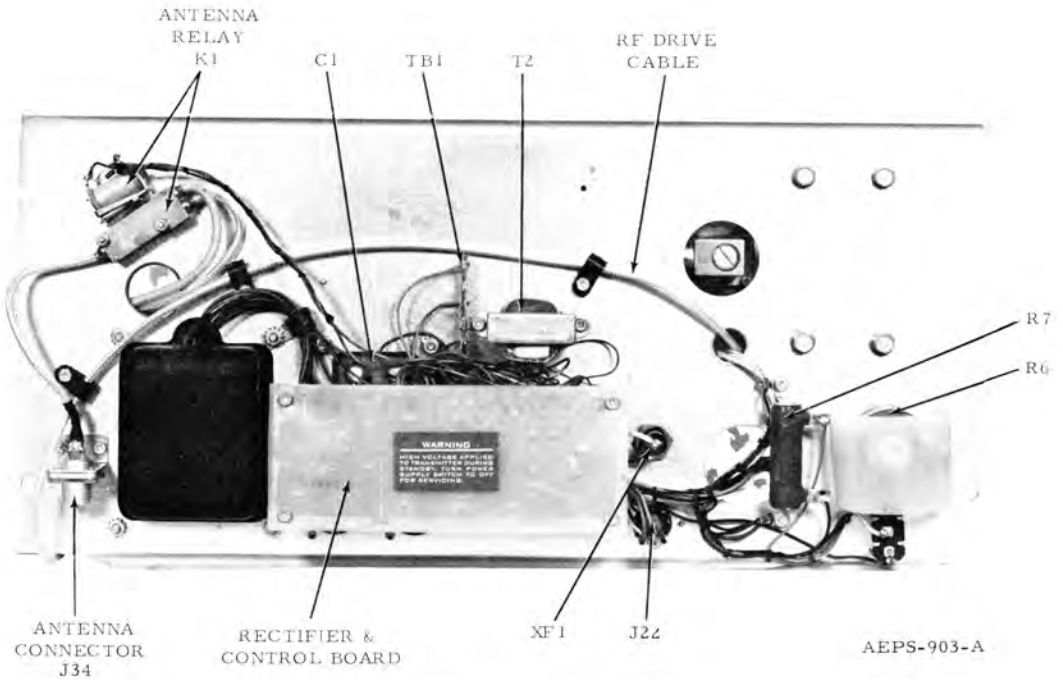
Tighten tube clamp securely.

(8) Remove the screwdriver and refer to the Transmitter Alignment Procedure

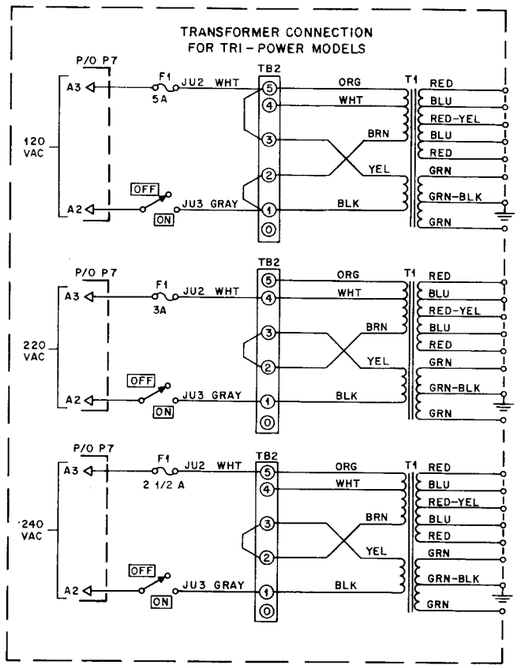
Power Amplifier Tube Removal Detail B

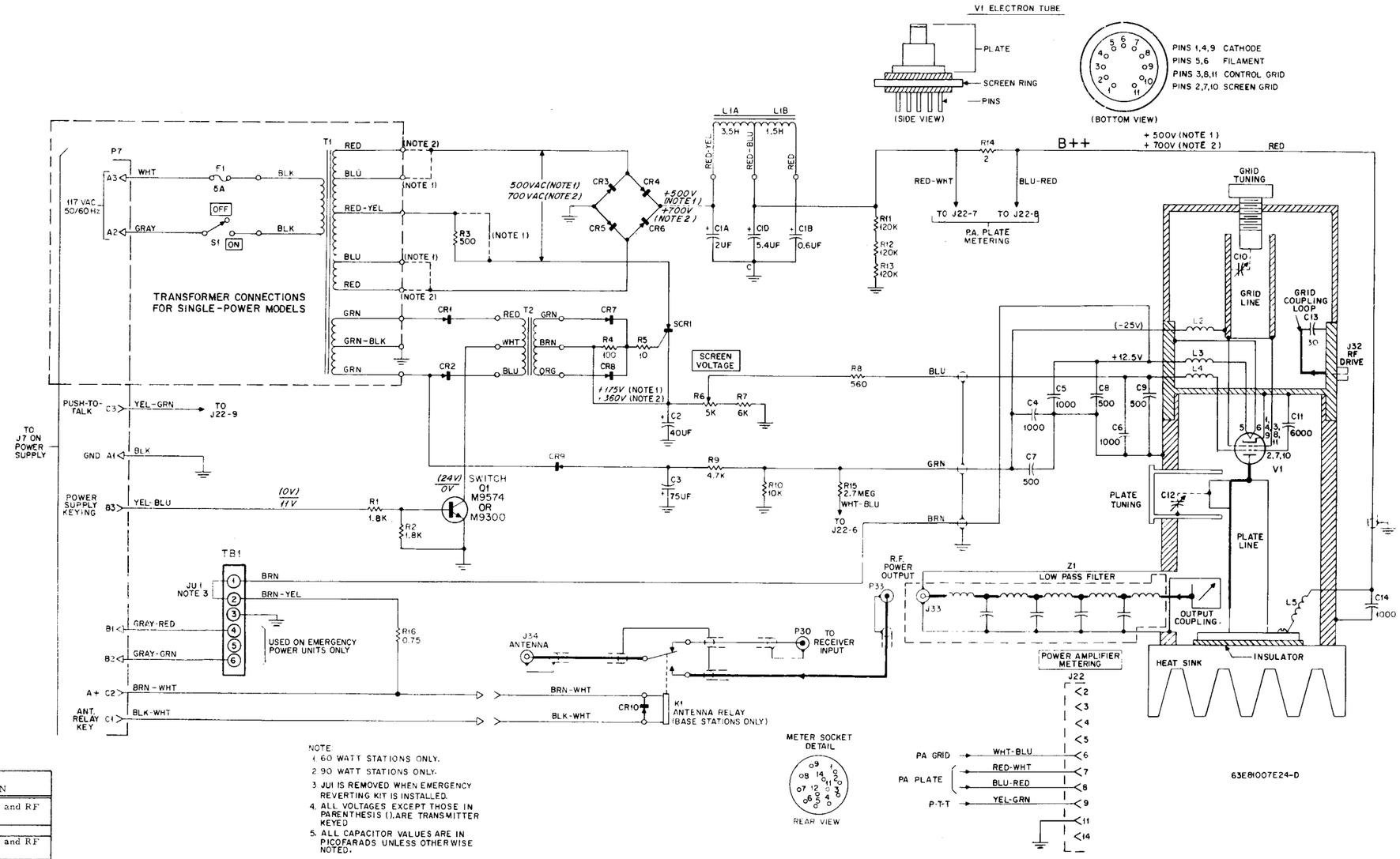


Power Amplifier (Front View)
Alignment and Parts Location Detail



Power Amplifier (Rear View)
Alignment and Parts Location Detail





NOTE

1. 60 WATT STATIONS ONLY.
2. 90 WATT STATIONS ONLY.
3. JU1 IS REMOVED WHEN EMERGENCY REVERTING KIT IS INSTALLED.
4. ALL VOLTAGES EXCEPT THOSE IN PARENTHESIS ( ), ARE TRANSMITTER KEYED.
5. ALL CAPACITOR VALUES ARE IN PICOFARADS UNLESS OTHERWISE NOTED.

MODEL TABLE

MODEL	SUFFIX	DESCRIPTION	SUB-MODEL	SUFFIX	DESCRIPTION
TLE1062B	None	120 V, 50/60 Hz (Single-Power) Extended Local Control	TLE6292B	None	Panel, Power Supply and RF Amplifier
			TLN8824A	None	Control Board
TLE1242B	None	120 V, 50/60 Hz (Single-Power) Local Control	TLE6492B	None	Panel, Power Supply and RF Amplifier
			TLN8824A	None	Control Board
TLE1392A	None	120/220/240 V, 50/60 Hz (Tri-Power) Extended Local Control	*TLN1407A	None	Panel, Power Supply and Control Board
			TLE6762A	None	RF Amplifier
TLE1402A	None	120/220/240 V, 50/60 Hz (Tri-Power) Local Control	**TLN1406A	None	Panel, Power Supply and Control Board
			TLE6762A	None	RF Amplifier

*TLN1407A consists of TGN6061A Panel & Power Supply and TLN8824A Control Board.
**TLN1406A consists of TGN6060A Panel & Power Supply and TLN8824A Control Board.

EPS-5551-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Amplifier
Schematic Diagram
Motorola No. 63D81007E24-D
6/5/74-NPC

PARTS LIST

TLE6292B Power Amplifier
TLE6492B Power Amplifier
TLE6492A Power Amplifier
TLE6292A Power Amplifier — PL-374-C

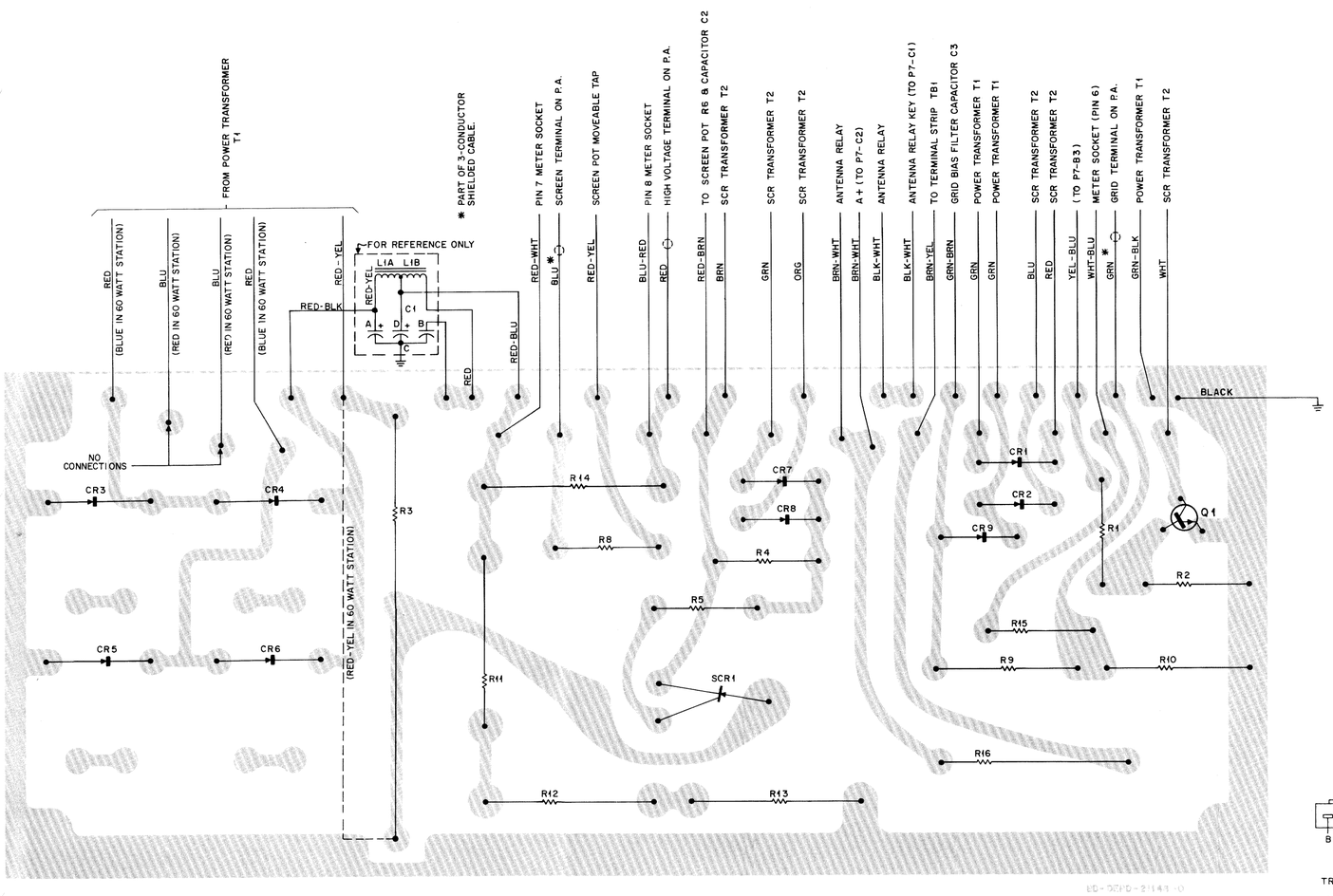
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	8C84195A01	3 sect; c/o:
C1A		2 uF +20-10%; 1200 v
C1B		0.6 uF ±10%; 1200 v
C1D		5.4 uF +20-10%; 1200 v
		NOTE "C" denotes common connection.
C2	23D83093G06	40 uF +150-10%; 450 v
C3	23D82304B28	75 uF +100-10%; 250 v
C4 thru 9		(replaceable as an assembly only): order 1V80781A71 CAPACITOR ASSEMBLY
C10		(for reference only; inherent capacitance in grid circuit)
C11	21C84636A01	6000 pF ±1000 pF; 500 v
C12		tuning capacitance; c/o the following items: 1V80783A56 PLATE TUNING SCREW ASSY (adjustable), 36A83984G01 SLUG, metallic: (stationary; mounts on plate line)
C13		(for replacement, order 1V80784A17 CAPACITOR & CLAMP ASSY)
C14	21K868902	1000 pF ±20%; 3000 v
		FUSE, cartridge: 1-1/4" x 1/4":
F1	65R52293	5 a; 250 v
		CONNECTOR, receptacle:
J22	9C82201E01	female; 12 cont
J32		female; coaxial; (for reference only; field-replacement not recommended)
J33		female; coaxial; (for reference only; field-replacement not recommended)
		REACTOR:
L1	25C83962A01	2 sect; c/o:
L1A		3.5 H; res 48 ohms ±10%
L1B		1.5 H; res 80 ohms ±10%
		COIL, RF: choke;
L2, 4, 5	24C82542E08	.039 uH
L3	24C84346A01	6 turns
		CONNECTOR, plug:
P7		c/o: 14C82337A03 BODY, 29C82335A01 TERMINAL, cont; male (specify qty), 29C82336A01 TERMINAL, cont; female (specify qty) 15C83934A07 COVER
		RESISTOR, variable:
R6	18C82782H01	5K ±10%; 25 w; does not incl. 14B83143H01 INS. mtg, and 36B83764G01 KNOB, control
		RESISTOR, fixed:
R7	17K804758	6K ±10%; 25 w
		SWITCH, toggle:
S1	40B858304	spst
		TRANSFORMER, power: 117 v; 60 Hz:
T1	25D84124A01	pri: BLK, BLK; res 0.873 ohm ±20% sec No. 1: RED, RED w/RED-YEL center tap (680 volts, no load); incl. intermediate BLU taps (500 volts no load); total res 25.72 ohms ±20% sec No. 2: BLU, BLU; (res not stated); sec No. 3: GRN, GRN w/GRN-BLK center tap; res 7.2 ohms ±20%
		TRANSFORMER, control: 25 v ac; 60 Hz:
T2	25C83023H01	pri: RED, BLU w/WHT center tap; sec: GRN, ORG w/BRN center tap
		ELECTRON TUBE:
V1	65C83999G01	11 cont base
		FUSEHOLDER:
XF1	9C82083C01	extractor post type
		FILTER, RF: low-pass;
Z1	1V80781A75	"harmonic filter"; field repair and/or adjustment not recommended (replace entire unit only)
		NON-REFERENCED ITEMS
	31S121227	TERMINAL BOARD: wafer type; 6 soldering terminals (5 insulated and 1 mtg)
	64A851940	PLATE, capacitor mtg; (for C2)
	64A10844	PLATE, capacitor mtg; ins. (for C3)
	1V80702B78 (TLE6292A & TLE6492A)	PLATE LINE & CAVITY ASSY, incl. ref part C12, C14, L5 and the following: 26B83909G01 HEATSINK, 58D83985G01 CAVITY, plate tuning, 14B83906G01 INSULATOR, plate line mtg, 1V80783A57 PLATE LINE & CLAMP ASSY, 4B82345A11 WASHER, insulating; shoulder type (3 req'd) 43B82413A01 "PLUNGER" (metallic); friction stop for plate tuning screw, 41A83877E01 SPRING, compression (for plunger), 7B83900G01 BRACKET, plunger retainer, 55A879705 CATCH, draw-pull: (secures TUBE SOCKET & GRID LINE ASSY in place; 2 catches req'd, 36A83984G02 KNOB, plate-line
	or 1V80706B73 (TLE6292B & TLE6492B)	PLATE LINE & CAVITY ASS'Y, incl. ref part C12, C14, L5 and the following; 1V80706B72 PLATE LINE CLAMP ASS'Y (secures tube socket & grid line ass'y in place; 2 catches req'd) 7B83900G01 BRACKET, plunger retainer, 41A83877E01 SPRING, plunger compression 43B84213A01 "PLUNGER" (metallic); friction stop for plate tuning screw, 4B82345A11 WASHER, shoulder: insulating (3 req'd), 14B83906G01 INSULATOR, plate line mtg (NOTE: This item may be replaced, but careful alignment of the assembly is req'd.)
	55A83990G01	STRIKE, draw-pull: 2 req'd (companion piece to draw-pull catch)
	1V80701B81	GRID DRIVE CABLE ASSY
	1V80781A68	TUBE SOCKET & GRID LINE ASSY: incl. the following replaceable parts and sub-assemblies: Ref. Part C11, 24B83987G01 GRID COUPLING LOOP, 1V80784A17 CAPACITOR & CLAMP ASSEMBLY, 1V80781A73 GRID TUNING SCREW ASSEMBLY 1V80781A74 GRID CAVITY & NUT ASSEMBLY
		47B83910G01 "PLUNGER" (nylon); friction stop for grid tuning screw, 41B83901G01 SPRING, plunger compressor 36B82632H07 KNOB, control (grid tuning), 47B83989G01 GRID LINE, 1V80781A71 CAPACITORS & BRACKET ASSEMBLY: incl. C4 thru C9
		NOTE Do not attempt to replace any parts of 1V80781A68 TUBE SOCKET & GRID LINE ASS'Y or 1V80702B78 and 1V80706B73 PLATE LINE & CAVITY ASS'Y unless they appear in the above listing. Instead, order a new replacement assembly.
	1V80701B79	PANEL ASS'Y (riveted) used with TLE6292A and TLE6292B
	1V80704B44	PANEL ASS'Y (riveted) used with TLE6492A and TLE6492B

TLN8804A Antenna Relay — PL-375-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR10	48C82466H01	silicon
		RELAY, armature: coaxial;
K1	80D83796C03	13.5 v dc; 1 form "C"; incl. attached coaxial connecting leads
		CONNECTOR, receptacle: coaxial;
J34	9C82442E05	female; uhf type; does not incl. 15A483599 SHIELD
		CONNECTOR, plug: coaxial;
P30	28B82133G02	male; min. ("Cinch" type)
P33	28K852527	male; type "N"

NOTES:

I. Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.
II. Do not attempt to replace any parts of the TUBE SOCKET & GRID LINE ASSEMBLY and/or the PLATE LINE & CAVITY ASSEMBLY unless the parts appear in the listing for these assemblies. If the part to be replaced is not listed, order the entire assembly.



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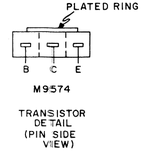
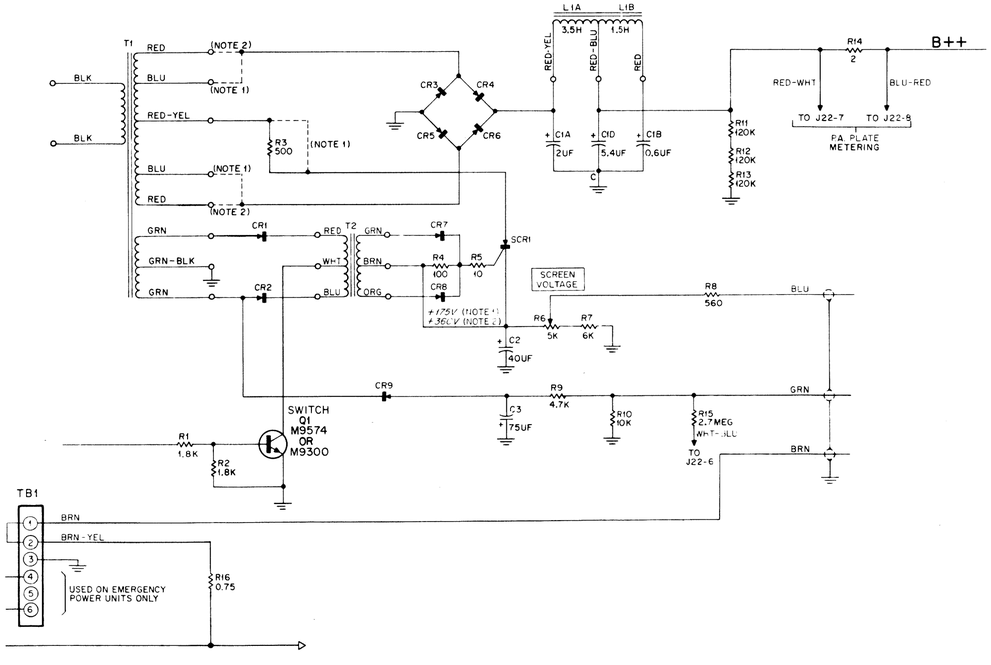




REFER TO COMPLETE SCHEMATIC DIAGRAM FOR NOTE REFERENCES

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN8824A Rectifier & Control
Circuit Board Detail
Motorola No. PEPS-1244-B
6/5/74-NPC

TLE1060B POWER AMPLIFIER

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8824A Control Board PL-373-O

		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 9	48C82466H04	silicon
CR3, 4, 5, 6	48C83024H01	silicon
CR7, 8	48C82466H01	silicon
		TRANSISTOR: (SEE NOTE)
Q1	48R869574	N-P-N; type M9574
	or48R869300	N-P-N; type M9300
		RESISTOR, fixed: ±10%; 1/2 w unl. stated
R1, 2	6S2089	1.8K
R3	17D83027H02	500 ±5%; 5 w
R4	6S6326	100
R5	6S5621	10
R8	6S6291	560
R9	6S5576	4.7K; 1 w
R10	6S6430	10K; 1 w
R11, 12, 13	6S5781	120K; 2 w
R14	17K847359	2 ±2%; 1 w
R15	6S488186	2.7 meg ±5%
R16	17D83027H01	0.75 ±5%; 5 w
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
SCR1	48R869349	controlled type

NOTE:

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

PARTS LIST

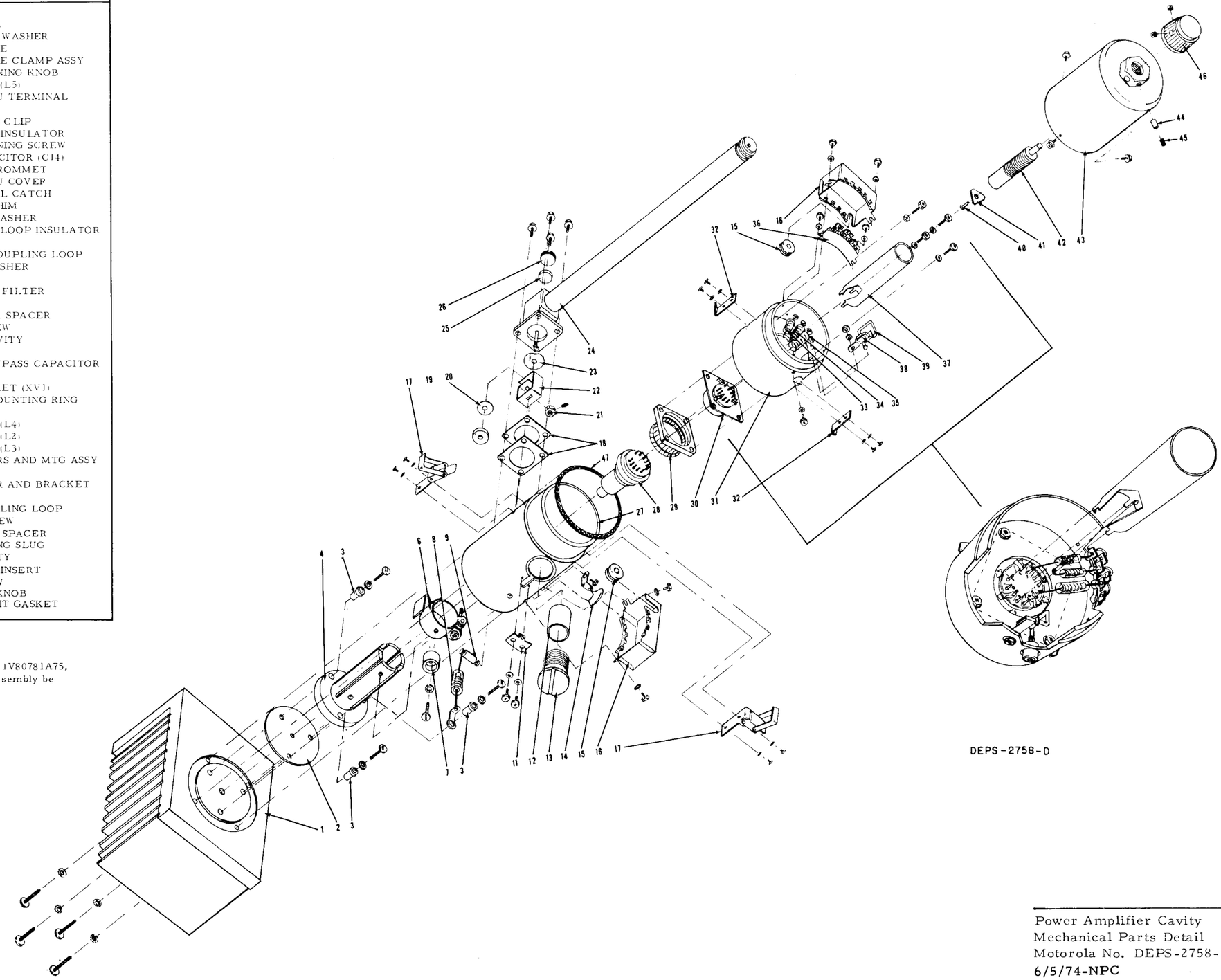
PL-672-C

CODE	MOTOROLA PART NO.	DESCRIPTION
1	26B83909G01	HEAT SINK
2	14B83906G01	INSULATOR
3	4B82345A11	SHOULDER WASHER
4	-	PLATE LINE
6	1V80706B72	PLATE LINE CLAMP ASSY
7	36A83984G02	PLATE TUNING KNOB
8	*	RF CHOKE (L5)
9	29B83988G01	FEED THRU TERMINAL
10		NOT USED
11	42-83229F01	RETAINING CLIP
12	37A83173H01	"TEFLON" INSULATOR
13	3B83908G01	PLATE TUNING SCREW
14	*	DISC CAPACITOR (C14)
15	37C82633B09	RUBBER GROMMET
16	15B83992G01	FEED THRU COVER
17	55A879705	DRAW-PULL CATCH
18	32A83384H01	HOUSING SHIM
19	**4A84401A01	SPECIAL WASHER
20	**14A84400A01	COUPLING LOOP INSULATOR
21	**2A83383H01	NUT
22	**24B83996G01	OUTPUT COUPLING LOOP
23	**4C82414E06	SPRING WASHER
	**15B83997G01	
24	**47A82427E03	HARMONIC FILTER
	**47C83028H01	
25	**14A83191H01	INSULATOR SPACER
*26	3A83907G01	PLUG SCREW
27	58D83985G01	PLATE CAVITY
28	*	TUBE (V1)
29	*	SCREEN BYPASS CAPACITOR (C11)
30	*	TUBE SOCKET (XV1)
31	42D83995G01	SOCKET MOUNTING RING
32	55A83990G01	STRIKE
33	*	RF CHOKE (L4)
34	*	RF CHOKE (L2)
35	*	RF CHOKE (L3)
36	1V80781A71	CAPACITORS AND MTG ASSY
37	47B83989G01	GRID LINE
38	21D82785H16	CAPACITOR AND BRACKET
	42A82765C03	(C-13)
39	24B83987G01	GRID COUPLING LOOP
40	3S8154	DRIVE SCREW
41	43B83904G01	"TEFLON" SPACER
42	76A83905G01	GRID TUNING SLUG
43	58B83993G01	GRID CAVITY
44	46A852210	"TEFLON" INSERT
45	3S7148	SET SCREW
46	36B83579B01	CONTROL KNOB
47	32-84045E01	METAL KNIT GASKET

NOTES:

*See Electrical Parts List

**Part of Harmonic Filter Assembly, 1V80781A75, It is recommended that the entire assembly be replaced.



DEPS-2758-D

TLE1060B POWER AMPLIFIER

Power Amplifier Cavity
Mechanical Parts Detail
Motorola No. DEPS-2758-D
6/5/74-NPC

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"SENSITRON" RECEIVER

RECEIVER MODEL TABLE

COMPLETE RCVR. MODEL SERIES	BASIC RCVR. MODEL SERIES	DESCRIPTION	CHANNEL SPACING
TRE1150AB	TRE1180AB	Single-Frequency Carrier Squelch	25 kHz
TRE1150AD	TRE1180AD	Multi-Frequency Carrier Squelch	25 kHz
TRE1150AF	TRE1180AF	Single-Frequency "Private-Line"	25 kHz
TRE1150AH	TRE1180AH	Multi-Frequency "Private-Line"	25 kHz
TLN1227A		(Receiver 3rd & 4th Oscillator Assembly; used with TRE1150AD & TRE1150AH Series Receivers)	

1. DESCRIPTION

a. General

These receivers are fully transistorized, dual-conversion superheterodyne units that receive FM signals on one to four crystal-controlled frequencies. Multi-frequency receivers are the same as one-frequency units except for additional first oscillators and control circuits. In a multi-frequency receiver, only one frequency can be received at a time.

The one-frequency receivers can be used in local control or remote control stations. Receivers in local control stations are controlled from the local control panel and the audio output is applied to the speaker. Receivers in remote control stations are controlled by dc line currents or tone bursts from the remote control point and the audio output is applied to a 600-ohm audio line which carries the audio to the remote control point. Operating voltages for the receiver are supplied by the base station power supply. A metering receptacle is provided for monitoring the various stages of the receiver for test and alignment purposes.

The "Private-Line" receivers incorporate a tone controlled squelch circuit that normally controls the receiver. The normal carrier noise activated squelch circuit is used for monitoring purposes. A switching lead is brought out from the receiver to control the monitor function. When this lead is grounded by the control circuit, only the tone controlled squelch circuit operates. Thus, the receiver output is heard only when the incoming rf carrier is modulated by the appropriate continuous tone. When the operator presses the MONITOR key on the remote control console (or operates the "Private-Line" disable switch

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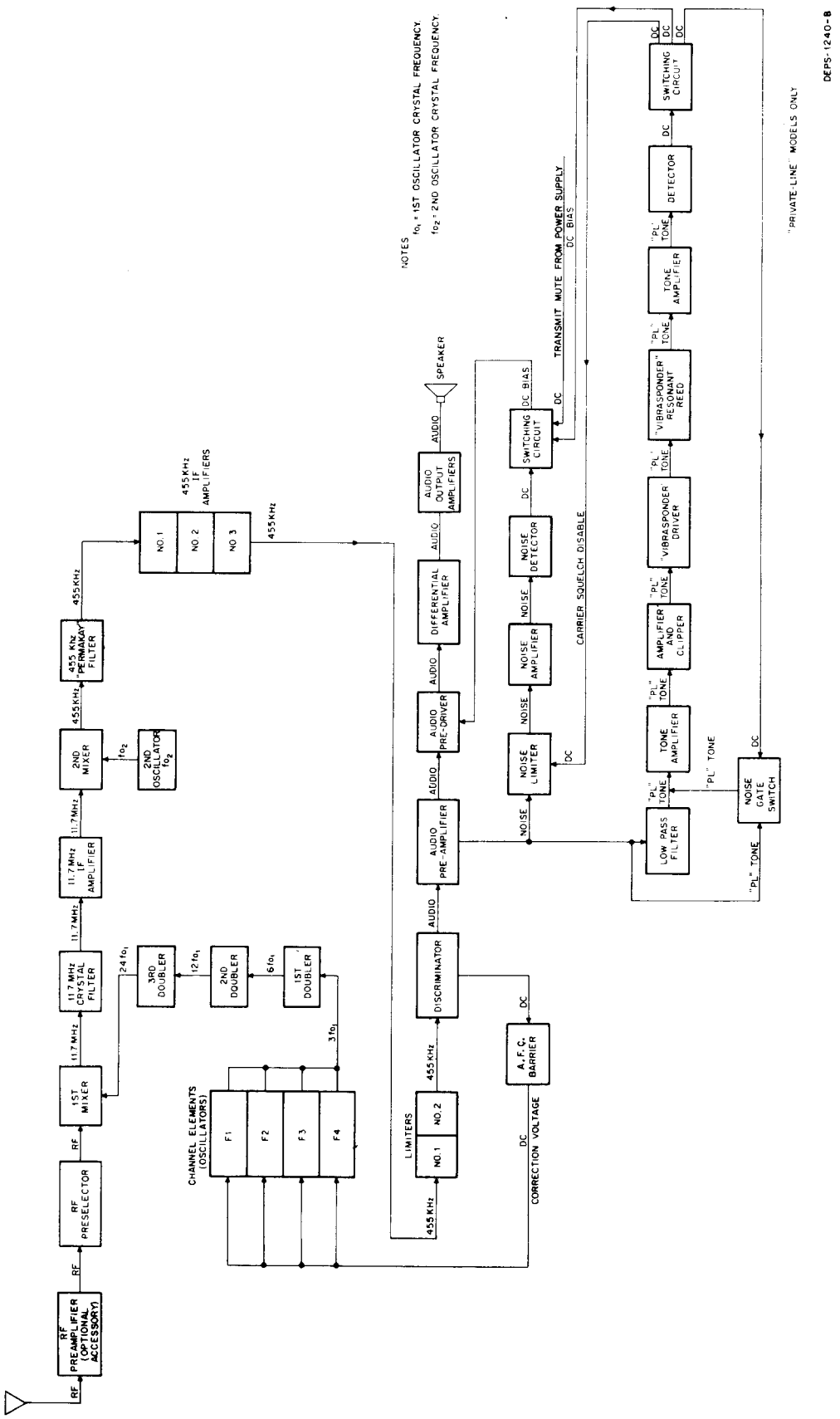


Figure 1.
Receiver Block Diagram

on local control stations) the control circuits open the ground connection on this lead, activating the noise squelch circuit. Any on-frequency signal may now be heard.

b. Two-Frequency Operation

Some base station models contain two complete single-frequency receivers. When two single-frequency receivers are employed, each receiver will receive one specific frequency. Both receivers are identical.

The audio from both receivers is applied to the 600-ohm audio line output for remote control stations, or to the speaker for local control stations. If both receivers are in operation simultaneously, receiver No. 2 can be muted from the remote control point by applying a dc control current or tone bursts on the line or operating a receiver No. 2 mute switch on the local control panel.

2. CIRCUIT DESCRIPTION

a. RF Preselector

The rf signal received at the antenna is routed to the preselector stage. The preselector has a flat acceptance bandwidth and a steep skirt response to provide rapid attenuation of signals outside the accepted bandwidth. Capacitive and magnetic coupling are used to couple the signal through the resonant cavity apertures. The preselector contains six low-loss, highly selective, helical resonant cavities (L1 through L6).

b. First Oscillator-Multiplier

The first oscillator circuit may contain up to four channel elements. Oscillator selection is accomplished by grounding the appropriate circuit (F1, F2, F3 or F4). On single-frequency units, the oscillator stage is permanently grounded.

The channel element is a factory-sealed, temperature-compensated, plug-in module with an oscillator using an unheated crystal in a Colpitts circuit. The output of the oscillator is tuned to the third harmonic by a double-tuned circuit (L14 and L15) on the multiplier board. A variable "warp" capacitor, mounted in the channel element base, is accessible through an opening in the circuit board for fine frequency adjustment.

The third harmonic of the crystal frequency is applied to a 1st doubler circuit (Q5) producing an output of six times the crystal frequency. The second and third doublers (Q6 and Q7) raise the frequency to 24 times the crystal frequency prior to injection to the 1st mixer stage. Coils L14 and L15 are tuned to the third harmonic of the fundamental crystal frequency; L16 is tuned to six times the crystal frequency; L17 and L18 are tuned to 12 times the fundamental frequency; L19, L20 and L21 (Hi-Q aperture coupled coils) are tuned to 24 times the crystal frequency.

Oscillator noise and harmonics are attenuated by coils L19 through L21 before the injection signal is applied to the source lead of field-effect transistor Q1 (first mixer stage).

c. Voltage Regulator and Current Regulator

The receiver voltage regulator (CR6 and CR7) provides a constant 9.5 volts dc to the 1st oscillator (channel element) and the three doubler stages (Q5, Q6 and Q7) of the multiplier circuit. By applying a constant voltage to these critical circuits, frequency and injection stability are maintained. Current regulator Q8 provides a constant total current to zener diode CR6 in the voltage regulator and the multiplier board. This current regulation assures a constant voltage supply for the 1st oscillator and multiplier circuits, under a wide range of possible variations in the A+ supply.

Current regulator Q8 functions as a variable resistance in series with the Zener current path of CR6, which also includes diode CR7 and resistor R31. The 8.8-volt zener voltage of CR6, added to the voltage across forward-biased diode CR7 (approximately 0.7 volt), develops a stable voltage of 9.5 volts across the two diodes (in series). If the A+ voltage should start to decrease, the voltage change (applied via diodes CR9 and CR8) drives the base of P-N-P transistor Q8 in the negative direction, increasing its forward base-to-emitter bias. The collector current of Q8 increases, causing a decrease in its effective collector-to-emitter resistance. This causes a decrease in the total resistance in the "zener current" circuit, which includes R31, the emitter-to-collector path of Q8, zener diode CR6 and diode CR7. The decrease in resistance in the "zener current path" compensates for the decrease in A+ voltage, so that the actual zener current of CR6 remains unchanged.

d. First Mixer

Signals from the rf preselector and multiplier circuits are applied to the first mixer transistor (Q1). This N-channel field-effect transistor functions as a depletion-mode device. The elements of the FET are: the gate (G) which controls the electrostatic field in the channel through which electrons must flow (similar to the grid of a vacuum tube); the source (S) which is similar to the cathode; and the drain (D) which is similar to the plate.

As the dc drain-source voltage is applied, current flows in the channel of Q1 and through resistor R1. The current flowing through resistor R1 develops a reverse bias voltage for Q1 between the source and gate elements. This reverse bias permits Q1 to operate below the "pinch off" current of the FET. In this square law operating region, heterodyne action occurs to produce an intermediate frequency (i-f) of 11.7 MHz.

In two-receiver base stations where the rf carrier frequencies are separated by 5.85 MHz ±50 kHz or 11.7 MHz ±50 kHz, the i-f of the second receiver is shifted from 11.7 MHz to 11.6 MHz. The formulas used to calculate the high i-f frequencies of both receivers are stated as follows:

$$f_c - 24 f_1 = 11.7 \text{ MHz or } 11.6 \text{ MHz}$$

rf carr. input	mult. factor	1st osc. freq.	non-shifted 1st i-f (Rcvr #1)	shifted 1st i-f (Rcvr #2)

NOTE: If a shift of high i-f frequency is required in a two-receiver station, it will be the higher (rf) frequency receiver whose i-f frequency is shifted from 11.7 to 11.6 MHz.

NOTE

In "second receivers", the shifted i-f is used only when rf carrier separation is 5.85 MHz ±50 kHz, or 11.7 MHz ±50 kHz.

e. First Intermediate Frequency (High IF) Circuit

The output from the 1st mixer (Q1) is coupled through a crystal filter to a common emitter high i-f amplifier circuit (Q2). Resonant circuit L8, two crystals (Y1 and Y2), and tuned transformer T1 are used in a crystal filter circuit. This provides highly selective filtering for high i-f interference rejection.

The output of the i-f amplifier is coupled to the base of the second mixer circuit (Q3) through a highly selective triple-tuned network consisting of T2, L10 and L11.

f. Second Oscillator

Crystal-controlled 2nd oscillator Q4 provides the local oscillator signal required for the second conversion in this dual-conversion receiver. Either "low-side" or "high-side" injection is provided for the 2nd mixer, by selection of the proper crystal frequency for this oscillator. Selection of either low-side or high-side injection is determined by the operating frequency of the receiver, in order to minimize the susceptibility of the receiver to spurious responses or self-quieting.

(1) In single-receiver stations or in the majority of two-receiver stations, the 2nd oscillator crystal frequencies are as follows:

For low-side injection, the operating frequency of crystal Y3 is 11.245 MHz;

For high-side injection, the operating frequency of crystal Y3 is 12.155 MHz.

NOTE

The 1st i-f frequency in these receivers is 11.7 MHz.

(2) In the higher frequency receiver in a two-receiver station with 5.85 MHz ±50 kHz or 11.7 MHz ±50 kHz separation the 2nd oscillator crystal frequencies are as follows:

For low-side injection, the operating frequency of crystal Y3 is 11.145 MHz;

For high-side injection, the operating frequency of crystal Y3 is 12.055 MHz.

NOTE

The 1st i-f frequency in these receivers is 11.6 MHz.

The output signal from the emitter of 2nd oscillator Q4 is coupled via capacitor C26 to the base of 2nd mixer Q3.

g. Second Mixer

Second mixer Q3 heterodynes the output signal of high i-f amplifier Q2 with the output signal of 2nd oscillator Q4 to produce a difference frequency of 455 kHz. This is the "low i-f" or "second intermediate frequency". A common-emitter

circuit is used, with the i-f and oscillator signals both fed into the base of Q3.

In the collector circuit of Q3, the difference frequency of 455 kHz is coupled through a narrow-bandpass ("Permakay") filter, Z1, which rejects all other frequencies present.

The second i-f frequency (455 kHz) is calculated as follows:

(1) "Unshifted i-f" Receivers:

High-Side Injection		Low-Side Injection
12.155 MHz (2nd osc.)		11.700 MHz (1st i-f)
-11.700 MHz (1st i-f)	OR	-11.245 MHz (2nd osc.)
.455 MHz (455 kHz)		.455 MHz (455 kHz)

(2) "Shifted i-f" Receivers:

High-Side Injection		Low-Side Injection
12.055 MHz (2nd osc.)		11.600 MHz (1st i-f)
-11.600 MHz (1st i-f)	OR	-11.145 MHz (2nd osc.)
.455 MHz (455 kHz)		.455 MHz (455 kHz)

h. 455 kHz "Permakay" Filter

Filter Z1, located between the output of the 2nd mixer stage (Q3) and the input to the 1st 455-kHz amplifier stage (Q301), is the major factor in determining the bandwidth and selectivity of the receiver. It greatly attenuates all signals below and above a pre-determined bandpass. The filter is permanently sealed in polyesterstyrene and is unconditionally guaranteed for the life of the receiver provided the seal is not broken and the housing is not tampered with.

i. 455 kHz Second Intermediate Frequency (Low i-f Amplifiers)

The output signal from filter Z1 is applied to the base of 1st 455-kHz amplifier Q301. It is amplified by three i-f amplifiers (Q301, Q302 and Q303), each with approximately 30 db gain. These stages are RC-coupled, "forced gain" amplifiers, which provide sufficient output to drive the limiters into full clipping, even with only front-end noise present as an input signal.

Built-in metering points (meter positions 1 and 2) are provided for measuring relative signal levels at the outputs of 2nd and 3rd 455-kHz amplifiers.

j. Limiter Stages

Two limiter stages (Q304 and Q305) are used to improve the signal-to-noise ratio. These stages remove amplitude variations from the received signal. The limiters are in full saturation at all times (weak signals, strong signals, or receiver noise). When the 1st limiter (Q304) receives the negative alternation of the incoming signal, the base is driven negative with respect to the emitter, consequently, the base-emitter junction is reverse biased, causing the collector current to decrease. On the positive half of the incoming signal, the base-emitter junction is forward biased, causing the collector current to increase to maximum. The operation of the second limiter stage is essentially the same as the first limiter except for phase reversal. Q304 and Q305 operate between cut-off and saturation, removing amplitude variations from received signals.

k. Discriminator

The discriminator circuit translates frequency variations of the 455-kHz signal into audio information.

Operation of the circuit is dependent upon a 90° phase shift which occurs (at resonance) between the primary and secondary voltages of the tuned transformer (T3). As a signal is applied to the discriminator, the resonant circuit phase shift appears capacitive or inductive depending upon the frequency applied to diodes CR303 and CR304 (early versions used transistors Q306 and Q307 functioning as diodes). These diodes produce a null (zero volts) at the output of the discriminator at resonance.

An unmodulated input signal exactly 455 kHz produces a null (zero volts) at the output of the discriminator. When modulation is applied, the i-f signal varies in frequency (at the audio rate) above and below 455 kHz. A positive or negative voltage is produced at the output of the discriminator for deviation above or below 455 kHz, resulting in an audio signal at that point (see Figure 2). The discriminator output is developed at the cathode of CR303 (collector of Q306) with respect to the cathode of CR304 (collector of Q307) (ground). The audio signal is coupled from the output of the discriminator through filter choke L302 to the preamplifier on the audio & squelch circuit board.

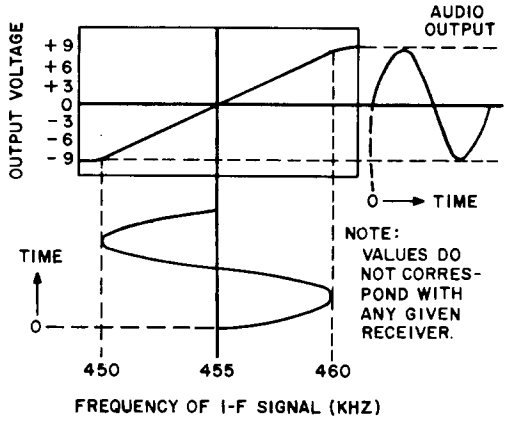


Figure 2.

l. Automatic Frequency Control (AFC)

The automatic frequency control circuit provides automatic frequency adjustment to compensate for carrier frequency or receiver frequency drift.

When an off-frequency condition is detected by the discriminator, a dc error voltage is produced. This positive or negative error voltage is filtered by R329, R30, C326, C51 and C49. The filtered correction voltage is applied to the channel element to adjust the oscillator frequency in the direction of the received carrier frequency. A diode barrier circuit (CR4 and CR5) protects the receiver from being "pulled" onto the adjacent channel.

m. Audio Stages

The output of the discriminator is capacitively coupled to preamplifier stage Q341. This stage provides a 4 dB gain with a low output impedance. The collector output is applied to (1) the receiver volume and squelch controls and (2) the "Private-Line" decoder. The audio signal from the volume control is routed to a filter which removes the "PL" tone from the audio signal before it is applied to pre-driver stage Q342. In the unsquelched state, the stage is forward biased and in the squelched condition, a reverse bias exists between the emitter and the base. When a signal is received, Q342 is forward biased to allow signals to pass.

In local control stations and repeaters without wire line control, the audio output of the pre-driver stage is applied directly to the differential drivers Q343 and Q344. In remote control stations and repeaters with wire line control, the audio from the pre-driver is applied to the 600-ohm line via the remote control unit. An amplified sample of that audio is returned to the differential drivers for providing a speaker output during testing and maintenance.

A differential amplifier with one transistor in a common base and another in a common emitter configuration is used. Common emitter stage Q343 drives common base amplifier Q344 in a push-pull operation.

The power amplifier (audio output) consists of a pair of transistors in a push-pull arrangement to provide 5 watts of audio power to a 3.2-ohm speaker.

n. Noise Actuated Squelch Circuit

The squelch circuit eliminates disturbing noise which would otherwise be heard at the speaker during intervals between received messages. A noise voltage from the squelch control is applied to the noise limiter, noise amplifier and noise detector stages. The dc output of the noise detector controls a switching stage which turns the pre-driver stage on or off.

When a signal is received, the absence of noise causes the switching transistor (Q350) to stop conducting, which allows the pre-driver stage to conduct. The receiver squelch action occurs as a result of emitter-base bias of the pre-driver stage. Forward bias allows the audio signal to pass through the audio amplifier stages and the speaker (unsquelched).

The operation of switch transistor Q350 depends upon the base voltage. Noise coming from the squelch control provides forward bias for the switch transistor. In the absence of noise, switch Q350 does not conduct. When the switch transistor is not conducting, the current through R384 is small, as a result, the voltage appearing at the emitter of Q342 becomes more positive (higher than the base voltage); the transistor becomes forward biased and the stage operates normally (unsquelched).

Noise voltages normally present in the receiver have sufficient amplitude to drive the noise limiter stages to saturation and produce full conduction at the noise detector. Thus, squelch action is positive. Carrier squelch or noise-actuated squelch sensitivity is adjustable. The squelch control, located between the output of the audio preamplifier and the input to the noise limiter, determines the

noise level into the limiter and the conduction level at the detector.

o. Tone-Coded Squelch Circuit

The "Private-Line" ("PL") decoder circuit consists of a low-pass filter network, a high-gain amplifier, an amplifier/clipper, a "Vibrasponder" driver stage, a "Vibrasponder" resonant reed, an output amplifier, a detector, an output switch stage, and a noise gate switch.

The output from the audio preamplifier is connected to the low-pass filter network, which passes frequencies below 300 Hz. The low-frequency signals ("PL" tone) are amplified by Q751 and coupled to the input of the amplifier/clipper Q752. The output of the amplifier/clipper is applied to the "Vibrasponder" driver stage to drive the resonant reed. After being detected and amplified, the "PL" tone energizes the resonant reed. If a different tone is present, or if no tone is present, the reed will not respond due to its highly selective design. The output from the "Vibrasponder" driver is applied to the resonant reed coil through an emitter-follower circuit. The reed is permanently tuned and sealed at the factory.

The reed vibrates in response to the incoming tone signal. The vibrating reed produces a sinusoidal output which is amplified by Q754 and detected by Q755. The detected output is applied to the output switch (Q756) which provides a dc voltage that reverse biases the squelch switching transistor (Q350), turning it off.

The low-pass "PL" filter is paralleled by a high pass filter circuit to keep low frequency noise from activating the "Vibrasponder" resonant reed detector circuit. When the proper tone signal is received and the audio pre-driver stage is turned on, the high-pass path is shorted to ground through the noise switch (Q350).

In "Private-Line" operation, the squelch control is not used and the setting of it does not affect the "Private-Line" squelch circuit. With the "PL" disable switch not operated only the tone-coded squelch circuit is in operation. When the carrier squelch circuit is disconnected from the audio preamplifier, the squelch switching transistor (Q350) receives its control voltages from the noise switch (Q757). Switch Q350 is forward biased until a proper tone-coded signal is received. Switch Q757 then provides a positive voltage to Q350. This reverse biases Q350. With less current through the emitter resistor (R384), forward bias is applied to the pre-driver stage (Q342) allowing it to conduct and pass the audio signal to the speaker.

The "PL" squelch circuit is operative at all times. The "PL" disable switch actually switches the noise squelch circuit in or out. With the "PL" disable switch unoperated the noise-actuated squelch circuitry is inhibited and the noise detector will not disable the switching transistor to permit audio to reach the speaker. Only an output from the "Private-Line" decoder will operate the switching transistor.

With the "PL" disable switch operated, the inhibit input to the noise-actuated squelch circuit is removed and the switching transistor operates from the noise-actuated or "Private-Line" tone-coded squelch circuits.

3. MAINTENANCE

a. General

Malfunctions in the receiver can be localized by using the optional built-in station metering kit or connecting a Motorola portable test set to the receiver metering receptacle and making stage measurements. The meter readings may be compared to the values listed in the charts, but preferably, a log of readings should be maintained for reference. Each new set of readings should then be compared to previous readings. An abrupt change in a meter reading indicates a circuit failure while a gradual change in a reading may indicate an impending failure which can be corrected before operation becomes marginal.

b. Receiver Priority

Stations with two receivers may have the optional receiver priority feature added. Local control stations can use a busy light kit for receiver #1 priority. Two busy light kits can be used for first come-first served priority, or priority can be given to receiver #1 or receiver #2. Remote control stations can use a receiver #1 priority kit. With these kits, an incoming signal on a receiver mutes the other receiver.

c. Recommended Test Equipment

Servicing and trouble shooting will be effective and efficient only if the proper test equipment is used and used properly. Test equipment must also be calibrated periodically to maintain its accuracy. The following items of test equipment should be considered a minimum for "Compa-Station" receiver servicing.

(1) Built-in station metering or Motorola S1056A-9A Portable Test Set with TEK-11 Audio Adapter and TKN6025A Adapter Cable.

(2) Motorola Solid-State AC Voltmeter, or equivalent. This meter has 10 megohms input impedance shunted by 15 pF in the 1- to 300-volt range and 1 megohm input impedance shunted by 30 pF in the 1- to 300-millivolt range and is calibrated in voltage and db scales.

(3) Motorola Solid-State DC Multimeter with rf probe, or equivalent. This meter has 11 megohms input impedance.

(4) Motorola Model S1318A or S1319A FM Signal Generator, or equivalent, with TEK-10 RF Injection Probe.

(5) Motorola Model TEK-1A Transistorized Tone Generator, Model S1067A Transistorized Audio Oscillator, or equivalent (1000 and 400 Hz output for adjusting and testing receiver audio stages).

(6) Motorola Model SLN6221A "Private-Line" Tone Generator (generates "PL" tone for servicing "Private-Line" tone-coded squelch receivers).

(7) Motorola Model TEK-7A RF/DC Alignment Meter (or SLN6055A RF Probe for use with solid-state dc multimeter) for making receiver stage gain measurements.

(8) Motorola Model S1331A Single Channel Oscilloscope or S1301A Solid-State Oscilloscope or equivalent.

d. Performance Checks

The following checks give an indication of overall receiver performance. The checks may be used in troubleshooting to determine the need for repairs or alignment and should always be performed upon completion of servicing to guarantee that proper operation of the receiver is fully restored.

Insert a carrier signal directly into the antenna input jack and make the following checks:

NOTE

If the signal is injected through a 6 dB pad, subtract 6 dB from the attenuator reading for the actual signal level.

(1) 20 dB Quieting Sensitivity Check

The 20 dB quieting sensitivity should be 0.5 microvolt or less. The following procedure may be used to measure the 20 dB quieting sensitivity.

(a) Unsquelch the receiver and disable the receiver "Private-Line" function. "PL" disable can be accomplished by the momentary contact switch or by connecting TB1-1 in the junction box to chassis ground with a test lead.

(b) Connect the FM signal generator to the receiver antenna jack through a 6 dB pad. Set the signal generator to the receiver frequency, then turn the output down to minimum.

(c) Measure the receiver audio output with a solid-state ac voltmeter or equivalent. The measurement of noise can be taken across TB1-6 and -7 in any station except a repeater or wire line controlled station that does not have a local speaker. In that case a 3.2-ohm resistor or a 3.2-ohm speaker must be connected to TB1-6 and -7. The volume is controlled by R #1 LINE OUTPUT control in repeaters, LOCAL SPEAKER LEVEL in wire line control stations, and the VOLUME control on local control base stations. Adjust the receiver volume for a convenient meter reading such as 1 volt.

(d) Increase the output of the signal generator until the meter reading is 1/10th of that in step (c) (i. e., 20 dB below that in step (c)) making sure that the signal generator is exactly on-frequency. (The noise level decreases as the rf input to the receiver increases.)

(e) Read the setting on the signal generator output control and subtract 6 dB for the pad. This value in microvolts is the 20 dB quieting sensitivity of the receiver, which should be no greater than 0.5 microvolts.

(2) "Private-Line" Squelch Sensitivity Check

The "Private-Line" squelch sensitivity should be 0.25 microvolt or less. It may be measured as follows:

Make sure the station is not "PL" disabled (including the squelch gate jumper in repeaters). Connect a local speaker if one is not on the station to monitor the receiver audio.

Externally modulate the rf output of the signal generator with a "Private-Line" tone of the proper frequency to unsquelch the receiver at ±0.5 to 1 kHz deviation. The "Private-Line" tone can be generated by using a Motorola SLN6221A Transistorized "Private-Line" Tone Generator and the "Vibrasender" resonant reed from the

power supply of the radio set or by using a Motorola S1067A Transistorized Audio Oscillator and adjusting it to the "Private-Line" tone frequency. The tone frequency to be used is indicated on the "Vibrasponder" resonant reed in the receiver. Set the signal generator output level to zero and increase the level until the receiver unsquelches (noise is heard in the speaker). Take the reading from the attenuator of the signal generator. No more than 0.25 microvolt should be required to cause the receiver to unsquelch.

(3) Carrier Squelch Threshold Sensitivity Check

The squelch threshold sensitivity should be 0.25 microvolt or less. It may be measured as follows:

Disable the "Private-Line" function. Connect a local speaker if one is not on the station to monitor the receiver audio. If the station has two receivers, turn the other receiver's squelch control maximum clockwise. With no signal input, set the SQUELCH control so the noise just quiets (squelch threshold). Modulate the rf output of the signal generator with a 1000-Hz tone to produce a deviation of ±3.3 kHz. Set the signal generator output to zero and increase the level until the tone is heard in the speaker. Take the reading from the attenuator of the signal generator. No more than 0.25 microvolt should be required to open the squelch.

(4) Full Squelch Sensitivity Check

The full squelch sensitivity should be 1.25 microvolts or less. It may be measured exactly as the squelch threshold sensitivity except that the SQUELCH control is turned fully clockwise. No more than 1.25 microvolt should be required to open the squelch.

e. Test Set Readings

Use the built-in metering kit or connect a Motorola Portable Test Set and TKN6025A Adapter Cable to the receiver metering receptacle and set the function selector switch to the RCVR position. With no signal input, typical readings are as shown in Table 1.

NOTE

On multi-frequency models, check the readings on each frequency.

f. "Noise Gain" Measurements

If the receiver has no meter reading or an abnormal meter reading in position 1, the "noise-gain" check is a quick method of locating major

TABLE 1.
RECEIVER METERING READINGS (NO SIGNAL APPLIED)

Built-In Meter Selector Switch Position	Portable Test Set Metering Switch Position	Stage	Typical Reading (Microamps)
R1	1	455 kHz IF Amp (Q302)	2.0
R2	2	455 kHz IF Amp (Q303)	23
R+4, R-4	4	Discriminator Output	±2
R5	5	Base of 1st Dblr. (Q5)	25
R6	6	Base of 2nd Dblr. (Q6)	18

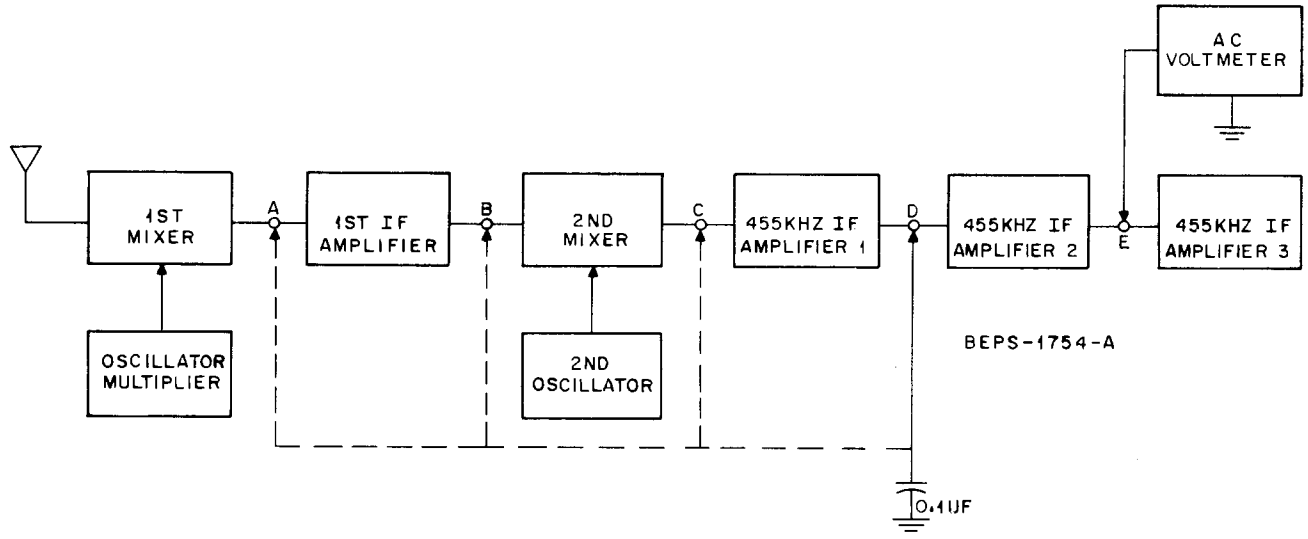


Figure 3. "Noise Gain" Measurement Test Set-Up

TABLE 2.
TYPICAL "NOISE GAIN" MEASUREMENTS

CAPACITOR CONNECTION POINT	TYPICAL VOLTMETER READING		"NOISE GAIN" STAGE	"NOISE GAIN" GAIN
Q10 Collector	4.8 mV	-44 dBm		
Q9 Collector	7.7 mV	-40 dBm	Q10	4 dB
Q3 Collector	12 mV	-36 dBm	Q9	4 dB
Q2 Collector	26 mV	-29 dBm	Q3	7 dB
Q1 Drain	35 mV	-27 dBm	Q2	2 dB
None	100 mV	-17 dBm	Q1	10 dB

malfunctions in the rf stages. This method will not locate misalignment or low rf gain, but will tell whether a stage is operative or inoperative.

Essentially, the "noise gain" check is a signal tracing method of troubleshooting. An ac voltmeter is connected at the base of Q11, then the input signal of each previous stage, in turn, is shorted to ground by a capacitor, starting at Q10 and working toward the antenna. Each additional stage should provide more noise which will be read on the voltmeter. A stage which produces no increase in noise or significantly less gain than listed in the table is defective. If this method does not locate the defective stage, perform the oscillator checks and stage gain measurements as listed in the following paragraphs.

The "noise gain" measurements may be performed as shown in Figure 3 and the results evaluated by comparing the readings obtained with the typical values listed in Table 2.

g. Oscillator Checks

(1) 1st Oscillator

(a) Connect a Motorola Portable Test Set to the receiver metering receptacle. Check position 5 (oscillator activity). If there is no reading or a low reading (18 uA is typical minimum reading) proceed to step (b). If the reading is normal, proceed to step (c).

(b) Measure the rf voltage with a Motorola Solid-State DC Multimeter with rf probe at pin 1 of the channel element. A normal reading of approximately 1.7 volts rf should be obtained. Make voltage and resistance checks to locate the defective component.

(c) Measure the rf voltage with a Motorola Solid-State DC Multimeter with rf probe at the source of the 1st mixer Q1. A normal reading of at least 0.3 volt rf should be obtained. Make voltage and resistance checks to locate the defective component.

(2) 2nd Oscillator

Measure the rf voltage with a Motorola Transistorized DC Multimeter at the emitter of the 2nd oscillator (Q4) or the base of the 2nd mixer (Q3). A normal reading of 0.10 volt rf should be obtained. Make voltage and resistance checks to locate the defective component.

h. Stage Gain Measurements

Simple troubleshooting procedures such as transistor substitution into a suspected stage may tell little about the source of trouble. Because transistors are current devices with negative temperature co-efficients damage can occur when soldering or unsoldering. A different approach to troubleshooting transistorized circuits must be used. The defective section must first be isolated through stage gain measurement before any attempt is made to locate and replace the defective component. When the defective section has been isolated, the defective stage can be determined by voltage and resistance checks which can also isolate the defective component.

A typical stage-by-stage checkout follows. Individual stage gains may vary somewhat from the typical values given if overall gain is maintained. The amplifiers must be kept out of saturation to present a true presentation of gain. Do not use signal levels higher than indicated in the following procedures.

(1) RF Deck

(a) Connect the portable test set to the receiver metering receptacle, place the function selector in the RCVR position, and place the selector switch in position 1.

(b) Using the FM signal generator and TEK-10 RF Probe, inject a carrier frequency signal at the rf input receptacle of the receiver chassis. Adjust the signal generator output level for a reading of 10 microamperes on the test set meter. Note the signal level in db on the attenuator of the signal generator.

(c) Move the TEK-10 RF Probe to the output of the rf deck (drain of Q1) and inject a carrier frequency signal. Increase the output level of the signal generator until the test set meter again reads 10 uA. Note the attenuator settings in db.

(d) The apparent gain should be at least 55 dB; that is the reading in step (c) should be at least 55 dB greater than the reading in step (b).

NOTE

If a reading cannot be obtained on the test set meter, inject a 455-kHz signal into the 3rd 455-kHz amplifier so that a reading is obtained and into each stage progressing toward the antenna until the defective stage is found.

(2) 11.7-MHz IF Circuit

(a) Connect the signal generator to the rf input receptacle of the receiver chassis. Set the signal generator to the receiver frequency.

(b) Place the TEK-7A RF/DC Alignment Meter switch in the .5 V RF position and the probe RF/DC switch in the RF position.

OR

Use a Motorola Solid-State DC Multimeter with an rf probe and place the range selector switch in the .3 VOLT position.

(c) Place the rf probe of the meter at the input to the 11.7-MHz i-f circuit board (WHT lead to L8) and adjust the signal generator output level for an indication of 5 uA (.05 volt) on the alignment meter, or 0.3 volt if a dc multimeter is used. Note the setting of the attenuator in db on the signal generator.

(d) Move the rf probe of the meter to the output of the 11.7-MHz i-f circuit board (BRN lead from the collector of Q3 and again adjust the signal generator for an indication of 5 uA on the alignment meter, or 0.3 volt on the multimeter. Again note the setting of the attenuator in dB.

(e) The gain should be at least at 16 dB; that is the reading in step (c) should be at least 16 dB greater than the reading in step (d). If the gain is low, the following steps may be performed to further isolate the trouble.

(f) Using the same procedure that was used in steps (a) through (d), move the rf probe to each of the following points and readjust the output level of the signal generator for an alignment meter indication of 5 uA or multimeter indication of 0.3 volt at each point. Take readings from the attenuator of the signal generator.

Point of Measurement	Typical Gain or Loss
Base of 11.7-MHz IF Amplifier Q2	5 dB less than input to circuit board
Collector of 11.7-MHz IF Amplifier Q2	12 dB greater than base of Q2
Collector of 2nd Mixer Q3	15 dB greater than collector of Q2

(3) 455-kHz "Permakay" Filter

(a) Set up the signal generator and the alignment meter or dc multimeter as described for the 11.7-MHz IF Circuit in the preceding paragraph.

(b) Place the rf probe at the input to the 455-kHz i-f filter (BRN lead to the i-f circuit board) and adjust the signal generator level for an indication of 5 uA on the alignment meter or 0.3 volt on the dc multimeter. Note the setting of the attenuator in dB.

(c) Move the rf probe of the meter to the output of the 455-kHz i-f filter and readjust the signal generator so that the meter gives the same indication as in step (b). Again note the setting of the attenuator in db.

(d) The gain should be 29 dB; that is, the reading in step (b) should be 29 dB greater than the reading in step (c). If the gain is abnormally low, the filter is defective.

(4) 455 kHz IF Amplifiers 1 and 2

(a) Leave the signal generator connected to the rf input receptacle of the receiver chassis and adjusted to the receiver carrier frequency.

(b) If the TEK-7A RF/DC Alignment Meter is used, set the range selector switch to the 5 V RF position and the switch on the probe to the RF position. If the Solid-State DC Multimeter and rf probe are used, set the range selector switch to the 1 VOLT position.

(c) Place the rf probe of the meter at the input to the 455-kHz i-f amplifier circuit board (BRN lead at the base of Q301) and adjust the level of the signal generator for 5 uA (0.5 volt) on the alignment meter or 0.5 volt on the multimeter. Note the setting of the attenuator in dB.

(d) Move the rf probe of the meter to the base of 455-kHz i-f amplifier #3 (Q303) and readjust the signal generator level so that the meter gives the same indication as in step (c).

(e) The gain should be at least 53 dB; that is, the reading in step (c) should be at least 53 dB greater than the reading in step (d). If the gain is low, the individual gain of each stage may be checked as given in the following step.

(f) Move the rf probe to the base of 455-kHz i-f amplifier #2 Q302 and readjust the signal generator for the same indication on the meter that was obtained in steps (c) and (d). The gain of Q301 should be 26 dB; that is, the reading should be 28 dB less than the reading in step (c). The gain of Q302 should be 27 dB; that is, the reading for this step should be 27 dB greater than the reading in step (d).

(5) 455-kHz IF Amplifier 3 and Limiters

Due to the saturation condition of the remaining 455-kHz i-f stages, further stage gain measurements are not applicable. Measurements may be made with a Motorola Solid-State AC Voltmeter or equivalent. Typical value with no receiver signal input are as follows:

3rd 455-kHz i-f amplifier collector (Q303)	1.5 Vac
1st 455-kHz i-f limiter collector (Q304)	1.6 Vac
2nd 455-kHz i-f limiter collector (Q305)	5.5 Vac

(6) Audio Circuit Checks

(a) Connect the TEK-11 Audio Adapter between the portable test set and the TKN6025A Adapter Cable, then connect the adapter cable to the receiver metering receptacle. Place the function selector switch in the RCVR position, and the selector switch in position 11.

(b) Set the volume or line output control on the control unit to minimum (full counterclockwise) and disable the "PL" (a test lead from TB1-1 to ground will disable the "PL").

(c) Inject a 1000-Hz tone from a Motorola TEK-1A Transistorized Tone Generator at the "input from discriminator" lead to the audio and squelch circuit board (GRN-RED lead from 455-kHz i-f amplifier circuit board). Set the tone generator for 0.4 volt rms output.

(d) Inject a carrier signal from the FM signal generator into the receiver antenna receptacle and set "on-frequency". Set the attenuator at 1000 microvolts. (This step quiets the noise to give an audio only measurement.)

(e) Turn the volume or line level control clockwise until the test set meter reads at least 30 uA (5 watts of audio power). The OPEN-SPKR-LOAD switch on the test set must be in the LOAD position and the TEK-11 Audio Adapter must be used to prevent driving the meter off-scale. If the station has a local speaker use the OPEN position.

TABLE 3.
TYPICAL RECEIVER AUDIO READINGS

METERING POINT	TYPICAL READING*
Base of preamplifier Q341	100 mV
Collector of preamplifier Q341	700 mV
Center arm of volume control (GRN lead connections of audio and squelch circuit board)	320 mV
Base of pre-driver Q342	100 mV
Collector of pre-driver Q342	700 mV
Base of differential amplifier Q343	100 mV
Base of differential amplifier Q344	56 mV
Collector of differential amplifiers Q343, Q344	3 V (each)
Base of output amplifiers Q345, Q346, (WHT-BLU and WHT-BRN connections)	0.55 V (each)
Collector of ourput amplifiers Q345, Q346	10 V (each)
Across speaker or secondary of T351	5.0 V

*Signal injection 0.4 v @ 1000 Hz at input to audio board.
Volume control setting @ maximum.
Receiver in full squelch and 1000 microvolts unmodulated signal.

TABLE 4.
TYPICAL CARRIER SQUELCH CIRCUIT READINGS

METERING POINT	TYPICAL READING
Input to audio board (GRN-RED lead from 455-kHz i-f board)	0.5 to 1 Vac
Base of limiter Q347	0.35 to 0.70 Vac
Collector of limiter Q347	3 Vac
Base of noise amplifier Q348	0.6 V ac
Collector of noise amplifier Q348	2.8 V ac
Base of noise detector Q349	0.7 V USQ -- 1.3 V FSQ
Collector of noise detector (Q349)	10.5 V USQ -- 4.8 V FSQ
Base of switch Q350	10.5 V USQ -- 4.9 V FSQ
Emitter of switch Q350	7.9 V USQ -- 5.6 V FSQ
USQ = Receiver Unsquelched. FSQ = Receiver Fully Squelched.	

(f) If 5 watts of audio output cannot be obtained, signal level readings may be taken at each stage of the audio and squelch circuit to isolate the trouble to a defective stage. Readings may be taken with a Motorola Solid-State AC Voltmeter, or equivalent, with a 1000 Hz tone input at 0.4 volt as described in step (c). With this input, and maximum VOLUME setting, the minimum signal level at each stage in the circuit is shown in Table 3.

NOTE

Normally, signal levels will be significantly higher than the minimum levels shown. Final audio output will often be over 8 watts.

(7) Squelch Circuit Checks

Disable the "Private-Line" function and turn the SQUELCH control fully clockwise to completely squelch the receiver. With no rf signal input, make the measurements as listed in Table 4 to determine whether or not the stages are operating properly and to isolate any malfunction in the circuit. If the receiver does not have sufficient noise to obtain the first reading, it may be necessary to connect the antenna to the receiver. Make the ac voltage measurements with a Motorola Solid-State AC Voltmeter, or equivalent, and dc voltage measurements with a Motorola Solid-State DC Multimeter or equivalent.

(8) Receiver Mute

If a two-receiver station is equipped with a receiver priority option, disconnect the muting input lead to the receiver and recheck operation. If operation is normal, troubleshoot the receiver priority circuits. In the local control unit (local control models) or power supply (remote control units).

i. "Private-Line" Tone-Coded Squelch Circuit Maintenance

(1) General

The "Vibrasponder" resonant reed serves as the frequency sensitive switching device in the receiver "Private-Line" squelch circuit. The reed is a precision built device. It consists of a tuned cantilever reed of special steel mounted on a rugged base with a coil and two permanent magnets. The entire assembly is spring-mounted and hermetically sealed in a metal housing to insure long life at peak performance under all types of conditions. Its resonant frequency is accurate within ±0.15%.

The tone-actuated squelch circuit begins with a low-pass filter and "PL" amplifier in the "PL" decoder which receives its input directly from the audio preamplifier. The output of the "PL" amplifier is coupled to an amplifier and clipper stage before it is applied to a driver stage which drives the coil of the resonant reed. When the detected tone signal applied to the reed is the same as its resonant frequency, the reed vibrates and causes a detector to respond and forward bias the output switch transistor in the decoder.

The output of the switch supplies cutoff bias to the squelch switch. When the squelch switch is cut off, the audio pre-driver stage turns on to convey audio to the differential amplifiers. In the absence of a proper tone signal, the squelch switch is on, cutting off the audio stages and quieting the speaker.

The sensitivity of the resonant reed is factory adjusted to give optimum performance for several years of continuous duty in the average system. The design of the "Vibrasponder" resonant

reed eliminates the need for servicing throughout its useful life.

(2) Servicing

There are no special adjustments involved. Servicing is a matter of detecting and replacing defective components.

It is recommended that the serviceman keep a record of the test performed, voltage readings and other pertinent servicing data, each time the equipment is serviced. This will serve as a guide to normal operating conditions of individual units.

(3) Performance Checks

The receiver "PL" squelch sensitivity should be 0.25 microvolt or less.

There should be no "squelch tail" (noise burst from the speaker when the push-to-talk switch is first released). Also, there should be no "squelch tail" at the end of transmission from other stations in the communications system.

(4) Localizing the Defective Component

Gain measurements in the "Private-Line" decoder should be made with an input of 60 millivolts. Set up test equipment for gain measurements as follows:

Externally modulate the rf output of the signal generator with a "Private-Line" tone of the proper frequency to unsquelch the receiver at 0.5 kHz deviation. The "Private-Line" tone can be generated by using a Motorola Model SLN6221A Tone Generator and the "Vibrasender" resonant reed from the power supply of the radio, or by using a Motorola S1067A Transistorized Audio Oscillator and adjusting it to the "Private-Line" tone frequency. The tone frequency to be used is indicated on the "Vibrasponder" resonant reed in the receiver. Set the signal generator to the receiver carrier frequency and inject the output into the rf receptacle on the receiver chassis. Adjust the output level of the signal generator to 1000 microvolts. Make ac voltage measurements with a Motorola Solid-State AC Voltmeter or equivalent. Measure the ac signal voltage at the input to the decoder board and readjust the tone modulator for 60 millivolts on the ac voltmeter. Make voltage measurements at the points designated and compare with the typical readings in Table 5.

If "squelch tail" noise bursts are heard in listening receivers, check voltages in the "reverse burst" switch circuit of the transmitting station.

j. Receiver Balance

Check receiver balance. Shift the signal generator frequency above and below the carrier frequency while monitoring the portable test set meter on position 4. The meter should swing equal distances above and below the zero center reading for equal shifts in frequency.

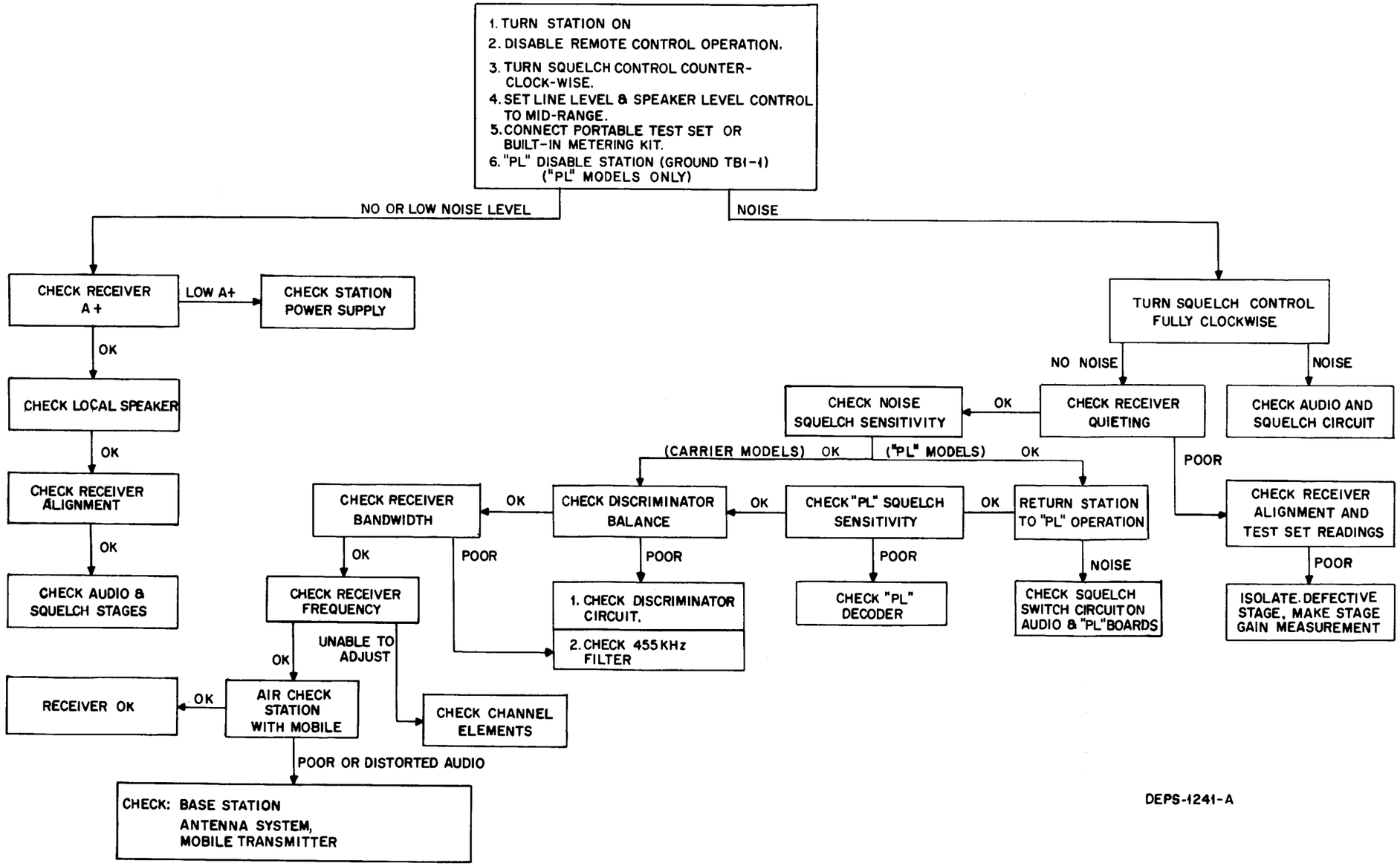
k. Receiver Audio

Check the receiver audio section. With the VOLUME control at maximum and the carrier signal modulated with 1000-Hz tone at 2/3 rated system deviation (3.3 kHz), there should be at least 5 watts audio output (4 volts ac across the speaker).

TABLE 5.
"PL" DECODER READINGS

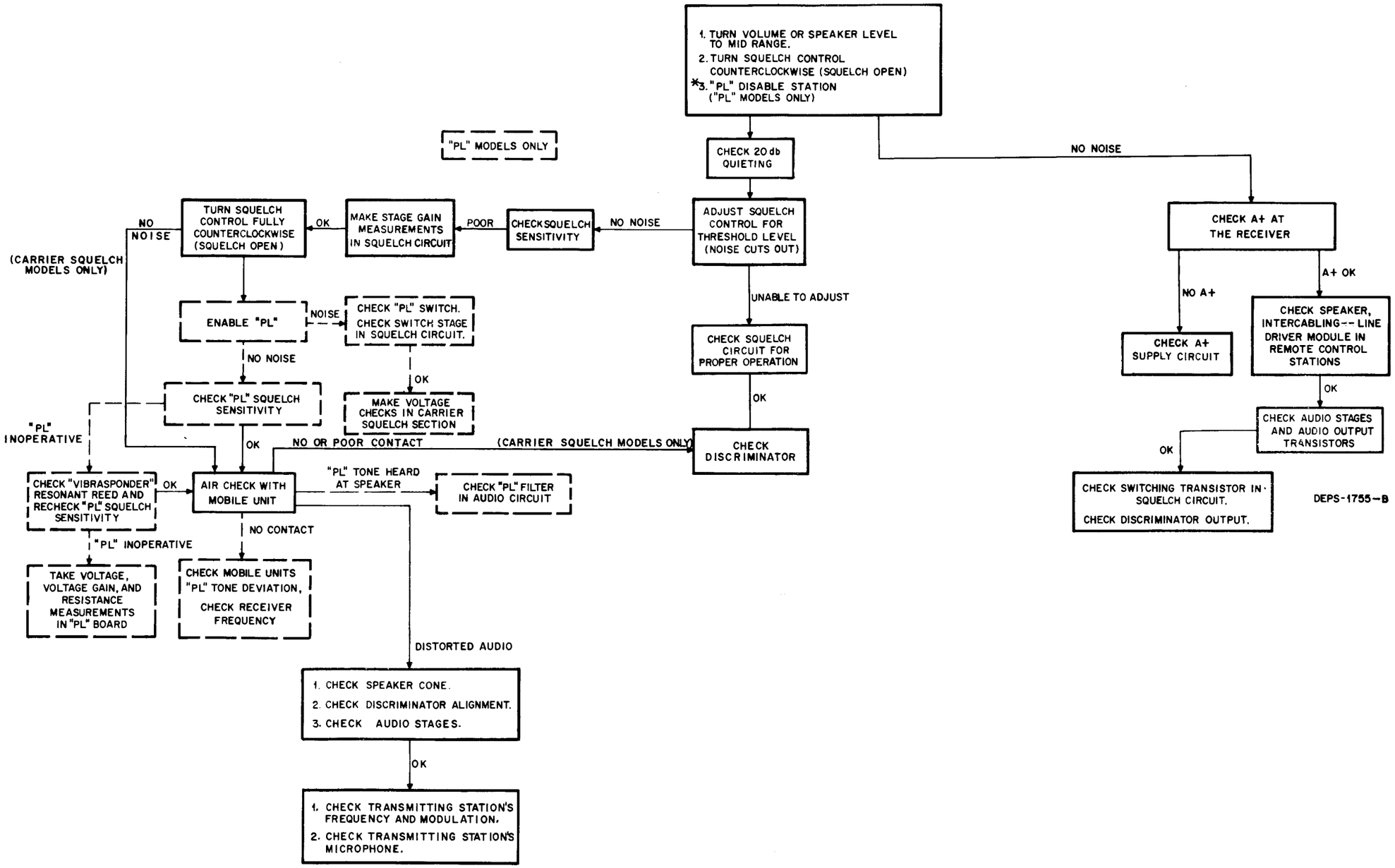
METERING POINT	TYPICAL READING*
Input to decoder board (GRAY-GRN lead from audio board)	60 mV ac
Base of "PL" Amplifier (Q751)	10 mV ac
Collector of "PL" Amplifier (Q751)	220 mV ac
Base of amplifier/clipper (Q752)	210 mV ac
Collector of amplifier/clipper (Q752)	2.8 V ac
Base of "Vibrasponder" driver (Q753)	540 mV ac
Emitter of "Vibrasponder" driver (Q753) (primary of resonant reed)	500 mV ac
Base of amplifier (Q754) (secondary of resonant reed)	100 mV ac
Collector of amplifier (Q754)	2.0 V ac
Base of detector (Q755)	1.8 V ac
Collector of detector (Q755)	2.7 V dc
Base of output switch (Q756)	11.4 V dc
Collector of output switch (Q756)	11.9 V dc
Base of noise switch (Q757)	0.7 V dc
*Readings taken with 1000 mv input rf signal and 0.5 kHz tone deviation.	

RECEIVER TROUBLESHOOTING CHART



DEPS-1241-A

AUDIO AND SQUELCH TROUBLESHOOTING CHART



Individual stages can be checked by injecting an audio signal and measuring signal voltages at each stage. Set the receiver VOLUME control to maximum and the SQUELCH control fully counterclockwise (unsquelched). On "Private-Line" tone-coded squelch models, also "PL" disable. Inject a 1000-Hz tone at 0.4 volt rms into the audio board (input from discriminator). The Motorola SLN6221A Transistorized Tone Generator is ideal for generating this tone.

1. Removal of Circuit Boards

Complete removal of the printed circuit boards for access to components is not always necessary.

The steps called out on the circuit board removal illustrations should be followed to prepare various parts of the receiver for servicing. Observe standard servicing practices, such as tagging of leads and identification of connecting points.

When removing circuit boards from the front of the receiver, remove the oscillator cover shield before starting to unsolder any leads.

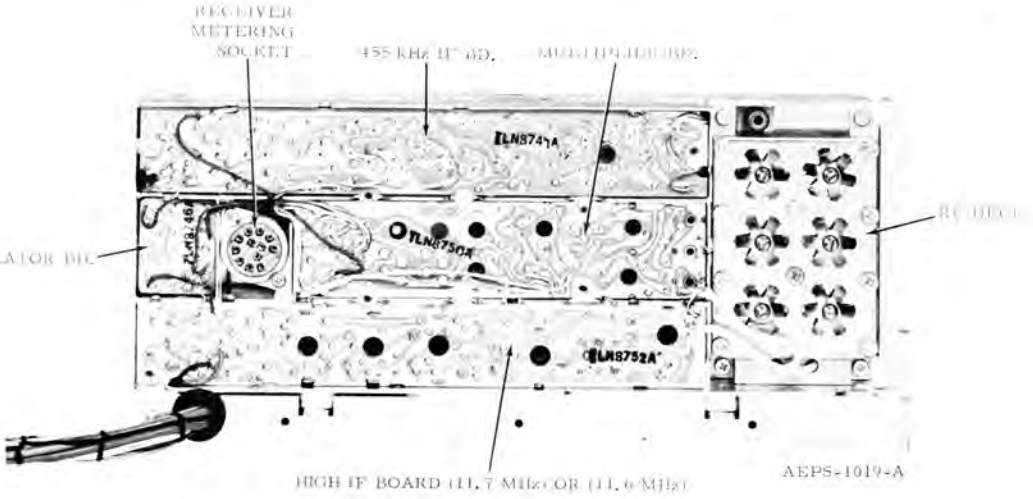


Figure 4.
Parts Location Detail, Front View

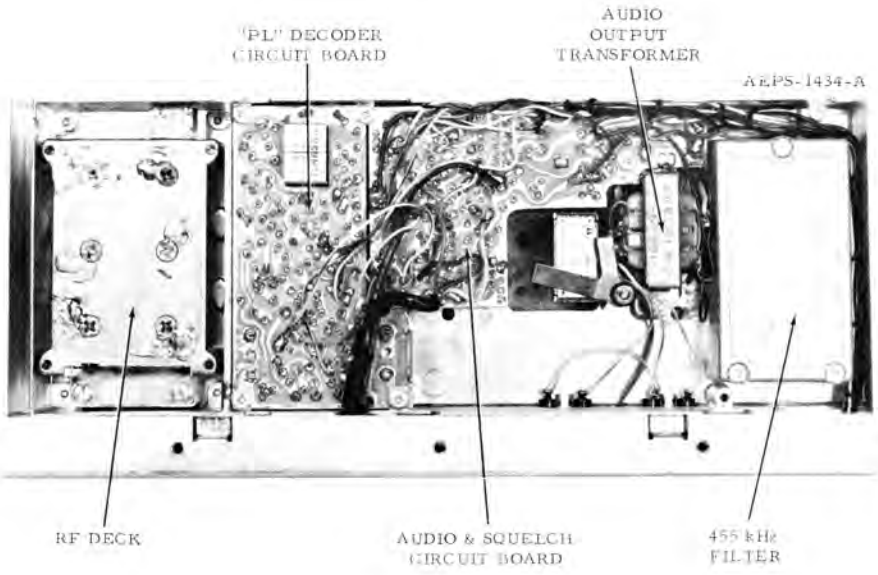


Figure 5.
Parts Location Detail, Rear View

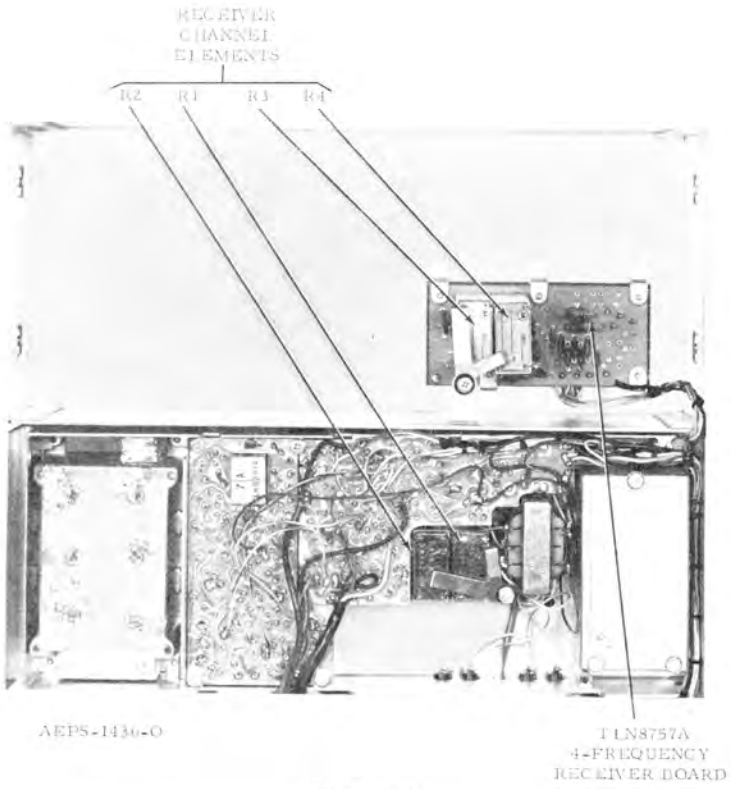


Figure 6.
Multi-Frequency Receiver Parts Location Detail

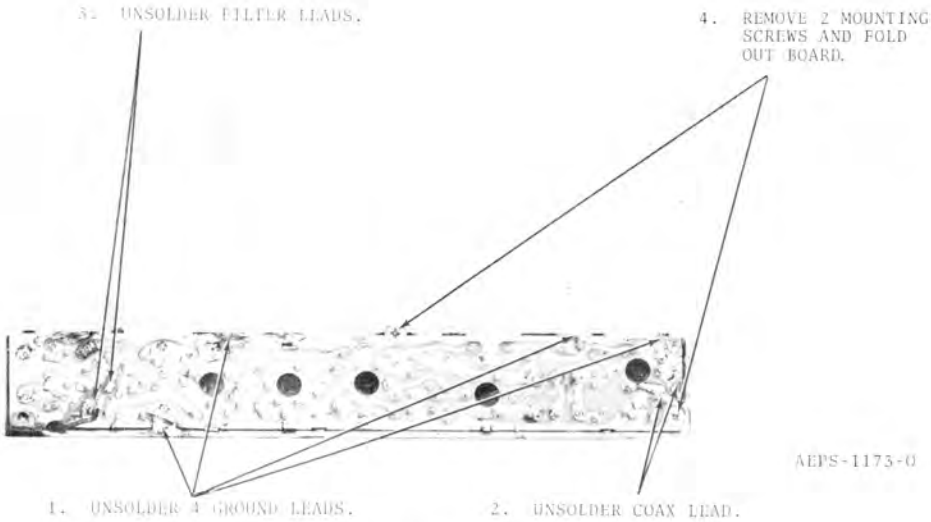


Figure 7.
Access to High IF Board

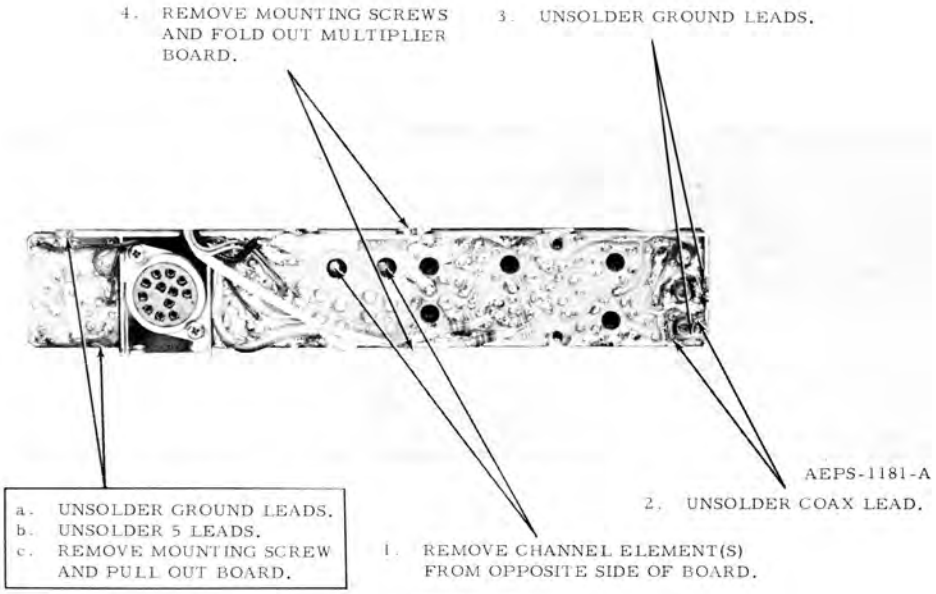


Figure 8.
Access to Multiplier and Regulator Boards

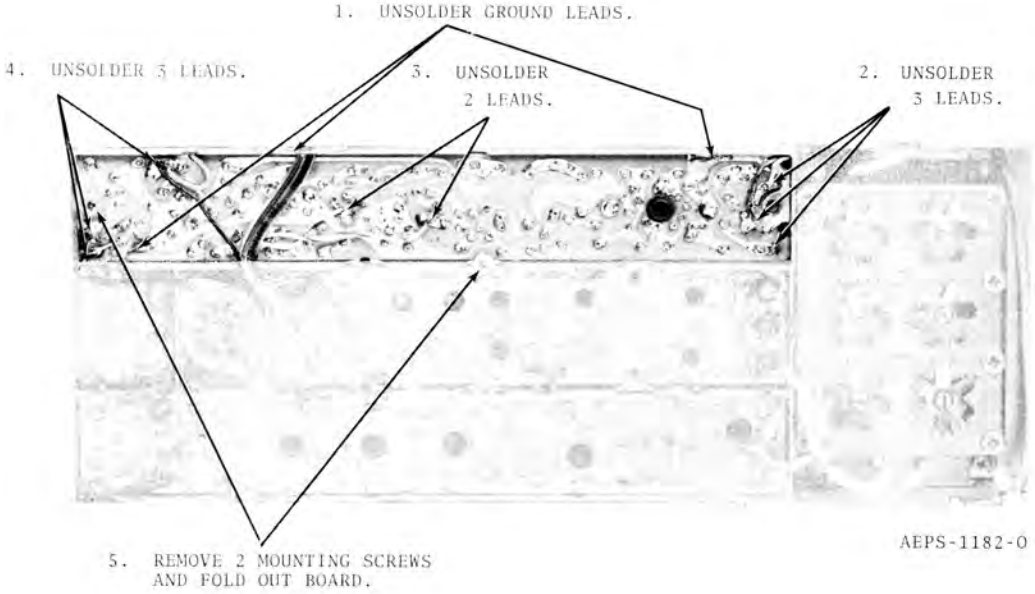
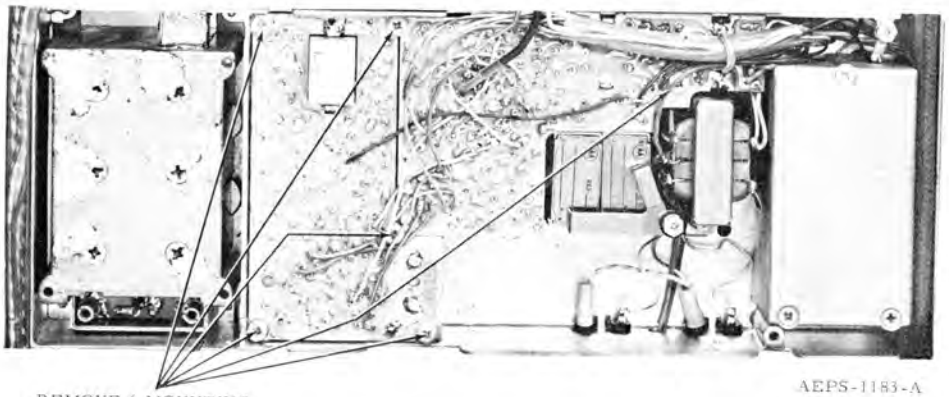


Figure 9.
Access to 455 kHz IF Amplifier Circuit Board

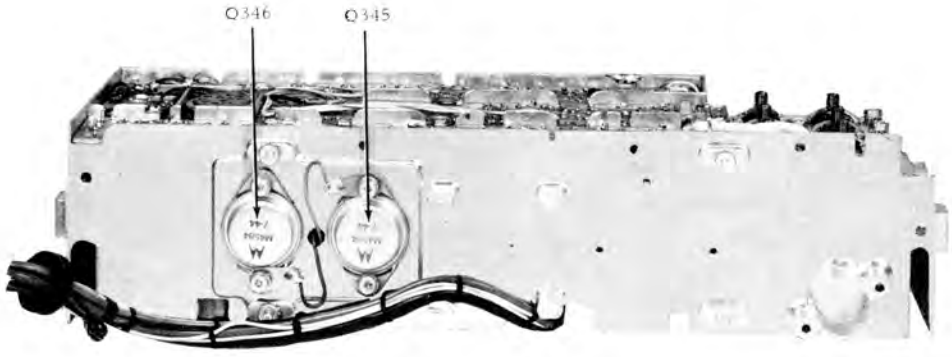


AEPS-1183-A

REMOVE 6 MOUNTING SCREWS AND FOLD OUT BOTH BOARDS TOGETHER.

USE CARE WHEN FOLDING OUT BOARDS TO INSURE THAT INTERCONNECTING LEADS ARE NOT BROKEN.

Figure 10.
Access to Audio & Squelch and "Private-Line" Decoder Circuit Boards

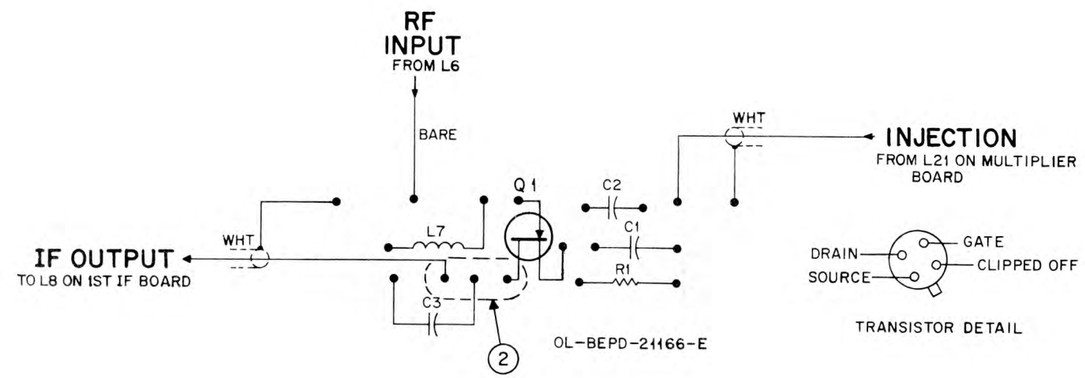


AEPS-1435-O

Figure 11.
Audio Power Transistor Locations

REVISIONS

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLE6362A	Q1	WAS 48R869565 TYPE M9565	1ST MIXER
TLE6362A-1 TLE6363A		430-450 MHz MODEL ADDED	PARTS LIST
TLE6364A TLE6365A		470-494 MHz & 494-512 MHz MODELS ADDED	



REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

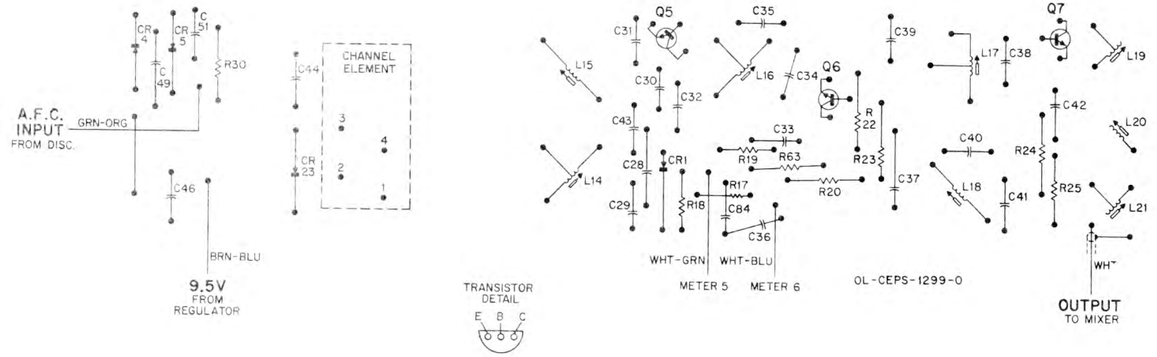
Model TLE6360A Series RF Deck
Circuit Board Detail
Motorola No. PEPS-1162-H
6/5/74-NPC

REVISIONS

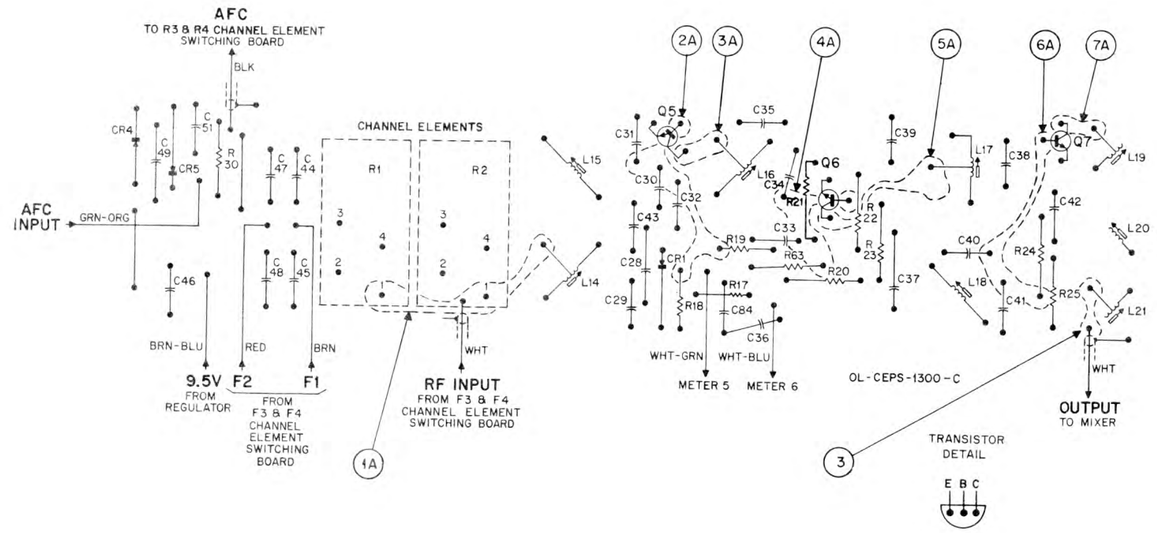
PEPS-14104-A

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8748A TLN8749A	C30	WAS 21C82187B06, 560 pF	PARTS LIST
TLN8748A-1 TLN8749A-1 TLN4563A TLN4564A		450-480 MHz MODELS ADDED	
TLN4770A TLN4771A TLN4772A TLN4773A		470-494 MHz & 494-512 MHz MODELS ADDED	

SINGLE-FREQUENCY



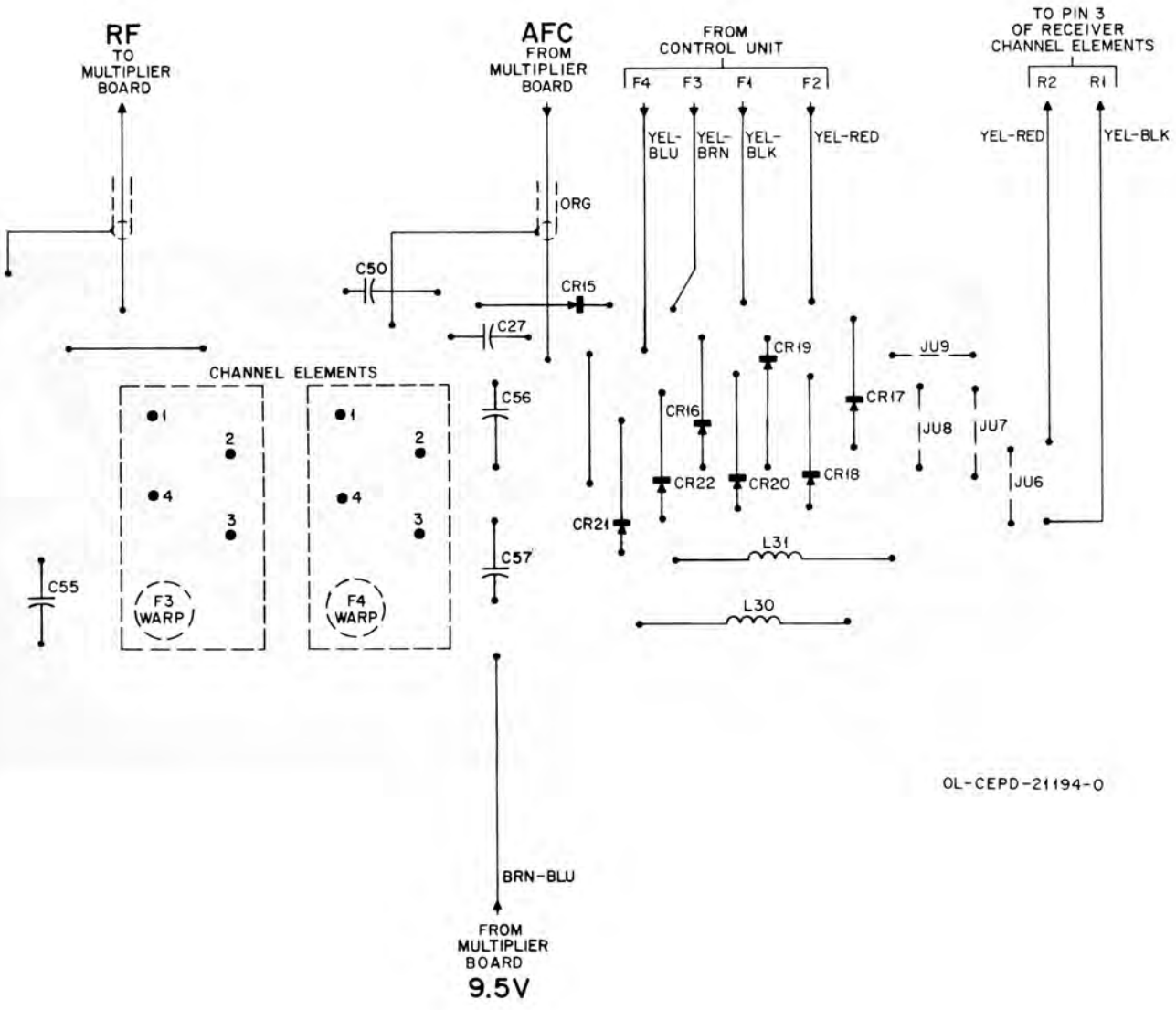
MULTI-FREQUENCY



RECEIVER

REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

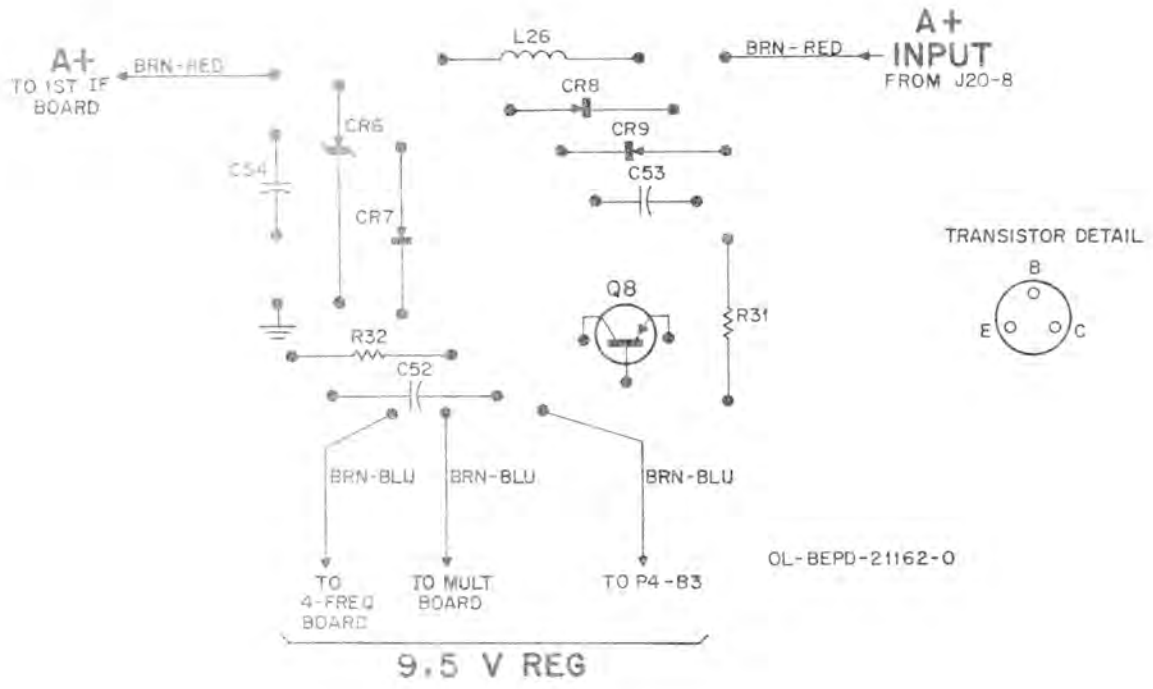
Multiplier Circuit Board Detail
For 1-Frequency and 4-Frequency Receivers
Motorola No. PEPS-14104-A
6/5/74-NPC



RECEIVER

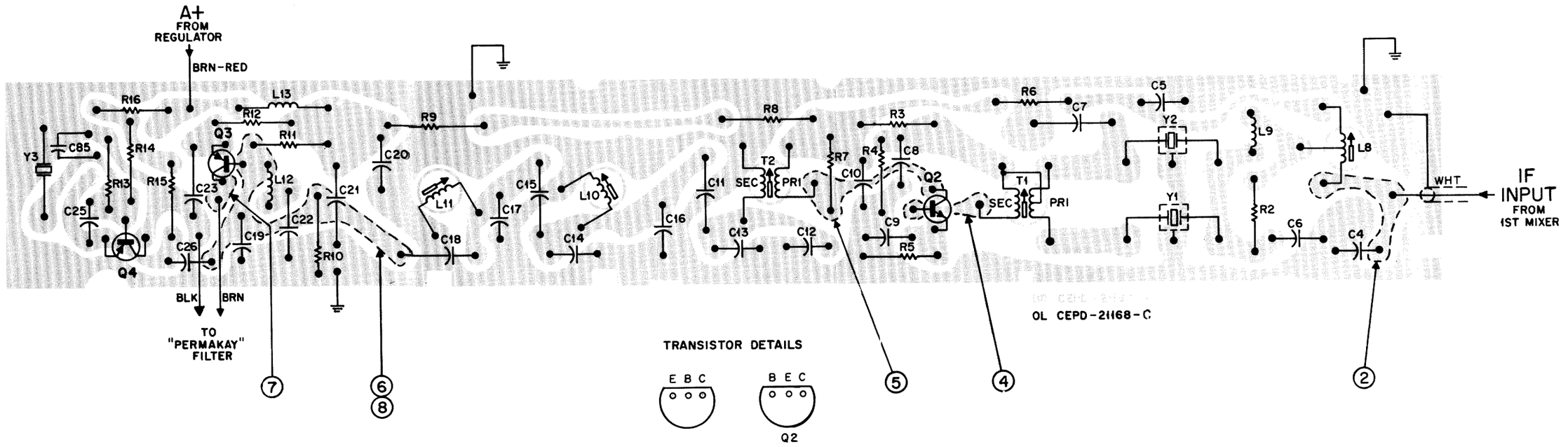
REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

Four-Frequency Receiver Channel Element and Switching Board Detail
Motorola No. PEPS-1163-C
6/5/74-NPC



RECEIVER

LENS7464 Voltage Regulator
Circuit Board Detail
Motorola No. FE1S-1110
6/13/71-NPC



RECEIVER

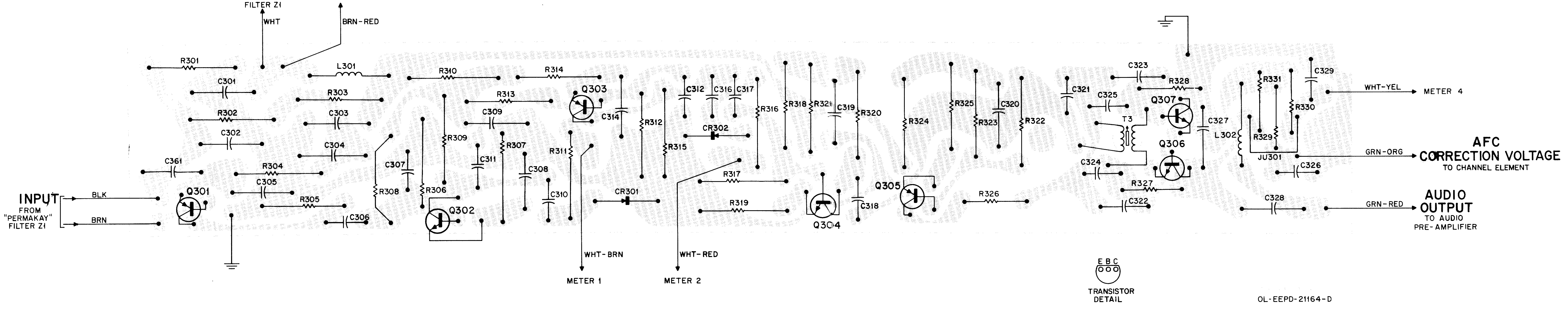
REFER TO RECEIVER SCHEMATIC
DIAGRAM FOR NOTE REFERENCES

TLN8752A 1st IF and
2nd Oscillator Circuit Board Detail
Motorola No. PEPS-1293-G
6/5/74-NPC

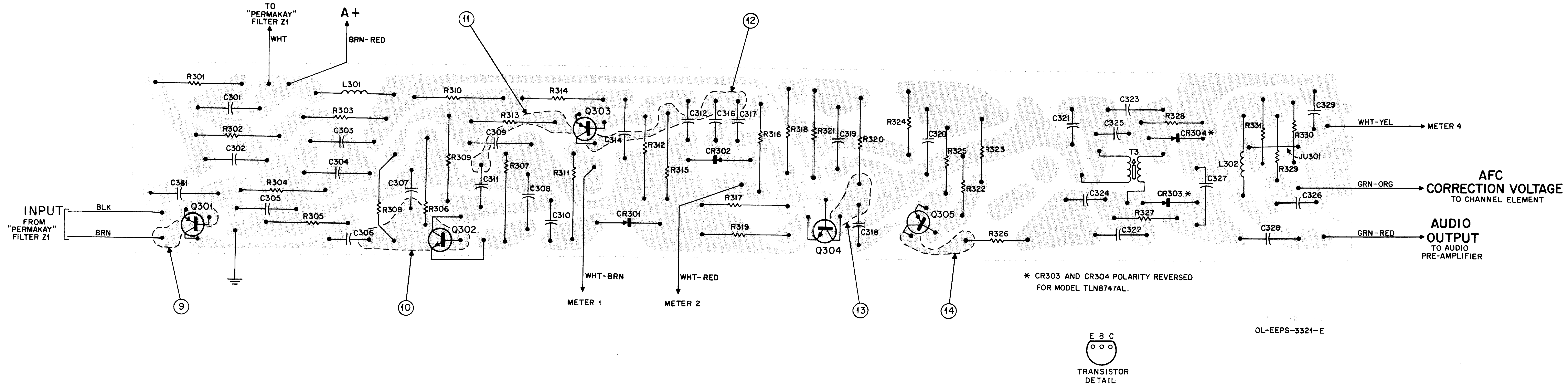
REVISIONS PEPS-14110-O

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8747A-1 TLN8747AL-1	C313	REMOVED (WAS 21D82428B59, .01 uF CONNECTED BE-TWEEN GROUND AND JUNCTION OF R311 AND WHT-BRN METER -1 LEAD)	CENTER OF BOARD
	C315	REMOVED (WAS 21D82428B59, .01 uF CONNECTED BE-TWEEN GROUND AND JUNCTION OF R316 AND WHT-RED METER -2 LEAD)	CENTER OF BOARD
TLN8747A-2 TLN8747AL-2		EXTENSIVE CIRCUIT CHANGES	REFER TO PEPS-3325-O

TLN8747A-1 & TLN8747AL-1



TLN8747A-2 & TLN8747AL-2



RECEIVER

REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

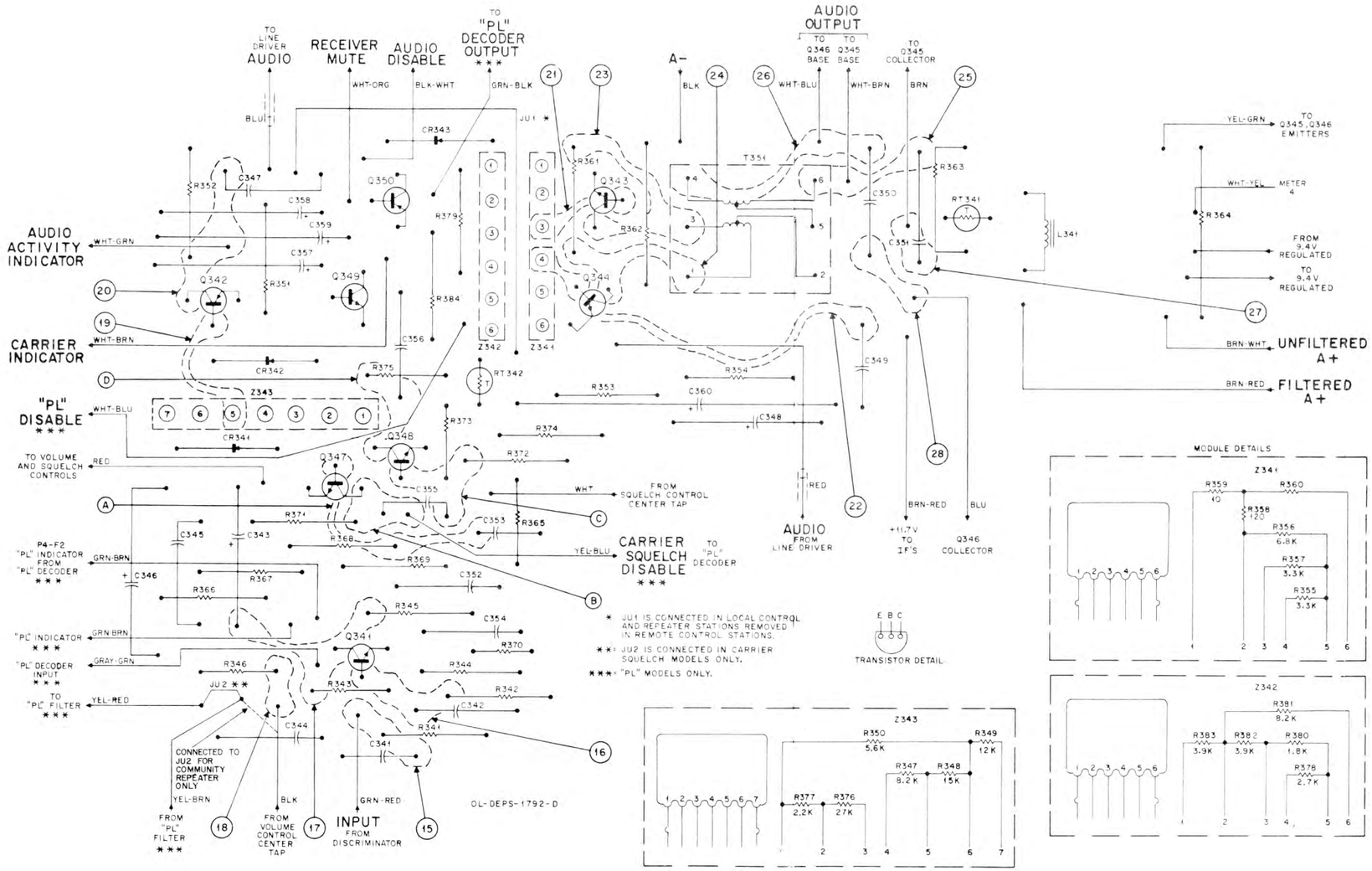
PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN8747A & TLN8747AL
455 kHz IF Amplifier
Circuit Board Detail
Motorola No. PEPS-14110-O
6/5/74-NPC

REVISIONS

PEPS-1793-F

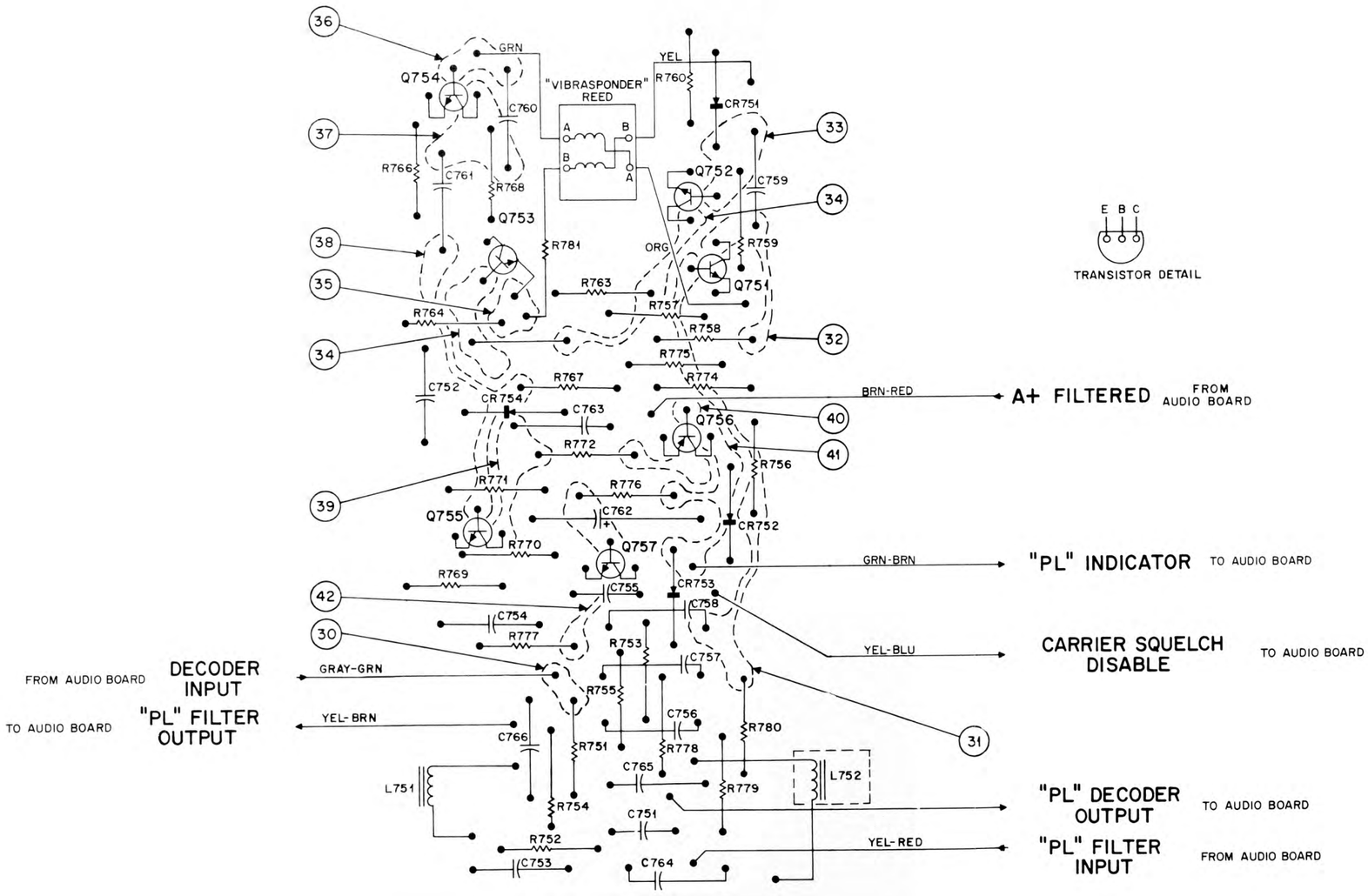
BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8783A-1	R362	WAS 68,241, 5%, ±10%, 1/2 W	13J2 PRIMARY LAY.
TLN8783A-2			



RECEIVER

REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

TLN8783A-2 Audio and Squelch Circuit Board Detail
Motorola No. PEPS-1793-F
6/5/74-NPC



OL-DEPS-444-B

RECEIVER

REFER TO RECEIVER SCHEMATIC DIAGRAM FOR NOTE REFERENCES

"Private-Line" Decoder and Filter
Circuit Board Detail
Motorola No. PEPS-446-D
6/5/74-NPC

REVISIONS

63P81001E17-L

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN8747A-1 TLN8747AL-1				455 kHz IF BD, PEPS-1167-A
TLN8747A-2 TLN8747AL-2		EXTENSIVE CIR-CUIT CHANGES		455 kHz IF BD, PEPS-1325-D
TLN8752A-1 TLN8752AL-1 TLN8753A-1 TLN8753AL-1				1ST IF & 2ND OSC, BD, PEPS-1291-A
TLE9362A-1				RF DECK, PEPS-1162-C
TLN8783A-2				AUDIO & SQUELCH BD, PEPS-1793-C
TLN8748A-1 TLN8749A-1				MULTIPLIER BD, PEPS-1783-C
TLN8846A	C62	ADDED .05 uF	J11-4	NONE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST (ALSO SEE SHEET 2)

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN8846A Metering Socket & Cable — PL-315-A

C58, 59, 60, 61	21C832501	CAPACITOR, fixed: .01 uF +60-40%, 250 v
C86	21C82372C07	.05 uF +80-20%, 25 v
J1	9C857358	CONNECTOR, receptacle: female; 12 cont.
R32, 34	6S129225	RESISTOR, fixed: 10K ±10%; 1/4 w

IF Filter — PL-314-O

Z1	TFN6022AS	FILTER, IF bandpass: (split channel); center freq. 455 kHz

TLN8993A Receiver Chassis Kit (Carrier Squelch)
TLN8994A Receiver Chassis Kit (Tone-Coded Squelch) — PL-317-A

Q345, 346	48K134584	TRANSISTOR: (SEE NOTE I) P-N-P; type M4584; does not incl, 14B82399B01 INSULATOR, mtg
T352	25C82061H02	TRANSFORMER, AF: lug terminals (not marked) pri: center tapped; total res 0.5 ohms ±10% sec: res 0.2 ohms max.
XQ345, 346	9B851303	SOCKET, transistor: 2 cont

Channel Element (Receiver) — PL-349-O

	CER-106A	receiver control: ±.0005% freq. stability incl, TLN8967A OSCILLATOR; receiver RES-106A RESONATOR, receiver

Channel Element (Receiver with AFC) — **PL-423-O**

	CER-106B	**CHANNEL ELEMENT, receiver control: capable of ±.0002% frequency stability in receivers with AFC; consists of: TLN8968A Oscillator Module RES-106B Resonator Module (crystal)**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

Channel Element — PL-313-A

	CER107B	CHANNEL ELEMENT, receiver control: frequency stability ±5 ppm; c/o: TLN8968A OSCILLATOR MODULE, receiver: 400-512 MHz, RES-107A RESONATOR MODULE incl, quartz crystal NOTE This channel element must be used in the "No. 2 receiver" in two-receiver installations when the incoming carriers have a separation of 5, 85 or 11.7 MHz (±50 kHz)

TLN8757A Four-frequency Receiver Board — PL-321-A

C27, 50, 55, 56, 57	21D82428B59	CAPACITOR, fixed: .01 uF +80-20%, 200 v
CR15 thru 22	48C82392B03	SEMICONDUCTOR DEVICE, diode: (NOTE I) silicon
L30, 31	24V80900A61	COIL, RF: choke; 0.62 uH

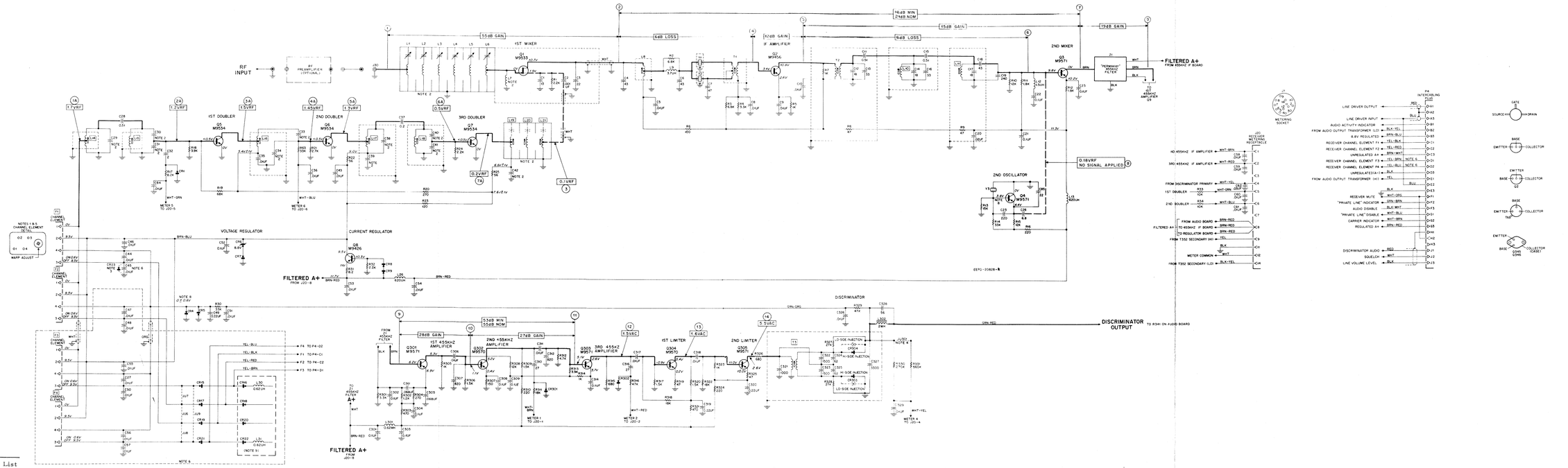
TKN6373A Cable Kit (1-Freq)
TKN6374A Cable Kit (4-Freq) — PL-316-A

P4		CONNECTOR, plug: c/o: 14C82337A11 BODY 29C8233A01 TERMINAL, contact: male 29C82336A02 TERMINAL, contact: female 15D83934A11 COVER

TLN8746A Regulator Board — PL-323-A

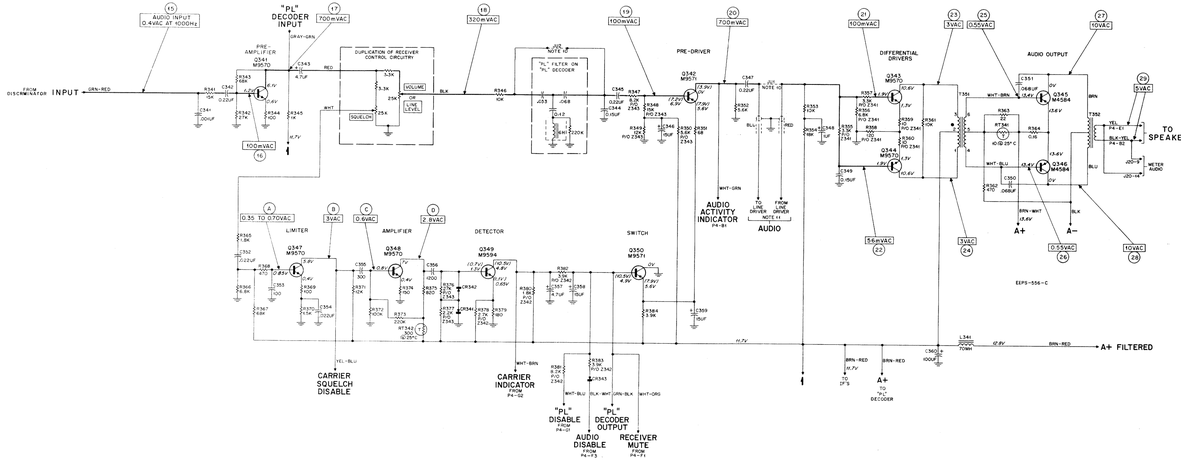
C52	8D82905G30	CAPACITOR, fixed: 0.1 uF ±10%; 50 v
C53	21D82428B59	.01 uF ±20%; 200 v
C54	21D82428B62	.01 uF ±20%; 200 v
CR6	48D8253JD10	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) silicon; zener type
CR7, 8, 9	48C82392B03	silicon
L26	24D82135G08	COIL, RF: choke; 620 uH
Q8	48R869426	TRANSISTOR: (SEE NOTE I) P-N-P; type M9426; does not incl, 14B83878G01 INSULATOR, mounting
R31	6S124B67	RESISTOR, fixed: 8.2 ±5%; 1/4 w
R32	6S128689	2.2K ±10%; 1/4 w

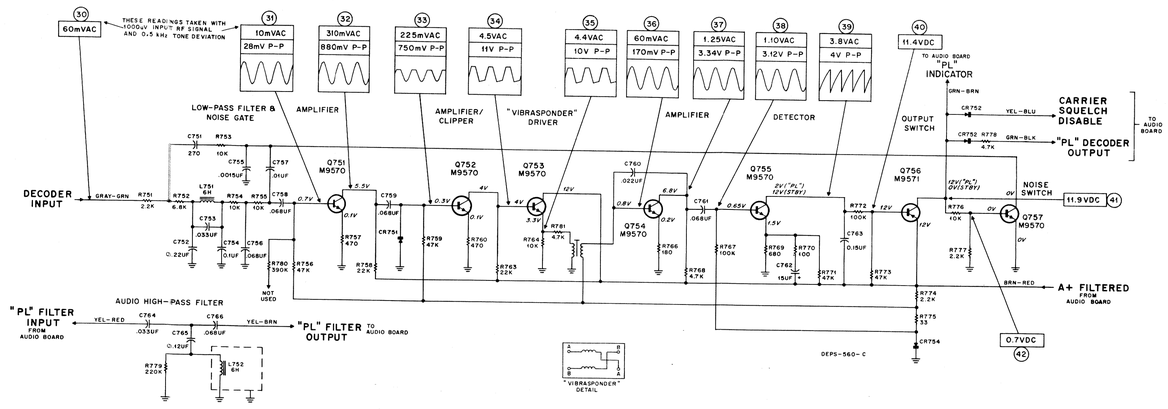
PARTS LIST CONTINUED ON THE BACK OF SHEET 2



RECEIVER

Receiver Schematic Diagram and Parts List
Motorola No. 63P81001E17-L
(Sheet 1 of 2)
6/5/74-NPC





NOTES:

1. FREQUENCY CALCULATIONS:

$$f_{o1} = \frac{f_c - 11.7 \text{ MHz (or } 11.6 \text{ MHz in two-receiver stations using shifted 1st LO)}}{24}$$

IN TWO-RECEIVER BASE STATIONS (WHEN THE CARRIER SEPARATION BETWEEN RECEIVERS IS 5.85 MHz OR 11.7 MHz #50 kHz), THE LOWER-FREQUENCY RECEIVER USES AN 11.7 MHz IF AND THE HIGHER-FREQUENCY RECEIVER USES AN 11.6 MHz (SHIFTED) IF.

2. SEE PARTS LIST FOR COMPONENT INFORMATION.
3. USED IN 1-FREQUENCY RADIOS ONLY.
4. JUMPER J0301 USED IN ALL MODELS.
5. PIN NUMBERS ARE FOR REFERENCE ONLY.
6. USED IN 4-FREQUENCY MODELS ONLY.
7. ALL DC VOLTAGES ARE MEASURED WITH A 20,000 OHM-PER-VOLT MULTIMETER, EXCEPT WHERE OTHERWISE NOTED.
8. USE VACUUM TUBE VOLTMETER.
9. NOT USED.
10. JUMPERS: JU1-REMOVED FOR REMOTE OPERATION; JU2-REMOVED FOR "PL" OPERATION.
11. REFERS ONLY TO REMOTE AUDIO PATH (REMOTE CONTROL STATIONS ONLY).
12. UNLESS OTHERWISE STATED:
CAPACITOR VALUES ARE IN PICOFARADS; RESISTOR VALUES ARE IN OHMS (K = 1000).
13. COMPONENT REFERENCES OUTLINED BY A RECTANGLE INDICATE MARKINGS ON CHASSIS.
14. DOUBLE VOLTAGE REFERENCE POINTS IN THE AUDIO AND SQUELCH CIRCUIT: PARENTHESES INDICATES VALUE FOR USQ (UNSQUELCHED MODE). NO PARENTHESES INDICATES VALUE FOR FSQ (FULL SQUELCH MODE).

EPD-21323-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Receiver Schematic Diagram and Parts List
Motorola No. 63P81001E17-L
(Sheet 2 of 2)
6/5/74-NPC

PARTS LIST (CONTINUED)

RF DECK

LEGEND:
LL = 406-430 MHz
L = 430-450 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz

TLE6361A (406-430 MHz)
TLE6363A (430-450 MHz)
TLE6362A (450-470 MHz)
TLE6364A (470-494 MHz)
TLE6365A (494-512 MHz) PL-1320-B

		CAPACITOR, fixed:
C1	21-86730Z	13 pF ±5%; 500 V
C2	21-83880G01	.001 uF ±10%; 100 V
C3	21-124554	22 pF ±5%; 500 V; NP0
		CONNECTOR, receptacle:
J1	9-84135B01	female; coaxial; miniature type
		COIL, RF:
L1LL	1-80714B11	4-3/8 turns; tapped at "ground" end
L1L	1-80718B55	4-1/8 turns; tapped at "ground" end
L1M	1-80780A73	4 turns; tapped at "ground" end
L1H	1-80727B50	3-7/8 turns; tapped at "ground" end
L1HH	1-80727B52	3-11/16 turns; tapped at "ground" end
L2LL	24-83853G19	4-3/8 turns
L2L	24-83853G25	4-1/8 turns
L2M	24-83853G03	4 turns
L2H	24-83853G32	3-7/8 turns
L2HH	24-83853G35	3-11/16 turns
L3LL	24-83853G19	4-3/8 turns
L3L	24-83853G25	4-1/8 turns
L3M	24-83853G03	4 turns
L3H	24-83853G32	3-7/8 turns
L3HH	24-83853G35	3-11/16 turns
L4LL	24-83853G19	4-3/8 turns
L4L	24-83853G25	4-1/8 turns
L4M	24-83853G03	4 turns
L4H	24-83853G32	3-7/8 turns
L4HH	24-83853G35	3-11/16 turns
L5LL	24-83853G19	4-3/8 turns
L5L	24-83853G25	4-1/8 turns
L5M	24-83853G03	4 turns
L5H	24-83853G32	3-7/8 turns
L5HH	24-83853G35	3-11/16 turns
L6LL	1-80714B10	4-1/2 turns; tapped at 1-5/8 turns from "ground" end
L6L	1-80718B54	4-1/8 turns; tapped at 1-5/8 turns from "ground" end
L6M	1-80780A72	4-1/4 turns; tapped at 1-5/8 turns from "ground" end
L6H	1-80727B49	3-7/8 turns; tapped
L6HH	1-80727B51	3-3/4 turns; coded RED
L7LL	24-83884G06	4-3/4 turns; coded WHT
L7L	24-83884G06	4-3/4 turns; coded WHT
L7M	24-83884G01	4-3/4 turns; coded RED
L7H	24-83884G07	2-1/2 turns; coded GRN
L7HH	24-83884G07	2-1/2 turns; coded GRN
		TRANSISTOR: (SEE NOTE I)
Q1	48-869533	field-effect; type M9533
		RESISTOR, fixed:
R1	6-185B83	2.2k ±10%; 1/8 W
		NON-REFERENCED ITEMS
	15-83855G01	PLATE, mixer cover
	1-80709B53	TUNING ASSEMBLY: includes; 64-83852G01 PLATE, cover *3-84127B01 SCREW, tuning 10-32 x 7/8" headless; slotted driver (6 req'd)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		*41-84410B03 NUT, tuning screw locking: "star" type (6 req'd)
		*Screws and nuts used with L1 thru L6.

LEGEND:
LL = 406-430 MHz
L = 430-450 MHz
M = 450-470 MHz
H = 470-494 MHz
HH = 494-512 MHz

MULTIPLIER BOARD

TLN8748A (Single-Frequency: 406-430 MHz)
TLN4564A (Single-Frequency: 430-450 MHz)
TLN8750A (Single-Frequency: 450-470 MHz)
TLN4770 (Single-Frequency: 470-494 MHz)
TLN4771 (Single-Frequency: 494-512 MHz)
TLN8749A (Multi-Frequency: 406-430 MHz)
TLN4563A (Multi-Frequency: 430-450 MHz)
TLN8751A (Multi-Frequency: 450-470 MHz)
TLN4772 (Multi-Frequency: 470-494 MHz)
TLN4773 (Multi-Frequency: 494-512 MHz) PL-1323-C

		CAPACITOR, fixed: pF: ±5%; 500 V; uni otherwise stated
C28	21-82450B29	0.5t: coded GRN-BRN-GRAY-GOLD
C29LL	21-83406D82	36; NP0
C29L	21-83406D71	33; NP0
C29M	21-11416	30 ±10%; NP0
C29H	21-82133G06	27; NP0 (single-freq)
C29HH	or21-840365	24; NP0 (multi-freq)
C30LL	21-840365	24; NP0 (single-freq)
C29HH	or21-82204B34	22; NP0 (single-freq)
C30LL	21-84493B27	51; 200 V; NP0
C30L	21-83406D37	43; NP0
C30M	21-82610C45	40; 100 V; NP0
C30H	21-82610C86	36; 200 V; NP0
C30HH	21-83406D19	33; NP0
C31LL	21-82610C09	120; 200 V; N220
C31L	21-82610C09	120; 200 V; N220
C31M	21-82610C44	100; 100 V; N220
C31H	21-82610C63	91; 200 V; N220
C31HH	21-84493B32	82; 200 V; N220
C32	21-857336	2 ±0.25 pF; NP0
C33LL	21-83406D83	12; N150
C33L	21-838686	10 ±5%; N150
C33M	21-859642	9 ±0.5 pF; N150
C33H	21-847873	8.2; N150
C33HH	21-847873	8.2; N150
C34LL	21-84493B29	47; 200 V; N470
C34L	21-83406D88	40; N470
C34M	21-859697	30; N470
C34H	21-124946	27; N470
C34HH	21-124946	27; N470
C35	21-832501	.01 uF +60-40% 250 V
C36	21-82428B59	.01 uF +80-20% 200 V
C37	21-82450B35	0.2 ±10%; coded RED-BLK-GRAY-SILVER
C38LL	21-83406D53	3.3 ±0.25 pF; NP0
C38L	21-83406D66	2.7 ±0.25 pF; NP0
C38M	21-857336	2 ±0.25 pF; NP0
C39LL	21-84493B14	68; 200 V; NP0
C39L	21-82187B06	560
C39M	21-82187B06	560
C39H	21-865922	390 ±10%
C39HH	21-865922	390 ±10%
C40LL	21-82204B03	6 ±0.5 pF; NP0
C40L	21-82204B03	6 ±0.5 pF; NP0
C40M	21-840850	4 ±0.5 pF; NP0
C40H	21-840850	4 ±0.5 pF; NP0
C40HH	21-83406D53	3.3 ±0.25 pF; NP0
C41LL	21-83406D73	7.5 ±0.5 pF; NP0
C41L	21-83406D65	5 ±0.25 pF; NP0
C41M	21-83406D65	5 ±0.25 pF; NP0
C41H	21-840847	5; NP0
C41HH	21-823553B39	4.7 ±0.25 pF; NP0
C42LL	21-84493B21	30; 200 V NP0
C42L	21-83406D67	22; NP0
C42M	21-848525	16; NP0
C42H	21-840365	24; NP0
C42HH	21-840365	24; NP0
C43	21-82428B62	.01 uF +80-20% 200 V
C44	21-82428B59	.01 uF +80-20% 200 V
C45	21-82428B59	.01 uF +80-20% 200 V (multi-freq only)
C46	21-82428B59	.01 uF +80-20% 200 V
C47	21-82428B59	.01 uF +80-20% 200 V (multi-freq only)
C48	21-82428B59	.01 uF +80-20% 200 V * (multi-freq only)
C49	8-82905G11	0.22 uF ±10% 50 V
C51	21-82428B59	.01 uF +80-20% 200 V
C84	21-82428B62	.01 uF +80-20% 200 V
		SEMICONDUCTOR DEVICE, diodes: (SEE NOTE I)
CR1	48-82921G02	germanium
CR4	48-82392B13	silicon
CR5	48-82392B13	silicon
CR23	48-82392B03	silicon (single-freq only)
		COIL, RF:
L14	24-83857G01	BRN: 8-1/2 turns, tapped at 2-1/8 turns; incl tuning core
L15	24-83857G02	RED; 8-1/2 turns: incl tuning core
L16	24-83857G03	ORG: 6-1/2 turns, tapped at 7/8 turn; incl tuning core
L17	24-83857G04	YEL: 3-1/2 turns, tapped at 7/8 turn; incl tuning core
L18	24-83857G05	GRN: 3-1/2 turns; incl tuning core
L19LL	1-80714B13	13-1/4 turns; tapped at 1-3/4 turns; requires 76-83419G02 CORE, tuning
L19L	1-80718B56	12 turns; tapped at 1-3/4 turns; requires 76-83419G02 CORE, tuning
L19M	1-80780A83	12-1/4 turns; tapped at 1-3/4 turns; requires 76-83419G02 CORE, tuning
L19H	1-80727B55	11-3/4 turns; tapped at 1-3/4 turns
L19HH	1-80727B57	10-5/8 turns; tapped at 1-3/4 turns
L20LL	24-83858G05	14-1/4 turns
L20L	24-83858G08	13 turns
L20M	24-83858G02	13-5/8 turns
L20H	24-83858G14	12 turns
L20HH	24-83858G17	11-5/8 turns
L21LL	1-80714B14	15-1/2 turns; tapped at 3-1/4 turns; requires 76-83419G02 CORE, tuning
L21L	1-80718B57	13-1/2 turns; tapped at 3-1/4 turns; requires 76-83419G02 CORE, tuning
L21M	1-80780A84	13-7/8 turns; tapped at 3-1/4 turns; requires 76-83419G02 CORE, tuning
L21H	1-80727B54	12-3/4 turns; tapped at 3-1/4 turns
L21HH	1-80727B56	12 turns; tapped at 3-1/4 turns
Q5	48-869534	TRANSISTOR: (SEE NOTE I) N-P-N: type M9534
Q6	48-869534	N-P-N: type M9534
Q7	48-869534	N-P-N: type M9534
R17	6-185B90	RESISTOR, fixed: ±10%; 1/4 W uni otherwise stated 8.2k; 1/8 W
R18	6-185B86	3.9k; 1/8 W
R19	6-185C02	68k; 1/8 W
R20	6-129752	270
R21	6-128688	2.7k
R22	6-129860	56
R23	6-129617	120
R24	6-128689	2.2k
R25	6-129860	56
R30	6-127807	33k
R63	6-127807	33k

		NON-REFERENCED ITEMS
	26-82221H01	SHIELD, coil; used with L14, L15
	26-82076C01	SHIELD, coil; used with L16, L17, L18
	1-80780A82	SHIELD, coil; used with L19, L20, L21

1ST IF & 2ND OSCILLATOR BOARD

TLN8752A (11.7 MHz, standard IF, high side injection)
TLN8752AL (11.7 MHz, standard IF, low side injection)
TLN8753A (11.6 MHz, shifted IF, high side injection)
TLN8753AL (11.6 MHz, shifted IF, low side injection) PL-318-D

		CAPACITOR, fixed: pF: ±5%; 50 V; uni, stated
C4	21DB2204B28	43; 200 V; N080
C5, 8, 9, 10	21DB2428B59	.01 uF +80-20%; 200 v
C6	21DB2204B29	43 ±3%; 200 v; NP0
C7	21DB3404D18	47; N150
C11, 15	21DB2450B29	0.5t
C12, 14, 17	21DB2133G44	18; N330
C13, 16	21DB3404D19	33; NP0
C18	21DB2133G52	43; NP0
C19	21K840048	240
C20	21DB2428B26	.02 uF +80-20%; 200 v
C21, 23	8D83293B01	0, 1 uF ±10%; 50 v
C22	21C82372C01	0, 1 uF +80-20%; 25 v
C25	21K859942	220
C26	21DB3406D10	6, 8 ±0.25 pF; NP0
C85	21R124554	22; 500 V; NP0
		COIL, RF:
L8	24E83879G01	coded BRN
L9	24C828385G21	choke; 3.7 uH
L10, 11	24E83879G04	coded YEL
L12	24D82135G04	choke; 1.5 uH
L13	24D82135G08	choke; 620 uH
		TRANSISTOR: (SEE NOTE I)
Q2	48R869456	N-P-N: type M9456
Q3, 4	48R869571	P-N-P: type M9571
		RESISTOR, fixed: ±10%; 1/4 w; uni, stated
R2, 3	6S128687	6.8k
R4	6S129231	3.3k
R5, 7	6S127802	1K
R6	6S127813	100
R8, 9	6S129233	47
R10, 15	6S129230	12K
R11, 12	6S129269	1.8k
R13	6S127805	15K
R14	6S127807	33K
R16	6S127800	220
T1	24E83879G02	TRANSFORMER, RF: coded RED; incl, tuning core
T2	24E83879G03	coded ORG; incl, tuning core
Y1	48D84228C38 or48D84228C25	CRYSTAL UNIT, quartz: (SEE NOTE II) type FSD; See Following 11.7065 MHz (TLN8752A, AL) 11.6025 MHz (TLN8753A, AL) type FSD; See Following
Y2	48D84228C36 or48D84228C31	11.6945 MHz (TLN8752A, AL) 11.5945 MHz (TLN8753A, AL) for standard IF; type GN; See Following
Y3	48D84229C17 or48D84229C13	12.155 MHz (TLN8752A) 11.245 MHz (TLN8752AL) for shifted IF; type GN; See Following
	48D84229C21 or48D84229C22	12.055 MHz (TLN8753A) or 11.145 MHz (TLN8753AL)

NOTE:
Standard IF = 11.7 MHz
Shifted IF = 11.6 MHz

455 KC IF BOARD

TLN8747A 455 kHz IF Board
TLN8747AL 455 kHz IF Board (NOTE II) PL-779-A

		CAPACITOR, fixed: uF; ±10%; 50 V; uni. stated
C303, 304, 309	8C82095G06	0, 1; 200 V
C302	8D8381H04 or8D82905G07	0, 1 0, 1
C308, 314, 301	21C82372C01	0, 1 +80-20%; 25 V
C305, 361	8D82905G04	.068
C306, 311, 317, 318, 326, 329	21DB2428B59	.01 +80-20%; 200 V
C307, 312	21C82187B17	820 pF; 500 V
C310, 316	21DB2133G23	27 pF; 500 V NP0
C319, 320	8D8381H09 or8D82905G11	0, 22 0, 22
C321	21E82537B18	1000 pF ±3%; 100 V
C322, 323	21E82537B19	1500 pF ±2%; 100 V
C324, 325	21DB3406D17	62 pF ±5%; 500 V NI750
C327	21DB2187B25	3300 pF; 500 V
C328	21K859219	56 pF ±5%; 500 V
		SEMICONDUCTOR DEVICE, diodes (SEE NOTE I)
CR301, 302	48C82921G01	germanium
CR303, 304	48C83654H02	silicon (NOTE III)
L101	24D82135G08	COIL, RF: choke; 0, 62 mH
L302	24D82135G07	choke; 2 mH
		TRANSISTOR: (SEE NOTE I) P-N-P; type M9571 N-P-N: type M9570
Q101, 303, 305	48R869571	
Q302, 304	48R869570	
		RESISTOR, fixed: ±10%; 1/2 W; uni, stated
R301	6S5581	3.3K
R302	6S6393	1.2K
R303, 321	6S6090	470
R304	6S6432	270
R305, 314, 323	6S6229	1K
R306, 309, 317, 320	6S6038	1.5K
R307	6S6373	150
R308	6S6394	12K
R310, 324	6S6270	220
R311, 318, 322	6S5591	18K
R312	6S6080	4.7K
R313	6S5659	5.9K
R315	6S6040	680
R316	6S6048	47K
R319, 325	6S5550	47
R326	6S128599	680; 1/4 W
R327, 328	6S129886	27K ±5%; 1/4 W
R329	6S128902	47K; 1/4 W
R330	6S129227	270K; 1/4 W
R331	6S129247	560K; 1/4 W
T3	24V80906A42	TRANSFORMER, discriminator; coded RED; incl, 76B82572G03 CORE, tuning

AUDIO & SQUELCH BOARD

TLN8783A Audio & Squelch Board PL-320-C

		CAPACITOR, fixed: uF; ±10%; 50 V; uni. stated
C341	21DB2187B29	270 pF; 500 V
C342, 345, 347	8D82905G11	0, 22
C343, 357	23C8651137	4, 7 ±10%; 25 v
C344, 349	8D82905G05	0, 15
C346, 358, 359	23C8651136	15 ±20%; 25 v
C348	23D82783B08	1 ±20%; 35 v
C350, 351	8D82905G04	.068
C352, 354	8D82905G02	.022
C353	21C8501118	100 pF ±5%; 300 v
C355	21C8859944	300 pF ±5%; 500 v
C356	21C874352	1200 pF ±5%; 300 v
C360	25DB2601A25	100 +150-10%; 20 v
CR341, 342, 343	48C82392B03	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) silicon
L341	25B82878A03	COIL, RF: choke; 70 mH
Q341, 343, 344, 347, 348	48R869570	TRANSISTOR (SEE NOTE I) N-P-N: type M9570
Q342, 350	48R869571	P-N-P: type M9571
Q349	48R869594	N-P-N: type M9594
R341	6S127805	RESISTOR, fixed: ±5%; 1/4 w; uni, stated 15K ±10%
R342	6S127806	27K ±10%
R343	6S185C02	68K ±10%; 1/8 w
R344, 369	6S131524	100
R345	6S129805	1K
R346	6S185B91	10K ±10%; 1/8 w
R351	6S129861	68 ±10%
R352	6S129433	5.6K ±10%
R353, 361	6S129225	10K ±10%
R354	6S129804	4.8K ±10%
R362	6S488045	470 ±5%; 1 W
R363	6S131641	22 ±10%
R364	17C82350A05	0, 16 ±10%; 1 w
R365	6S185B82	1.8K ±10%; 1/8 w
R366	6S129237	6.8K
R367	6S129238	68K
R368	6S127801	470 ±10%
R370	6S185A06	1.5K; 1/8 w
R371	6S129887	12K
R372	6S124A97	100K
R373	6S185B06	220K; 1/8 w
R374	6S131276	150
R375	6S185A47	820; 1/8 w
R379	6S129431	180
R384	6S129232	3.9K ±10%
RT341	6C82769A01	THERMISTOR: 10 ohms @ 25°C
RT342	6B866641	300 ohms @ 25°C
T351	25C82058H01	TRANSFORMER, AF: lug terminals (not marked): pri: (center-tapped): total res. 670 ohms max. sec: (center-tapped): total res. 13 ohms max (primary center tap coded WHT dot)
Z341	51D82070H06	PACKAGED RESISTOR NETWORK: incl, R355, R356, R357, R358, R359, R360
Z342	51D82070H08	incl, R378, R380, R381, R382, R383
Z343	51D82070H09	incl, R347, R348, R349, R350, R376, R377

"PL" DECODER BOARD

TLN8785A "PL" Decoder Board PL-324-B

		CAPACITOR, fixed: uF; ±10%; 50 V; uni stated
C751	21DB2187B10	.001; 100 v
C752	8D82905G11	0, 22
C753, 764	8D82905G08	.033
C754	8D82905G07	0, 1
C755	21DB2187B18	.0015; 100 V
C756, 758, 759, 761, 766	8D82905G04	.068
C757	8D82905G01	.01
C760	8D82905G02	.022
C762	23D83214C02	15 ±20%; 25 V
C763	8D82905G05	0, 15
C765	8D82905G09	0, 12
CR751, 752, 753, 754	48C82392B03	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) silicon
L751	24C84003A01	REACTOR: AF choke; 6 H
L752	24C84004A01	6 H; shielded
Q751, 752, 753, 754, 755, 757	48R869570	TRANSISTOR: (SEE NOTE I) N-P-N; type M9570
Q756	48R869571	P-N-P; type M9571
R751, 777	6S128689	RESISTOR, fixed: ±5%; 1/4 W; uni. stated 2.2k ±10%
R752	6S128687	6.8k ±10%
R753, 754, 755, 764, 776	6S129225	10k ±10%
R756, 759, 773	6S131527	47k
R757, 760	6S129709	470
R758, 763	6S129667	22k
R766	6S129434	180
R767, 772	6S124A97	100k
R768, 771, 778, 781	6S129669	4.7k
R769	6S129984	680
R770	6S129753	100 ±10%
R774	6S129804	2.2k
R775	6S124A13	33
R779	6S129147	220k ±10%
R780	6S128682	2.2M ±10%
		NON-REFERENCED ITEM
	14C834854C01	SOCKET, "Vibrasponder" Resonant Reed; 4 cont.

NOTES:

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

II. TLN8747AL used in receivers which employ low-side injection in high IF board.

III. CR303 and CR304 are reversed in polarity for Model TLN8747AL.

RECEIVER ALIGNMENT PROCEDURE

A. TEST EQUIPMENT REQUIRED

1. Motorola S1056A-9A Series Portable Test Set with a TKN6025A Adapter Cable (available on separate order). A 0-50 microampere meter with 20,000 ohms equivalent series resistance may be used if a test set is not available.
2. Motorola Model S1318A FM Signal Generator (or equivalent).
3. Motorola Model TLN6845A Tuning Tool Kit. A small screwdriver may be used for some of the alignment.
4. Motorola Solid-State DC Multimeter, rf probe, and 50-ohm termination (or equivalent).

B. HOW TO SET UP THE S1056A PORTABLE TEST SET

1. Set function selector switch to RCVR position.
2. Switch on 455 kHz crystal oscillator.
3. Connect 20-pin meter cable plug to test set; connect the adapter cable to the cable coming from the test set; connect the other end of the adapter cable to the receiver metering socket. When the test set is not in use, disconnect the 20-pin metering cable to conserve internal battery life. The plug on the cable acts as an on-off switch completing the battery circuit.
4. Connect the rf extension cable to the test set; connect the rf probe cable to the rf extension cable.

C. HOW TO SET UP THE SIGNAL GENERATOR FOR RF ALIGNMENT

1. Set up the signal generator according to the instructions supplied with the unit.
2. Connect the signal generator cable to the antenna input.
3. Turn the generator output up to maximum.
4. Keep the test set in position 4.
5. Rotate the signal generator dial back and forth near the assigned rf carrier frequency. Watch the test set meter. The pointer should swing above and below the zero reading as the dial is rotated. If no indication can be obtained, place the center conductor of the generator cable at the top of L8 on the 11.7 MHz i-f board. Set the dial for exact zero reading. Be sure the generator frequency is kept at zero meter reading.

D. FREQUENCY CALCULATIONS

For all One-Receiver Stations and most Two-Receiver Stations

$$f_1 = \frac{f_c - 11.7\ \text{MHz}}{24}$$

f_2 = 12.155 MHz (11.245 MHz is factory selected for some units)

WHERE:

f_1 = channel element frequency

f_c = carrier frequency

f_2 = second oscillator frequency

For Receiver on Highest Frequency in Two-Receiver Stations where carrier frequencies are separated by 5.85 MHz ±50 kHz or 11.7 MHz ±50 kHz

$$f_1 = \frac{f_c - 11.6\ \text{MHz}}{24}$$

f_2 = 12.055 MHz (11.145 MHz is factory selected for some units)

WHERE:

f_1 = channel element frequency

f_c = carrier frequency

f_2 = second oscillator frequency

E. TEST SET SELECTOR SWITCH POSITIONS

S1056A-9A TEST SETS	1	2	4	5	6	11
CIRCUIT METERED	455 kHz IF Ampl. #2	455 kHz IF Ampl. #3	Discrim.	1st Osc.	Multiplier	Audio Output
TYPICAL NO SIGNAL READING WITH RECEIVER ALIGNED	8 uA or more (with preamp)	26 uA	±2 uA	20 uA	13 uA	---
	2 uA or more (without preamp)					

F. RECEIVER ALIGNMENT

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
1	T3	1 and 4	DISCRIMINATOR - Set up the test set as described in paragraph B. Adjust T3 so that the slug is close to the center of the coil. Insert a 2 pF capacitor in series with the rf probe. Place the probe on the base of the second mixer (POINT 1). Use a signal input to produce an indication on meter position 1, between 5 uA and 15 uA. Adjust T3 for an absolute zero on the "0" center (top) scale with the switch in position 4. Use screwdriver end of tuning tool A. This is a critical adjustment and should be exactly on zero. Remove the rf probe.
2	L14, L15, L16, L17, L18, L19, L20, L21	5, 6 and 1	MULTIPLIER - On multi-frequency models place the frequency selector switch in the F1 position. Use a small hex-end of tuning tool B. Adjust all coils so that the slugs are very close to the top of the coil (i.e., near the board). Adjust coils L15 and L14 (in that order) for maximum indication on meter position 5. Repeak coils L15 and L14. Adjust L16 for maximum indication on meter position 6. Adjust coils L17 and L18 for a minimum indication on meter 6. Adjust L19 for a small peak indication on meter position 6. Set up the signal generator as described in paragraph C. Apply as much signal as is required at the carrier frequency for an indication of 5 uA on meter position 1. Align coils L21, L20, L19, L18 and L17 (in that order) for maximum indication on meter position 1.

ALIGNMENT CONTINUED ON REVERSE SIDE

F. RECEIVER ALIGNMENT (CONT'D)

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
3*	C1, C2	1	RF PREAMPLIFIER - Adjust C2 and C1 in that order on the rf preamplifier for maximum meter indication in position 1. Use screwdriver end of tuning tool B.
4	L1 thru L6	1	RF DECK - Use a screwdriver and preset L1 through L6 by turning the tuning screws counterclockwise (away from the top plate) until the screws are approximately 1/2 inch above the top plate (3.8 inch for frequencies below 460 MHz). Increase the output of the signal generator until an indication of 5 uA is observed on meter position 1. Tune L1 through L6 (in that order) for maximum indication on meter position 1. (Decrease the signal generator output level back to an indication of 5 uA on meter position 1 each time the current rises to 15 uA.) Repeak L1 through L6.
5	L8, T1 T2, L10, L11	1 and 4	11.7 MHz IF - Readjust carrier frequency for an exact zero reading on meter position 4. Use a signal input of approximately 15 uA on meter position 1. Use large hex end of tuning tool B. Detune L8 and T1 by turning slugs counterclockwise to the top of coil forms (i.e., near the board). Tune L11, L10 and T2 (in that order) for a maximum indication on meter position 1. Repeak L11, L10 and T2. (Do not attempt to repeak these coils during the subsequent adjustments.) Peak L8 and T1 (in that order) for maximum indication on meter position 1. Repeak L8 and T1 two more times. NOTE It is very important that L8 be tuned before T1. Tune by maximum meter indication, not by audio noise.
6	L1 thru L6, L21	1 and 6	Detune L16 approximately 5 uA on meter position 1. Tune L17, L18, L19, L20 and L21 for a maximum indication on meter position 1. Retune L16 for peak on meter position 6. Repeak L1 thru L1 (in that order) for maximum indication on meter position 1. Repeat. Reduce generator output to 20 dB quieting level. Retune L6 and L21 for best quieting.
7*	C1, C2	1 and 11	RF PREAMPLIFIER - Increase the signal generator output for a small indication in meter position 1 (5-10 uA). Repeak C2 for maximum meter indication in meter position 1. Reduce the signal generator output to the 20 dB quieting level and retouch C1 and L1 for best quieting sensitivity.
8	F1, F2, F3, F4	1, 2, 4	ON-FREQUENCY ADJUSTMENT - Transmit a carrier from the transmitter which the receiver is normally intended to receive. Test set position 1 should indicate a rise when the transmitter is keyed. If necessary, connect the antenna to the radio set. Check the meter reading in test set position 4. Disable the AFC by shorting the AFC test point to the shield. Zero indicates an on-frequency condition. Set the F1 "warping" capacitor for exact zero meter reading in position 4 on the F1 frequency. On multiple frequency models, set the additional warp capacitors for a zero meter reading on each position of the frequency selector switch. Remove the short from the AFC test point. DO NOT READJUST COILS L14 AND L15

*Skip this step unless the radio set is equipped with an optional RF Preamplifier.

G. TWO-RECEIVER STATIONS TUNING INSTRUCTIONS

20 DB QUIETING SENSITIVITY WITHOUT RF PREAMPLIFIER	20 DB QUIETING SENSITIVITY WITH RF PREAMPLIFIER	TWO-RECEIVER FREQUENCY SEPARATION
1.0 uV	0.5 uV	Up to 3 MHz
0.7 uV	0.35 uV	3 MHz - 5 MHz
0.62 uV	---	5 MHz and greater
---	0.31 uV	5 MHz - 10 MHz

WITHOUT RF PREAMPLIFIER

1. Tune each receiver individually with the antenna coupler disconnected.
2. Insert the coupler between the two preselectors.
3. Measure the 20 dB quieting for each receiver. If the sensitivity does not compare with that in the preceding table, slight retuning of preselector input coil (L1) should be all that is required.

For stations which do not meet the 20 dB quieting sensitivity, monitor the receiver with the poorest sensitivity. While monitoring, tune the preselector input coil (L1) of the receiver. If the receiver being monitoried is on a higher frequency than the receiver being tuned, the coil (L1) should be turned inward until the sensitivity improves to that of the preceding chart. Then recheck the sensitivity of the other receiver; if on a lower frequency the coil is turned outward. After the worse case degradation is within specification, remeasure the other unit.

WITH RF PREAMPLIFIER

Up to 5 MHz Receiver Frequency Separation

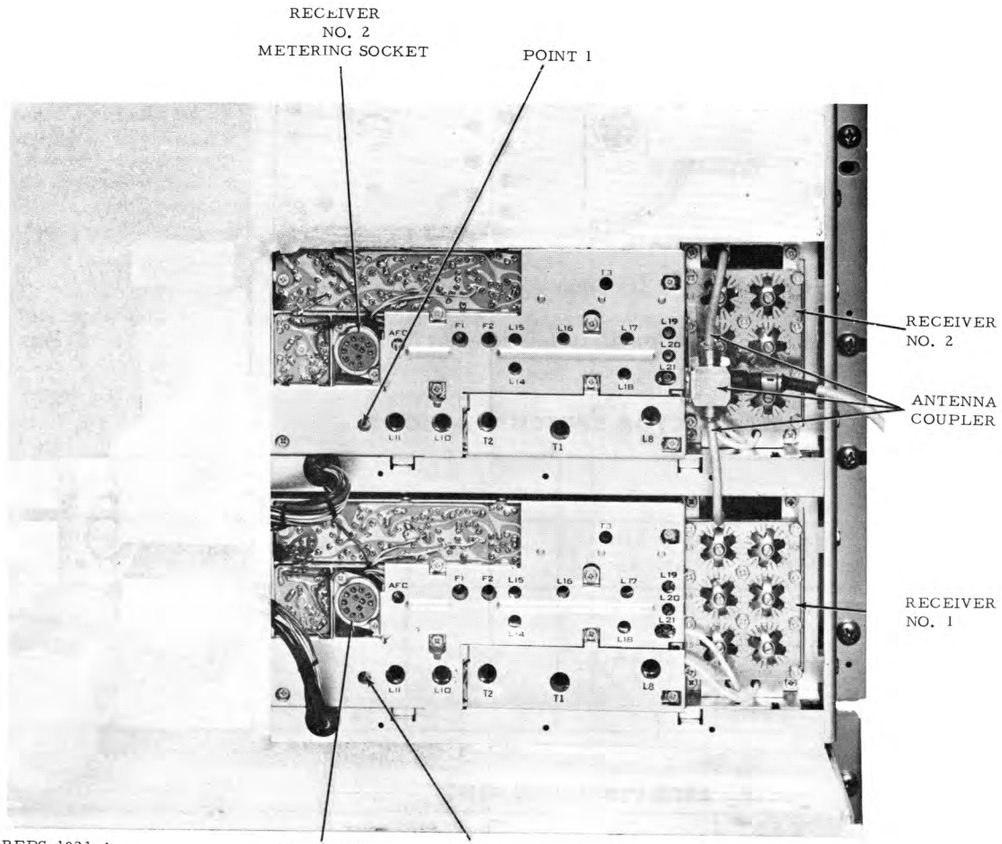
1. Tune each receiver individually with the antenna coupler and rf preamplifier disconnected. Follow the previously detailed single-receiver alignment procedure without an rf preamplifier.
2. Insert the antenna coupler and rf preamplifier between the two receiver preselectors.
3. Adjust C2 and C1, in that order. on the preamplifier for maximum meter indication in position 1 on the higher frequency receiver. Repeat.
4. Perform step 3 in paragraph G -- TWO-RECEIVER STATIONS TUNING INSTRUCTIONS WITHOUT RF PREAMPLIFIER -- to complete the alignment procedure.

5 to 10 MHz Receiver Frequency Separation

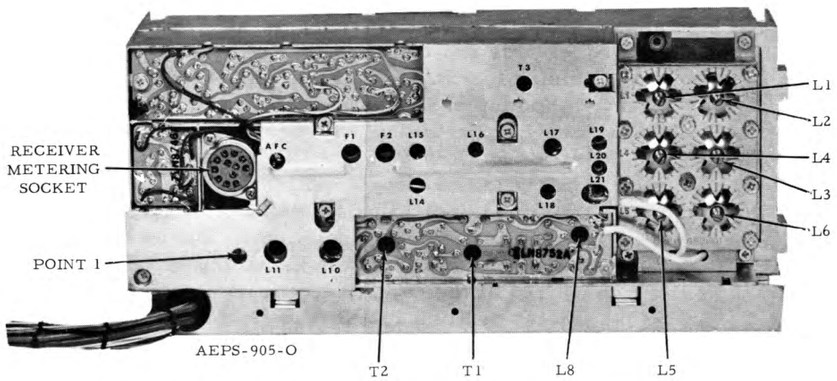
1. Tune each receiver individually with the antenna coupler and rf preamplifier disconnected. Follow the previously detailed single-receiver alignment procedure without an rf preamplifier.
2. Tune the rf preamplifier to a frequency midway between the frequencies of the two receivers while disconnected from the antenna coupler.
   (a) Connect the rf voltmeter through a 50-ohm termination to the OUTPUT of the rf preamplifier.
   (b) Connect the rf signal generator to the INPUT of the rf preamplifier and set to a frequency midway between the frequencies of the two receivers.
   (c) Adjust C2 and C1, in that order, on the preamplifier for a maximum meter indication on the rf voltmeter. Repeat.
   (d) Disconnect the test equipment from the rf preamplifier.
3. Connect the rf preamplifier and antenna coupler to the receivers.
4. Perform step 3 in paragraph G -- TWO-RECEIVER STATIONS TUNING INSTRUCTIONS WITHOUT RF PREAMPLIFIER -- to complete the alignment procedure.

Greater than 10 MHz Receiver Frequency Separation

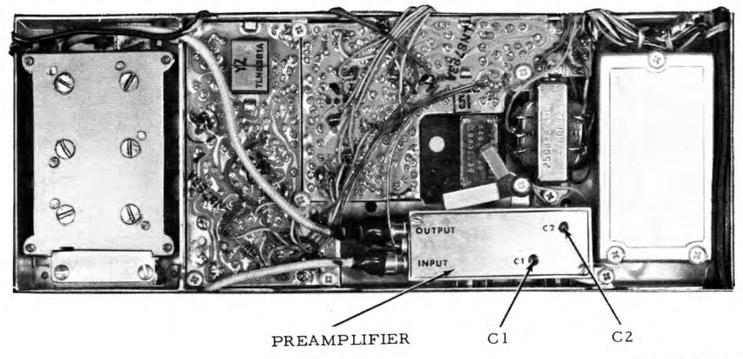
Use of an rf preamplifier is not recommended for receiver frequency separations greater than 10 MHz.



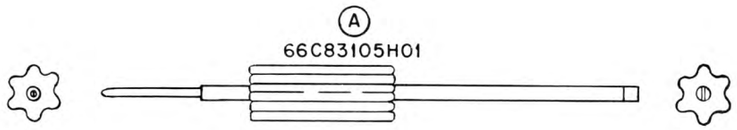
Two Receiver Station Tuning Adjustment Locations

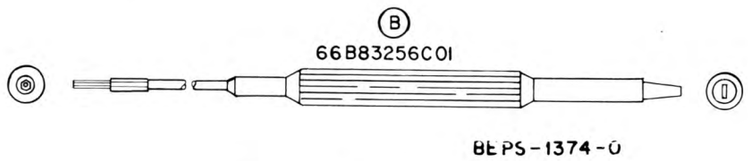


Single Receiver Station Tuning Adjustment Locations



Receiver RF Preamplifier Location

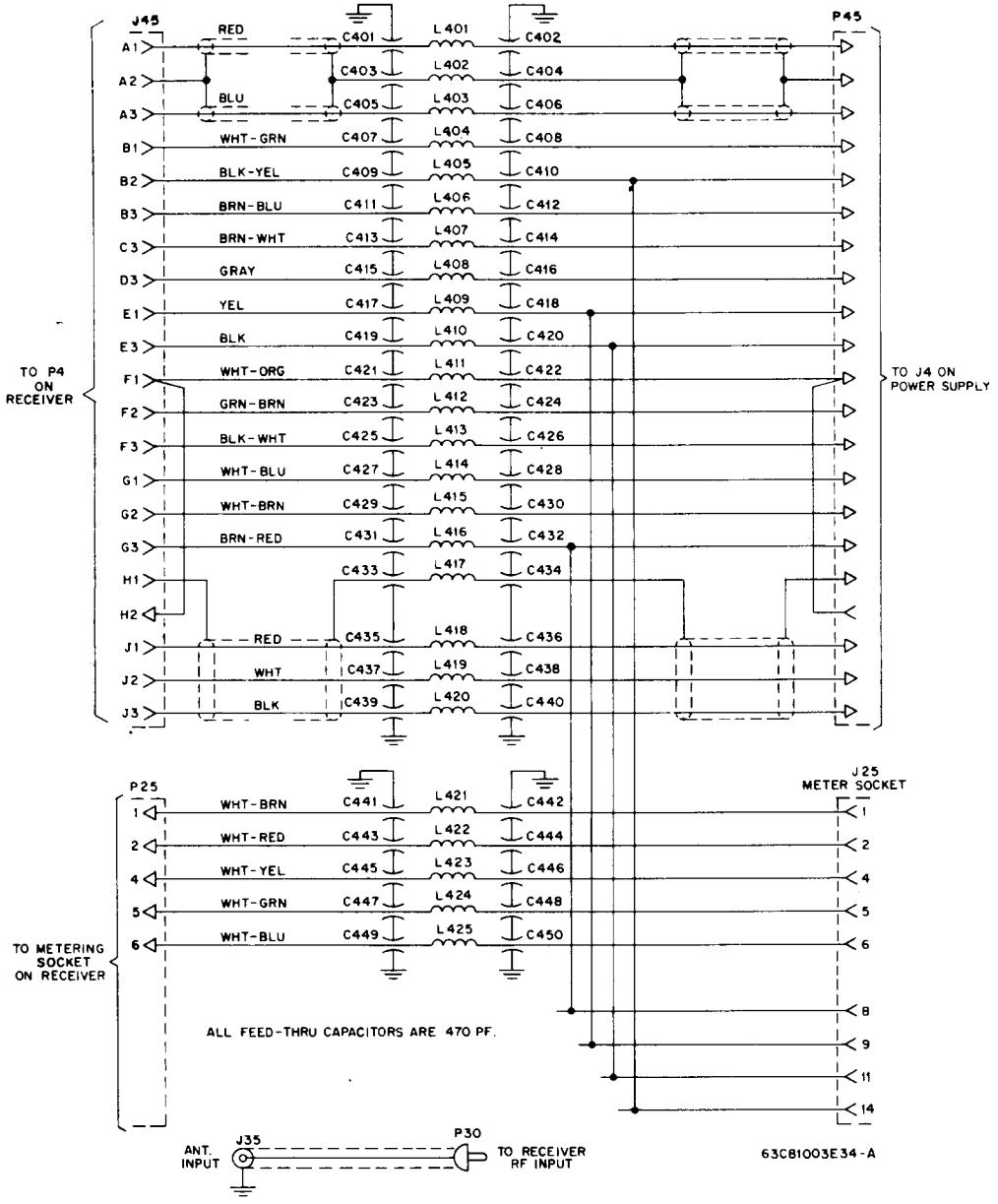




Receiver Tuning Tools

RECEIVER SHIELD KIT

MODEL TLN8889A



PARTS LIST SHOWN ON BACK

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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8889A Receiver Shield Kit PL-407-B

		CAPACITOR, fixed:
C401 thru 450	21K821474	470 pF
		COIL, rf: choke;
L401 thru 404, 411 thru 415, 417 thru 425	24A890687	2 uH
L405, 406, 407, 408, 409, 410, 416	24K858989	0.176 uH
		CONNECTOR, receptacle:
J25	9C83478E01	female; 12 contact
J35	9C82323G01	female; single contact
J45		c/o: 14C83783A08 INSULATOR, conn: 29C82336A01 TERMINAL, wire: female; 18 req'd 29C82336A02 TERMINAL, wire: female; 12 req'd 29C82335A02 TERMINAL, wire: male; 1 req'd
		CONNECTOR, plug:
P25	28B864669	male; 12 contact; does not incl. 15A82798H01 SHELL, conn. and 37K10559 GROMMET, rubber:
P30	28B82331G01	male; single contact
P45		c/o: 14C82337A11 INSULATOR, connector: 29C82335A01 TERMINAL, wire: male; 12 req'd 29C82335A02 TERMINAL, wire: male; 9 req'd, 29C82336A02 TERMINAL, wire: female; 1 req'd, 15D83934A11 COVER, connector, 37K103664 GROMMET rubber
NON-REFERENCED ITEMS		
	1V80783A31	CABLE AND PLUG ASSY: incl. ref part P30
	1V80783A34	CONNECTOR AND BRACKET ASSY: incl. ref part J35
	15C83089H01	SHIELD, front
	15C83090H01	SHIELD, rear
	38K890353	BUTTON, plug: 1/2"
	15C83094H01	COVER, filter

MODEL TABLE

MODEL	DESCRIPTION
TPN1061AA	120 V, 50/60 Hz Power Supply (Carrier Squelch)
TPN1061AC	120 V, 50/60 Hz Power Supply (PL Tone-Coded Squelch)
TPN1092AA	120/220/240 V, 50/60 Hz Power Supply (Carrier Squelch)
TPN1092AC	120/220/240 V, 50/60 Hz Power Supply (PL Tone-Coded Squelch)

1. DESCRIPTION

The power supply provides low-voltage power for operating the "Compa-Station" radios described in this manual. This includes power for all associated accessories, and filament power for the 8072 tube in the TLE1060A Power Amplifier.

The power supply comprises one large chassis located centrally within the station cabinet to facilitate interconnections to all of the units requiring low-voltage dc power. Connector cables from the exciter-transmitter, power amplifier, receiver(s), and control unit all plug into the power supply chassis.

The output voltage of the power supply is extremely well regulated. Current limiting and overvoltage protection are provided for the output. In addition, a separate current-limiting protection circuit for the Pre-driver driver and final amplifier stages of the exciter-transmitter is included on the power supply chassis.

The power supply offers an emergency battery-operation feature with terminals provided for connection to a storage battery. In stations using the emergency power feature, the batteries would normally be at their "float" voltage. A battery-charging function is provided to boost the battery terminal voltage to the equalization value.

An electronic filter provides a well-filtered output voltage for the low-power stages of the transmitter and receiver. This voltage is free of any spurious pulses, spikes, or ripple which might appear in the A+ output.

2. BASIC CIRCUITS

a. General UJT Data

The unijunction transistor (UJT) is a special type of transistor used in pulse generators, triggering circuits and other uses where a pulse must be generated repeatedly at a predictable instant of time. The UJT is comprised of two bases (known as "base 1" and "base 2") and an emitter. It has a high input impedance and a stable "firing" (emitter) voltage which is a fixed percentage of the dc "interbase" voltage applied to the circuit. The input circuit of the UJT is between the emitter and "base 1". When the emitter voltage reaches a certain fraction of the interbase voltage, the UJT "fires", providing a pulse of current to the base 1 circuit. The typical output is a positive pulse, developed at base 1.

b. UJT Circuit Operation

As shown in Figure 1, the input dc voltage charges capacitor C1 through resistor R1. When the C1 voltage reaches a precise value (the firing point), the emitter-to-base-1 junction becomes forward biased and conducts.

Capacitor C1 discharges rapidly through the base-1-to-emitter junction, which has a strong negative-resistance characteristic (junction resistance decreases sharply as the current through it increases). The negative-resistance characteristic facilitates the discharge of C1, which continues until the voltage across the junction is no longer sufficient to keep it forward-biased. At this point, the UJT turns off and current flow ceases in the base 1 circuit.

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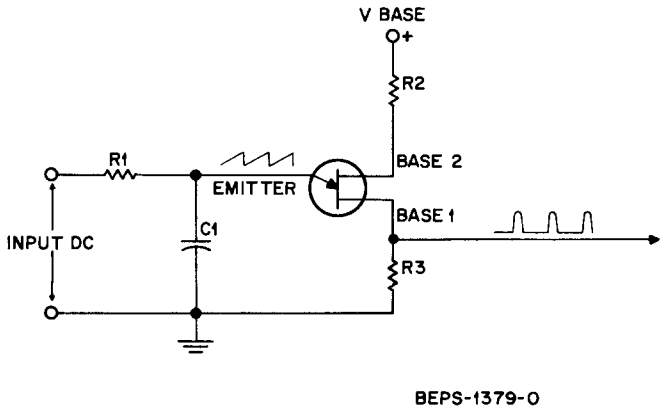


Figure 1.
Typical UJT Pulse Generator

With the base-1-to-emitter junction cut off, the junction once again acts like an open circuit, allowing C1 to start charging up again through R1. When the voltage across C1 reaches the firing point, the UJT fires and another current pulse flows in the output circuit. The process continues as long as the dc voltage is applied to the UJT circuit, developing a continuous train of output pulses from the UJT.

3. CIRCUIT OPERATION

(Refer to Figure 2, Power Supply Block Diagram, and to the Power Supply Schematic Diagram, 63E81000E39.)

a. General

This solid-state power supply consists of a silicon-controlled rectifier (SCR) pre-regulator, which is controlled by a unijunction transistor (UJT) triggering circuit. The pre-regulator feeds a series regulator whose output powers all the high-current, low-voltage circuits. An electronic filter removes variations in the output of the series regulator and feeds the low levels of the receiver and transmitter.

b. Pre-Regulator

When 117 volts ac is applied to the primary of T1, the voltage from the secondary is applied to the pre-regulator bridge circuit. The pre-regulator uses a pair of diodes (CR1 and CR2) and a pair of SCR's (SCR1 and SCR2) in a bridge configuration to feed an LC filter (L1 and C2). The output of this filter is sampled and fed back through

PRE-REGULATOR

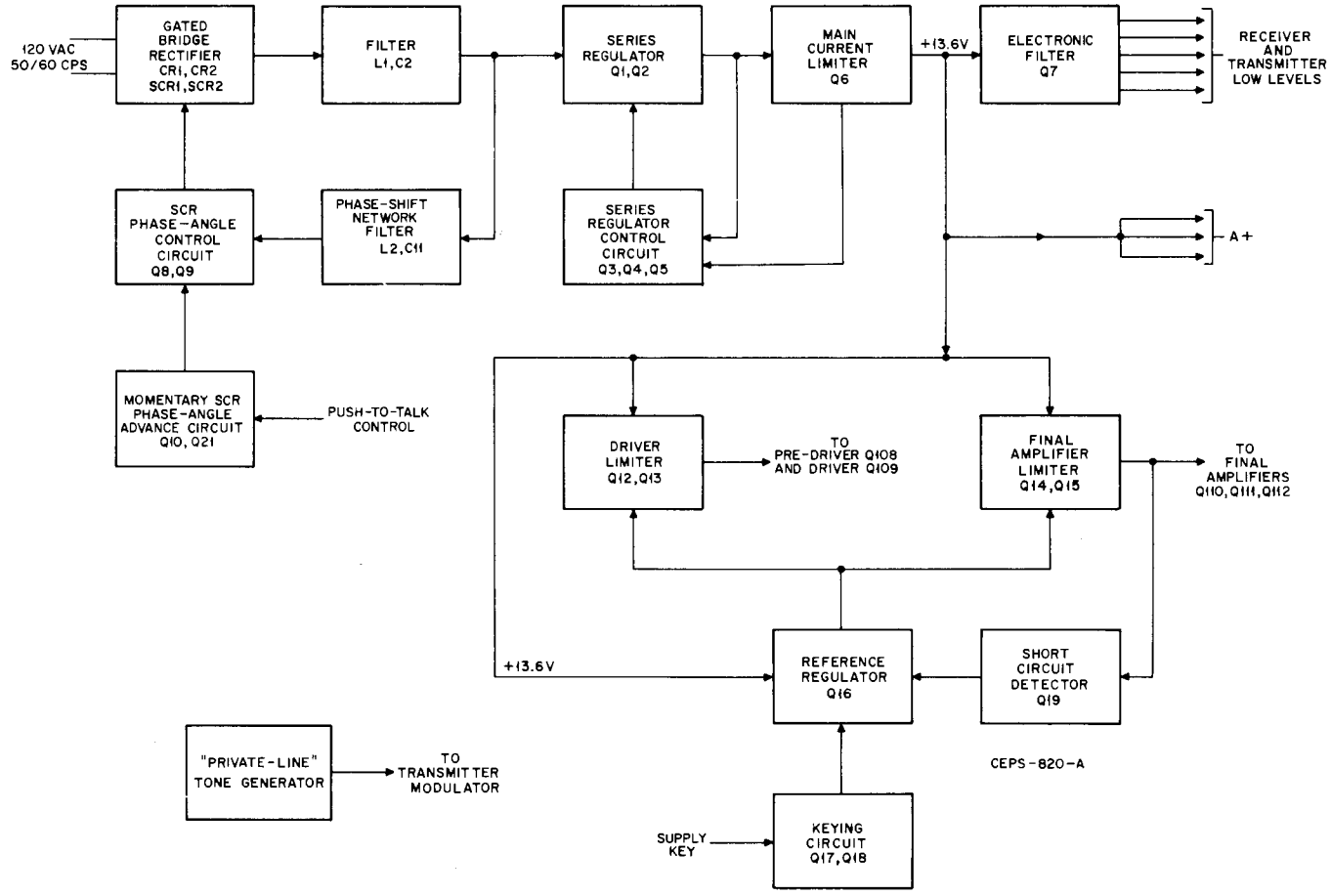


Figure 2.
Power Supply Block Diagram

a phase-shift network (L2 and C11) to a unijunction transistor (UJT) trigger circuit. The UJT trigger circuit incorporates its own constant voltage source and a line-synchronized interbase voltage for the UJT (Q8).

c. UJT Trigger Circuit

The UJT trigger circuit adjusts the firing angle of the bridge SCR's, thereby keeping the output of filter L1-C2 at a relatively constant dc level. Full-wave rectifier CR3, CR4 at the secondary of T1 supplies the voltage for the UJT control circuit. The full-wave rectified voltage (waveform C on Schematic Diagram 63E81000E39) is supplied to a peak rectifier circuit (CR12 and C10) and clamped by a Zener diode (CR14). The constant 16 volts across CR14 is applied to the charging network (R21, C8) in the UJT emitter circuit. At the same time, a portion of the full-wave rectified voltage is clamped by Zener diode CR13 to supply a line-synchronized interbase voltage to UJT Q8. (See waveform D on Schematic Diagram 63E81000E39.) With these voltages applied to Q8, the unijunction transistor fires and supplies pulses of current to the base of transistor Q20 at regular intervals. The pulses occur at twice the frequency of the ac line voltage due to the full-wave rectifying action of CR3 and CR4.

The primary of pulse transformer T2 is in series with the collector of amplifier Q20. When UJT Q8 fires current into the base of Q20, its collector current pulse is coupled to the secondary of the pulse transformer and applied to the gates of the SCR's through isolating resistors R1 and R4.

Depending on which SCR has the positive anode voltage at that instant, either SCR1 or SCR2 is triggered into conduction. Diode CR6 supplies current continuity when the voltage across L1 changes, polarity, thereby allowing SCR1 and SCR2 to shut off.

The voltage at C2 is phase-shifted by L2 and C11 and divided down to the base of Q9. As the voltage across C2 inscreases, the voltage at the base of Q9 also increases. As a consequence, the collector voltage of Q9 is lowered and the Q8 emitter charging circuit is charged at a slower rate. By charging C8 at a slower rate through R21, Q8 is fired at a later time in each cycle, thereby delaying the firing of SCR1 and SCR2. The result is lower voltage across C2.

Conversely, if the voltage at C2 decreases, the voltage at the base of Q9 also decreases, resulting in a higher Q9 collector voltage. This, in turn, charges C8 at a faster rate, firing Q8 earlier. SCR1 and SCR2 are correspondingly fired sooner in each cycle, causing an increase in the voltage across C2.

The dc voltage across C2 is set by adjusting the arm of "regulator input" potentiometer R29.

The "closed loop" operation as described above is slow to respond to sudden load variations. This is due to the lone time constants of the loop. Additional circuitry is therefore used to advance the firing angles of the SCR's just before a heavy load is applied, i.e., when the station is keyed.

During standby conditions, a positive voltage on the keying line from the control unit is applied via R68 to the base of Q10. Transistor Q10 is in saturation and the collector is close to ground potential. When the station is keyed, Q10 is turned off and a pulse through capacitor C13 pulses Q21 "on", which removes some of the charge from C11. This in turn, lowers the base voltage of Q9. The collector voltage of Q9 increases, thereby charging C8 faster and advancing the firing angle of SCR1 and SCR2. As a consequence, more energy is supplied to filter L1-C2, and a heavy load can then be applied to the output without any appreciable decrease in output voltage.

When a heavy load is applied and held (steady-state conditions), the long time-constant system adjusts the firing angles of the SCR's.

d. Series Regulator

(1) Description

Transistor Q5 is a high-impedance current source, supplying base drive to Q3 in the series regulator. Q3 is the driver transistor for series regulators Q1 and Q2, which are connected in parallel. High current gain is achieved, since Q3 drives the bases of Q1 and Q2 in a Darlington circuit. The A+ voltage is divided by resistors R12, R14, R15 and R16, and "A+" potentiometer R13. The sample voltage is applied from the arm of R13 to the base of reference regulator Q4. The emitter of Q4 is held constant at +6.8 volts by zener diode CR18, which is kept in the breakdown state by resistor R11 connected to A+. "A+" control R13 is adjusted so that Q4 is conducting at the level needed to maintain the A+ voltage at 13.6 volts.

(2) Operation

If an increase in A+ output voltage occurs across capacitor C6, the increase is sensed at the arm of R13, increasing the forward base-to-emitter bias on reference regulator Q4. As a consequence, Q4 collector current increases and has the effect of "robbing" some of the base current to series regulator driver transistor Q3. This decreases base drive to Q1 and Q2. The collector-to-emitter voltage across Q1 and Q2 increases, reducing the A+ voltage back to its original level.

With a decrease in A+ output voltage, the voltage on the arm of R13 decreases. As a consequence, Q4 collector current decreases and Q3 base drive increases. The collector-to-emitter voltage of Q1 and Q2 decreases and the A+ voltage comes back to its original value as set by the A+ potentiometer.

The entire circuit action is almost instantaneous, so that the fluctuation in A+ voltage is only momentary.

e. Main Current Limiter

Limiting of the main dc load current through the power supply is obtained by sensing the current through R9, which is in series with the dc current path from series regulators Q1 and Q2. The base-to-emitter bias for current limiter control transistor Q6 is determined by the voltage drop across R9 due to the main dc load current through it and the drop across "C. L." potentiometer R8. R8 is adjusted so that, with a normal load on the power supply, the forward base-to-emitter bias voltage on Q6 is below the level needed to make it conduct. While Q6 is in this "normal load current" condition, it is cut off, and its collector draws no current from current source Q5.

If a heavy load on the power supply occurs, the increased dc output current will cause an increase in the voltage drop across resistor R9. This will cause the base of Q6 to become more positive while its emitter voltage remains unchanged.

As a result, Q6 turns on and decreases the drive current to Q3. Accordingly, transistors Q1 and Q2 start turning off and thereby drop the output voltage. The setting of C. L. potentiometer R8 determines at what output current the current limiting begins.

f. Overvoltage Protection

If the DC voltage at the output of the pre-regulator or the output of the series regulator increases sufficiently, CR17 starts to conduct in its Zener region. The voltage developed across R22 turns SCR3 on, which in turn removes the charging voltage to UJT Q8. This keeps the emitter of the UJT at nearly ground potentail, preventing the UJT from firing and generating gate pulses for SCR1 and SCR2 in the main bridge rectifier. The lack of gate pulses prevents SCR1 and SCR2 from conducting and thereby disables the power supply completely.

(1) Output of Pre-Regulator

If the output voltage of the pre-regulator (voltage across C2) increases, the increase in voltage is sensed across R28 and R33, and the portion across R33 is applied through diode CR16 to the cathode of Zener diode CR17. If the increase in voltage across C2 is sufficiently high, Zener diode CR17 will "breakdown" and supply the current needed to the gate of SCR3 to shut down the power supply.

(2) Output of Series Regulator

If the A+ voltage at the output of the series regulator increases, it is sensed through diode CR19 and applied to the cathode of Zener diode CR17. If the increase in voltage across C6 is sufficiently high, Zener diode CR17 will "breakdown" and apply the positive pulse needed to the gate of SCR3 to shut down the power supply.

(3) Resetting

In the event that the power supply is disabled by the overvoltage protection circuit as described, primary power (117 v ac) to the power supply must be interrupted in order to turn off SCR3.

g. Electronic Filter Circuit

The electronic filter circuit provides the necessary filtering action for the A+ source which supplies the low levels of the receiver(s) and transmitter.

Electronic filter transistor Q7, basically a capacitance multiplier, filters out spikes and any ripple that many appear on the A+ lines. If a spike

occurs in the A+ output (across C6), it is coupled via R17 to the base of electronic filter Q7. The spike is integrated by R17 and C7 to reduce its amplitude and remove the sharp leading edge. As a consequence, the spike that appears at the emitter is attenuated. The electronic filter has an effect similar to a filter capacitor many times the size of C7.

h. Exciter/Transmitter Current Limiting and Protection Circuit

The current limiter circuit prevents excessive current in the rf power transistors due to detuning and short circuit. The protection circuit consists of two separate limiter circuits controlled from a common reference regulator. The circuit operation for the driver transistor limiter is basically the same as for the final transistor limiters.

Transistor Q15 functions as a current limiter for the final transistor, and Q14 controls the base current to the limiter. R47 senses the current and varies the base-emitter voltage of Q14. Reference regulator transistor Q16 establishes a reference level for current limiter operation. When the current is lower than that of the preset (limiting) level, transistor Q14 is cut-off and Q15 is saturated. As more current is drawn through transistor Q15, the voltage drop across R47 increases. When the voltage across R47 becomes slightly greater than the fixed voltage at the emitter of Q14, the transistor becomes forward biased and its collector current reduces the base drive supplied to Q15. This in turn starts turning off Q15. The output current, therefore, cannot become greater than the preset level. If a short develops in the rf power transistor circuit, it will cause the output voltage to drop sufficiently to drive short-circuit detector Q19 into cut-off, removing the base bias voltage applied to Q16. This in turn cuts off the driver as well as the final transistor limiters.

i. "Private-Line" Tone Generator

The tone generator consists basically of a two-stage oscillator (Q103 and Q104) and a tone amplifier (Q106). The frequency-determining element of the oscillator is a "Vibrasender" resonant reed (an electromechanical equivalent of a parallel-tuned high Q tank circuit). The output stage of the oscillator (Q104 provides a tone from both its emitter an its collector. Tones from the two outputs are of opposite phase to each other, with the Q104 emitter output supplying the "PL" tone during a transmission and the Q104 collector output supplying the out-of-phase tone (reverse burst) at the end of a transmission.

Passage of tones from one or the other output of oscillator stage Q104 to the base of tone amplifier Q106 is controlled by the "PL" Tone Gate and the Reverse Burst Gate. During a transmission, the "PL" Tone Gate is open, passing the tones from the emitter output of Q104 to tone amplifier Q106. (At this time, the Reverse Burst Gate is closed). When the operator releases his push-to-talk switch at the end of a transmission, the "PL" tone gate closes, terminating transmission of the in-phase "Private-Line" tone. Simultaneously, the reverse burst gate opens, passing the out-of-phase tone signal from Q104 to the tone amplifier. The out-of-phase tone signal is transmitted for a short interval (approximately 150 milliseconds) to provide a positive damping action for the "Vibrasponder" reed in the listening receiver.

The 150 millisecond delay is developed by "PL" reverse burst delay generator Q102. It delays the actual unkeying of the transmitter after the operator releases his push-to-talk switch, to permit transmission of the short burst of out-of-phase tone (described previously). At the end of the delay interval, the "delayed push-to-talk" output signal of Q104 (at pin P8-5) causes the transmitter to unkey.

An additional circuit (Q101) provides a "Private-Line" Disable signal for the receiver(s) in the station using this board, when the "PL" disable mode is selected. Q101 is an inverter which is saturated when the receiver(s) are in their normal mode ("Private-Line" circuits in use). With Q101 saturated, the R1 and R2 "PL" Disable lines are clamped to ground through diodes CR101 and 102, respectively. The "Private-Line" mode is disabled by application of a ground at the "PL" Disable Control input, pin P8-7. This turns off Q101, removing the ground connection to the "PL" Disable output lines at pins 6 and 4 of P8.

(1) Standby (Unkeyed) State

In the unkeyed state, the "Push-To-Talk Control" signal at pin P8-3 is a positive voltage (approximately +12 volts) which is developed in the local or remote control unit. Diode CR103 is reverse-biased because its cathode is at a higher positive voltage than its anode. The anode voltage for CR103 is taken from a voltage divider comprising R124, R122 and R123 between the +8.8 volt bus and ground. Approximately +0.6 volt is applied from the voltage divider to the base of reverse burst switch Q105, holding Q105 in saturation. The grounded collector of Q105 reverse-biases CR106, whose cathode is connected via R131 to a positive voltage tap (+3.9 volts) on

a voltage divider comprising R129 and R126 between the +8.8 volt bus and ground.

With CR106 reverse-biased, the cathode of CR108 assumes a positive voltage much lower than the 5.4 volts on its anode. CR108 is therefore foreward-biased while the transmitter is unkeyed. At the same time, the positive voltage at the junction of R124 and R122 is applied via R125 to the anode of CR105, forward-biasing it and applying a positive voltage via R128 to the cathode of CR107 sufficient to reverse-bias CR107.

Reverse burst delay generator Q102 is at this time held in saturation, as follows. The positive voltage applied at pin P8-3 keeps capacitor C101 essentially uncharged. (CR103 being reverse-biased acts as an open circuit.) The base voltage of Q102 is approximately 0.7 volt less positive than the A+ voltage at its emitter, forward-biasing the base-emitter junction. (The base voltage is determined by a voltage divider comprised of R106, CR104, R104 and R105 between A+ and ground.) With Q102 saturated, its collector voltage is 12.7 volts and the "Delayed Push-To-Talk" signal at pin P8-5 is approximately the same vlaue.

(2) Transmit (Keyed) State

When the transmitter is keyed, a ground (nominal zero volts) is applied to the "push-to-talk control" input (pin P8-3). This ground forward-biases CR103, grounding the base of reverse burst switch Q105 and turning it off. The Q105 collector voltage rises to approximately 6.6 volts, forward-biasing CR106 and applying a positive voltage via R132 to the cathode of CR108. This reverse-biases CR108, preventing tone signals from C108 from passing through CR108 to the base of tone amplifier Q106. With the ground provided by the "P-T-T Control" signal, diode CR103 clamps the junction of R122 and R124 to ground, removing the forward bias on CR105. With CR105 reverse-biased, the cathode voltage of CR107 drops to a much lower positive voltage tapped off the R129-R126 voltage divider. With 5.4 volts on its anode, CR107 is forward-biased, allowing the "forward-phase" tone signal to pass through it to the base of amplifier Q106. (The complete tone-path is from the emitter of Q104, through JU1, R120, JU2, C106, C107 and CR107 to the base of Q106.)

When the transmitter is keyed, the P-T-T Control signal at P8-3 grounds the negative side of C101, causing C101 to charge rapidly to approximately 12 volts. Reverse burst delay generator Q102 remains on while transmitting however, because its emitter voltage (12.8 volts) is still more positive than its base.

(3) End of Audio Transmission

When the operator releases his push-to-talk switch at the end of the transmission, the transmitter does not unkey immediately. It continues to transmit an rf carrier for approximately 150 milliseconds, modulated only by a reverse-phase "PL" tone. During this short burst, the "PL" tone, being out of phase with the original "PL" tone, provides a damping action to the "Vibrasponder" reed in the listening receiver. Positive damping of the "Vibrasponder" is necessary to prevent it from "ringing" for a short interval after the normal "PL" tone ends, which would cause a "squelch tail" in the listening receiver(s).

The 150 millisecond delay is provided by the "Delayed P-T-T" output signal of reverse burst delay generator Q102. When the push-to-talk switch is released, the P-T-T control signal at P8-3 returns to +12 volts. Capacitor C101 which was charged during P-T-T operation is now discharged thru R104 and R105, momentarily back-biasing CR104. This removes drive from Q102, resulting in Q102 cutoff. The Delayed P-T-T signal at P8-5 is then maintained at near ground potential by current thru R108 and R107. When C101 becomes completely discharged (approximately 150 milliseconds after P-T-T control is removed) Q102 will turn on, being again driven by current through R104 and R105. This causes a high positive potential (12.7 volts) being applied to the junction of R107 and R108, which removes the ground drive from Delayed P-T-T, resulting in transmitter turn off.

4. POWER SUPPLY ADJUSTMENT PROCEDURE

EQUIPMENT REQUIRED:

1. A DC voltmeter with sensitivity of 20,000 ohms / volt or better.
2. A 1.0 ohm, 200 watt resistor.

The power supply must be properly adjusted in order for the regulator circuits to function correctly. Refer to Figure 3. the Power Supply Detail, for the locations of potentiometers to be adjusted.

Use the following procedure to set the voltage and current-limiting levels in the power supply.

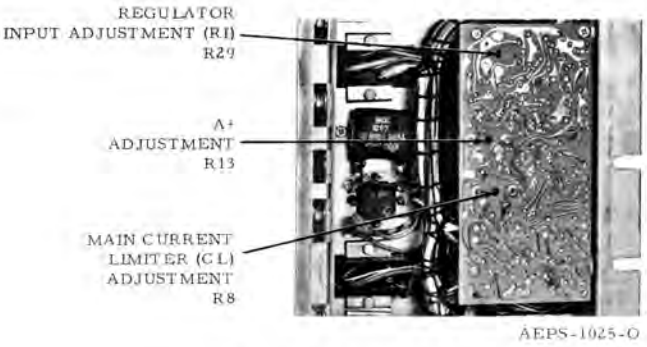


Figure 3.
Power Supply Adjustment Detail

a. Set the R.I. potentiometer R9 fully clockwise as viewed from the plated side of the board.

b. Set C.L. potentiometer R8 fully clockwise.

c. Key the transmitter.

d. Adjust A+ potentiometer R13 for exactly 13.6 volts at terminal TB1-2 on the power supply.

e. Turn R.I. potentiometer R29 counterclockwise until the collector-to-emitter voltage of Q1 and Q2 is exactly 4.3 volts.

NOTE

Make sure that transmitter is keyed.

f. Unkey the transmitter and disconnect transmitter plug P6 from connector J6 on the power supply. Also disconnect power amplifier plug P7 from connector J7.

g. Connect a 1.0 ohm, 200 watt resistor between terminals 2 and 3 of TB1 on the power supply chassis.

h. Turn C.L. potentiometer R8 until the A+ voltage just begins to fall.

1. Remove the 1.0 ohm load resistor and connect all plugs.

5. TROUBLESHOOTING

Use standard troubleshooting techniques to isolate a power supply malfunction to a particular stage. Compare the voltage readings to those on the schematic diagram to determine the faulty component. Waveforms (A), (B), (C) and (D) are provided on the schematic diagram for checking circuit operation at those key points.

a. Loading

Power supply troubleshooting should begin with a normal load (or simulated normal load) applied. If either an overvoltage or overcurrent condition exists, the power supply should be disconnected from its normal load and appropriate dummy load resistors connected. The dummy load resistors used should total 1.25 ohms ±10% at 200 watts. They are connected between TB1-2 and TB1-3 on the power supply.

b. Voltage Measurements

Normal voltage measurements in the power supply circuit are shown on the Power Supply Schematic Diagram, 63E81000E39. Voltages are given for a full load (transmitter keyed) and also for the standby condition (transmitter unkeyed).

6. SERVICE AIDS

a. Parts Location

Locations of electrical parts within the power supply are shown in Figures 4, 5, and 6.

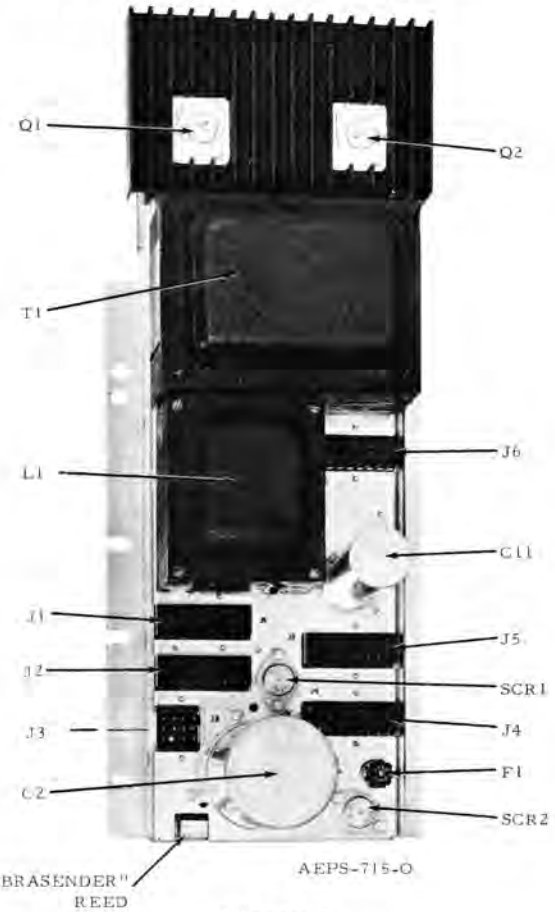


Figure 4.
Power Supply Parts Location Detail (Front View)

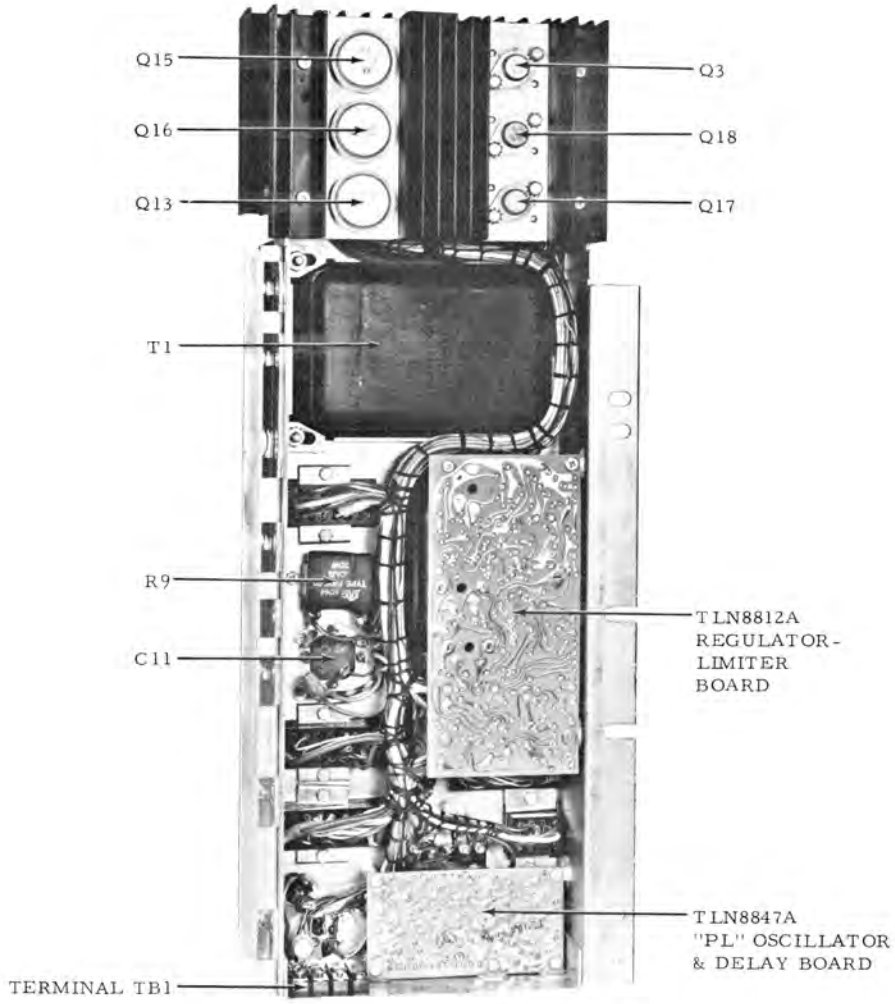


Figure 5.
Power Supply Parts Location Detail
(Rear View)

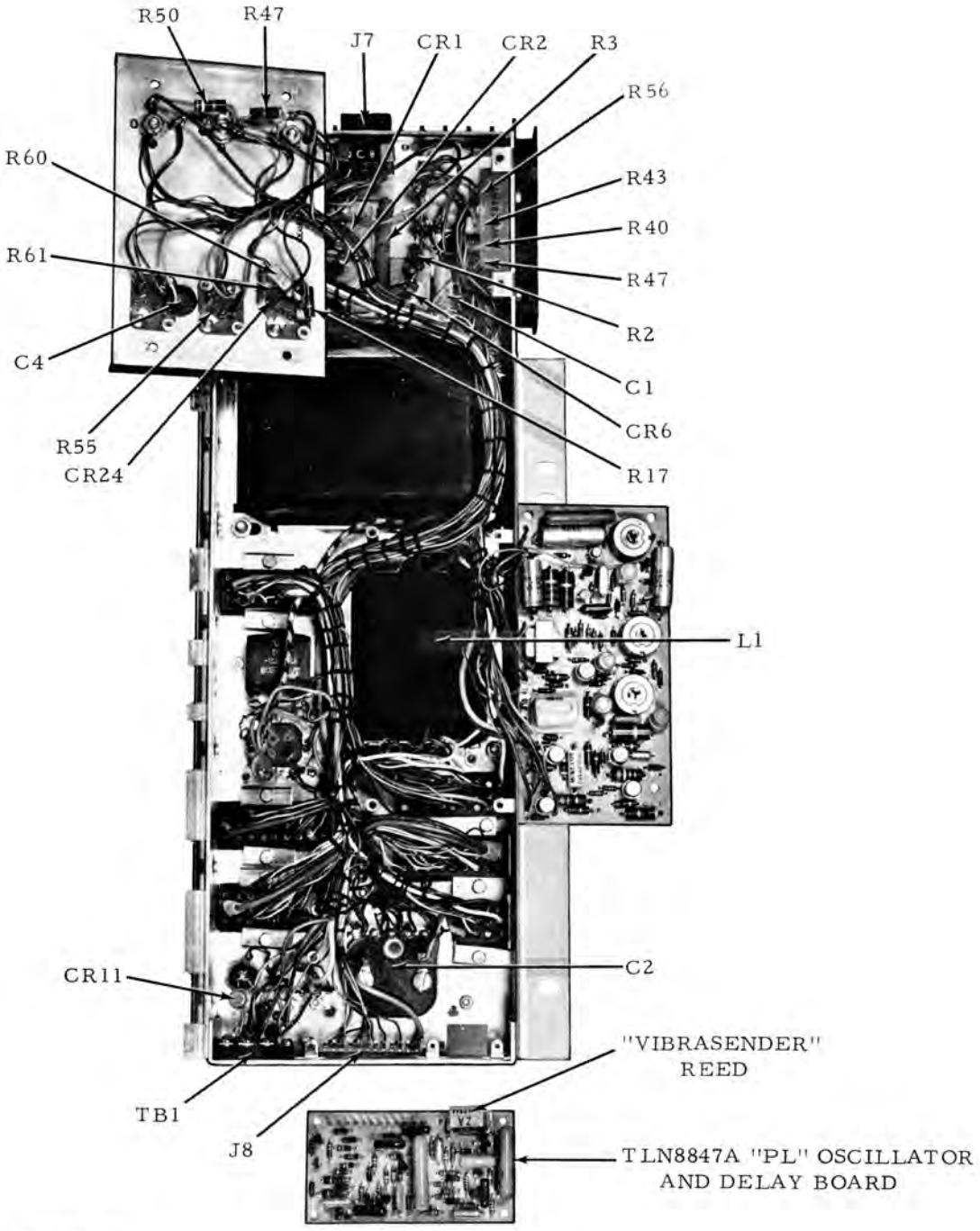


Figure 6.
Power Supply Parts Location Detail
(Rear View, Subassemblies Removal)

b. Circuit Board Removal

(1) Complete removal of the regulator-limiter printed circuit board for access to the components is not necessary. The circuit board can be folded away from the power supply chassis to expose the components, after first removing the four mounting screws. Fold the board out and to the right of the power supply chassis.

(2) To remove the "Private-Line" tone generator board; (a) remove the five mounting screws; (b) unplug the board carefully from its receptacle.

c. Power Transistor Removal (Heat-Sink Mounted Units)

To remove a heat-sink mounted power transistor:

(1) Using a 1/4-inch hex-nut driver, remove the four metal-tapping screws holding the heat-sink to the chassis.

(2) Unsolder all lead(s) from the base and emitter pins on the transistor.

(3) Remove the two mounting screws and pull the transistor out of its socket. Exercise care so as not to damage the mica insulator between the transistor case and heat-sink.

d. Power Transistor Replacement

Replacement of type M9394 power transistors must be done carefully to ensure that the mica washers and insulating sleeve are installed correctly. Failure to do so may cause arcing to the chassis with resultant damage to the power transistor(s). Refer to Figure 7. Power Transistor Assembly Detail for proper orientation of the various parts when installing an M9394 transistor (reference designations Q213, Q215, and Q216).

When replacing a power transistor, inspect the mica insulator for cracks or tears, and replace if defective. If a new transistor is being installed, always discard the old mica insulator and install the new one supplied with the transistor.

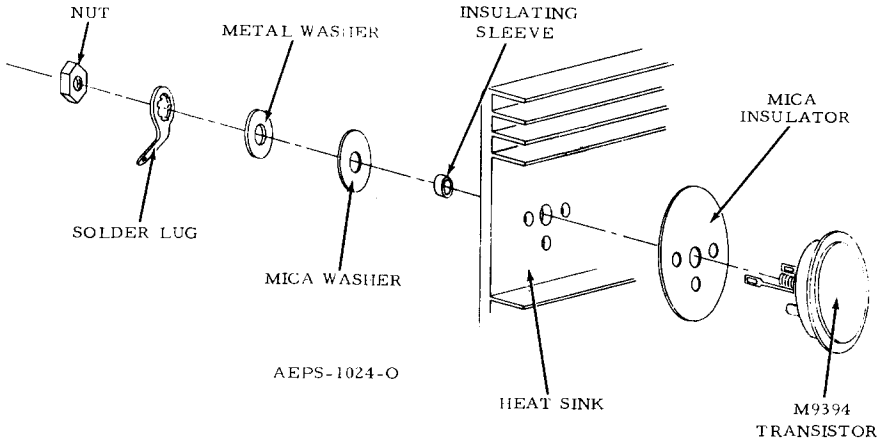
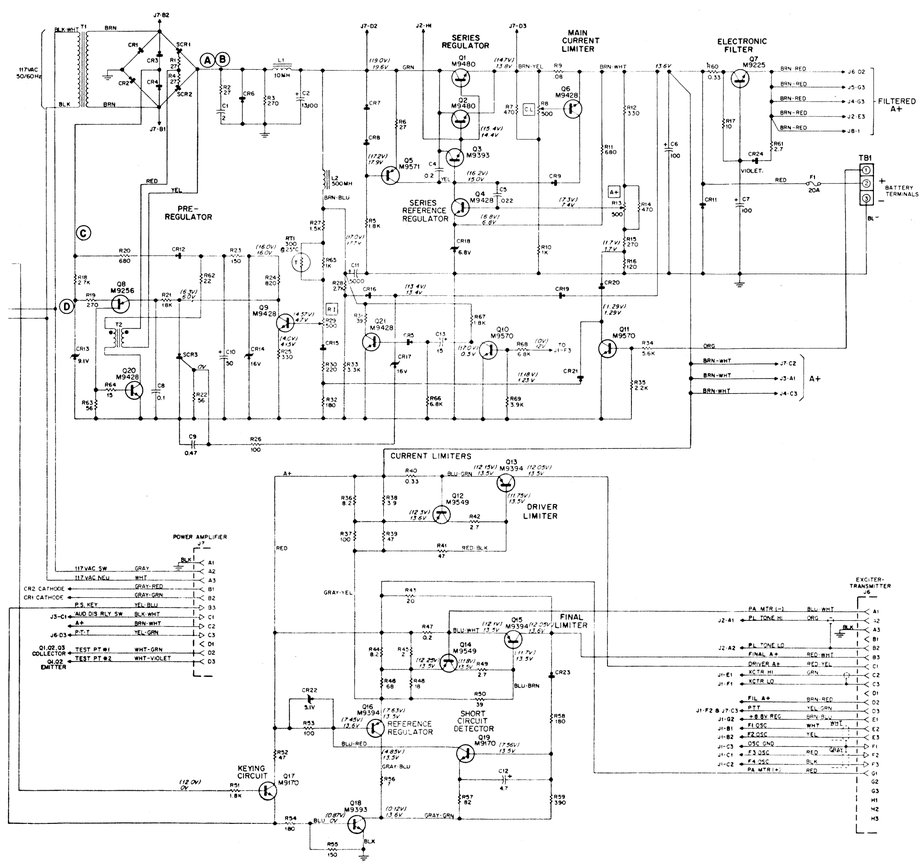
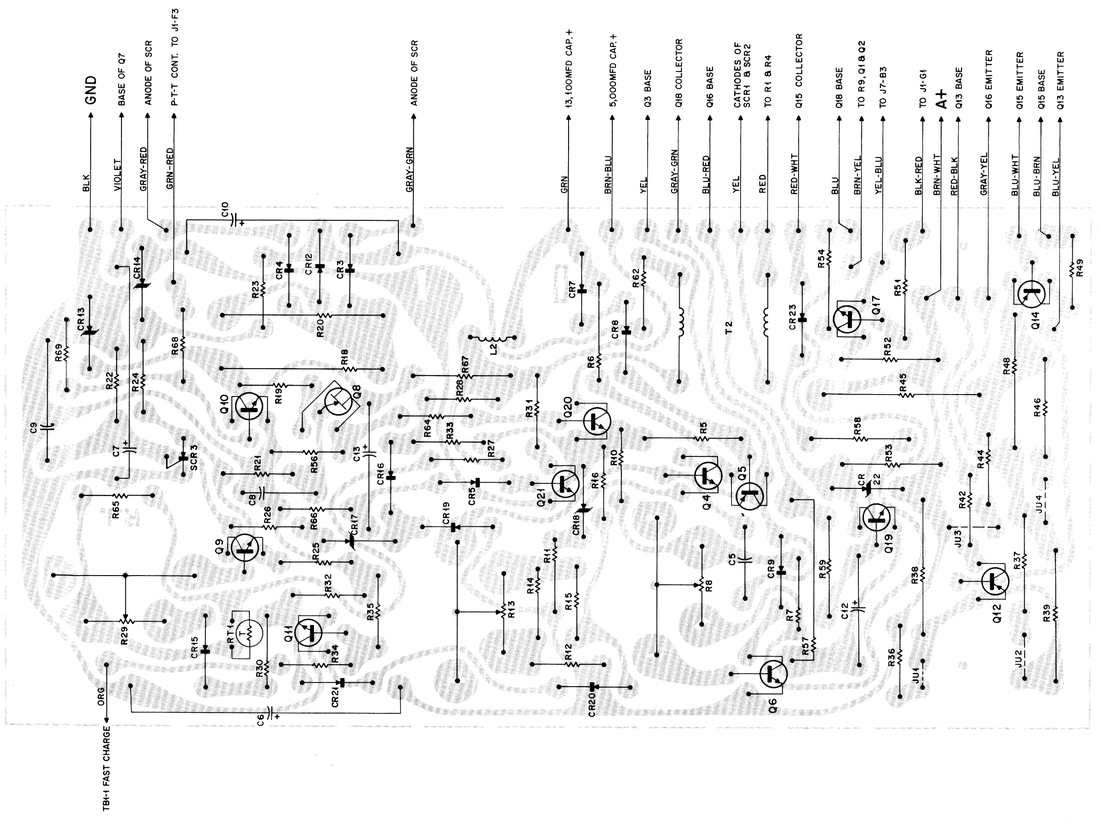


Figure 7.
Power Transistor Assembly Detail

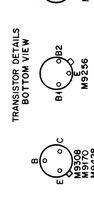




NOTE:
JUMPERS J4; J2, J3 AND J4 ARE FACTORY PRE-CUT, AS REQUIRED.

OL-DEPS-1375-A

TRANSISTOR DETAILS BOTTOM VIEW



POWER SUPPLY

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN8812A Regulator-Limiter
Circuit Board Detail
Motorola No. PEPS-503-A
6/5/74-NPC

REVISIONS

PEPS-503-A

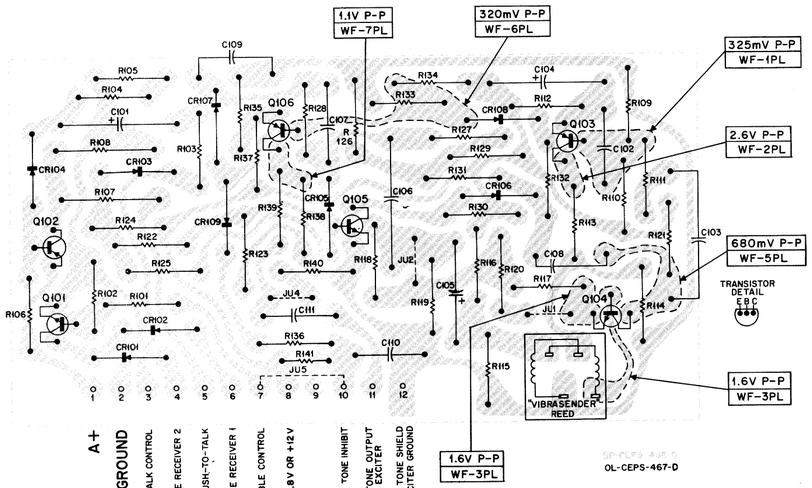
BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8812A-1	Q5	WAS 48R869571, TYPE M9571	SCHEMATIC & PARTS LIST

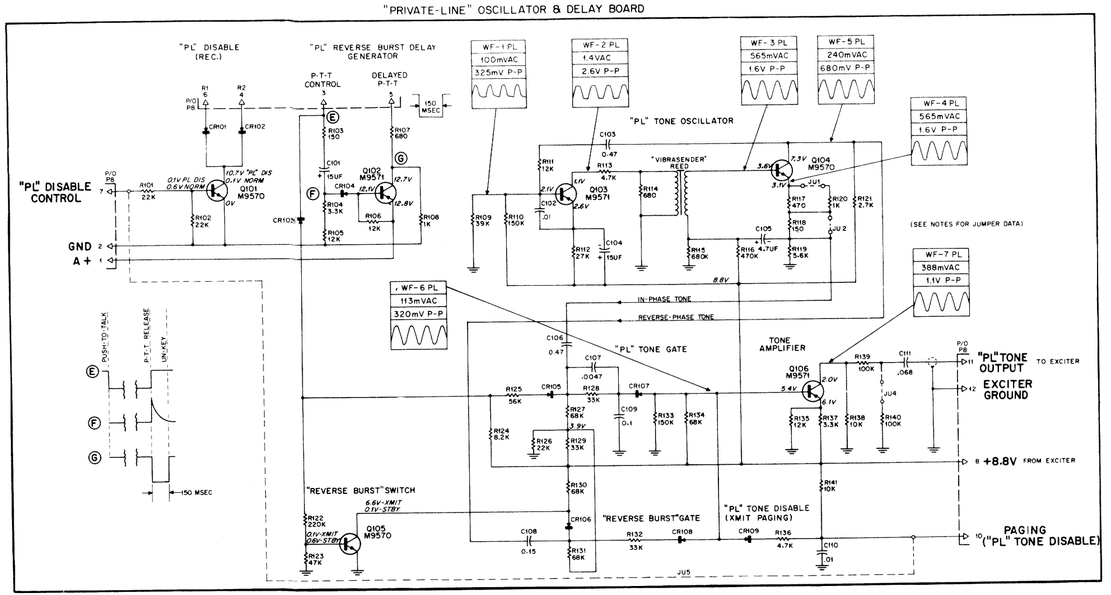
PARTS LIST

TLN8812A Regulator Limiter Board PL-185-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 50 v; unl stated
C5	8D82905G02	.022
C6	23D82601A19	100 +60-0%; 25 v
C7	23D82601A25	100 +150-10%; 20 v
C8	8C83514G02	0.1
C9	8C82905G33	0.47 ±20%
C10	23C82601A36	50 +150-10%; 35 v
C12	23D82783B25	4.7; 25 v
C13	23D83214C02	15 ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR3, 4	48C82466H02	silicon
CR5, 9, 15, 16, 20, 21, 23	48C82392B03	silicon
CR7, 8, 19	48C82392B05	silicon
CR12	48C82466H01	silicon
CR13	48D82256C43	silicon; zener type; 9.1 v
CR14	48C83461E07	silicon; zener type; 16 v ±10%
CR17	48D83461E01	silicon; zener type; 16 v ±5%
CR18	48D82256C37	silicon; zener type; 6.8 v
CR22	48D82256C51	silicon; zener type; 5.1 v
SCR3	48R869577	silicon; controlled type
		REACTOR:
L2	25B82349A01	power filter choke; 500 mH
		TRANSISTOR: (NOTE)
Q4, 6, 9, 20, 21	48R869428	N-P-N; type M9428
Q5	48R869308	N-P-N; type M9308
Q8	48R869256	unijunction; type M9256
Q10, 11	48R869570	N-P-N; type M9570
Q12, 14	48R869549	P-N-P; type M9549
Q17, 19	48R869170	N-P-N; type M9170
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R6	6S5683	27; 1/2 w
R7	6S127801	470
R8, 13	18C83168C01	variable: 500 ±20%; 2 w
R10, 65	6S127802	1K
R11	6S128599	680
R12	6S129806	330 ±5%
R14	6S129708	470 ±5%
R16	6S124A27	120 ±5%
R18	6S5764	2.7K; 2 w
R19	6S129752	270
R20	6S490015	680; 2 w
R21	6S128904	18K
R22, 63	6S129860	56
R23	6S129862	150
R24	6S129432	820
R25	6S129775	330
R26	6S129753	100
R27	6S127803	1.5K
R28	6S128688	2.7K
R29	18C83168C01	variable: 500 ±20%; 3 w
R31	6S131652	39
R32	6S129662	180
R33	6S129231	3.3K
R34	6S129433	5.6K
R35	6S128689	2.2K
R36, 44	6S124B67	8.2 ±5%
R37, 53	6S6326	100; 1/2 w
R38	17K837834	3.9 ±5%
R39	6S5583	47 ±5%; 1 w
R42, 49	6S124B55	2.7 ±5%
R45	17K847359	2 ±2%; 1 w
R46	6S2039	68; 1/2 w
R48	17C82036G27	18 ±5%; 2 w
R52	6S5550	47; 1/2 w
R54, 58	6S5660	180; 1/2 w
R57	6S488222	82; 2 w
R59	6S5554	390; 1/2 w
R62	6S131641	22
R64	6S131377	15
R66, 68	6S129687	6.8K
R69	6S129232	3.9K
T2	25C83039H01	TRANSFORMER, pulse: bifilar; res (each winding) 1.5 ohms max
RT1	6B865641	THERMISTOR: 300 ohms

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





POWER SUPPLY

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN8847A "Private-Line" Oscillator & Delay (Encoder)
Circuit Board Detail
Motorola No. PEPS-469-D
6/5/74-NPC

REVISIONS

PEPS-469-D

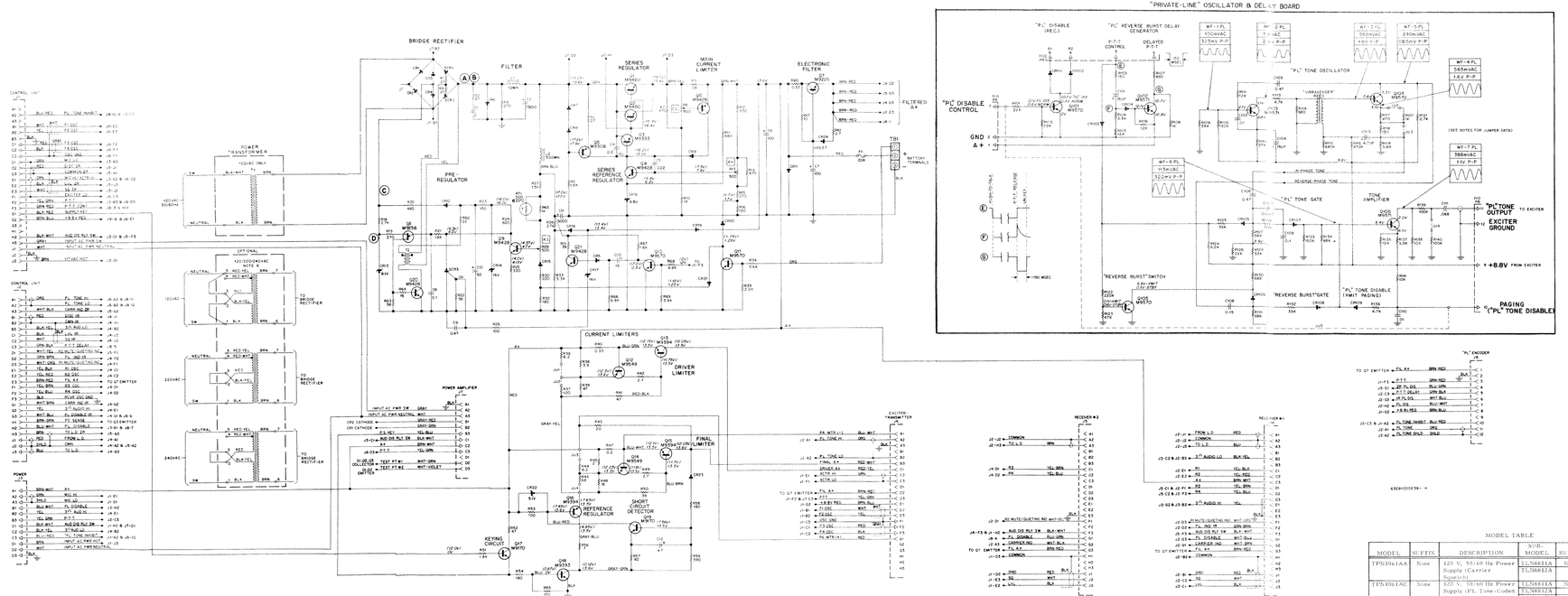
BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8847A-1	R141	ADDED 100K	Q106 EMITTER CIRCUIT

PARTS LIST

TLN8847A "Private-Line"
Oscillator & Delay Board

PL-293-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; 50 V; unl. stated
C101	23-82783B24	15 ±10%; 25 V
C102	8-82905G01	.01 ±10%
C103	8-82905G33	0.47 ±20%
C104	23-865136	15 ±20%; 25 V
C105	23-865137	4.7 ±10%; 25 V
C106	8-82905G33	0.47 ±20%
C107	8-82905G26	.0047 ±10%; 100 V
C108	8-82905G05	0.15 ±10%
C109	8-82905G07	0.1 ±10%
C110	8-82905G01	.01 ±10%
C111	8-82905G04	.068 ±10%
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101 thru 109	48-82392B03	silicon
		TRANSISTOR: (SEE NOTE)
Q101	48-869570	N-P-N; type M9570
Q102, 103	48-869571	P-N-P; type M9571
Q104, 105	48-869570	N-P-N; type M9570
Q106	48-869571	P-N-P; type M9571
		RESISTOR, fixed: ±5%; 1/4 W: unl. otherwise stated
R101, 102	6-128685	22k ±10%
R103	6-129862	150 ±10%
R104	6-124A60	3.3k
R105, 106	6-129887	12k
R107	6-129984	680
R108	6-6411	1k; 1/2 W
R109	6-129777	39k
R110	6-128683	47k ±10%
R111	6-129887	12k
R112	6-129886	27k
R113	6-129669	4.7k
R114	6-5651	680; 1/2 W
R115	6-131857	680k
R116	6-129149	470k
R117	6-129709	470
R118	6-131276	150
R119	6-129982	5.6k
R120	6-129805	1k
R121	6-129707	2.7k
R122	6-129147	220k ±10%
R123	6-128902	47k ±10%
R124	6-128686	8.2k ±10%
R125	6-128684	56k
R126	6-129667	22k
R127	6-129299	68k
R128, 129	6-129526	33k
R130, 131	6-129299	68k
R132	6-129526	33k
R133	6-128683	47k ±10%
R134	6-129299	68k
R135	6-129887	12k
R136	6-129699	4.7k
R137	6-124A60	3.3k
R138	6-129668	10k
R139, 140	6-124A97	100k
R141	6-129668	10k



MODEL	SUFFIX	DESCRIPTION	SUB-MODEL	SUFFIX	DESCRIPTION
TPX1061AA	None	120 V, 50/60 Hz Power Supply (Carrier Squelch)	TLN8811A	None	Chassis
			TLN8812A	1	Regulator-Limiter
TPX1061AC	None	120 V, 50/60 Hz Power Supply (PL Tone-Coded Squelch)	TLN8811A	None	Chassis
			TLN8812A	1	Regulator-Limiter
			TLN8847A	1	Tone Osc. & Delay
TPX1092AA	None	120/220/240 V, 50/60 Hz Power Supply (Carrier Squelch)	TLN8452A	None	Chassis
			TLN8812A	1	Regulator-Limiter
TPX1092AC	None	120/220/240 V, 50/60 Hz Power Supply (PL Tone-Coded Squelch)	TLN8452A	None	Chassis
			TLN8812A	1	Regulator-Limiter
			TLN8847A	1	Tone Osc. & Delay

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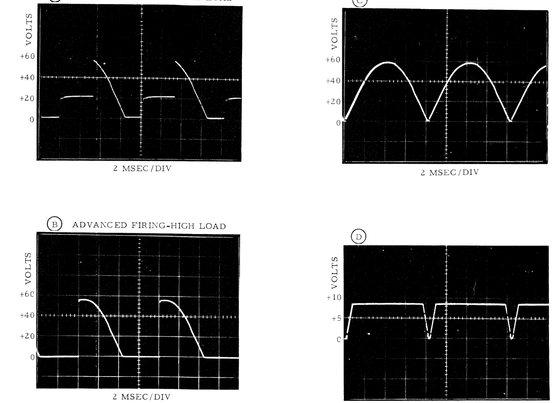


AEPS-1017-O

NOTES:

1. UNLESS OTHERWISE STATED:
   ALL CAPACITOR VALUES ARE IN MICROFARADS;
   ALL RESISTOR VALUES ARE IN OHMS (K=1000).
2. COMPONENT REFERENCES WITHIN RECTANGLES ARE MARKED ON THE CHASSIS.
3. CIRCLED LETTERS INDICATE THE POINT AT WHICH EACH WAVEFORM APPEARS.
4. ALL DC VOLTAGE MEASUREMENTS TAKEN WITH RESPECT TO CHASSIS, USING A METER HAVING AN INPUT RESISTANCE OF 20K OHMS-PER-VOLT OR HIGHER.
5. JU1, JU2, JU4 + ANY ONE OF ALL MAY BE CUT IN FACTORY TO ADJUST OSCILLATOR OUTPUT LEVEL TO MATCH SYSTEM REQUIREMENTS. JU3 IS CONNECTED ONLY IN DC REMOTE CONTROL STATIONS WITH PAGING CAPABILITY.
6. WHEN USING THE 120-VOLT INPUT POWER RANGE WITH THE TRI-POWER SUPPLY, BOTH 5 AMP FUSES MUST BE USED IN THE JUNCTION BOX. A 5 AMP FUSE MUST BE USED FOR 220-VOLT INPUT AND A 2-1/2 AMP FUSE USED FOR 240-VOLT INPUT.
7. WHERE TWO VOLTAGES ARE GIVEN, THE ONE IS PARENTHESES IS FOR THE "TRANSMIT" CONDITION (KEYED); THE OTHER VOLTAGE IS FOR "STANDBY" (UNKEYED).

EPS-1419-D

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Supply
Schematic Diagram
Motorola No. 63E81000E39-H
6/5/74-NPC

REVISIONS

63E81000E39-H

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN8812A-1				REGULATOR-LIMITER BD. PEPS-503-A

PARTS LIST

PARTS LISTS FOR PRINTED CIRCUIT BOARDS ARE ON THE BACK OF THE CORRESPONDING PRINTED CIRCUIT BOARD DETAILS

TLN8811A Power Supply Chassis ("Single-Power")
TLN4562A Power Supply Chassis ("Tri-Power") PL-184-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF;
C1	8C82045E05	2.0 ±10%; 350 v
C2	23D82464C06	13100 +75-10%; 40 v
C4	21C82372C05	0.2 +80-20%; 25 v
C11	23D82304B16	5000 +150-10%; 35 v
C14	8D82905G04	.068 ±10%; 50 v (used in carrier squelch models only)
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR1, 2, 6	48C82732C11	silicon
CR11	48C82525G01	silicon
CR24	48C82392B03	silicon
SCR1, 2	48R869306	silicon; controlled type; does not include 14K865854 INSULATOR, mounting
		FUSE, cartridge:
F1	65S135013	20 a; 125 v
		CONNECTOR, receptacle:
J1, 2, 4, 5		includes: 14C83783A08 BODY 29C82335A01 TERMINAL, contact: male; 29C82336A01 TERMINAL, contact: female (p/o J1, J2 only)
J3		includes: 14C82337A03 BODY 29C82336A01 TERMINAL, contact; female
J6		includes: 14C83783A03 BODY 29C82335A01 TERMINAL, contact: male; 29C82336A01 TERMINAL, contact: female
J7		includes: 14C82689A01 BODY 29C92335A01 TERMINAL, contact: male; 29C82336A01 TERMINAL, contact: female
		TERMINAL BOARD:
J8	1V80700B15	12 female contact terminals
		REACTOR:
L1	25D83967G01	power filter choke; 10 mH; res 0.1 ohm
		TRANSISTOR:
Q1, 2	48R869480	N-P-N; type M9480: does not include 14A82360D01 SLEEVE, insulating: (for transistor mtg screws)
Q3, 18	48R869393	N-P-N; type M9393; does not include: 14A83575A01 INSULATOR, mounting; 14A82360D01 SLEEVE, insulating: (for transistor mounting screws)
Q7	48R869225	N-P-N; type M9225
Q13, 15, 16	48R869394	P-N-P; type M9394; does not include: 14A82923G01 INSULATOR, mounting: mica; 1-1/4" o.d.; 4C82418B64 SLEEVE, insulating: (for transistor mtg stud)
		RESISTOR, fixed: ±10%; 5 w; unl stated
R1, 4	6S131594	27; 1/4 w
R2	6S5676	27; 1 w
R3	6C82394D12	270; 7 w
R9	17C83212C02	.08; 30 w
R17	6R488022	10; 1 w
R40	17C82586H04	.033 ±5%
R41	6S126A17	47 ±5%; 1 w
R43	17D82177B07	20 ±5%
R47	17C82586H01	0.2 ±5%
R50	6S400436	39 ±5%; 1 w
R55	6S129862	150; 1/4 w
R56	17K865603	7
R60	17C82350A11	0.33; 1 w
R61	6S124D55	2.7; 1/4 w

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		TRANSFORMER, power: 50/60 Hz
T1	25D83971G01	pri: BLK, BLK-WHT; res 0.225 ohms ±10% sec: BRN, BRN; res .005 ohms ±10% ("Single-Power")
	or25D84508C01	120/220/240 V AC; pri: BLK, RED-YEL with RED, BLK-YEL and RED-WHT taps sec: BRN BRN ("Multi-Power")
		TERMINAL BOARD:
TB1	31B84002A01	3 dual screw terminals
		FUSEHOLDER:
XF1	9C82083C03	extractor post type
		SOCKET, transistor:
XQ1, 2	9D82673A01	2 contact
XSCR1, 2	9D82673A01	2 contact
XQ3, 7, 18	9B83662A01	2 contact
	NON-REFERENCED ITEMS	
	1V80781A90	HEAT SINK ASSEMBLY: (front); includes transistor sockets XQ1, 2
	1V80781A92	HEAT SINK ASSEMBLY: (rear); includes transistor sockets XQ3, 7, 18
	7A83959A01	PLATE, heat sink: (top); used for mounting CR1, 2
	64B83562D01	PLATE, heat sink: (bottom); used for mounting CR6

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

CONTROL UNIT

MODEL TABLE

MODEL	DESCRIPTION
TCN1059A	Control Chassis
TLN1183A	Master Decoder Module
TLN1177A	4-User Control Module
TLN1173A	*Station Logic Module
TLN1180A	*Squelch Gate Module
TLN1179A	*Time-Out Timer Module
TLN1181A	*Single-Tone Decoder Module (Optional)

*Described in separate sections of this manual.

1. DESCRIPTION

The control unit permits the station to operate as an automatic, unattended community repeater by performing the following functions:

-- Detecting the presence of an rf input signal.

-- Detecting the presence of proper "Private-Line" tone coding (up to 16 different "Private-Line" tone frequencies can be used).

-- Keying the transmitter when an input of a predetermined quieting level (or greater) and a proper "Private-Line" tone input are present.

-- Applying received audio to the transmitter at the proper level for retransmission.

-- Filtering and retransmitting the "Private-Line" tone.

-- Limiting the maximum time the repeater can be operated continuously by one user.

The control unit features all solid-state circuitry and modular construction. The basic assembly consists of a control unit chassis and five plug-in modules as listed in the Model Table. A basic community repeater includes one 4-user control module, which permits the use of up to four "Private-Line" tone frequencies. If more "Private-Line" tone frequencies are required, more 4-user control modules may be added by merely plugging them into the control chassis. A total of four of these modules can be used, for a maximum station capability of 16 "Private-Line" tone frequencies. A space is also provided for adding an optional single-tone decoder module. If this accessory is used, a specific audio tone frequency is required at the beginning of each initial incoming message, in addition to the "Private-Line" tone, to operate the repeater.

2. BASIC CIRCUITS

Several basic circuits are used extensively in the logic circuitry of the control unit. The AND gate, the OR gate, the transistor switch, the Schmitt trigger and the bistable multivibrator are the most common. These circuits are described in the following paragraphs.

a. AND and OR Logic

An AND gate has two or more inputs and a single output. All inputs (A and B and C and etc.) must be in the "active" state before the output will be switched from the "inactive" to the "active" state.

An OR gate also has two or more inputs and a single output. Any input (A or B or C or etc.) which is in the "active" state will switch the output from the "inactive" to the "active" state.

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

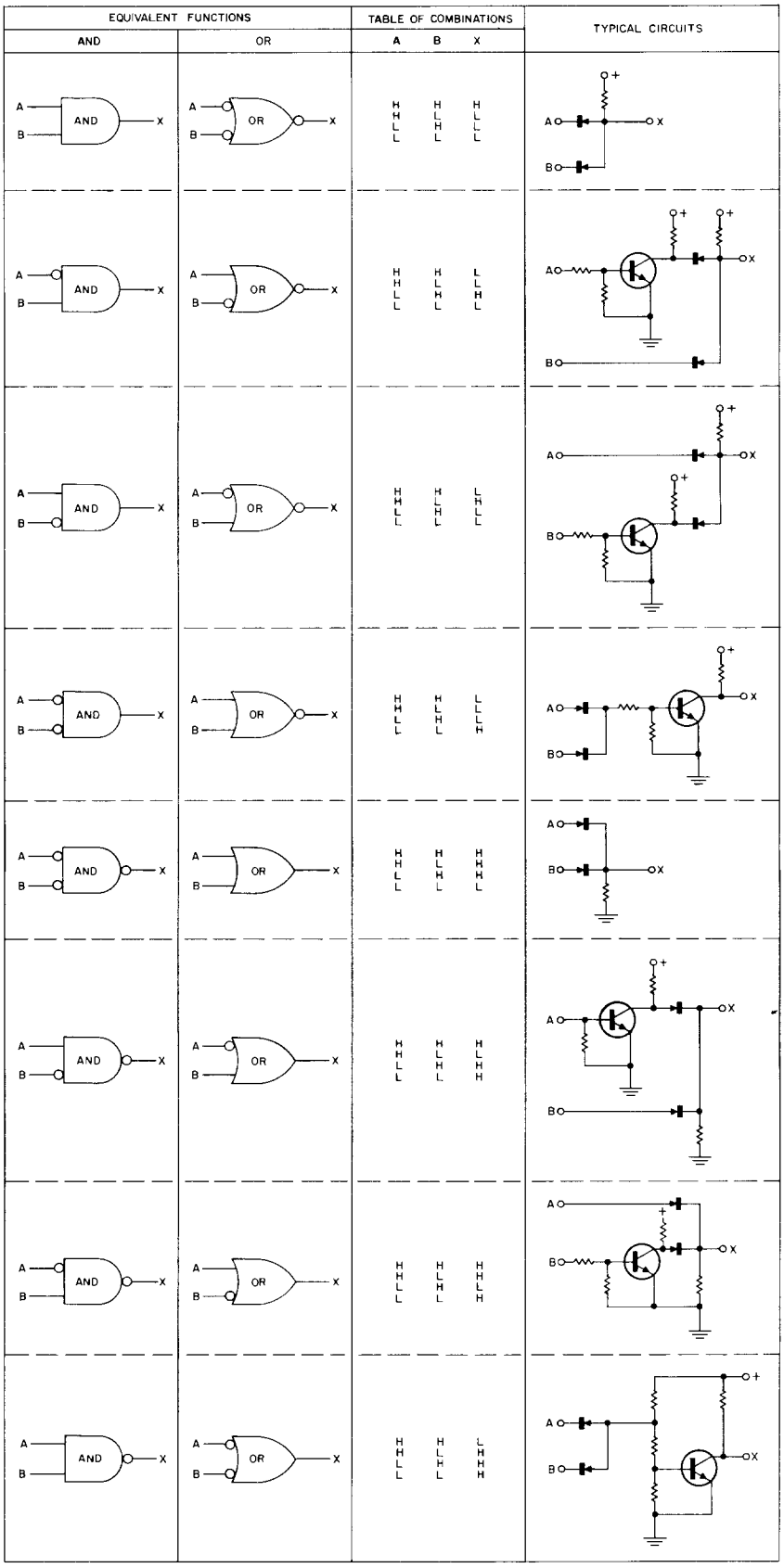


Figure 1.
Chart of Typical AND and OR Logic Presentations and Typical Equivalent Circuit Diagrams

Binary logic circuits have two states which are designated "active" and "inactive". Each of these states may be either of two distinct voltage levels. These voltage levels are designated "high" and "low". The more positive voltage source is considered to be the "high" level and the less positive voltage source is considered to be the "low" level. The "high" and "low" levels are represented by the letters "H" and "L" in the logic truth table. Logic symbols for AND and OR gates show the "high" and "low" voltage levels as follows: A small circle at the input to a gate indicates that the "low" level activates the function. Conversely, the absence of a small circle indicates that the "high" level activates the function. The same is true of the output. A small circle at the output indicates that the "low" level is present when the function is activated and absence of the circle indicates that the "high" level is present when the function is activated.

A non-inverted output is obtained when the transistor is connected in the common collector configuration. With no input signal, the transistor is cut off and the emitter is at ground potential. When a positive input voltage is applied, the transistor is forward biased and the emitter voltage follows the base voltage until the collector voltage (supply voltage) is approached. A large power gain can be obtained from the common collector circuit, however, the voltage gain is always less than one.

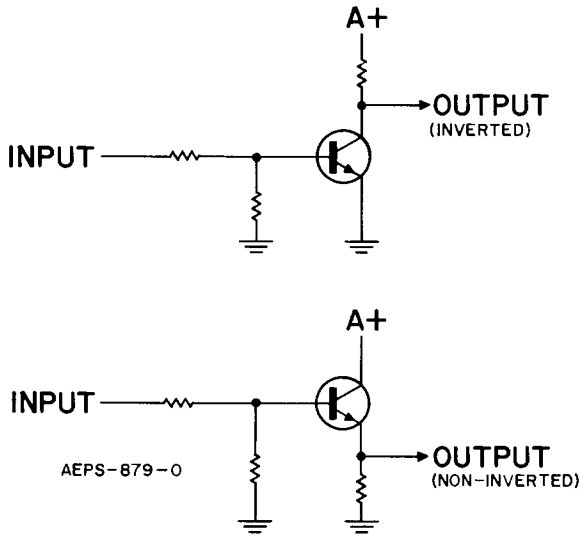


Figure 2.
Typical Transistor Switches

c. Schmitt Trigger

A Schmitt Trigger is a regenerative bistable circuit whose state depends on the amplitude of the input voltage and where feedback is provided by the use of a common emitter resistor. Figure 3. shows the configuration of a typical Schmitt trigger circuit. The output of the Schmitt trigger will be one value if the input exceeds a given level and the output will return to its initial value if the input goes below another level. The circuit is used for detecting a dc level and providing a fast rise square wave output.

In the initial state, Q1 is biased at cut-off and Q2 is biased into conduction. The common emitter voltage is a function of the voltage divider formed by R5 and R7.

When the input drives the base of Q1 positive, Q1 starts to conduct. Its collector voltage drops and this voltage is coupled through R4 to the base of Q2 turning it off. With Q2 in the off state, its collector voltage rises abruptly from its original low level. The common emitter voltage is now a function of the voltage divider formed by R5 and R3.

To return the Schmitt trigger circuit to its original state, the input voltage must drop to a level which no longer forward biases the base of Q1. The output of a Schmitt trigger may be taken at the collector of either Q1 or Q2. The output at the collector of Q1 will be inverted while the output at the collector of Q2 will be non-inverted.

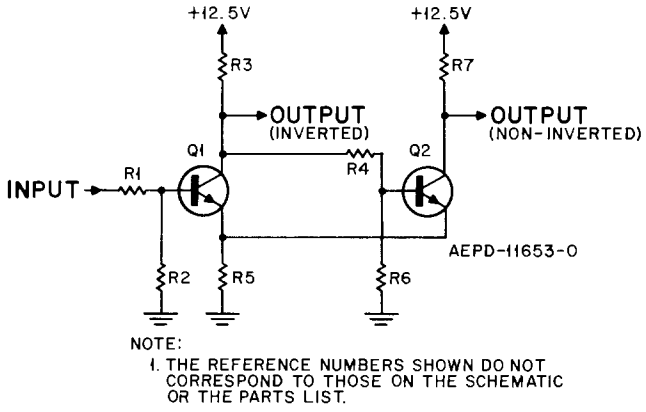


Figure 3.
Typical Schmitt Trigger

d. Bistable Multivibrator

The bistable multivibrator is a double input switching circuit whose state is determined by the

input applied and where feedback is used to maintain a given state. Figure 4. shows the configuration of a typical bistable multivibrator circuit.

Due to normal variations in the multivibrator circuit, one transistor will saturate and the other will be cut off upon initial application of dc power. Each transistor is held in its particular state by the condition of the other.

Assume that Q1 begins conducting first when power is applied. The collector voltage of Q1 will attempt to approach the emitter voltage (ground). This voltage is coupled to the base of Q2 through R3, preventing Q2 from conducting. When Q2 is cut off, the collector voltage attempts to rise to the supply voltage. This voltage is coupled through R4 to the base of Q1 driving it further into conduction, which in turn lowers the voltage being coupled to the base of Q2 even more. This sequence continues until one transistor is saturated and the other is cut off.

The inputs are positive voltage signals applied to the bases of the bistable circuit. A positive voltage applied to input #2 forces transistor Q2 to conduct. As Q2 conducts, the collector voltage begins to decrease. This decrease in voltage appears at the base of Q1, cutting it off. When Q1 stops conducting, the collector voltage attempts to rise to the supply voltage. This voltage is then coupled through R3 to the base of Q2, driving it further into conduction.

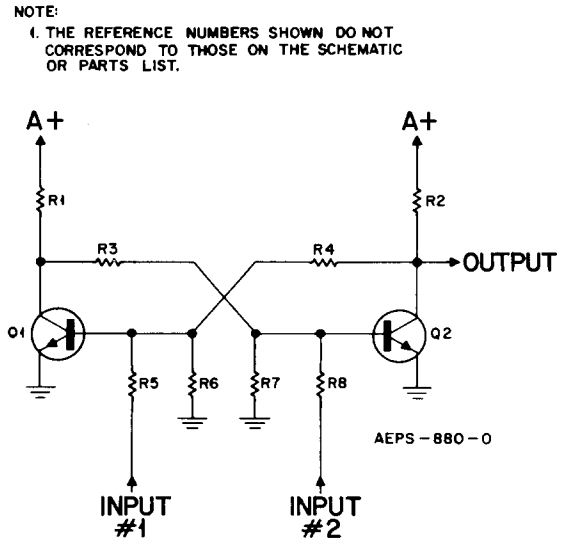


Figure 4.
Typical Bistable Multivibrator

The desired output of the bistable multivibrator circuit may be selected by applying a positive voltage to the appropriate input. If a positive voltage is applied to input #1, the output will approach the level of the collector supply voltage of Q2. If a positive voltage is applied to input #2, the output will approach zero volts. An output may also be taken from the collector of Q1. This output will be inverted from the Q2 collector output.

3. CONTROL CHASSIS

The control chassis consists of a wrap-around chassis which houses the modules, a circuit board which interconnects the modules, and a local control panel from which the station can be tested.

Nylon guide rails snapped into place in this chassis align the modules to mate with connecting pins on the interconnect printed circuit board at the rear of the "wrap-around" chassis.

The local control panel provides the following local control facilities for service and maintenance.

- XMIT switch -- for local keying of the transmitter.
- "PL" DISABLE switch -- disables receiver "Private-Line" tone-coded squelch operation for monitoring all on-frequency signals.
- LOCAL MIKE connector -- allows the use of a local microphone for transmitter service and maintenance.

A cable from the interconnect printed circuit board to the power supply provides all required interconnections between the control unit and the remainder of the station.

4. MASTER DECODER MODULE

a. General

The master decoder module performs the following functions:

-- Separate "Private-Line" tones from voice audio.

-- Filters and amplifies "Private-Line" tones for decoding and retransmission.

-- Provides "PL" indicator signal to enable the squelch gate (which, in turn, enables the repeater).

-- Eliminates squelch tail and low frequency noise in listening receivers during the turn-off delay of the repeater.

-- Inverts the "PL" disable signal.

b. Functional Operation

The discriminator output from the receiver is applied to the low-pass filter and noise gate (pin 22). This filter blocks voice frequency audio and noise above 300 Hz and passes the low-frequency "Private-Line" tones. A high-pass filter parallels the low-pass filter and is gated on and off by output switch Q5. It passes high-frequency noise (above 3000 Hz) to help prevent false decoding by low-frequency noise signals when no rf signal is received. When a signal is received, the filter is gated off to eliminate the noise.

The output of the low pass filter and noise gate is amplified by the buffer and amplifier stages, then applied to the transmit "PL" level control and low pass filter which applies the "PL" tone to the modulator for retransmission. The filter exhibits a 6 db/octave de-emphasis characteristic to counteract the 6 db/octave pre-emphasis characteristic of the transmitter. The result is approximately equal deviation for all "Private-Line" tone frequencies. The output of the amplifier stage is also applied to the amplifier/clipper stage. All received "PL" tones of the proper deviation will drive the transistor to saturation and cutoff, thus providing a constant amplitude output free of noise. The driver provides sufficient power gain to drive up to four 4-User Control Modules.

Whenever any of the proper "Private-Line" tone frequencies are received and decoded by a 4-user control module, a switched ground is applied to pin 17 of the master decoder module. This input turns on the output switch and its collector voltage goes to A+. This logic "high" output gates the low pass filter and noise gate, unsquelches the receiver (pin 23), and enables the squelch gate by providing the "PL" indicator signal (pin 16).

Audio from the line output (volume) control is applied to the "PL" high-pass filter which blocks the low-frequency "Private-Line" tones and passes the voice audio frequencies above 300 Hz to the receiver.

The "PL" disable switch stage inverts the ground input from the "PL" DISABLE switch on the local control panel to a voltage that unsquelches the receiver audio section.

Stages Q6, Q7 and Q8 help eliminate "squelch tail" (a noise burst at the end of a transmission) in the listening receivers and also eliminates low-frequency noise during the repeater turn-off delay. Whenever a carrier signal is present in the receiver, the quieting indicator input (pin 19) from the squelch gate module is logic "low". During this time, switch Q6 is cut off, delayed switch Q7 is on and transmit "PL" mute switch Q8 is off. The "PL" tone is permitted to pass to the transmitter. During approximately the last 150 milliseconds of the incoming signal, a reverse-burst "PL" tone will be received from the radio set which originated the transmission. The reverse-burst tone is retransmitted by the community repeater until the radio set stops transmitting. However, the community repeater has a turn-off delay which is controlled by the squelch gate module.

When the rf signal into the community repeater ends, the quieting indicator signal reverts to a logic "high". Switch Q6 again turns on, but the turn-off of Q7 is delayed approximately 100 milliseconds to permit any "PL" tone signal to dampen. Transmit "PL" mute switch Q8 then turns on and the transmitter operates without "PL" tone modulation until repeater turn-off. Q8 shunts the "PL" tone output potentiometer, thus muting any low frequency noise or signals.

Two voltage dividers in the master decoder module provide the bias voltages for the detectors in all 4-user control modules.

5. 4-USER CONTROL MODULE

a. General

This module contains four identical circuits, which perform the following functions:

-- Detects the presence of a properly-coded "PL" tone.

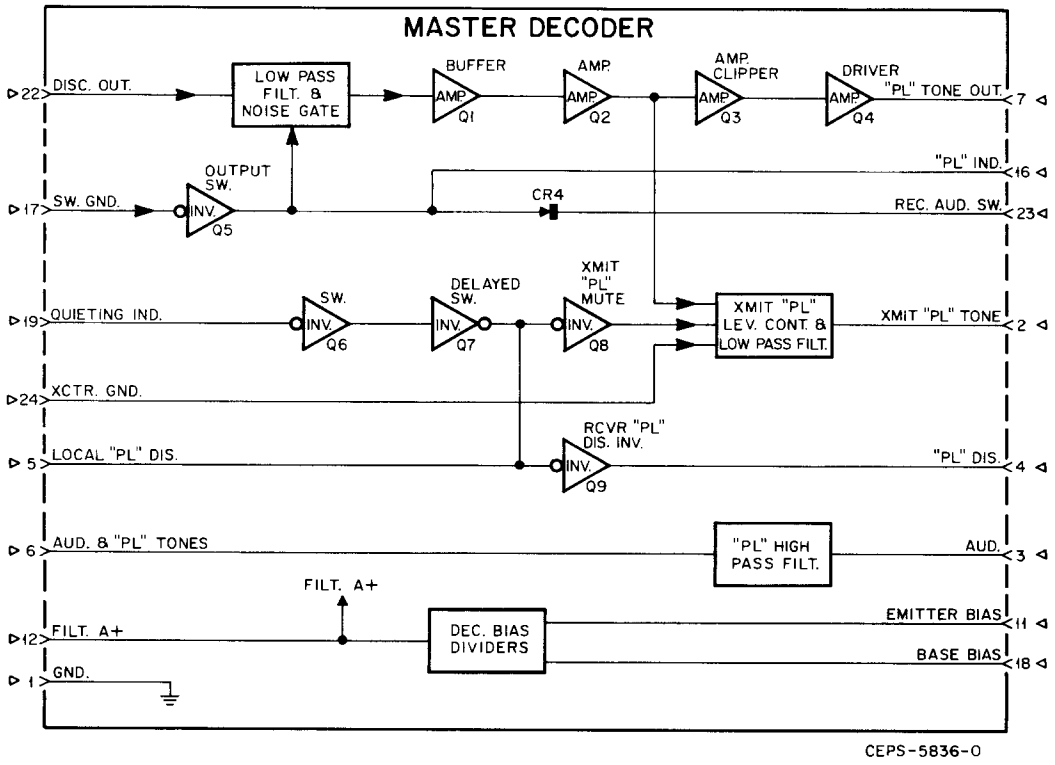
-- Converts the tone to a switched dc logic voltage.

-- Allows a channel to be disabled.

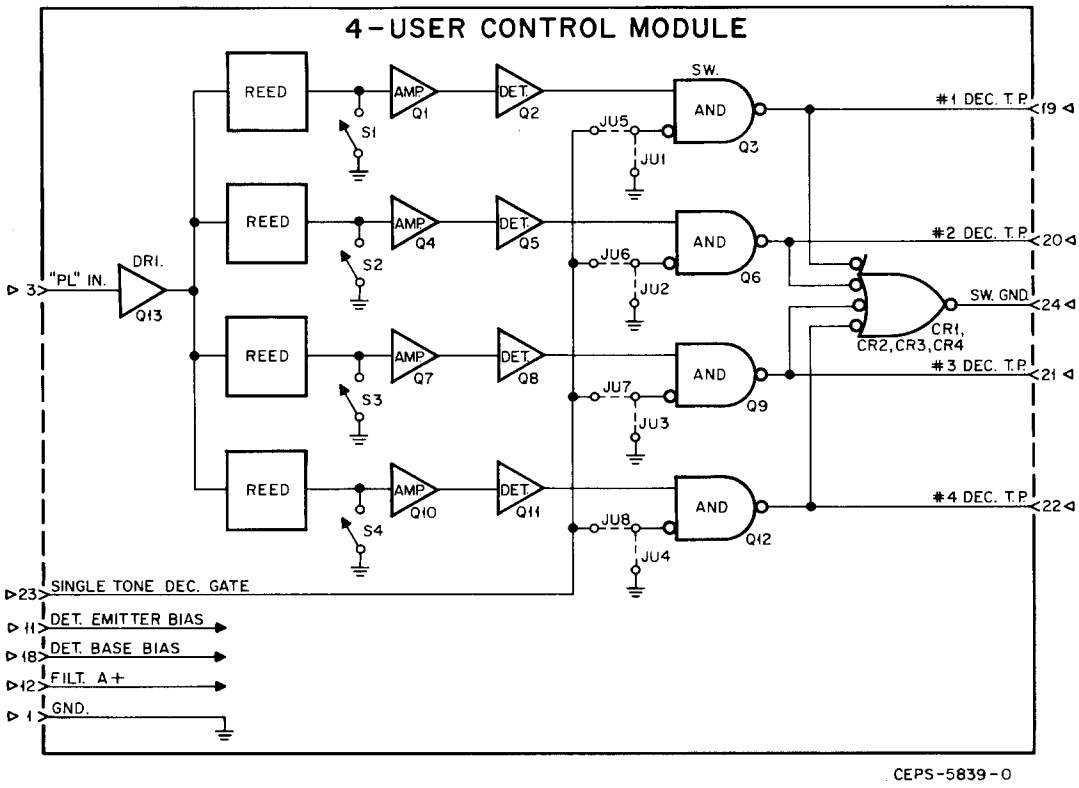
-- Provide the AND gate function when both single-tone and "PL" decoding are required.

b. Functional Operation

All received low-frequency signals (below 200 Hz) from the master decoder module are applied at pin 3 of the 4-user control module. The driver transistor provides the required power gain to drive up to four "Vibrasponder" resonant reeds.



Master Decoder Module Functional Block Diagram



4-User Control Module Functional Block Diagram

The "Vibrasponder" resonant reeds are the frequency sensitive elements for each decoder channel. Coupling from the primary to the secondary winding of the reed will occur only over a very narrow frequency range. At this critical frequency, the reed vibrates within the magnetic influence of the coil. The combination of vibrating reed and coil acts as a high Q resonant circuit. The "Vibrasponder" resonant reed is packaged as a small plug-in unit and is completely enclosed. No adjustments are provided or necessary. Reeds are available in the 82.5 to 192.8 Hz frequency range. Reed assignment is coordinated by the factory for each system. Contact the factory if additional tone frequencies are to be added to your system of if frequencies below 82.5 Hz are required.

The ON-OFF switches on the front panel of the module allow any decoder channel to be disabled if desired, without removing the reed. When the switch is placed in the OFF position, ground is applied to the secondary winding of the reed and no tone output can be developed.

When the correct tone frequency is applied to activate a reed, a sinusoidal wave tone signal will be developed in the secondary winding and amplified. The detector stage converts the tone signal to a dc voltage. The logic "high" output of the detector forward biases the switch transistor when the correct tone is present. Jumpers JU1 through JU4, which connect the emitters of the switch stages directly to ground, are used unless the community repeater is equipped with an optional single-tone decoder.

The switched ground output of the 4-user control module (pin 24) is applied to the master control module. Up to four 4-user control modules can be used in a community repeater station with each module responsive to four "Private-Line" tones. Therefore, as many as 16 groups, each assigned a separate "Private-Line" tone frequency, can use a community repeater station.

If the single-tone decoder is used, jumpers JU1 through JU4 are removed and jumpers JU5 through JU8 are installed. With this arrangement, the switch stage is inhibited until the single-tone decoder is activated; thus, both the proper single-tone signal and "Private-Line" tone must be received before the community repeater is activated. Not all "PL" decoders need be "AND" gated with single-tone signals. For example, if JU1 is removed and JU5 is installed, only the number 1 decoder requires single-tone and "PL" coding to provide an output. Decoders #2, 3 and 4 will operate with only "PL" coding.

6. MAINTENANCE

a. Removal and Replacement of Modules

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 module is labelled 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 Control Unit.
2. Always be sure of the correct module position before plugging in a module.
3. There are keying plugs in some modules to prevent insertion in the wrong position. Do not remove these plugs from the modules except when using the service board kit.
4. Turn off power to the station before removing or inserting modules to prevent transistor damage from transients.

The Motorola Model TLN8799A Service Board Kit is available for extending the module to provide access to the circuitry while providing all power and signal connections.

Technicians who service many of these stations may wish to carry spare modules 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.

b. Adjustments

All adjustment procedures are provided in the INSTALLATION AND OPERATION section of this manual.

c. Troubleshooting

The first step that should be performed when looking for trouble in the remote control unit is to check all modes of operation. This helps localize the source of trouble because some of the circuitry is common to all types of operation; while some of it is used only for one type of operation. The next

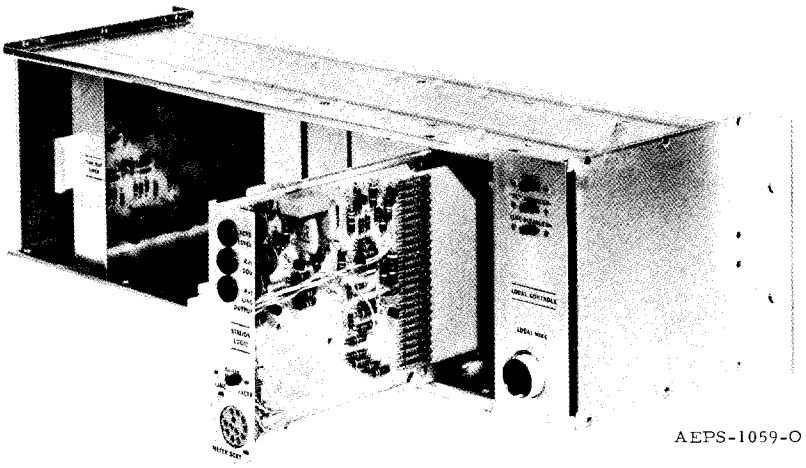


Figure 5.
Module Extended for Servicing

step should be to connect a portable test set to the metering receptacle and check the meter readings. A list of typical readings for a normally operating unit is given in the following table. The meter readings will isolate the trouble to a few stages. Voltage or signal measurements may then be taken in these suspected stages to isolate the defect to a specific component. Typical dc voltages are shown on the schematic diagrams.

NOTE

Some of the circuits may operate properly although the test set or voltage readings may vary considerably from the typical values given. Proper operation of the logic circuits can usually be presumed if there is a distinct difference in the reading between the active and inactive states.

SET UP THE PORTABLE TEST SET AS FOLLOWS

1. Function switch - XMTR position
2. Oscillator switch - METER REV. position
3. The AUDIO switch on the Station Logic Module must be in the EXTR position to provide a ground for the test set meter.

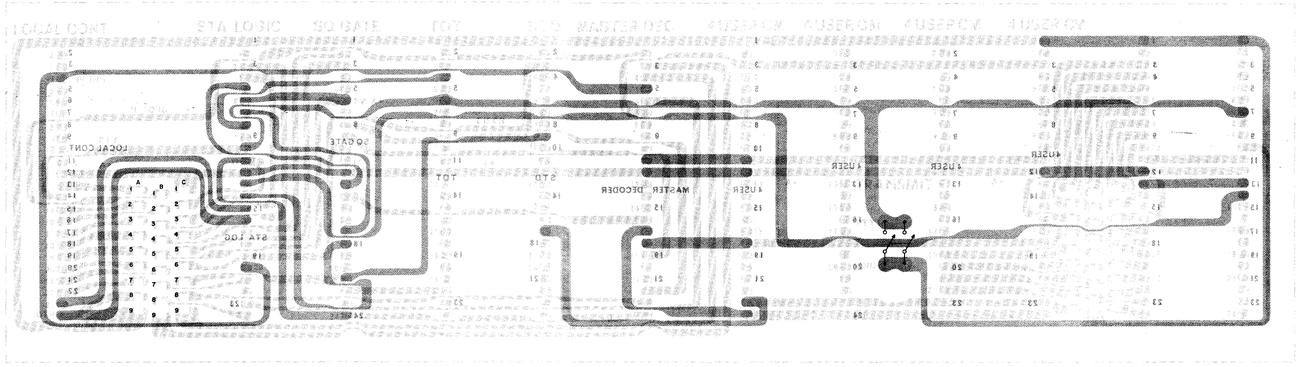
SELECTOR SWITCH POSITION	CIRCUIT CHECKED	TYPICAL METER READING	
		STANDBY	TRANSMIT
1	NONE	-	-
2	A+	40 uA	40 uA
3	SWITCHED A+	0	40 uA
5	RCVR MUTE	20 uA	*0
6	"PL" DISABLE	2 uA	**0
11	AUDIO	***	

*Remains 20 uA during repeater operation.
**Meter reading is for "PL" disable condition rather than transmit condition.
***Dependent upon audio levels used at the individual station.

COMMUNITY REPEATER INTERCONNECT BOARD

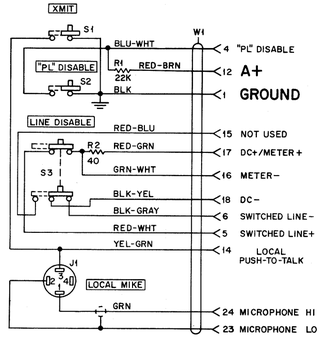
	LOCAL CONTROL PANEL	STATION LOGIC MODULE	MASTER DECODER MODULE	1-USER CONTROL MODULE	4-USER CONTROL MODULE	4-USER CONTROL MODULE	4-USER CONTROL MODULE	4-USER CONTROL MODULE	GATE MODULE	TIME-OUT TIMER MODULE	SINGLE-TONE DEC CODER MODULE	PLUG (P9)	P-T-T SW
GROUND	1	1	1	1	1	1	1	1	1	1	1	9A	X
A+	12	12	12	12	12	12	12	12	12	12	12	1C	
P-T-T		14							18			3C	
P-T-T CONTROL	14	10								6			X
SWITCHED A+		6							6			5B	
F1 OSCILLATOR SWITCHED									3			5C	
OSCILLATOR GROUND									2			4B	
STATION INHIBIT		8								4			
"PL" DISABLE	4	20	5										
"PL" DISABLE			4									9C	
"PL" TONE			2									1B	
EXCITER HI	24	16										8A	
MIKE LO	23	15											
1R DISCRIMINATOR		19	22						10		3	6C	
1R SQUELCH		21										7B	
1R COMMON		24										8B	
1R LINE OUTPUT		23	6										
1R MUTE		3										4C	
MUTE INHIBIT		7							17				
EXCITER LEVEL		4										3B	
EXCITER GROUND		11	24						24			2C	
REPEATER LEVEL		5							13				
REC. AUDIO SW.			23									8C	
METER +	13											1A	
METER -	16											2B	
METER EXCITER +	15											2A	
METER LINE +	17											3A	
METER LINE -	18											4A	
METER 1R	22											7A	
METER 2R	19											5A	
METER EXCITER -	20											6A	
METER PA GRID	21											6B	
20 DB QUIETING INDICATOR			19						9				
"PL" DRIVE			7	3	3	3	3						
DETECTOR EMITTER BIAS			11	11	11	11	11						
DETECTOR BASE BIAS			18	18	18	18	18						
SINGLE-TONE DECODER P-T-T				23	23	23	23				17		
"PL" OUTPUT			17	24	24	24	24						
"PL" INDICATOR			16						14				
HIGH PASS AUDIO OUT			3									9B	
T-O-T RESET									22	22			
SINGLE TONE RESET									8		9		
RPTR A+									21			7C	

EPS-2025-A



AO EEPS-657-O

OL EEPS-719-O



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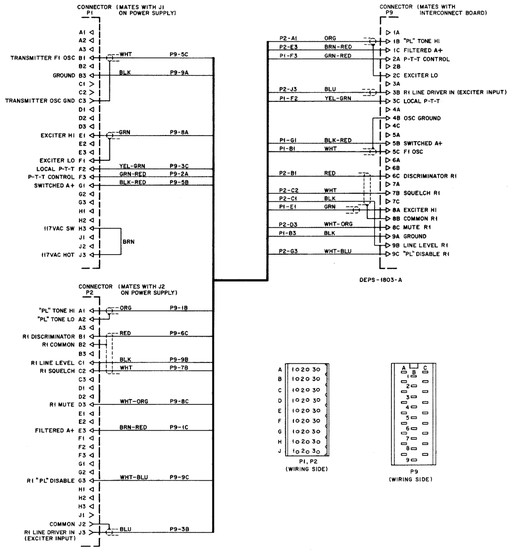


DEPS-1803-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8760A Local Station Control Panel PL-268-A

J1	9K830418	CONNECTOR, receptacle: female; 4 contact; does not include; 4S7699 LOCKWASHER 13/16"; 2A482070 NUT, ring
		RESISTOR, fixed:
R1	6S128685	22K ±10%; 1/4 w
R2	17C82036G31	40 ±2%; 2 w
		SWITCH, slide:
S1, 2	40B83468E01	spst
S3	40B83204B01	dpst
		CABLE ASSEMBLY:
W1	1V80700B34	includes ref. parts R1, R2, misc. leads and the following: 9B83012H01 RECEPTACLE, wire crimp; 11 req'd.
		SLEEVING, coded
		37C82603D01 No. 1
		37C82603D04 No. 4
		37C82603D05 No. 5
		37C82603D06 No. 6
		37C82603D12 No. 12
		37C82603D14 No. 14
		37C82603D16 No. 16
		37C82603D17 No. 17
		37C82603D18 No. 18
		37C82603D23 No. 23
		37C82603D24 No. 24
NON-REFERENCED ITEM		
	1V80781A16	PANEL & SWITCHES ASSY.

CONTROL UNIT

TCN1059A Control Chassis
Wiring Diagram
Motorola No. 63P81005E61-C
8/6/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN5803A Master Decoder Circuit Board PL-2749-O

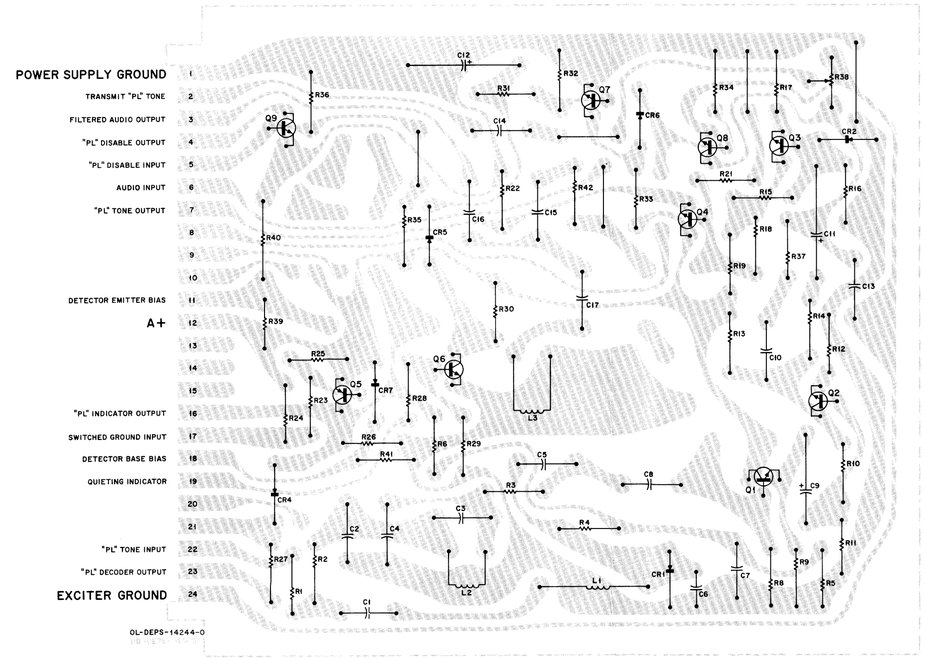
		CAPACITOR, fixed:
C1	21C82187B25	.0033 uF ±10%; 500 v
C2, 8, 10, 13, 14	8D82905G11	0.22 uF ±10%; 50 v
C3	8D82905G08	.033 uF ±10%; 50 v
C4	8D82905G07	0.1 uF ±10%; 50 v
C5	8D82905G10	.015 uF ±10%; 50 v
C6	21D82187B18	.0015 uF ±10%; 100 v
C7, 9, 11	23K865136	15 uF ±20%; 25 v
C12	23K865137	4.7 uF ±20%; 25 v
C15	8D82905G03	.047 uF ±10%; 50 v
C16	8D82905G04	.068 uF ±10%; 50 v
C17	8D82905G05	0.15 uF ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 4 thru 7	48C82392B03	silicon
		COIL:
L1	24K864763	rf; choke; 5.7 mH
L2, 3	25C82024D02	audio; choke; 6.6 H
		TRANSISTOR: (SEE NOTE)
Q1, 2, 3, 4, 6, 7, 8, 9	48R869570	N-P-N; M9570
Q5	48R869571	P-N-P; M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1, 9, 26, 30, 33, 41	6S128689	2.2K
R2	6S128687	6.8K
R3	6S129231	3.3K
R4	6S128688	2.7K
R5	6S127805	15K
R6, 14, 23, 24, 25, 31, 32, 42	6S129225	10K
R7, 8, 28, 34	6S128902	47K
R10	6S129144	68K
R11	6S127806	27K
R12	6S129754	33
R13, 22	6S127802	1K
R15	6S124B04	180K ±5%
R16, 21	6S129526	33k ±5%
R17	6S131276	150 ±5%
R18	6S129805	1k ±5%
R19, 27, 30, 33, 41	6S128689	2.2K
R29, 35, 36, 37	6S128685	22K
R38	18C83083G01	var; 100K
R39	6S131524	100 ±5%
R40	6S6411	1K ±5%; 1/2 w

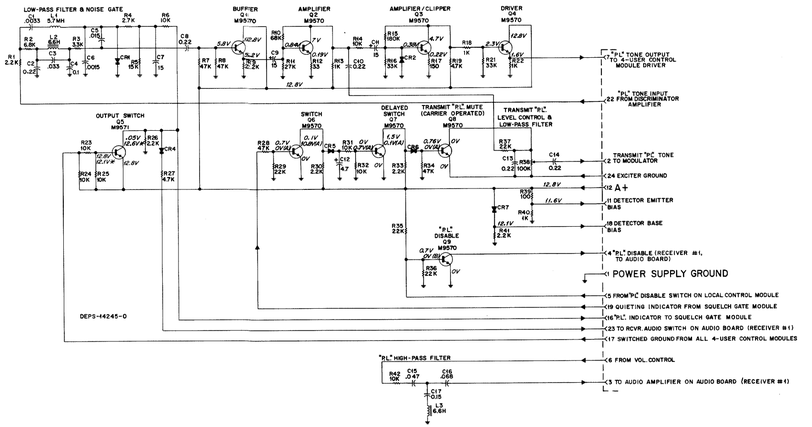
NOTE

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

CONTROL UNIT

TLN1684A Master Decoder Module
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81021E73-A
8/6/74-NPC





TRANSISTOR DETAILS

NOTES

1. VOLTAGES MARKED (+) READINGS WHEN RECEIVING A PROPER "PL" TONE.
2. VOLTAGES MARKED (A) READINGS WHEN SQUELCH GATE IS QUIETED.
3. VOLTAGES MARKED (B) READINGS WHEN "PL" DISABLE SWITCH IS PRESSED.
4. UNLESS OTHERWISE STATED
   ALL RESISTOR VALUES ARE IN OHMS (K = 1000).
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1684A MASTER DECODER MODULE		TLN5803A		MASTER DECODER BOARD
		TLN8780A		MASTER DECODER PANEL

EPS-14248-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

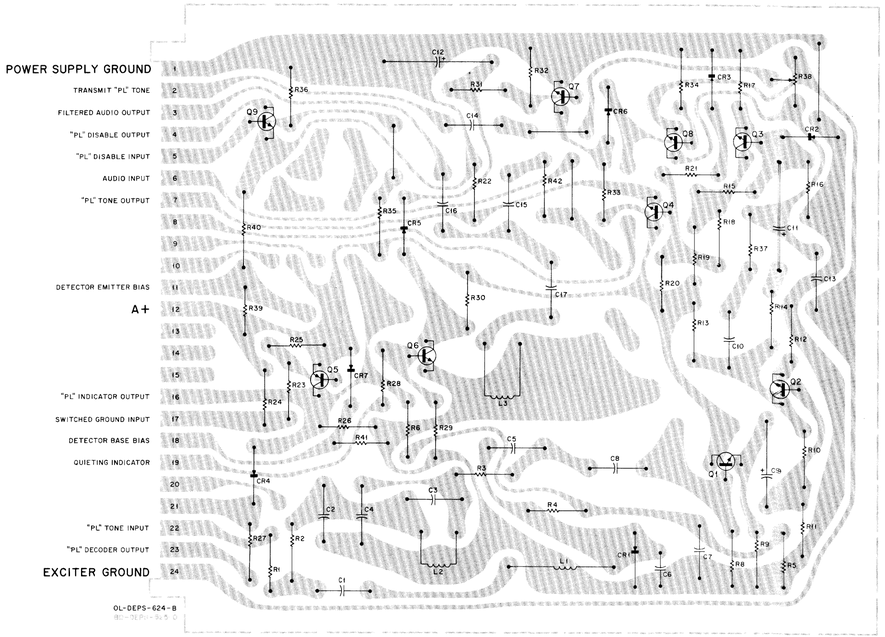
PARTS LIST

TLN8779A Master Decoder Circuit Board PL-288-A

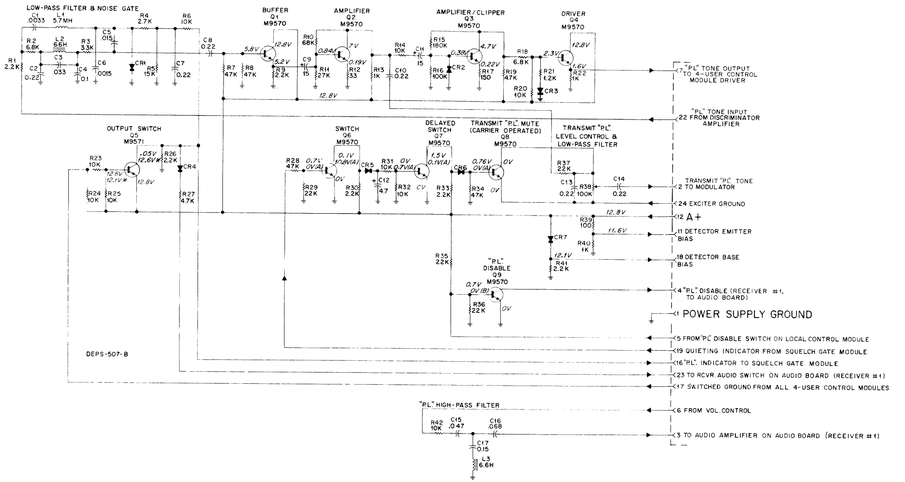
		CAPACITOR, fixed:
C1	21C82187B25	.0033 uF ±10%; 500 v
C2, 8, 10, 13, 14	8D82905G11	0.22 uF ±10%; 50 v
C3	8D82905G08	.033 uF ±10%; 50 v
C4	8D82905G07	0.1 uF ±10%; 50 v
C5	8D82905G10	.015 uF ±10%; 50 v
C6	21D82187B18	.0015 uF ±10%; 100 v
C7, 9, 11	23K865136	15 uF ±20%; 25 v
C12	23K865137	4.7 uF ±20%; 25 v
C15	8D82905G03	.047 uF ±10%; 50 v
C16	8D82905G04	.068 uF ±10%; 50 v
C17	8D82905G05	0.15 uF ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 4 thru 7	48C82392B03	silicon
		COIL:
L1	24K864763	rf; choke; 5.7 mH
L2, 3	25C82024D02	audio; choke; 6.6 H
		TRANSISTOR: (SEE NOTE)
Q1, 2, 3, 4, 6, 7, 8, 9	48R869570	N-P-N; M9570
Q5	48R869571	P-N-P; M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1, 9, 26, 30, 33, 41	6S128689	2.2K
R2	6S128687	6.8K
R3	6S129231	3.3K
R4	6S128688	2.7K
R5	6S127805	15K
R6, 14, 23, 24, 25, 31, 32, 42	6S129225	10K
R7, 8, 28, 34	6S128902	47K
R10	6S129144	68K
R11	6S127806	27K
R12	6S129754	33
R13, 22	6S127802	1K
R15	6S124B04	180K ±5%
R16, 21	6S129526	33k ±5%
R17	6S131276	150 ±5%
R18	6S129805	1k ±5%
R19, 27, 30, 33, 41	6S128689	2.2K
R29, 35, 36, 37	6S128685	22K
R38	18C83083G01	var; 100K
R39	6S131524	100 ±5%
R40	6S6411	1K ±5%; 1/2 w

NOTE:

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



TRANSISTOR DETAILS



NOTES:

1. VOLTAGES MARKED = = READINGS WHEN RECEIVING A PROPER "PL" TONE.
2. VOLTAGES MARKED (A) = READINGS WHEN SQUELCH GATE IS QUIETED.
3. VOLTAGES MARKED (B) = READINGS WHEN "PL" DISABLE SWITCH IS PRESSED.
4. UNLESS OTHERWISE STATED,
   ALL RESISTOR VALUES ARE IN OHMS (K = 1000);
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1183A MASTER DECODER MODULE	1	TLN8779A	1	MASTER DECODER BOARD
		TLN8780A		MASTER DECODER PANEL

EPS-1029-A

CONTROL UNIT

TLN1183A Master Decoder Module
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81005E63-A
8/6/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN5804A Four-Tone Decoder Board PL-2750-O

		CAPACITOR, fixed:
C1, 3, 5, 7, 9, 11, 13, 15	23K865137	4.7 uF ±20%; 25 v
C2, 6, 10, 14	8D82905G07	.002 uF ±10%; 50 v
C4, 8, 12, 16	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 3, 4	48C82392B03	silicon (SG3182)
		TRANSISTOR: (SEE NOTE)
Q1, 3, 4, 6, 7, 9, 10, 12, 13	48R869570	N-P-N; type M9570
Q2, 5, 8, 11	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R1, 9, 17, 25	6S129144	68K
R2, 5, 10, 13, 18, 21, 26, 29	6S127806	27K
R3, 11, 19, 27	6S124A13	33 ±5%
R4, 12, 20, 28	6S129805	1K ±5%
R6, 7, 8, 14, 15, 16, 22, 23, 24, 30, 31, 32	6S129225	10K
R33	6S10053A26	33 ±5%; 1/2 W
R34	6S127802	1K
R35	6S129753	100
R36 thru 39	6S129982	5.6K ±5%
NON-REFERENCED ITEMS		
	9C83035A02	SOCKET, "Vibrasponder"; 4 used
	9B83011H01	CONNECTOR, receptacle: female; 12 used

TLN8782A Four-Tone Decoder Panel PL-292-O

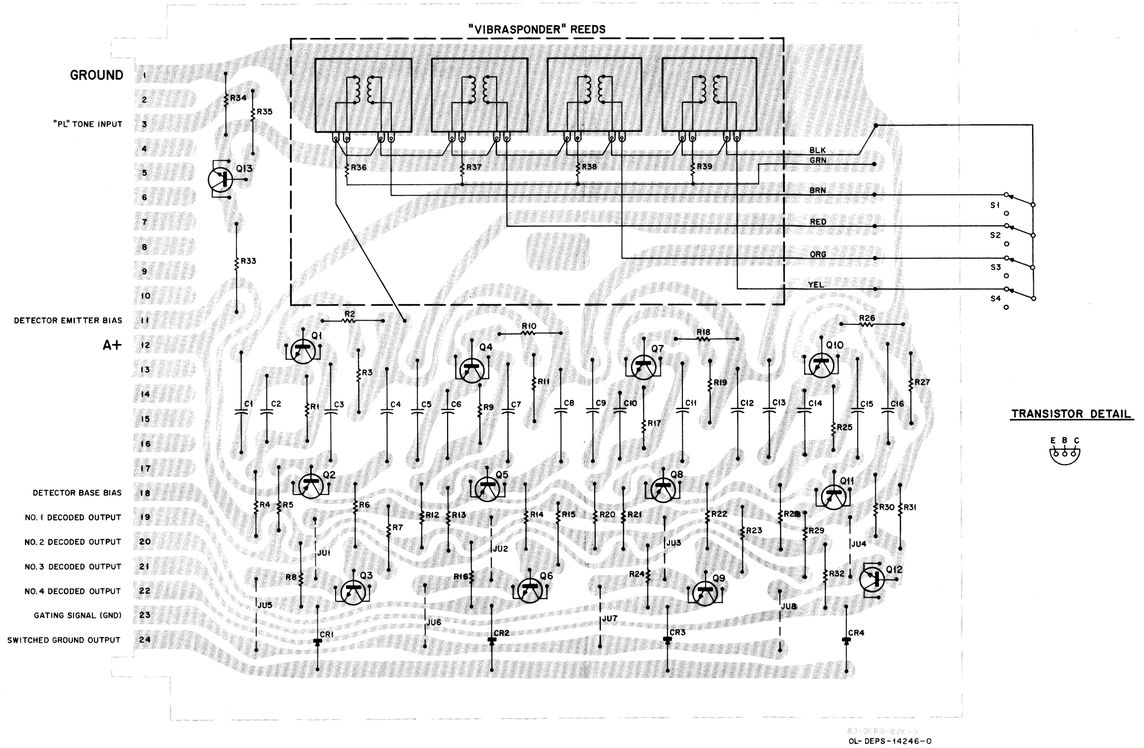
S1, 2, 3, 4	40B83204B01	SWITCH, slide: dpdt

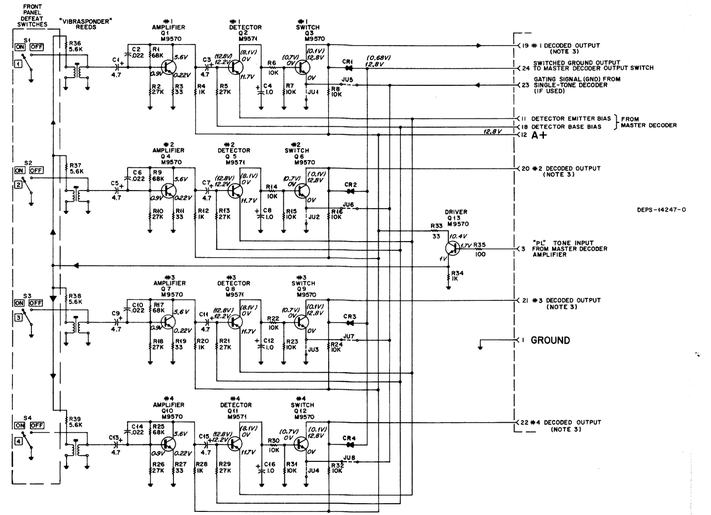
NOTE:

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

CONTROL UNIT

TLN1685A 4-User Decoder Module
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81021E74-A
8/6/74-NPC





NOTES

1. JUMPERS JU5 THROUGH JU8 ALLOW "AND" GATING OF "PL" DECODER WITH SINGLE-TONE DECODER. JUMPERS JU1 THROUGH JU4 PROVIDE OPERATION WITHOUT SINGLE-TONE DECODER.
2. VOLTAGE READINGS IN PARENTHESES ARE LEVELS PRESENT WHEN THAT PARTICULAR CIRCUIT IS DECODING.
3. TESTING POINT ONLY.
4. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES ARE IN OHMS (K = 1000).
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1685A FOUR-USER CONTROL MODULE		TLN5804A		FOUR-TONE DECODER CIRCUIT BOARD
		TLN8782A		FOUR-TONE DECODER PANEL

EPS-14249-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8781A Four-Tone Decoder Board — PL-291-A

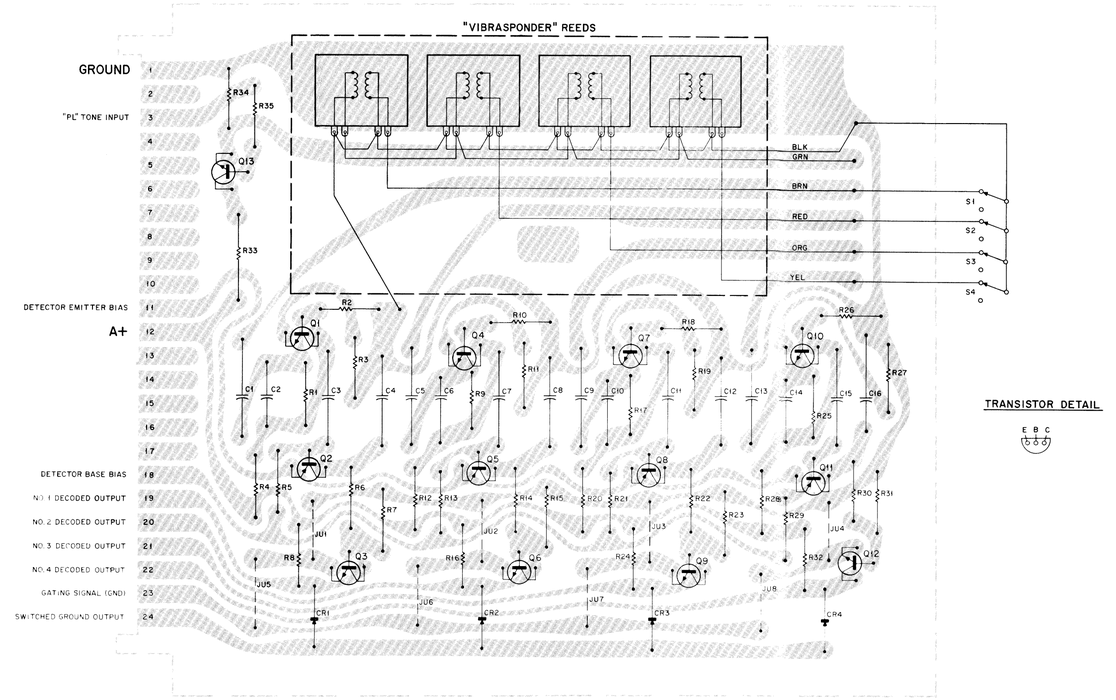
		CAPACITOR, fixed:
C1, 3, 5, 7, 9, 11, 13, 15	23K865137	4.7 uF ±20%; 25 v
C2, 6, 10, 14	8D82905G07	.002 uF ±10%; 50 v
C4, 8, 12, 16	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 2, 3, 4	48C82392B03	silicon (SG3182)
		TRANSISTOR: (SEE NOTE)
Q1, 3, 4, 6, 7, 9, 10, 12, 13	48R869570	N-P-N; type M9570
Q2, 5, 8, 11	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 w: unl. stated
R1, 9, 17, 25	6S129144	68K
R2, 5, 10, 13, 18, 21, 26, 29	6S127806	27K
R3, 11, 19, 27	6S124A13	33 ±5%
R4, 12, 20, 28	6S129805	1K ±5%
R6, 7, 8, 14, 15, 16, 22, 23, 24, 30, 31, 32	6S129225	10K
R33	6S10053A26	33 ±5%; 1/2 W
R34	6S127802	1K
R35	6S129753	100
R36 thru 39	6S129982	5.6K ±5%
NON-REFERENCED ITEMS		
	9C83035A02	SOCKET, "Vibrasponder"; 4 used
	9B83011H01	CONNECTOR, receptacle: female; 12 used

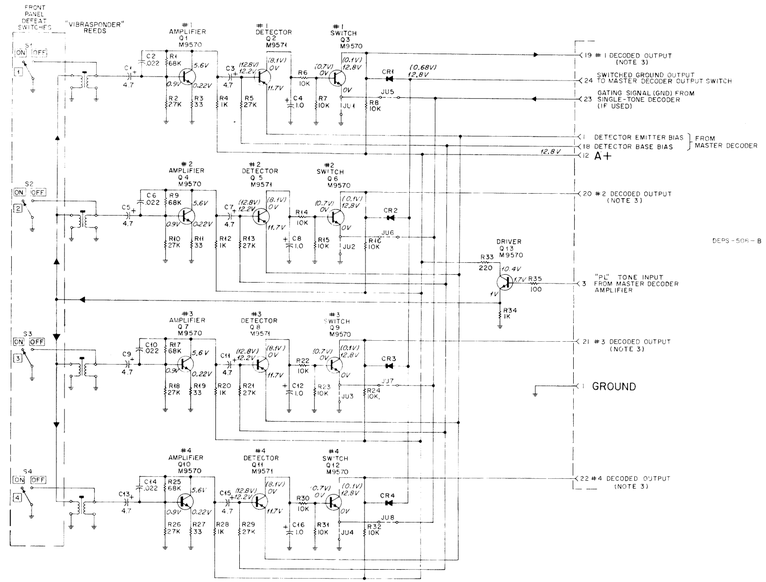
TLN8782A Four-Tone Decoder Panel — PL-292-O

S1, 2, 3, 4	40B83204B01	SWITCH, slide: dpdt

NOTE:

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





NOTES:

1. JUMPERS JU5 THROUGH JU8 ALLOW "AND" GATING OF "PL" DECODER WITH SINGLE-TONE DECODER. JUMPERS JU1 THROUGH JU4 PROVIDE OPERATION WITHOUT SINGLE-TONE DECODER.
2. VOLTAGE READINGS IN PARENTHESES ARE LEVELS PRESENT WHEN THAT PARTICULAR CIRCUIT IS DECODING.
3. TESTING POINT ONLY.
4. UNLESS OTHERWISE STATED:
   ALL RESISTOR VALUES ARE IN OHMS (K = 1000);
   ALL CAPACITOR VALUES ARE IN MICROFARADS.

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1177A FOUR-USER CONTROL MODULE	1	TLN8781A	1	FOUR-TONE DECODER CIRCUIT BOARD
		TLN8782A		FOUR-TONE DECODER PANEL

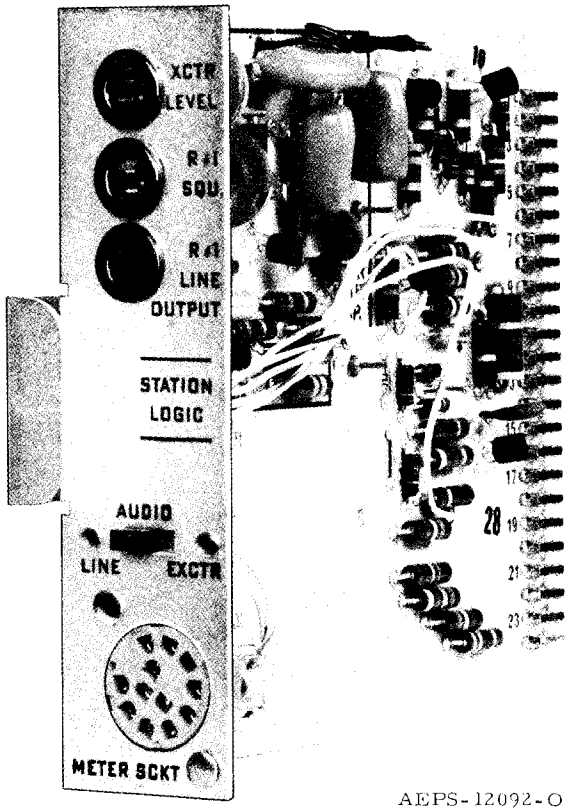
EPS-1030-A

CONTROL UNIT

TLN1177A 4-User Control Module
Schematic Diagram and
Circuit Board Detail
Motorola No. 63P81005E64-A
8/6/74-NPC

STATION LOGIC MODULE

MODEL TLN1173A



AEPS-12092-O

1. DESCRIPTION

The TLN1173A Station Logic Module is a full, transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnect board of the remote control chassis.

2. FUNCTIONS

This module contains the line output level and squelch controls for the station receive audio, and amplification and level adjustment of the station transmit audio. It exercises push-to-talk control of the station from local or line push-to-talk commands. This push-to-talk control includes switching of the antenna relay, receiver muting, line driver disable, power supply turn-on, and transmitter channel element turn-on. Sequencing circuits are included to switch the antenna relay before activating high power transmitter rf circuits. For repeater applications, a receiver mute inhibit input allows the receiver to continue operating while the transmitter is keyed. Additionally, the metering socket for testing the station logic control functions is located on this module.

3. CIRCUIT DESCRIPTION

NOTE

For a description of the basic circuits used in the logic circuitry, refer to the remote control chassis section.

a. Control Functions

A signal from the receiver discriminator, entering the module on pin 19, is routed to the receiver squelch circuit through the R#1 SQUELCH control and pin 21. The signal also passes through the R#1 LINE OUTPUT control to pin 23 for amplification in the receiver audio stages when the receiver is unsquelched.

b. Audio Functions

An audio signal entering the module on pin 4 passes through capacitor C1 into the XCTR LEVEL control and into Paraphase Amplifier Q1. For the line levels below 0 dBm, JU2 is installed. If the

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level is above 0 dBm, JU2 is not used. From the collector of Q1, the amplified signal is sent to Exciter Audio Amplifier Q2 for further amplification and out the transmitter exciter audio input.

The Repeater Level control (external to the module) is connected to the circuit through pin 5 at diode CR1. When a high-resistance path appears at pin 5, CR1 is reverse-biased, and the audio path from pin 4 is through amplifier Q1 as previously described. When the path at pin 5 becomes a low resistance, diode CR1 becomes forward-biased and gates the signal around Paraphase Amplifier Q1. The signal then feeds into Exciter Audio Amplifier Q2 as before.

The Local Mic Audio Switch is normally conducting to provide a ground for local microphone audio. Whenever line push-to-talk occurs, Q3 is cut off, removing the local microphone audio ground path. This cutoff gives line audio priority over local microphone audio signals.

c. Circuit Control Functions

When a local or line push-to-talk input is applied to pin 10 or 14, it is applied to the base of P-T-T Inverter, Q4. The "low" input is changed to a "high" level in the inverter, then applied to the Antenna Relay and Mute Switch.

In "Private-Line" applications, push-to-talk release is delayed at the end of a transmission by an input to pin 13 from the external "Private-Line" reverse-burst circuitry. This input holds the P-T-T circuit operated for the duration of the reverse-burst tone.

When a "high" from the P-T-T Inverter is received at the Antenna Relay and Mute Switch, a "low" at its output mutes receiver No. 1 and operates the antenna relay switch, audio disable, and line driver disable circuits.

In repeater applications, a ground appears at pin 7, which prevents Mute Switch Q6 from operating. This allows the receiver in the repeater to remain operational for retransmission of the received signal.

The P-T-T Inverter controls the switched A+. Switched A+ is applied after a 35-millisecond delay to allow the antenna relay to switch to the transmit position before the rf power is applied. A+ from the external redundancy circuit must also be present through pin 9 for switched A+ to be present. When the redundancy input is present, and the switched A+ is turned on by the P-T-T Inverter, the external transmitter circuits are energized to produce an rf output.

In repeater applications without wire-line control, jumper JU1 is used and switched A+ is provided without the redundancy input previously described.

When the time-out timer reaches the end of its cycle, the Transmitter Key Inhibit (through pin 8 on the module) removes the switched A+.

d. Metering Facilities

A receptacle is provided on the module front panel for metering of the functions available at the module. The functions metered and their corresponding Motorola Test Set positions are given in the following table:

METERING TABLE

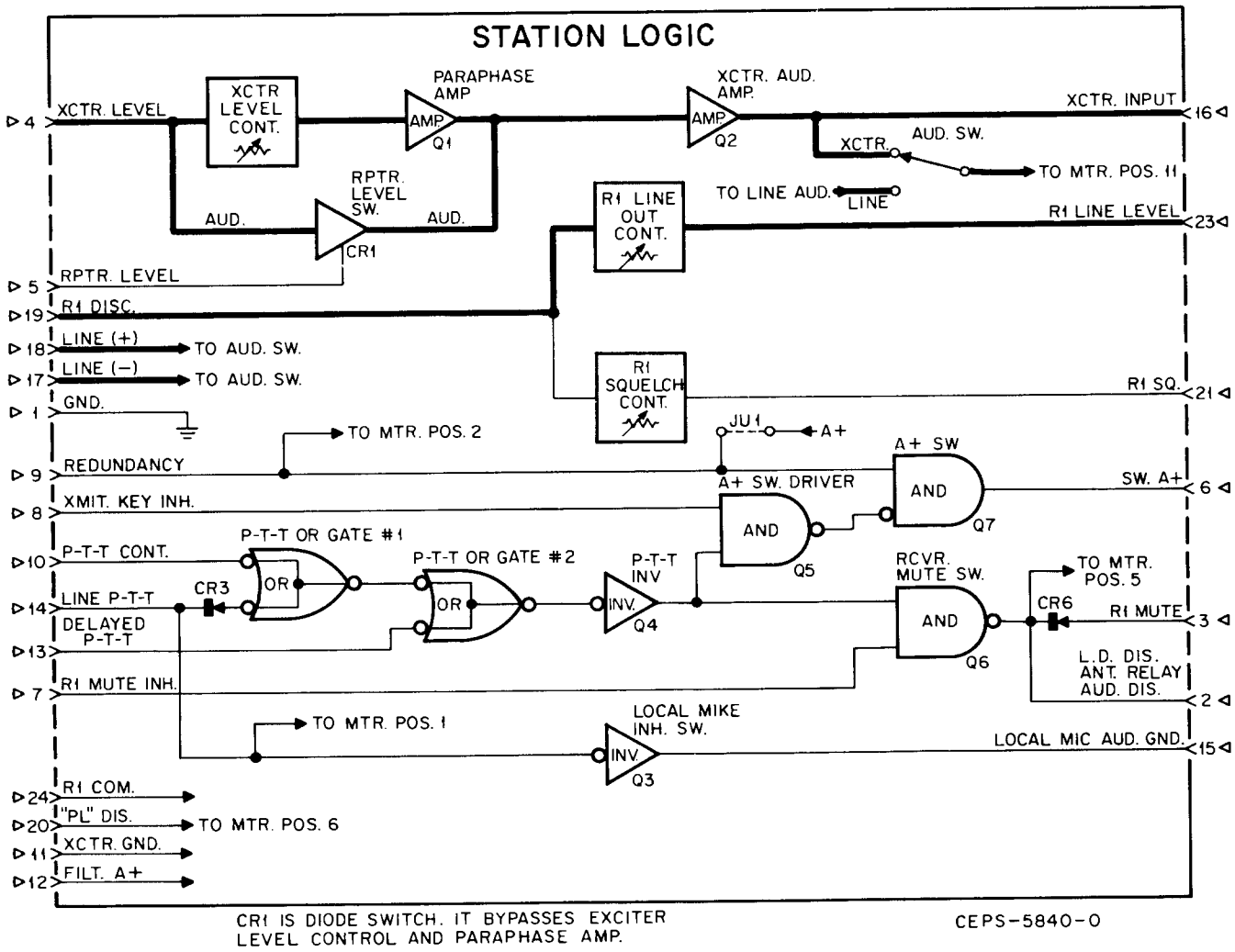
SET UP THE PORTABLE TEST SET AS FOLLOWS:

1. Function switch - XMTR position.
2. Oscillator switch - METER REV. position.
3. The AUDIO switch on the Station Logic Module must be in the EXCTR position to provide a ground for the test set meter.

SELECTOR SWITCH POSITION	CIRCUIT CHECKED	TYPICAL METER READING	
		STANDBY	TRANSMIT
1	LINE P-T-T	25 uA (NOTE 1)	0
2	REDUNDANCY	0 (NOTE 5)	40 uA
3	SWITCHED A+	0	40 uA
5	RCVR MUTE	20 uA	0 (NOTE 2)
6	"PL" DISABLE	20 uA (NOTE 6)	0 (NOTE 3 & 6)
11	AUDIO	(NOTE 4)	

NOTES:

1. No reading when keyed locally or in repeater operation.
2. Remains 20 uA during repeater operation.
3. Meter reading is for PL disable condition rather than transmit condition.
4. Dependent upon audio levels used at the individual station. Refer to the INSTALLATION AND OPERATION section of the manual for set-up instructions and typical readings.
5. 25 min in tone remote control applications.
6. 2 uA in community repeaters.



Functional Block Diagram

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access, remove the module, insert the Model TKN8799A Module Extension Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

Servicing may be done without connection to a remote control chassis if the proper power and terminations are connected to the module. A convenient method of connection is through the use of a TEK-38 Base Station Module Servicing Adapter. The module is simply plugged into the 24 pin male plug of the adapter. Connections are then made to the circuit module via the adapter using the standard and/or resistor push on patch leads supplied with the adapter.

Make the connections shown in the following out of the circuit servicing chart.

PIN NO.	CONNECT
1, 11, 24	Ground
4	Audio oscillator through 0.1 uF
12, 9	+12 volts dc
16	AC voltmeter to ground
2	10 kilohms to 12 volts dc
4	10 kilohms to 12 volts dc
6	10 kilohms to ground
NOTE: Temporarily connect JU1 for out-of-chassis servicing.	

b. Module Malfunction Location Techniques

(1) Connect voltage and signal sources to the module as indicated in the preceding table.

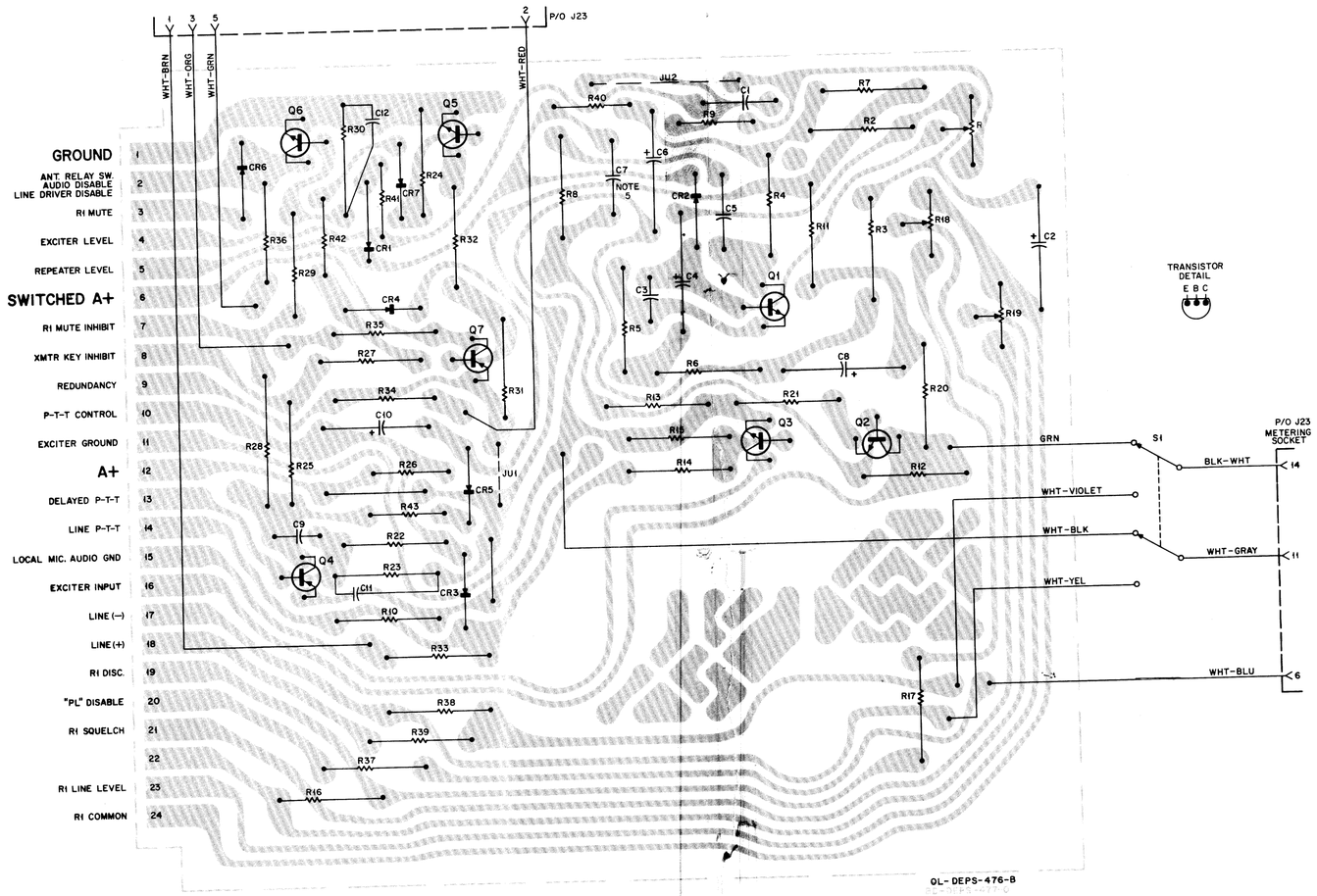
(2) Adjust the audio oscillator output for -25 dBm at pin 4. With this input, the level at pin 16 should measure approximately -10 dBm with JU2 connected. If this level cannot be achieved, check stages Q1 and Q2. If the level is correct, ground pin 5. The reading at pin 16 should fall to zero. If this does not occur, check diode CR1 and resistor R41.

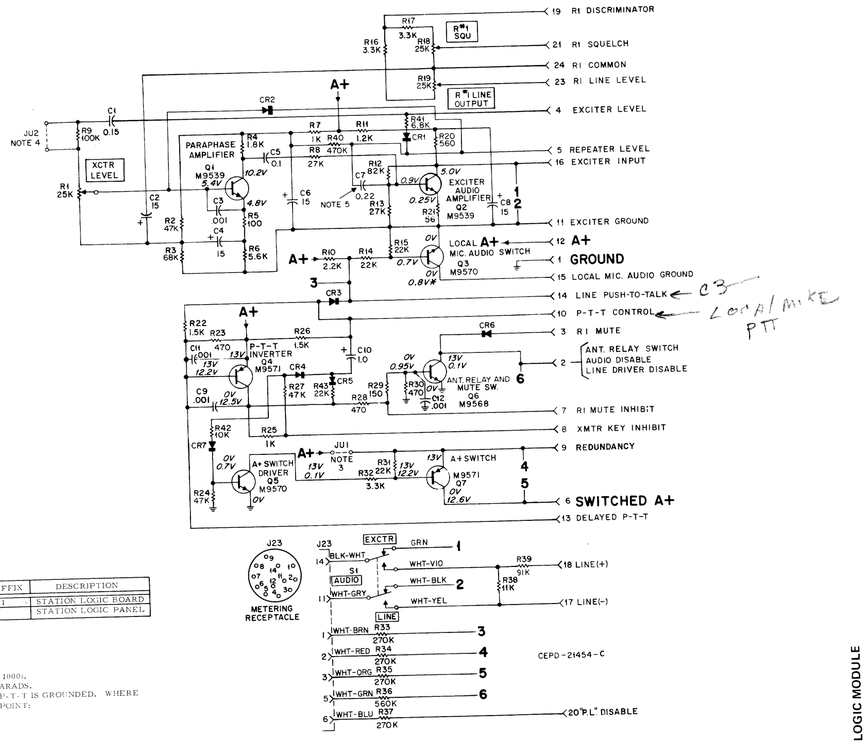
(3) Ground pin 14. With a dc voltmeter, measure the voltage at pins 6 and 15. Each should read +12 volts. The voltage measured at pin 2 should read zero.

Refer to the schematic diagram. If a voltage or ground does not appear at the prescribed location, check each stage, in turn, that feeds into the pin indicating the malfunction.

(4) With pin 14 grounded, ground pin 8. With a dc voltmeter, look for +12 volts dc at pin 2 and ground at pin 6. If these are present, the Antenna Relay and Mute Switch, A+ Switch Driver, and A+ Switch are functioning properly.

(5) With pin 14 grounded, unground pin 8 and ground pin 7. Pin 2 should read +12 volts dc and pin 6 should read +12 volts dc.





MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1173A		TLN8763A	1	STATION LOGIC BOARD
		TLN8764A		STATION LOGIC PANEL

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K = 1000).
   CAPACITOR VALUES ARE IN MICROFARADS.
2. ◇ INDICATES VOLTAGES WHEN LINE P-T-T IS GROUNDED. WHERE TWO VOLTAGES ARE GIVEN AT ONE POINT:
   UPPER VOLTAGE = RECEIVE
   LOWER VOLTAGE = TRANSMIT
3. JUMPER TABLE

DC AND TONE REMOTES

APPLICATION	JU1
BASE STATION	OUT◇
BASE (RA) STATION	IN
REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL	OUT◇
REPEATER (RA) STATION	IN
COMMUNITY REPEATER (RT)	IN

◇ "IN" ON TONE REMOTE STATIONS

4. REMOVE JUMPER JU2 WHEN THE TRANSMIT AUDIO LEVEL FROM THE REMOTE CONTROL POINT IS 0 dBm OR GREATER AS MEASURED AT THE STATION. CONNECT THE JUMPER IF THIS LEVEL IS BELOW 0 dBm.
5. C7 IS NOT USED IN C53, C63, C73MHB AND C711.HB SERIES STATIONS.

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STATION LOGIC MODULE

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1173A Station Logic Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E44-E
6/5/74-NPC

REVISIONS

63P81002E44-F

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8763A-1	C11	ADDED	BASE CIRCUIT OF Q4
	C12	ADDED	BASE CIRCUIT OF Q6

PARTS LIST

TLN8763A Station Logic Circuit Board — PL-285-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	8D82905G05	0.15 uF ±10% 50 v
C2, 4, 6, 8	23K865136	15 uF ±20%; 25 v
C3, 9, 11, 12	21D82187B20	.001 uF ±10%; 100 v
C5	8D82905G07	0.1 uF ±10%; 50 v
C7	8D82905G11	0.22 uF ±10%; 50 v
C10	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon; RD1343
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R869539	N-P-N; M9539
Q3, 5	48R869570	N-P-N; M9570
Q4, 7	48R869571	P-N-P; M9571
Q6	48R869568	N-P-N; M9568
		RESISTOR, fixed; ±10%; 1/2 w; unl stated
R1, 18, 19	18C83083G03	variable; 25K
R2, 27	6S6048	47K
R3	6S6074	68K
R4	6S2089	1.8K
R5	6S6326	100
R6	6S6117	5.6K
R7, 25	6S6229	1K
R8, 13	6S6434	27K
R9	6S129226	100K; 1/4 w
R10	6S6069	2.2K; 1/4 w
R11	6S6393	1.2K
R12	6S5644	82K
R14, 15, 31	6S6397	22K
R16, 17, 32	6S5581	3.3K
R20	6S6291	560
R21	6S5614	56
R22	6S6038	1.5K
R23, 30	6S6090	470
R24	6S5591	18K
R26	6S127803	1.5K; 1/4 w
R29	6S6373	150
R28	6S5772	470; 1 w
R33, 34, 35, 37	6S2050	270K ±5%
R36	6S5796	560K ±5%
R38	6S115017	11K ±5%
R39	6S5789	91K ±5%
R40	6S129148	470K; 1/4 w
R41	6S128687	6.8K; 1/4 w
R42	6S129225	10K; 1/4 w
R43	6S128685	22K; 1/4 w

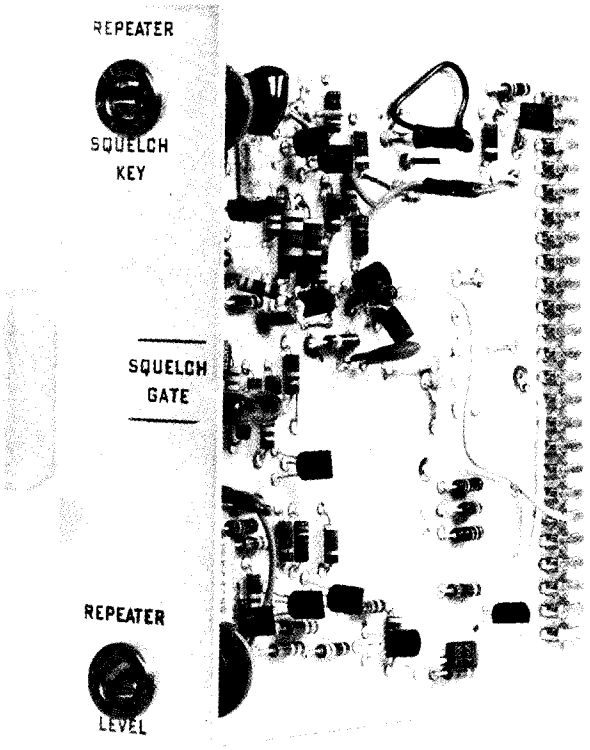
TLN8764A Station Logic Panel — PL-286-O

J23	9C83478E01	CONNECTOR, receptacle: female; 12 contact
S1	40B83204B01	SWITCH, slide: dpdt

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

SQUELCH GATE MODULE

MODEL TLN1180A



1. DESCRIPTION

The Squelch Gate Module is a plug-in unit for modular remote control units. It measures received noise levels and controls transmitter keying.

Using the inherent FM property of receiver quieting, it senses the presence of a received signal and converts it into a usable switched dc voltage for transmitter turn-on. When the noise level is high (no incoming receiver signal) the transmitter is turned off. When the noise level drops below the threshold value the squelch gate module provides an output that will key the transmitter ("Private-Line" tone-coded squelch stations also require a "PL" tone). The threshold level is adjustable to permit transmitter keying at approximately 10 to 25 dB receiver quieting.

NOTE

For most applications, the adjustment should be set for 20 dB quieting.

The F1 channel element switch used in the squelch gate module, in repeater (RT) stations without wire line control, controls the F1 transmitter oscillator. When the transmitter is keyed, the F1 channel element switch supplies a ground to the F1 channel element, enabling the oscillator.

During temporary rf signal fading conditions, the dropout delay generator is enabled which prevents transmitter turn-off during the preset time delay period (0, 1, 2, 4, or 8 seconds) until the rf signal is received again.

The push-to-talk switch supplies the necessary ground to enable the transmitter. It will remain on as long as a signal is being received or for the duration of the timed delay period.

The repeater level switch driven by the dropout delay generator, is used in repeater (RT) stations with wire line control to provide an output which activates the audio gate in the station logic module and places the REPEATER LEVEL control in the circuit. The REPEATER LEVEL control is used to adjust the audio from the receiver to a level equal with the audio from the line and is in the circuit only during repeater operation.

In repeater (RT) operation, the mute inhibit switch prevents the receiver from being muted

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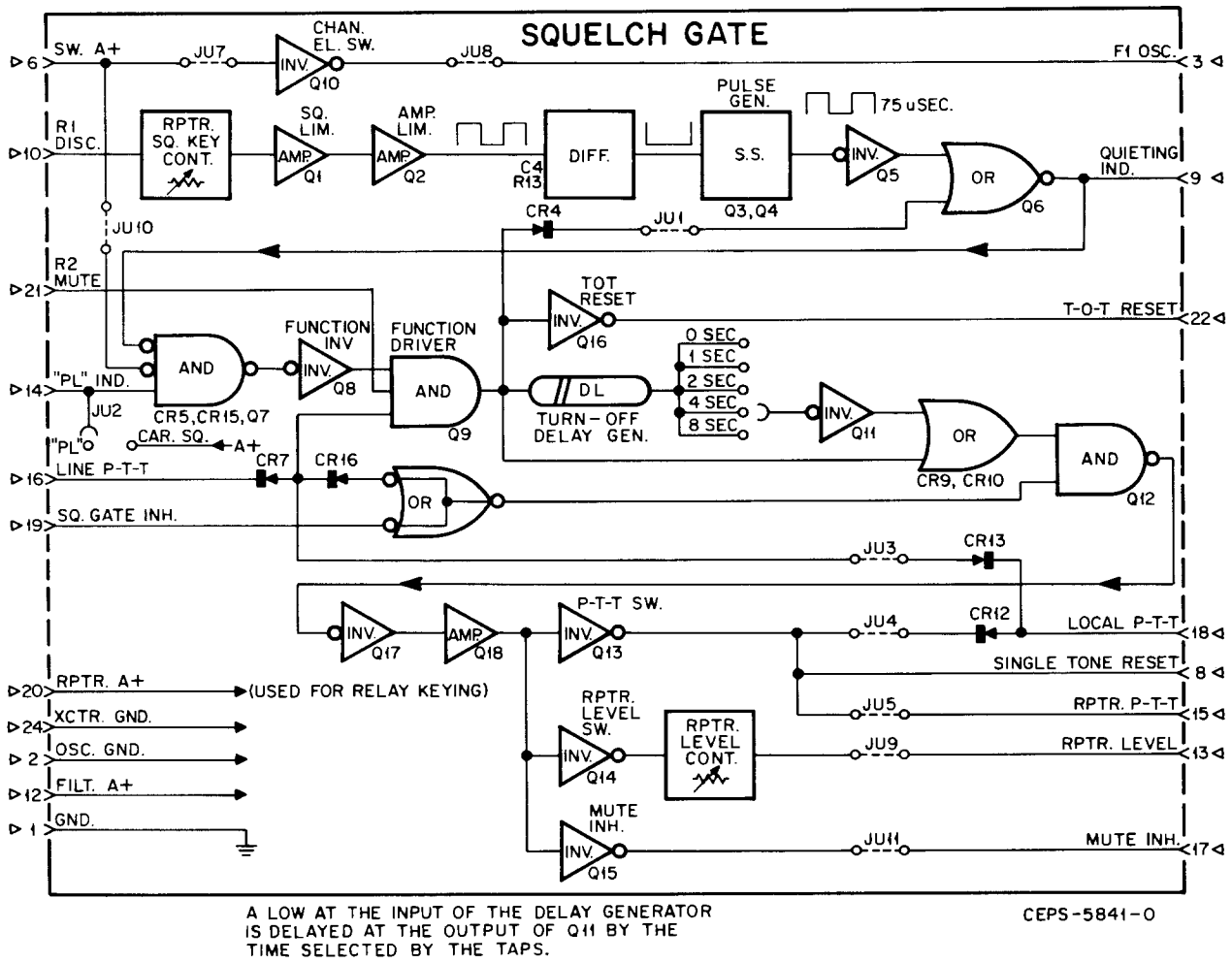


during a received rf signal or during the timed delay period. However, this switch is not enabled in the local or wire line control modes and the receiver will be muted.

When a second transmission follows immediately after the end of the first transmission, the time-out timer reset switch is turned off, then on again immediately, to reset the time-out timer. However, as previously described, the transmitter will not necessarily turn off immediately because of the dropout delay generator. The time-out timer limits the maximum transmission time for any one message, but not the total continuous time that the transmitter may be keyed.

The line push-to-talk lead shorts the inverter output and the dropout delay generator to prevent the squelch gate module from operating during wire line keying.

The squelch gate inhibit lead and single-tone reset lead are used when an optional single-tone decoder module is used. An output from the single-tone decoder module is used in conjunction with the previously described operation of the squelch gate module to turn on the transmitter. Upon termination of transmission, the push-to-talk switch changes state to reset the single-tone decoder module. This reset occurs after the dropout time delay period has ended.

2. CIRCUIT DESCRIPTION

NOTE

For a description of the basic circuits used in the logic circuitry, refer to the remote control chassis section.

a. Noise Detector

The R1 noise detector section in the squelch gate module includes the limiter, amplifier/switch, pulse generator, and inverter stages. The noise input from the discriminator of the receiver is adjusted to the desired threshold level by the REPEATER SQUELCH KEY potentiometer. The squelch limiter is driven between saturation and cutoff by noise spikes. When no rf input is applied to the receiver many noise spikes exceed the threshold level of the amplifier/switch, driving the transistor into saturation during such noise pulses. As the RF input to the receiver increases, fewer and fewer of the noise spikes exceed the threshold level. The coupling components between the amplifier switch and the pulse generator form a differentiation network for forming sharp triggers.

The pulse generator is a monostable multivibrator with Q3 cutoff and Q4 conducting in the quiescent condition. Each trigger applied to the pulse generator will produce a positive-going gate that is 75 microseconds in duration (output taken at the collector of Q4). With high noise the pulses will be very closely spaced, and with receiver quieting very few pulses will be generated.

The pulses are amplified and inverted by the inverter stage. An integrator network in the output of the inverter changes the pulses into a dc voltage that is proportional to the receiver quieting. With high noise input from the discriminator, the pulses are closely spaced and the integrated voltage resultant is a low dc voltage which turns on Q6. When the receiver quiets, the pulses are widely spaced and the integrated voltage resultant rises. When the quieting equals or exceeds the squelch gate threshold, the dc voltage resultant (or logic "high") is high enough to turn off Q6.

b. Switching Logic

(1) AND Gate Q7, CR5, & CR15 and OR Gate Q6

Q6 is an OR gate. It has two inputs; one from the inverter and the other through jumper JU1, which will be discussed later. The logic "high" from the output of the inverter will turn off Q6, causing its collector to go to a logic "low". The output of Q6 is applied to two places: (1) pin 9, which is a quieting indicator and will be used in the master decoder, in community repeaters, (2) to an AND gate consisting of Q7, CR5 and CR15. The output of Q6 is applied to the anode side of CR5. The anodes of CR5 and CR15 must be a logic "low" and the base of Q7 must be a logic "high" to obtain the desired logic "low" at the base of Q8.

The "PL" indicator is applied to the base of Q7. The "PL" indicator comes from the receiver's "PL" circuitry (if it is "PL" equipped), the master decoder in the community (RT) repeater, or will have an artificial input through the use of jumper JU2 (which is connected to A+) in carrier squelch stations. Switched A+ is applied to the other input of the AND gate through jumper JU10. This jumper is installed only in (RA) base stations and is used to give priority to transmissions originating from the control station.

In carrier squelch stations, receiver quieting is all that is required to key the transmitter. The "PL" input is simulated by connecting jumper JU2 to A+.

In "Private-Line" stations, jumper JU2 is open and a logic "high" is coupled to pin 14. This logic "high" causes Q7 to turn off; however, if the quieting indication (the output of OR gate Q6) is not a logic "low" CR5 will conduct, holding the output of the AND gate at the base of Q8 "high". When the output of OR gate Q6 goes "low", CR5 will cease to conduct and if no logic "high" is applied to the anode of CR15, or jumper JU10 is cut, the input to function inverter Q8 will be a logic "low". When Q8 turns off, its collector will go to a logic "high".

(2) Function Driver AND Gate Q9

The output of the function inverter is applied to the function driver AND gate, Q9. Q9 has three other inputs which are used to inhibit Q9. These inputs are line push-to-talk from pin 16, R2 mute from pin 21, and local push-to-talk through jumper JU3. The line push-to-talk input is used to inhibit the squelch gate on wire line controlled (RT) repeaters. This input is discussed in greater detail later. The R2 mute input on pin 21 is used as an inhibit signal for repeater knockdown in line controlled (RT) repeaters. The local push-to-talk input is used in repeater (RA) base stations. When jumper JU3 is installed, JU4 is out and the local push-to-talk is generated in the (RA) base station. This gives the control station priority over the repeater, or in other words, if a transmission is commanded from the control station, even though a signal is in the process of being relayed to the control station, the outgoing transmission will have priority.

The output from the function driver AND gate Q9 is applied thru CR4 to jumper JU1, to the dropout delay generator, to one input to the OR gate (anode of CR9) and to the time-out timer reset switch simultaneously.

(3) Jumper JU1

Jumper JU1 at the base of Q6 is used in "Private-Line" tone-coded squelch stations and removed in carrier squelch station. During temporary fading conditions in which receiver quieting is lost, the squelch gate module will remain enabled if a "PL" tone is present and jumper JU1 is connected. If the "PL" tone is also lost, the squelch gate module will become inhibited and the transmitter will turn off. It is important to note in carrier squelch stations jumper JU1 must be removed from the circuit or the output from the inverter will always be a logic "high" which continuously enables the squelch gate module. Jumper JU2 provides one of the necessary inputs to the AND gate transistor Q7 to enable the squelch gate module. JU2 is connected to A+ in all carrier squelch stations. Place JU2 in the "PL" position for use in "Private-Line" applications.

(4) Dropout Delay Generator and OR Gate CR9, CR10

Q11 in the dropout delay generator is normally conducting and is off only during the dropout delay. A+ is continually applied thru the input string of series delay resistors R35 thru R39 to the bottom side of C9 and thru CR8 to the base of Q11. Q11 is forward biased. Its collector is a logic "low" and is applied to one input of the OR gate (anode of CR10). C9 is charged at this time because one side is connected to A+ thru the delay resistors (R35 thru R39) and the other side is connected to a logic "low" from Q9.

When the output of Q9 switches to a logic "high" (the beginning of repeater transmission), the logic "high" is coupled into the OR gate anode of CR9, enabling the push-to-talk switch circuitry (Q12, Q17, Q18 and Q13) which turns on the transmitter. At the same time, the logic "high" is applied to capacitor C9, discharging it almost immediately, through resistor R40, transistor Q11, (emitter to base), and diode CR8. Q11 is forward biased from A+ on its base and is conducting while capacitor C9 is discharging. The time delay before transmitter turn-off is initiated when the logic "high" is removed from capacitor C9. The logic "high" is also removed from diode CR9, removing one input of the OR gate. Capacitor C9 cannot charge thru diode CR8 (as in discharging C9), but instead must charge through the chosen resistor, or resistors, R35 thru R39. This capacitor-resistor combination is a series RC time delay circuit that, with different values of resistance, makes it possible to vary the charge time of capacitor C9. While C9 is charging, the voltage on the base of Q11 is lower than required to make it conduct. With Q11 off, full A+ or a logic "high" is felt on CR10, the input to the OR gate and remains there until Q11 starts conducting again after C9 becomes charged.

A logic "high" arriving at the OR gate from either the dropout delay generator or diode CR9 is directly routed to the switch drive transistors, causing the transmitter to be keyed.

(5) Time-Out Timer Reset

The time-out timer reset transistor switch conducts whenever a logic "high" forward biases it. This conduction mode presents an effective ground potential, through the transistor, to the time-out timer which initiates the timed period in repeater (RT) operation. It should be noted that in wire-line controlled (RT) repeaters, the time-out timer is not operated during line transmissions.

(6) Switch Drivers and Output Switches

The switch driver transistors provide the necessary current drive to the push-to-talk switch, mute inhibit switch and repeater level switch on the squelch gate module. Fading signal conditions will not affect these switches during the dropout delay period because they are controlled from the drop-out delay generator. The push-to-talk, mute inhibit, and repeater level switch are enabled when the emitter of Q18 goes to a logic "high". All three switches turn on and the collectors of the push-to-talk switch, Q13, and the mute inhibit switch, Q15, go to a logic "low". The collector of Q14 also goes to a logic "low" and provides an effective ground at one end of the REPEATER LEVEL control R49. R49 adjusts the forward bias on a diode in the station logic module which adjusts the repeated audio exciter level. This output is used in wire-line controlled repeaters only. Jumper JU9 is cut in all other applications. The output from the mute inhibit switch disables the receiver muting circuitry in the station logic module during a repeat function.

Jumper JU4 is used in repeater (RT) and community repeater (RT) stations to provide the continuity path for the local push-to-talk switch output.

(7) F1 Channel Element Switch

The F1 channel element switch on the squelch gate module is used on all stations except wire-line controlled repeater (RT) stations. In

this case, jumpers JU7 and JU8 must be removed because the F1 channel element switch on the DC transfer module (or the F1 control module in tone systems) is used. When the transmitter is keyed, switched A+ from the station logic module is applied to pin 6 and coupled through jumper JU7 to the base of Q10. The F1 channel element switch Q10 turns on, providing an effective ground at the collector through jumper JU8 to the F1 channel element in the transmitter.

(8) Single-Tone Control

The squelch gate inhibit lead is used in conjunction with a single-tone decoder module. Normally, this lead is at ground potential and the squelch gate module is inhibited. When a single-tone signal arrives at the single-tone module, the squelch gate inhibit lead is removed from ground potential. This removes the ground potential from the input of the switch drivers, and, with a logic "high" from the function driver, enables the squelch gate module which, in turn, keys the transmitter. When the collector of the push-to-talk switch goes from a logic "low" to a "high", the single-tone decoder module is reset via the single-tone reset lead.

c. Wire Line Priority

As mentioned before, line push-to-talk is applied to pin 16 to inhibit the squelch gate during line transmissions. The line push-to-talk logic "low" is applied to two places in the squelch gate module: (1) the base of Q9, the function driver. This inhibits Q9 and prevents the time-out timer reset switch from operating during a line push-to-talk. (2) through the diode OR gate CR16 to the base of Q12, the first of the push-to-talk switch drivers. The purpose of this second application is to turn off the squelch gate push-to-talk circuitry immediately (no dropout delay) so that the repeater level switch and mute inhibit switch are disabled during line transmission.

d. Base (RA) and Repeater (RA) Applications

Jumper JU10 is installed in carrier squelch and "Private-Line" tone-coded squelch base (RA) stations to prevent the keying of repeater (RA) companion stations during the reverse burst period. In (RA) base stations, jumpers JU3 and JU10 are installed and JU4 is cut. Local P-T-T is an input in this application as an inhibit signal coupled thru JU3 to the function driver AND gate. When the (RA) repeater station keys the (RA) base station, (an outgoing transmission), the squelch gate module is prevented from keying the (RA) repeater transmitter.

At the end of an outgoing transmission, the (RA) repeater station will no longer provide a ground to the local P-T-T lead in the base (RA) station. This action results in the loss of the inhibit signal thru JU3 to the base of Q9, the function driver AND gate. In (RA) base stations equipped with "Private-Line" operation, the "PL" encoder will keep the (RA) base station keyed for approximately 150 milliseconds after the loss of P-T-T. During the reverse burst, switched A+ is maintained from the station logic module in the (RA) base station. This switched A+ is applied thru jumper JU10 to an input of an AND gate (CR15 anode) and maintains the inhibit to the base (RA) station squelch gate for the duration of the reverse burst.

In (RA) repeater stations jumpers JU3, JU4, and JU10 are cut. The inhibit signals just discussed are not used in (RA) repeater application to give the outgoing transmission priority.

(1) Solid State Companion Station

Jumper JU5 and JU6 are installed in repeater (RA) and base (RA) stations to complete the transmitter push-to-talk circuits in an associated (RA) station containing a solid state remote control chassis.

When the squelch gate module in either the (RA) repeater or the (RA) base station commands a transmission, a P-T-T "low" is coupled from the P-T-T switch Q13, out of the squelch gate module thru jumper JU5, to the repeater P-T-T, pin 15. Diode CR11 is removed in this application.

(2) Relay Keyed Companion Station

If the companion station is an older type using relay keying, the optional TLN4151A Relay Kit is used. Some of these stations require voltages greater than 100 volts and, therefore, it is not practical to use the solid state switching in the squelch gate module. When the relay kit is installed, jumpers JU5 and JU6 are cut and CR11 is installed as a transient suppressor. An external Repeater A+ is connected to pin 20 of the squelch gate module. When the squelch gate module commands a transmission, the P-T-T switch, Q13, completes the circuit to the relay, K1. When the relay energizes, it completes the circuit to provide switched A+ to the Repeater P-T-T lead (pin 15), which keys the companion station.

3. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment or the remote control chassis. To initially determine the location of the fault, operate the station by local means, and initiate the desired function from the module. If the desired function is performed, then the module is functioning properly. If the function does not perform, then the module is at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the circuitry, remove the module, insert a Model TLN8799A Servicing Board Kit and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

Servicing may be done without connection to a remote control chassis if the proper power and terminations are connected to the module. A convenient method of connection is through the use of a TEK-38 Base Station Module Servicing Adapter. The module is simply plugged into the 24-pin male plug of the adapter. Connections are then made to the circuit module via the adapter using the standard and/or resistor push on patch leads supplied with the adapter.

Use reasonable care in handling and servicing the module.

Remove the squelch gate module from the remote control unit by pulling it straight out. Check jumpers for correct application in the specific mode of operation.

NOTE

It will be advantageous to keep notes showing correct jumper hookups to facilitate reassembly after testing and repair is completed.

The jumpers and controls in the module must be set as follows during testing:

JU1 - OUT
JU2 - IN
JU3 - OUT
JU4 - IN
JU5 - (NOT APPLICABLE)
JU6 - (NOT APPLICABLE)
JU7 - IN
JU8 - IN
JU9 - IN
JU10 - OUT
DROPOUT DELAY LEAD - 8 SECONDS
REPEATER SQUELCH KEY - MAXIMUM (CLOCKWISE)
REPEATER LEVEL - MAXIMUM (COUNTERCLOCKWISE)

Set up a test condition as shown in the attached test set up diagram. Pin clip connectors are an efficient method of connecting the module pins to the test set up. Refer to the squelch gate module schematic diagram while testing the module and referencing pin numbers to corresponding stages. Any specific test result that does not correspond with the stated value in the following procedure can be related from the identifying pin number to the defective stage. Check the squelch limiter to function driver stages when many or all test output indications are incorrect.

Apply a 1-volt 10 kHz audio signal to pin 10 on the module. This simulates receiver noise from the discriminator during no received rf signal conditions. Within approximately 8 seconds, pins 13, 17, 18, and 22 should be at +12 v dc. Pin 3 should be (and remain at) ground potential.

Remove the audio oscillator from pin 10. This should cause pins 13, 17, 18, and 22 to go to ground potential immediately.

Reapply the audio signal to pin 10 on the module. Pin 22 should immediately go to +12 v dc. Pins 13, 17, and 18 should go to +12 v dc after the time delay of 8 seconds.

Remove the audio oscillator from pin 10 and connect the dropout delay lead to the specific delay interval pin required. Reconnect the audio oscillator and repeat the test procedure as previously done for the 8-second delay. This completes the test procedure and should have isolated the malfunction. Correct as necessary.

Replace all jumper connections as they should be for the specific mode of operation and install the module in the remote control unit. Reset the repeater squelch key and repeater level controls as described in the Installation and Operation Section of this manual.

c. Carrier Squelch Operation of "Private-Line" Station

While servicing "Private-Line" stations, jumpers JU1 and JU2 on the squelch gate module can be connected for carrier squelch operation, but the receiver remains continuously unsquelched. The receiver will squelch and unsquelch normally by removing the GRN-BRN lead (repeater control or PL indicator function) from the "Private-Line" decoder circuit board to the audio and squelch circuit board of the receiver. After the lead is removed, the receiver may be PL disabled with the "PL" DISABLE switch on the local control panel or by grounding the PL disable terminal in the junction box.

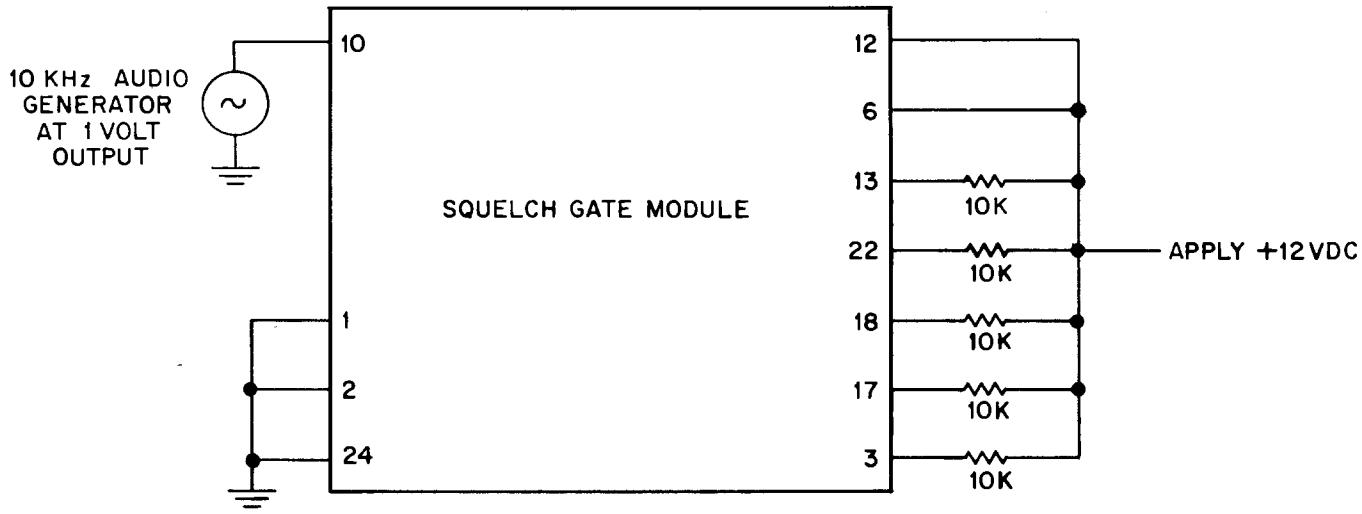
NOTE

In the 25-50 MHz repeater stations, an alternate security method (such as single-tone decoder) must be used if the station is operated with the "Private-Line" security disabled.

d. Prevention of Momentary Keying

In some instances momentary keying of a companion (RA) repeater at the end of a transmission, or a momentary switched output from the squelch gate module used in other base station applications, may occur. To prevent this, remove the cathode side of CR15 from the base of Q8 and connect it to the base of Q5 (when JU10 is in).

In this configuration, switched A+ turns inverter Q5 on through CR15 when the transmitter is keyed. This keeps the integrator capacitors (C6 and C7) from charging and activating the AND gate when switched A+ is removed. Jumpers JU10 and JU3 disable the squelch gate P-T-T switch (Q13) during the transmit mode.



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Test Set Up Diagram

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CAUTION
REMOVE DIODE CR11 IN RA STATIONS WHEN RELAY K1 IS NOT USED.

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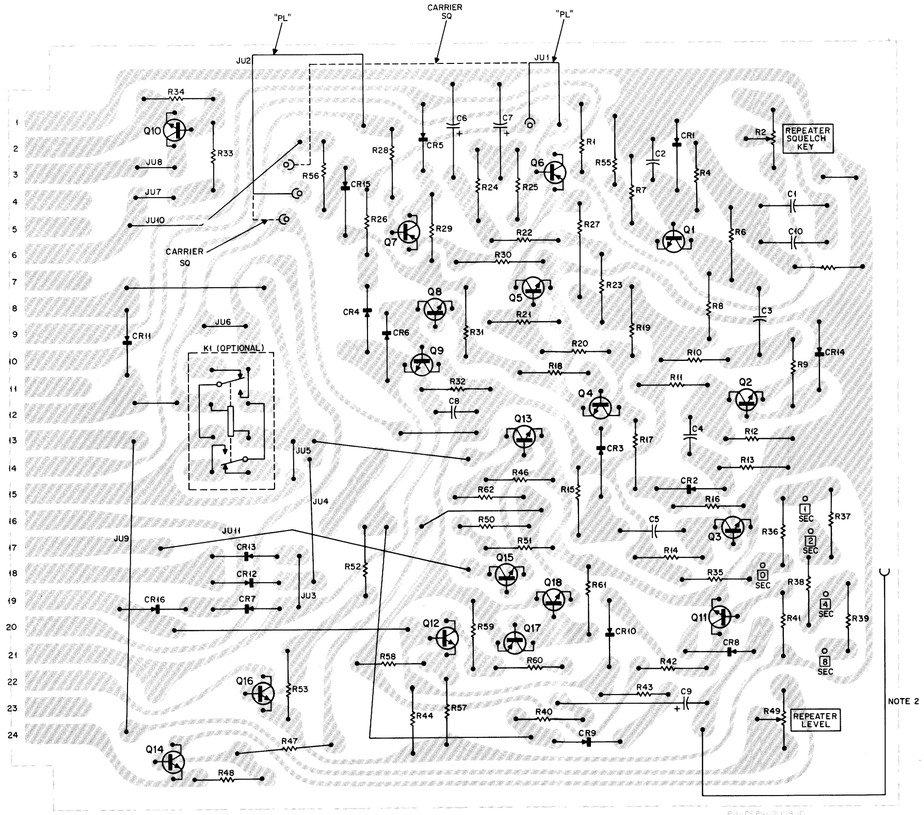

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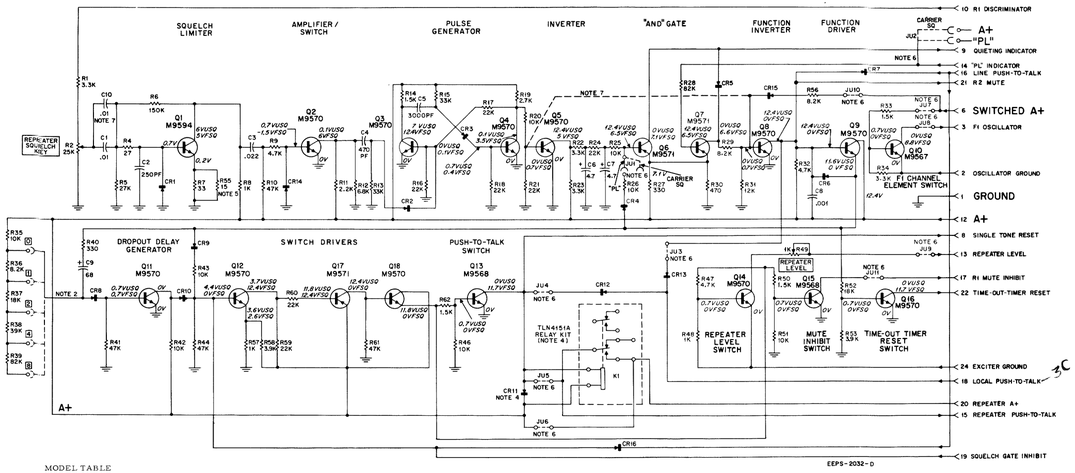
TRANSISTOR DETAIL



MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1180A		TLN8771A		SQUELCH GATE CIRCUIT BOARD
		TLN8772A		SQUELCH GATE PANEL

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K = 1000)
   CAPACITOR VALUES ARE IN MICROFARADS
2. JUMPER CONNECTS TO TERMINAL 0 , 1 , 2 , 4 OR 8 TO SET THE DROPOUT DELAY TIME (IN SECONDS)
3. VOLTAGE READINGS SHOWN FOR TWO CONDITIONS
   USQ = UNSQUELCHED
   FSQ = FULLY SQUELCHED
4. RELAY KIT IS AN OPTIONAL ACCESSORY ITEM. REFER TO RELAY APPLICATION CHART FOR CR11, JU5 AND JU6 USAGE WITH RELAY.
5. USE OF THIS RESISTOR IS DETERMINED AT FACTORY.
6. REFER TO JUMPER TABLE.
7. REFER TO "PREVENTION OF MOMENTARY KEYING" PARAGRAPH IN INSTRUCTIONS, FOR OPTIONAL CR15 CONNECTION.

JUMPER TABLE

APPLICATION	JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9	JU10	JU11
CARRIER SQUELCH REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	CARR. SQ.	CARR. SQ.	OUT	IN	IN	IN	IN	IN	OUT	OUT	IN
"PRIVATE-LINE" TONE-CODED SQUELCH REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	"PL"	"PL"	OUT	IN	IN	IN	IN	IN	OUT	OUT	IN
CARRIER SQUELCH REPEATER (RT) STATION WITH WIRE LINE CONTROL	CARR. SQ.	CARR. SQ.	OUT	IN	IN	IN	OUT	OUT	IN	OUT	IN
"PRIVATE-LINE" TONE-CODED SQUELCH REPEATER (RT) STATION WITH WIRE LINE CONTROL	"PL"	"PL"	OUT	IN	IN	IN	OUT	OUT	IN	OUT	IN
CARRIER SQUELCH BASE OR BASE (RA) STATION	CARR. SQ.	CARR. SQ.	IN	OUT	*	*	IN	IN	OUT	IN	OUT
"PRIVATE-LINE" TONE-CODED SQUELCH BASE OR BASE (RA) STATION	"PL"	"PL"	IN	OUT	*	*	IN	IN	OUT	IN	OUT
CARRIER SQUELCH REPEATER (RA) STATION	CARR. SQ.	CARR. SQ.	OUT	OUT	*	*	IN	IN	OUT	OUT	IN
"PRIVATE-LINE" TONE-CODED SQUELCH REPEATER (RA) STATION	"PL"	"PL"	OUT	OUT	*	*	IN	IN	OUT	OUT	IN
COMMUNITY REPEATER (RT) STATION	"PL"	"PL"	OUT	IN	IN	IN	IN	IN	OUT	OUT	IN

*RELAY APPLICATION CHART

TLN4151A RELAY KIT	DIODE CR11	JU5	JU6
NOT USED	OUT	IN	IN
USED	IN	OUT	OUT

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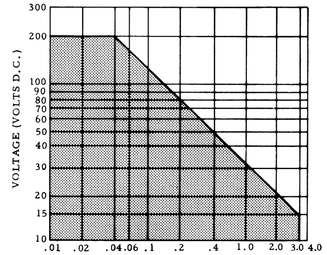

TLN4151A Relay Kit
Relay Contact Ratings

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1180A Squelch Gate Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81005E62-D
8/6/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8771A Squelch Gate Circuit Board — PL-462-O

		CAPACITOR, fixed:
C1, 10	8C82905G01	.01 uF ±10%; 50 v
C2	21K859943	250 pF ±5%; 500 v
C3	8C82905G02	.022 uF ±10%; 50 v
C4	21K850510	470 pF ±10%; 300 v
C5	21K850994	3000 pF ±5%; 500 v
C6, 7	23K865137	4.7 uF ±20%; 25 v
C8	21D82187B29	.001 uF ±10%; 100 v
C9	23K865594	68 uF ±10%; 15 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 16	48C82392B03	silicon; RD1343
		TRANSISTOR: (SEE NOTE)
Q1	48R869594	N-P-N; M9594
Q2, 3, 4, 5, 8, 9, 11, 12, 14, 16, 18	48R869570	N-P-N; M9570
Q6, 7, 17	48R869571	P-N-P; M9571
Q10	48R869567	N-P-N; M9567
Q13, 15	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1, 34	6S129231	3.3K
R2	18C83083G03	variable; 25K
R4	6S131594	27
R5	6S127806	27K
R6	6S129146	150K
R7	6S124A13	33 ±5%
R8	6S129805	1K ±5%
R9, 32, 47	6S127804	4.7K
R10, 41, 44, 61	6S128902	47K
R11	6S128689	2.2K
R12	6S128687	6.8K
R13	6S127807	33K
R14, 33, 50, 62	6S127803	1.5K
R15	6S129526	33K ±5%
R16, 17, 18, 21, 24, 59, 60	6S128685	22K
R19	6S128688	2.7K
R20, 25, 26, 35, 42, 43, 46, 51	6S129225	10K
R22, 23	6S129231	3.3K
R27	6S120638	330 ±5%; 1/2 w
R28, 39	6S129145	82K
R29, 36, 56	6S128686	8.2K
R30	6S400812	470 ±5%; 1/2 w
R31	6S129230	12K
R37, 52	6S128904	18K
R38	6S128903	39K
R40	6S129775	330
R48, 57	6S127802	1K
R49	18C83083G04	variable; 1K
R53, 58	6S129232	3.9K
R55	6S124A05	15 ±5%

TLN4151A Relay Kit — PL-455-O

		RELAY, armature:
K1	80C84201A01	2 form "C", coil res. 200 ohms

TLN8772A Squelch Gate Panel — PL-454-O

	64B83926G01	PANEL, squelch gate
	45B83914G01	GUIDE, printed circuit board: 2 req'd
	43B82721C01	INSULATOR, bushing: 2 req'd
	46B83284H01	PLUG, keying

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

TIME-OUT TIMER

MODEL TLN1179A

1. DESCRIPTION

The Time-Out Timer Module is used to limit transmission time. For base stations and (RA) repeaters, it limits the continuous transmission time. For repeaters, it limits the transmission time of individual users but not the period of continuous transmission that would occur if it was keyed during the turn-off delay. The unit can be preset for 1/2, 1, 2, 4, or 8 minutes operation.

2. CIRCUIT DESCRIPTION

Refer to the attached Time-Out Timer Module Schematic Diagram. Either JU1 or JU2 (but not both) is connected according to the table in NOTE 2. This allows the Time-Out Timer Module to operate for a time-out timer reset input or a push-to-talk input, whichever is applicable and prevents transmission beyond its preset timing period of 1/2, 1, 2, 4, or 8 minutes. The timing cycle starts when transmission occurs. At this time, a switched ground input is applied to the time-out timer reset stage. This switch stage is turned on and applies a switched A+ to all other stages of the Time-Out Timer Module.

Application of switched A+ starts the master timing generator, which is an astable multivibrator that operates at 15 seconds per cycle. The transistor and capacitors in this stage are specially selected for low leakage and must be replaced by low leakage components to retain the 15 second cycle. As shown in the waveform chart, the output section starts in the saturated condition and reverses every 7-1/2 seconds.

The time multipliers are identical bistable multivibrators. Each one starts with its output section saturated and reverses its condition only by application of a negative-going signal. The diodes in the base circuits of both sections block positive-going signals. The input is applied to both sections of the multivibrator so that each negative-going input reverses the state of the output, regardless of the previous state. Therefore, the output of each time multiplier is at one half the rate of its input.

The time-out storage stage is also a bistable multivibrator, but has an input to only one section. It acts as a driver for the inhibit switch. At the start of the time-out cycle, the output section (which has its output coupled to the inhibit switch) is saturated and the collector voltage is low. The input to the time-out storage stage is connected to any of the time multipliers, depending upon the desired time-out period. When the time multiplier to which the time-out storage input is connected produces a negative-going pulse, the time-out storage bistable will reverse states. The high collector voltage output will saturate the inhibit switch and provide a switched ground output.

The switched ground output turns off the transmitter. When the input is removed from the time-out timer reset stage, this stage cuts off and switched A+ is removed from all stages. As a result, the switched ground output is removed. When the input is again applied, the timer is instantly reset and another timing cycle starts.

3. TROUBLESHOOTING

If the troubleshooting procedure for the station indicates that the Time-Out Timer Module is defective, the troubleshooting chart should be followed to locate the defective stage. When the defective stage is located, dc voltage and

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resistance measurements should be checked to isolate the defective component. Set up the module for testing and troubleshooting as follows:

a. Remove the module from the chassis.

b. Connect a dc power supply across pins 1 and 12 with ground at pin 1. Connect a 5K resistor across pins 4 and 12. Connect either pin 6 or pin 22 (whichever is jumpered) through a means of switching to ground on the power supply. Set the power supply to 13.5 volts dc.

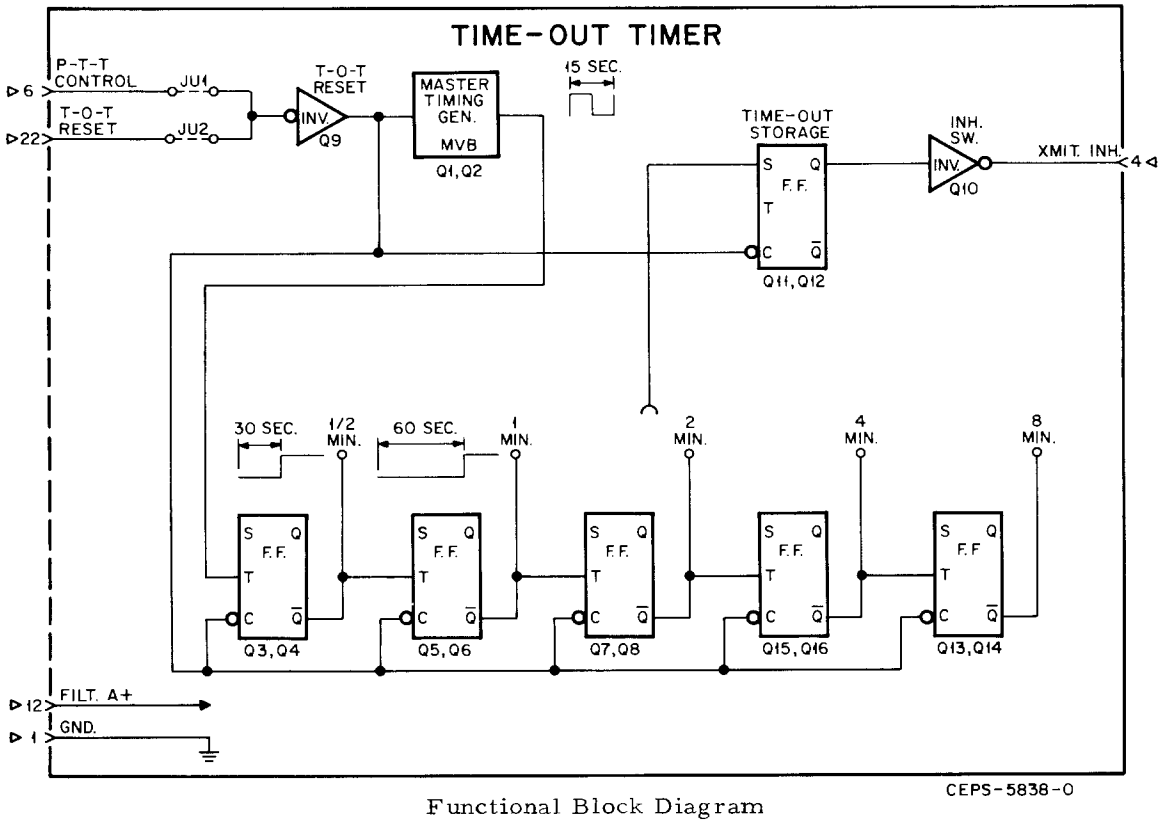
c. Refer to the attached schematic diagram and chart and note the desired timing cycle for different stages of the module. Follow the steps on the troubleshooting chart and use a watch to compare "highs" and "lows" on a VACUUM TUBE voltmeter with desired timing. Timing should be accurate ±10%.

d. If a defective stage is not located, check connections and continuity of plating for opens and shorts.

4. SPECIAL JUMPER INFORMATION

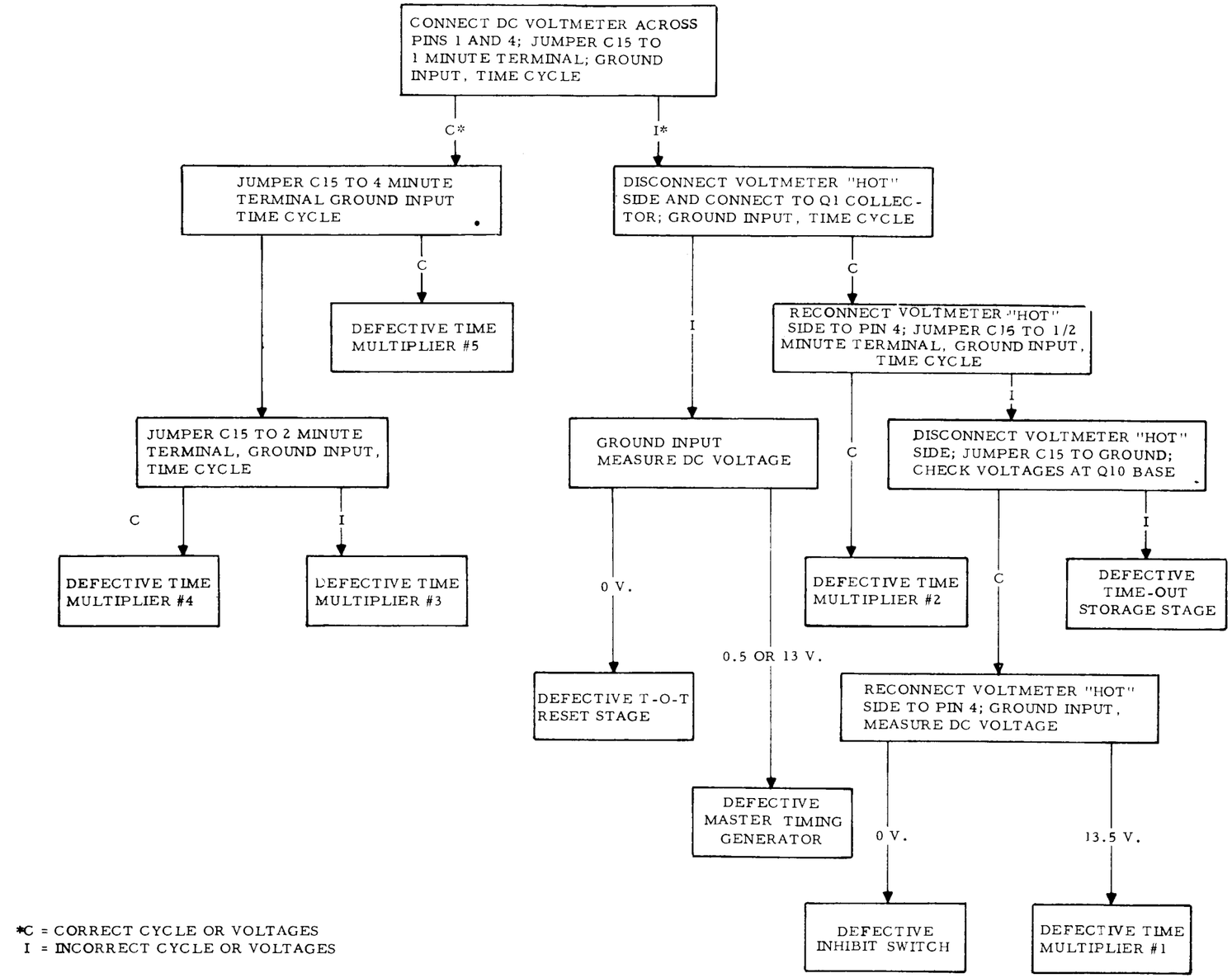
When JU-1 is used and JU-2 is out, the timer is driven by the transmitter push-to-talk (P-T-T) signal. As long as the station is keyed by any means (rf or wire line control), the timer is activated and will limit transmissions to the selected period. In repeater applications, as long as the station remains keyed by an rf carrier (even during the drop-out delay of the squelch gate), the timer continues to time out. Therefore, mobile-to-mobile communications through the repeater may exceed the selected time-out period and the station will cease to function as a repeater, even though no single mobile transmission exceeds the time-out period.

When JU-2 is used and JU-1 is out, the timer is driven from the squelch gate only. This configuration is useful only in repeater applications. However, the timer does not limit transmissions of repeater stations that are keyed via wire line control. When keyed as a repeater by the squelch gate, the timer begins to time out. However, if the squelch gate senses loss of quieting (even momentarily as it will at the end of a mobile transmission), it will reset the timer and the next carrier signal will start it on a new timing cycle. This is true even if the station remains keyed continuously due to the drop-out delay of the squelch gate. It therefore will limit transmission time of a particular user attempting to keep the station keyed for an extended period of time. It will not limit transmissions through the repeater as long as any one user does not exceed the selected time-out period. This is the recommended type of operation for most repeater applications, particularly community repeaters.



Functional Block Diagram

TIME-OUT TIMER TROUBLESHOOTING CHART



*C = CORRECT CYCLE OR VOLTAGES
I = INCORRECT CYCLE OR VOLTAGES

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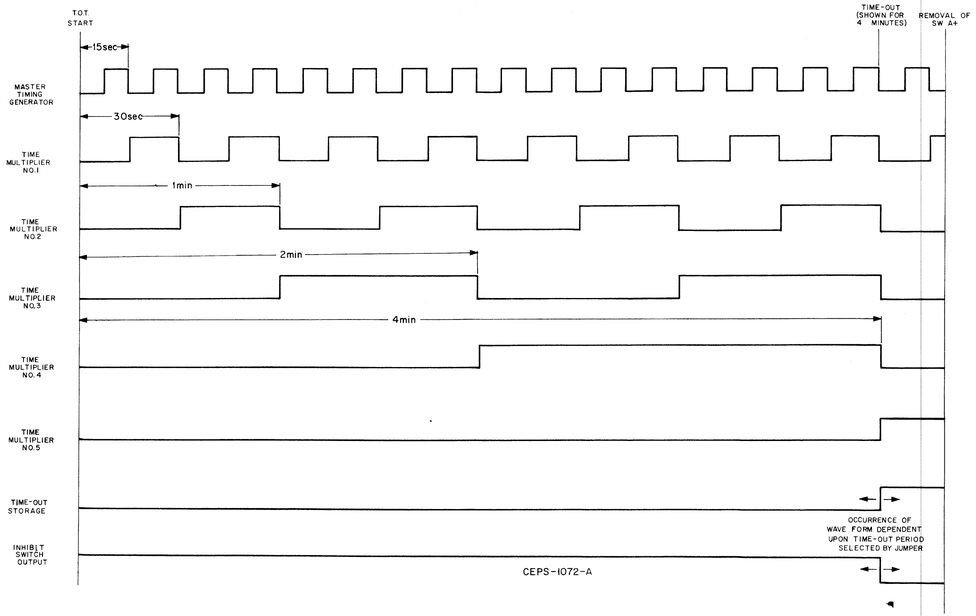

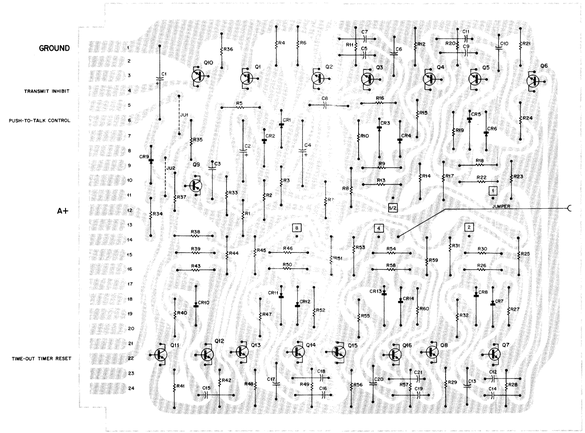

MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1179A		TLN8769A		TIME-OUT TIMER BOARD
		TLN8770A		TIME-OUT TIMER PANEL

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000)
   CAPACITOR VALUES ARE IN MICROFARADS.
2. JUMPER TABLE

APPLICATION	JU1*	JU2*
BASE STATION	IN	OUT
REPEATER (RT)	OUT	IN
BASE (RA) STATION	IN	OUT
REPEATER (RA) STATION	IN	OUT
COMMUNITY REPEATER	OUT	IN

*SEE SPECIAL JUMPER INFORMATION IN TEXT.

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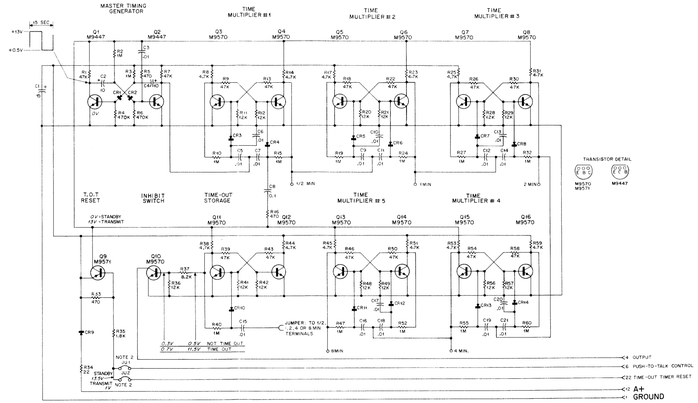


TIME-OUT TIMER

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1179A Time-Out Timer Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81001E13- D
6/5/74-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

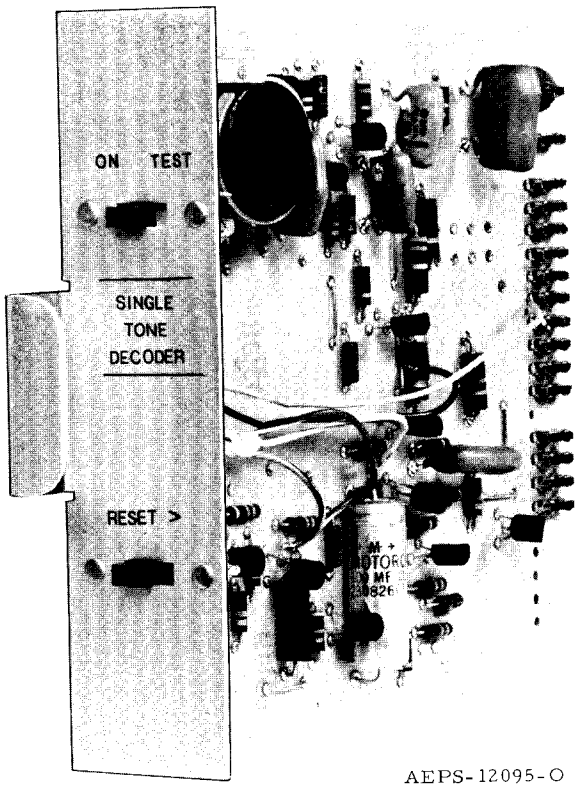
TLN8769A Time-Out Timer Board PL-284-B

		CAPACITOR, fixed:
C1	23K865136	15 uF ±20%; 25 v
C2, 4	23D82783B27	10 uF ±10%; 25 v
C3, 5, 6, 7, 9 thru 21	21D82428B35	.01 uF +80-20%; 500 v
C8	8D82905G07	0.1 uF ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 8	48C83654H01	silicon
CR9	48C82392B03	silicon
CR10 thru 14	48C83654H01	silicon
		TRANSISTOR: (SEE NOTE)
Q1, 2	48K869447	N-P-N; M9447
Q3 thru 8, 10 thru 16	48R869570	N-P-N; M9570
Q9	48R869571	P-N-P; M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R1, 7, 9, 13, 18, 22, 26, 30, 39, 43, 46, 50, 54, 58	6S128902	47K
R2, 3	6S129189	1 meg ±5%
R4, 6	6S129148	470K
R5, 16, 33	6S127801	470
R8, 14, 17, 23, 25, 31, 38, 44, 45, 51, 53, 59	6S127804	4.7K
R10, 15, 19, 24, 27, 32, 40, 47, 52, 55, 60	6S129013	1 meg
R11, 12, 20, 21, 28, 29, 36, 41, 42, 48, 49, 56, 57	6S129230	12K
R34	6S131641	22
R35	6S129269	1.8K
R37	6S128686	8.2K

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

SINGLE-TONE DECODER MODULE

MODEL TLN1181A



AEPS-12095-O

1. DESCRIPTION

The single-tone decoder module is an optional accessory item for Motorola FM two-way radio stations. It is a fully transistorized module that plugs into the dc remote control chassis. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed. Two test switches on the front panel permit manual operation for testing and maintenance.

The single-tone decoder module adapts stations for use in single-tone signalling systems. Such a system may use single-tone frequencies to select a specific repeater from a multiple repeater network. In such a system, each repeater is equipped with a single-tone decoder of a different frequency. The repeaters are disabled until the proper tone frequency is received. The proper tone is decoded by the module and its output used to enable the repeater.

Other typical applications for the module are remote monitoring and control of external signalling devices.

2. FUNCTIONS

A specific audio tone input in the 600 to 3300 Hz range actuates the module, providing a switched ground or switched voltage output (as desired) to control external circuits. Decoders are available in 19 different frequencies from 600 to 3300 Hz spaced at 150 Hz. Each module has its specific frequency of operation stamped on the chassis. The proper tone applied to the module for approximately 300 continuous milliseconds initiates operation.

Jumpers can be connected to place the module in either of two basic modes of operation; "lock" or "non-lock". In the "lock" mode, the correct tone input actuates the decoder. The decoder "locks" in this state until reset by an external signal. In the "non-lock" mode, the correct tone input actuates the decoder and it resets when the tone input is removed. The "non-lock" mode can have a 5-second turn-off delay by connecting another jumper.

An optional relay may be added to the circuit board, if desired, for special applications. The relay is energized in a "lock" or "non-lock" mode when the correct tone input actuates the decoder.

3. CIRCUIT OPERATION

NOTE

For a description of the basic circuits used in the logic circuitry, refer to the remote control chassis section.

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The tone input from the receiver discriminator is amplified by Q751. Frequencies above 3300 Hz are attenuated by coupling components. The amplified signal is converted into a square wave by clipper transistor Q752. Q753 is a buffer stage which isolates the clipper stage from the following LC tank circuit. The tank circuit determines the single-tone frequency at which the module will operate and converts the square wave signal back into a sine wave to drive Q754. This detector stage produces a positive-going sawtooth signal that is applied to integrator network (R767 and C758). A signal applied for approximately 300 continuous milliseconds on C758 charges the capacitor sufficiently to cause switching transistor Q755 to conduct. Diode CR753, resistor R766, and capacitor C757 help prevent unintentional operation from random voice signals of the proper frequency by discharging C758 almost immediately upon loss of the sawtooth signal.

Switching transistors Q755 and Q756 conduct or turn "on" during the presence of tone and are "off" during no-tone conditions. Switch stage Q757 is also "on" during the presence of tone. When tone is removed, capacitor C760 and resistor R774 will provide a 5-second delay in turn-off if jumper JU1 is connected ("non-lock" delay mode). Greater time delay is possible by replacing R774 with a larger resistor. The output of Q757 is the triggering voltage for Schmitt trigger Q758 and Q759.

Schmitt trigger (Q758 and Q759) provides a low level output while a tone is being received. During no-tone conditions the output returns to a higher level, when the decoder is operated in the "non-lock" mode. The "lock" mode is selected by connecting jumper JU2. In this mode, the Schmitt trigger "locks" in the "on" condition until a reset "high" is applied at pin 9 (or the RESET switch is operated).

The A+ switch (Q760) provides a switched A+ output when the proper tone is decoded. Inverter Q761 provides a switched ground output when the proper tone is decoded. Either output can be used depending upon the application. When jumper JU3 is removed and jumper JU4 is connected, an external ground input may be supplied to Q761. It will then operate as an AND gate, requiring both the external ground and the proper tone to give a switched ground output.

When the relay is used, the switched ground output of inverter Q761 energizes the relay. Two form "C" contacts permit connections for special applications.

Output switch Q762 is turned "off" when the proper tone is decoded. Before the tone is decoded, the stage provides a ground output at pin 18 to inhibit the squelch gate in repeater stations. When the tone is decoded, the ground is removed and the squelch gate is enabled. For applications where the single-tone decoder module does not control the squelch gate, jumper JU6 is removed.

Two test switches are provided on the face of the module to facilitate servicing. ON-TEST switch S751 is placed in the ON position for normal operation. In the TEST position, it simulates the application of the proper tone input and actuates the decoder. If the module is jumpered for the "non-lock" mode of operation, the decoder deactivates when the switch is returned to the ON position (after a 5-second delay if jumper JU1 is used). If the module is jumpered for the "lock" mode of operation, the decoder remains activated when the switch is returned to the ON position. Momentarily placing the ON-RESET switch to the RESET position will deactivate the decoder.

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A Servicing Board Kit, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

Servicing information as given in the "Servicing the Module out of the Chassis" paragraph is applicable to the module when connected to the service board if the jumpers are connected identically. Differences in operation due to jumper changes are described in the "Circuit Operation" paragraphs of this section. Refer to these paragraphs and note jumper placements to determine the modules specific functions. For example, JU1 connected and JU2 removed will delay module reset for approximately 5 seconds. JU2 connected will cause the module to operate in the "lock" mode.

b. Servicing the Module Out of the Chassis

Servicing may be done without connection to a remote control chassis if the proper power and terminations are connected to the module. A convenient method of connection is through the use of a TEK-38 Base Station Module Servicing Adapter. The module is simply plugged into the 24-pin male plug of the adapter. Connections are then made

to the circuit module via the adapter using the standard and/or resistor push on patch leads supplied with the adapter.

(1) Remove the single-tone decoder module and check the jumpers at this time for correctness in this module's mode of operation. Note any errors and continue with the test procedure.

Place the jumpers on the module as follows:

JU1 - OUT
JU2 - OUT
JU3 - IN
JU4 - OUT
JU5 - IN
JU6 - IN
JU7 - IN

(2) Set up the test equipment as shown in the Test Set Up Diagram.

(3) Perform an overall module operation check by injecting the proper single-tone frequency on pin 3. Pin 18 should be at A+ and remain there after approximately 300 milliseconds. Removal of the single-tone frequency should immediately cause pin 18 to go to ground potential.

If the output is abnormal, proceed to step (4).

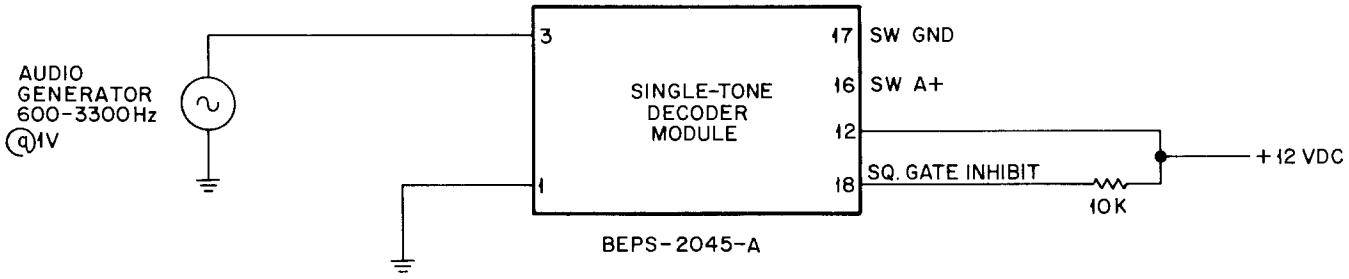
(4) Place the ON-TEST switch in the TEST position. Pins 16 and 18 should read A+ and pin 17 should read ground potential.

Return the switch to the ON position. Pins 16 and 18 should drop to near 0 volts and pin 17 should go to A+.

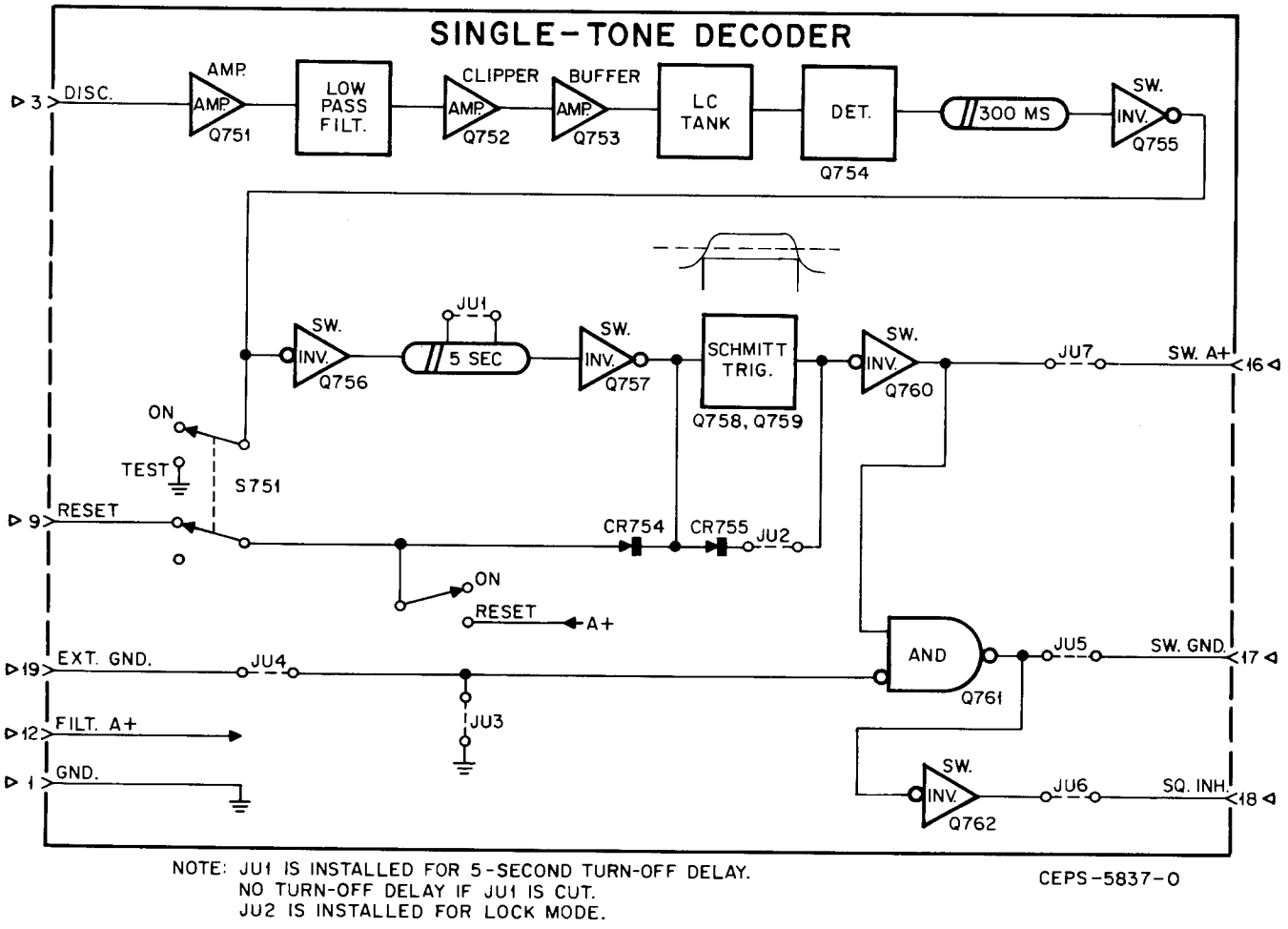
If all voltages are abnormal, check the dc voltages in switches Q756 and Q757, Schmitt trigger Q758 and Q759, and switch Q760. If pin 16 is normal but pins 17 and 18 are abnormal, check Q761. If only pin 18 is abnormal, check Q762. Correct the trouble and recheck step (3).

If all voltages are normal, stages Q756 through Q762 are operating satisfactorily. Proceed to step (5).

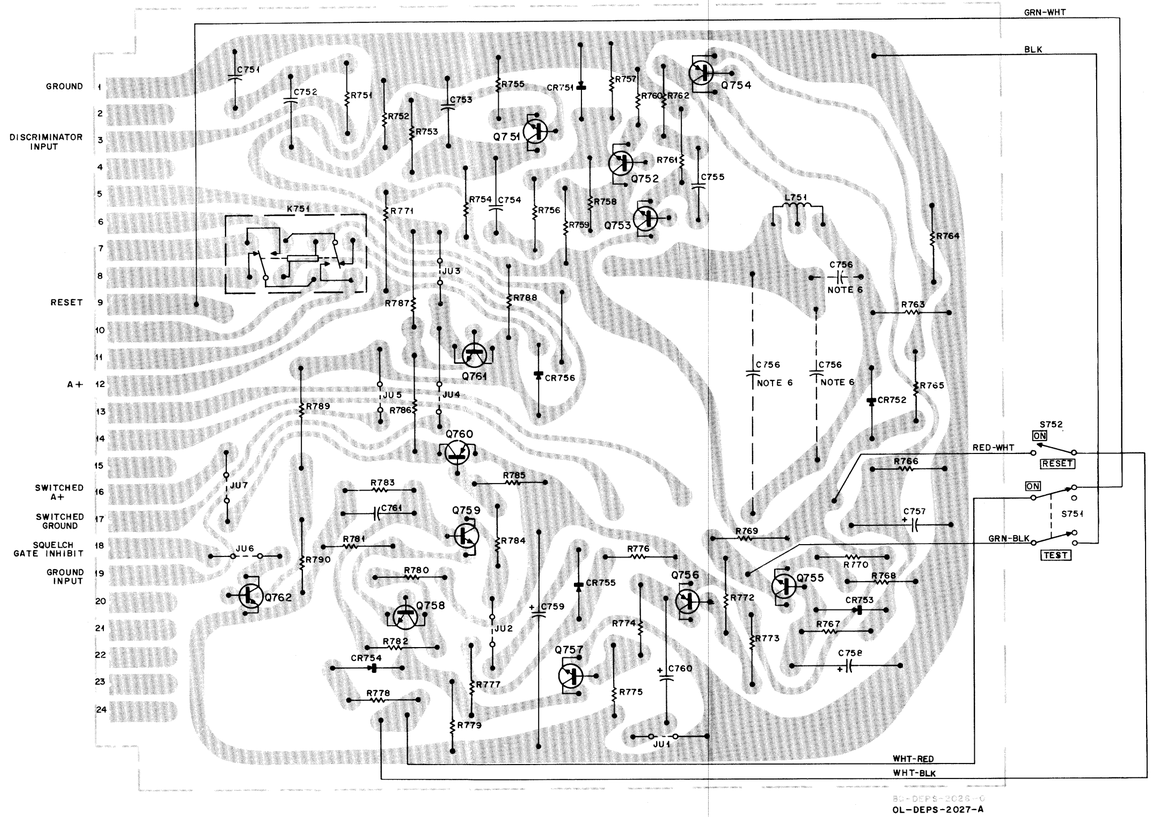
(5) Inject the proper single-tone frequency at pin 3. Measure waveforms and voltages as shown on the schematic diagram for stages Q751 through Q755. Correct any trouble and recheck step (3).

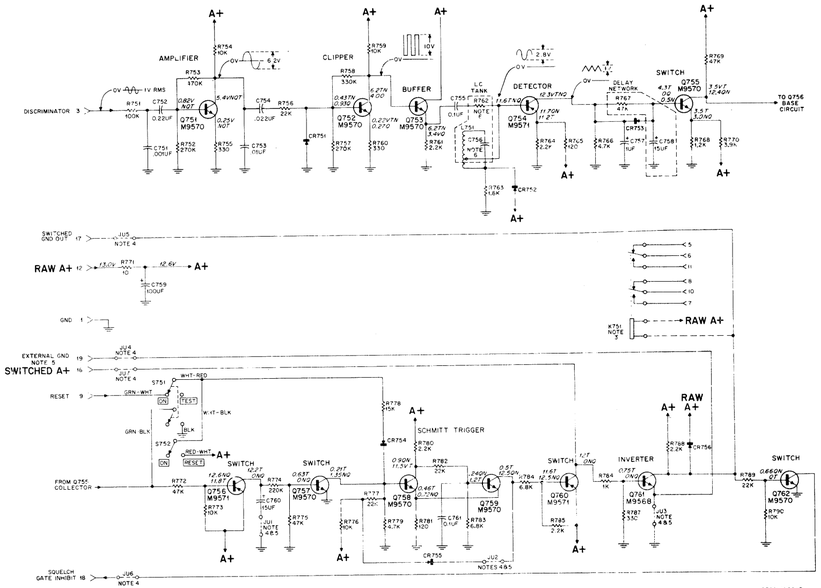


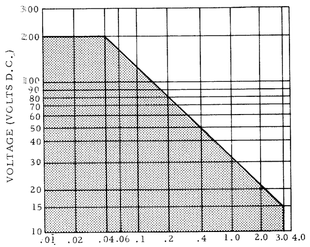
Test Set Up Diagram



Functional Block Diagram







NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K = 1000)
   CAPACITOR VALUES ARE IN MICROFARADS.
2. VOLTAGE INDICATED EXISTS FOR FOLLOWING CONDITION OR COMBINATION OF CONDITIONS.
   N = NOISE
   Q = QUIETING
   T = TONE
3. TLN4151A RELAY IS OPTIONAL ACCESSORY. REFER TO ACCOMPANYING GRAPH FOR RELAY CONTACT RATINGS.
4. JUMPER CONNECTIONS TABLE FOR REPEATER OPERATION.

JUMPER	REPEATER (RT)	COMMUNITY REPEATER (RT)
JU1	OUT	OUT
JU2	IN	IN
JU3	IN	IN
JU4	OUT	OUT
JU5	OUT	IN
JU6	IN	OUT
JU7	OUT	OUT

5. SPECIAL APPLICATIONS ONLY. REFER TO TEXT.
6. FREQUENCY-DETERMINING COMPONENT. SEE PARTS LIST FOR VALUE.
7. APPROXIMATELY 300 MILLISECONDS.
8. VOLTAGE READINGS AND WAVEFORMS ARE ±20%.

EPS-2046-A

AEPS-1527-O

SINGLE-TONE DECODER MODULE

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1181A Single-Tone Decoder Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81005E68-F
6/5/74-NPC

PARTS LIST

TLN8773A Single-Tone Decoder Board — PL-456-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 50 v; unl. stated
C751	21D82187B29	.001; 100 v
C752	8D82905G11	0.22
C753	8D82905G01	.01
C754	8D82905G02	.022
C755, 761	8D82905G07	0.1
C756		(see "FREQUENCY-DETERMINING COMPONENTS")
C757	23D82783B08	1 ±20%; 35 v
C758, 760	23D83214C02	15 ±20%; 25 v
C759	23D82601A25	100 +150-10%; 20 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR751 thru 756	48C82392B03	silicon
		COIL, AF:
L751	24C84200A01	1 H
		TRANSISTOR: (SEE NOTE)
Q751, 752, 753, 755, 757, 758, 759, 762	48R869570	N-P-N; type M9570
Q754, 756, 760	48R869571	P-N-P; type M9571
Q761	48R869568	N-P-N; type M9568
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R751	6S129226	100K
R752, 757	6S129227	270K
R753	6S129148	470K
R754, 759, 773, 776, 790	6S129225	10K
R755, 787	6S6022	330; 1/2 w
R756, 777, 782	6S128685	22K
R758	6S129228	330K
R760	6S129775	330
R761, 764, 780, 785, 788	6S128689	2.2K
R762		(see "FREQUENCY-DETERMINING COMPONENTS)
R763	6S129269	1.8K
R765, 781	6S129617	120
R766, 779	6S127804	4.7K
R767, 769, 772, 775	6S128902	47K
R768	6S129235	1.2K
R770	6S129232	3.9K
R771	6S5621	10; 1/2 w
R774	6S129147	220K
R778	6S127805	15K
R783, 784	6S128687	6.8K
R786	6S6229	1K; 1/2 w
R789	6S6397	22K; 1/2 w

FREQUENCY DETERMINING COMPONENTS

The frequency-determining components of this decoder are C756 and R762. In some cases, C756 consists of two capacitors connected in parallel. Refer to the following table.

C756			R762	
FREQ. (Hz)	MOTOROLA PART NO.	CAPACITOR, fixed:	MOTOROLA PART NO.	RESISTOR, fixed: ±10%; 1/4 w;
600	8D84326A27	.0557uF ±20%; 50 v	6S127803	1.5K
	&8D84326A06	.0095 uF ±3%; 50 v		
750	8D84326A26	.0420 uF ±2%; 50 v	6S127803	1.5K
900	8D84326A24	.0261 uF ±2%; 50 v	6S128689	2.2K
	&8D84326A02	.0030 uF ±3%; 50 v		
1050	8D84326A23	.0213 uF ±2%; 50 v	6S129231	3.3K
1200	8D84326A08	.0158 uF ±3%; 50 v	6S129231	3.3K
	&21K859947	510 pF ±5%; 500 v		
1350	8D84326A20	.0129 uF ±2%; 50 v	6S127804	4.7K
1500	8D84326A18	.0098 uF ±2%; 50 v	6S128687	6.8K
	&21K848236	650 pF ±5%; 300 v		
1650	8D84326A17	.00865 uF ±2%; 50 v	6S128687	6.8K
1800	8D84326A05	.0073 uF ±3%; 50 v	6S129225	10K
1950	8D84326A14	.0062 uF ±2%; 50 v	6S129225	10K
2100	8D84326A30	.0045 uF ±1%; 50 v	6S127805	15K
	&21K873269	820 pF ±2%; 300 v		
2250	8D84326A30	.0045 uF ±1%; 50 v	6S127805	15K
	&21K840047	150 pF ±5%; 500 v		
2400	8D84326A03	.0042 uF ±3%; 50 v	6S128904	18K
2550	8D84326A02	.0030 uF ±3%; 50 v	6S128685	22K
	&21K848236	650 pF ±5%; 300 v		
2700	8D84326A02	.0030 uF ±3%; 50 v	6S128685	22K
	&21K859942	220 pF ±5%; 500 v		
2850	8D84326A02	.0030 uF ±3%; 50 v	6S128685	22K
3000	8D84326A01	.0021 uF ±5%; 500 v	6S127806	27K
	&21K859947	510 pF ±5%; 500 v		
3150	8D84326A01	.0021 uF ±5%; 50 v	6S127807	33K
	&21K859178	270 pF ±5%; 300 v		
3300	8D84326A01	.0021 uF ±5%; 500 v	6S127807	33K

TLN4151A Relay Kit — PL-457-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
K751	80C84201A01	RELAY, armature: 2 form "C"; coil res. 200 ohms ±10%

TLN8774A Panel Kit, Single-Tone Decoder — PL-458-O

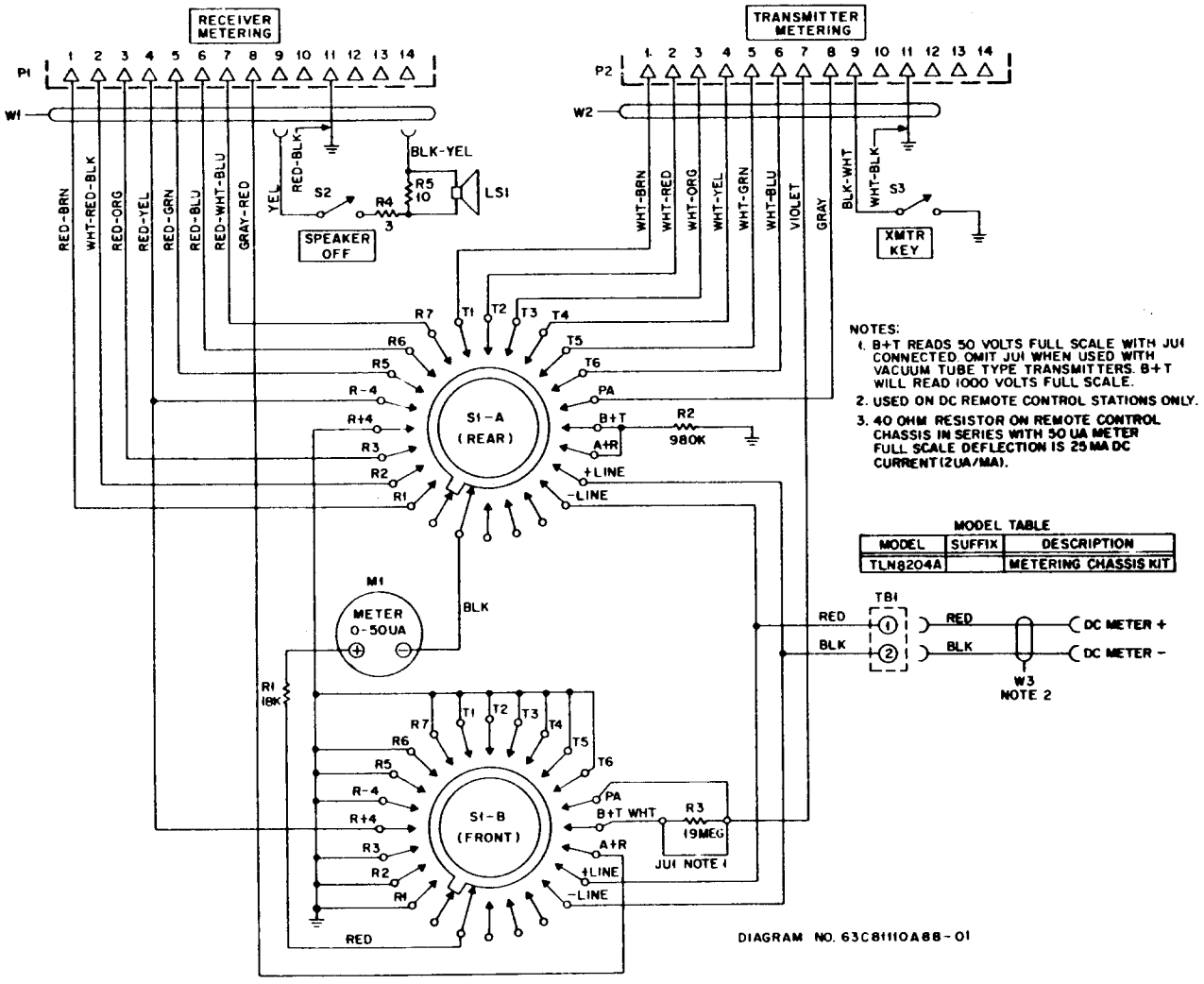
NON-REFERENCED ITEM		
	45B83914G01	GUIDE RAIL (slide-mount for circuit board); 2 req'd

NOTE:

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

METERING KIT

MODEL TLN8204A



NOTES:

1. B+T READS 50 VOLTS FULL SCALE WITH JUI CONNECTED. OMIT JUI WHEN USED WITH VACUUM TUBE TYPE TRANSMITTERS. B+T WILL READ 1000 VOLTS FULL SCALE.
2. USED ON DC REMOTE CONTROL STATIONS ONLY.
3. 40 OHM RESISTOR ON REMOTE CONTROL CHASSIS IN SERIES WITH 50 UA METER FULL SCALE DEFLECTION IS 25 MA DC CURRENT (2UA/MA).

MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
TLN8204A		METERING CHASSIS KIT

DIAGRAM NO. 63C81110A88-01

PARTS LIST ON BACK

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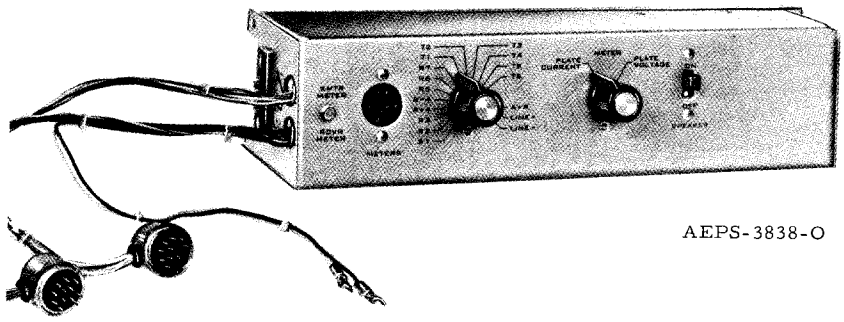
PARTS LIST

TLN8204A Metering Chassis PL-1749-C

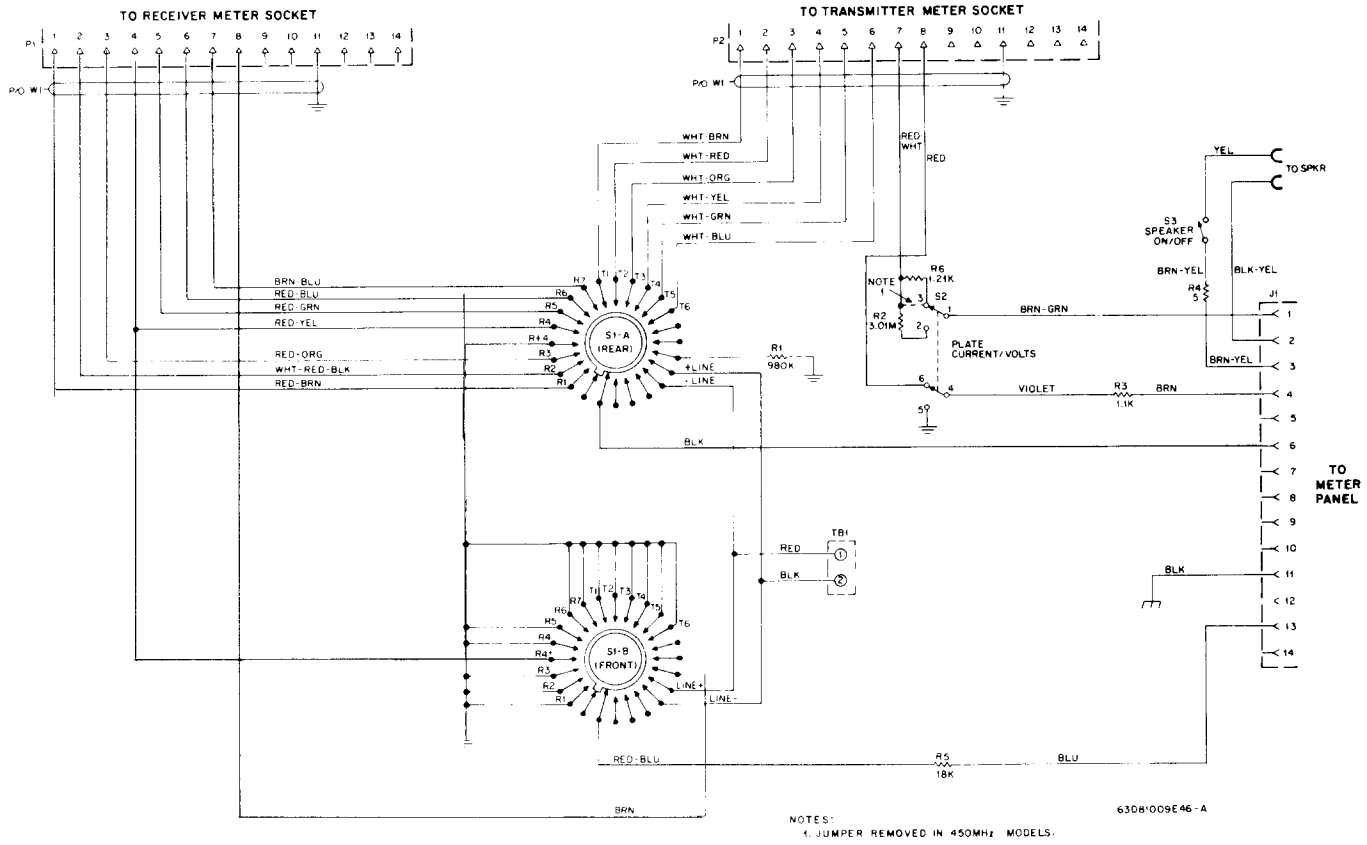
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		LOUDSPEAKER, permanent magnet:
LS1	50B893245	2-1/2"; square; 3.2 ohms impedance; weatherproof
	or 50K801757	2-1/2"; square; 3.2 ohms imp.
		AMMETER, DC:
M1	72D83120C02	0-50 uA; res. 1820 ohms ±10%
		CONNECTOR, plug:
P1, 2	28B864669	male; 12 contact; does not incl. 15A82798H01 SHELL, connector
		RESISTOR, fixed:
R1	6K892470	18k ±1%; 1/2 W
R2	6K811974	980k ±2%; 1/2 W
R3	6D82475B64	19 meg ±1%; 1/2 W
R4	17D82177B04	5 ±10%; 5 W
R5	6R488022	10 ±10%; 1 W
		SWITCH:
S1	40C83158C01	rotary; 2 section; c/o:
S1A		24 position; non-shorting
S1B		24 position; non-shorting
S2	40B82094H01	slide; spdt
S3	40A840806	slide; spdt (one position momentary)
		TERMINAL BOARD:
TB1	31A863823	2 screw terminals
		CABLE ASSEMBLY, special purpose:
W1	1V80755A64	incl. P1 & miscellaneous leads
W2	1V80755A65	incl. P2 & miscellaneous leads
W3	1V80755A85	CABLE ASSEMBLY, special purpose

METER SWITCHING PANEL

MODEL TLN4288A



AEPS-3838-O



PARTS LIST SHOWN ON BACK OF THIS PAGE.

METER SWITCHING PANEL

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

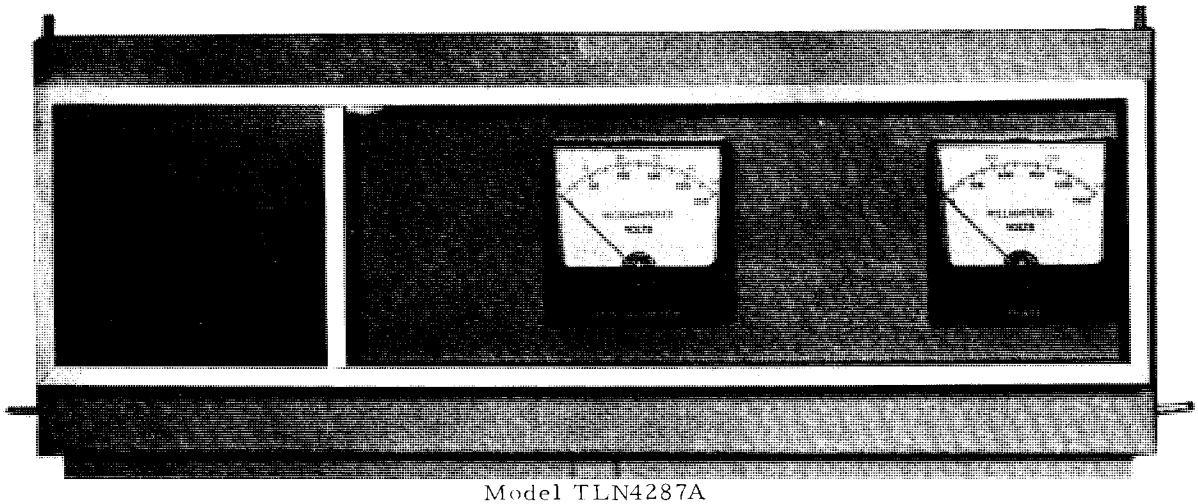
PARTS LIST

TLN4288A Meter Switching Panel PL-948-A

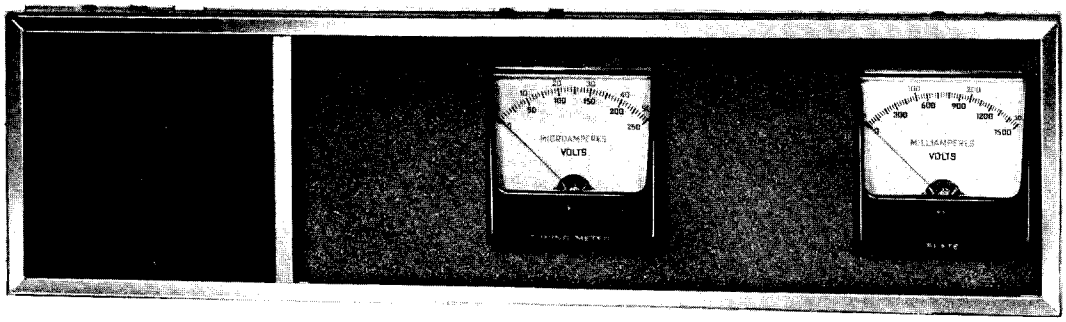
		CONNECTOR, receptacle:
J1	9C83478E01	female; 12 contact
		CONNECTOR, plug:
P1	28B864669	male; 12 contact
P2	28B864669	male; 12 contact
		RESISTOR, fixed:
R1	6K811974	980K ±2%; 1/2 W
R2	6D82672B10	3.01 meg. ±1%; 2 W
R3	6K872252	1.1K ±1%; 1/2 W
R4	17D82177B04	5 ±10%; 5 W
R5	6K892470	18K ±1%; 1/2 W
R6	6K877166	1.21K ±1%; 1/2 W.
		SWITCH,
S1	40C83158C01	rotary: 2 section; 2 pole; 24 position; non-shorting type
S2	40C82851H01	rotary: 2 pole - 2 position; non-shorting type
S3	40A11589	slide; spdt
		BOARD, terminal:
TB1	31A863823	2 screw terminals
		CABLE ASSY., special purpose:
W1	1V80708B82	receiver; incl. ref. part S1 and miscellaneous leads
	NON-REFERENCED ITEMS	
	15A82798H01	SHELL, connector: used with ref. parts P1, P2
	37K10559	GROMMET, rubber: used with ref. parts P1, P2
	36B82630H01	KNOB, switch: used with ref. parts S1, S2
	4S7698	LOCKWASHER: 3/8" internal; 2 req'd
	2S1376	NUT, hex: 3/8"-32 x 1/2"; 2 req'd.

EXTERNAL METER PANEL

MODELS TLN4287A & TLN4319A



Model TLN4287A



AEPS-3837-O

Model TLN4319A

DESCRIPTION

These panels provide metering facilities for alignment and troubleshooting of the station. The two models described here are the same except for the mounting plate and associated hardware. Both panels contain a speaker for monitoring of the receiver output and for use as a speaker-microphone for intercom between the remote control point and the station site.

The PLATE meter (M2) has two graduated scales: a 0-1500 V dc for plate voltage measurements and a 0-300 milliamperes scale for plate current measurement. On 450 MHz models when measuring the PA Plate current, multiply the meter reading by 2. When measuring the Exciter Current multiply the meter reading by 20. This meter provides continuous monitoring of power amplifier plate voltage or current as selected by the switch on the power amplifier.

The TUNING METER (M1) has two graduated scales: a 0-50 microampere scale used for receiver and exciter tuning or checking and control line current measurements; and a 0-250 V scale used for driver stage(s) alignment. Control line metering is selected by the switch on the meter switching panel.

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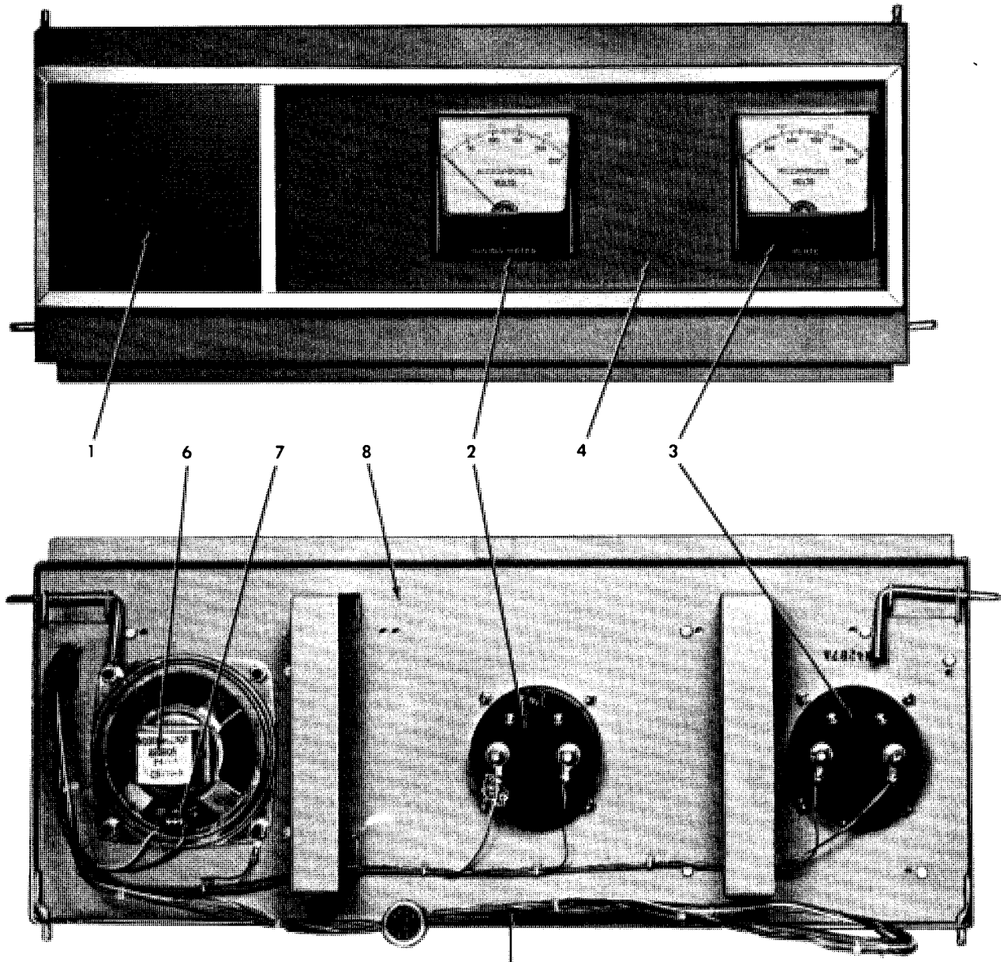
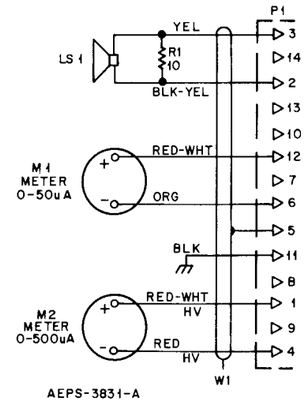
MODEL TLN4287A

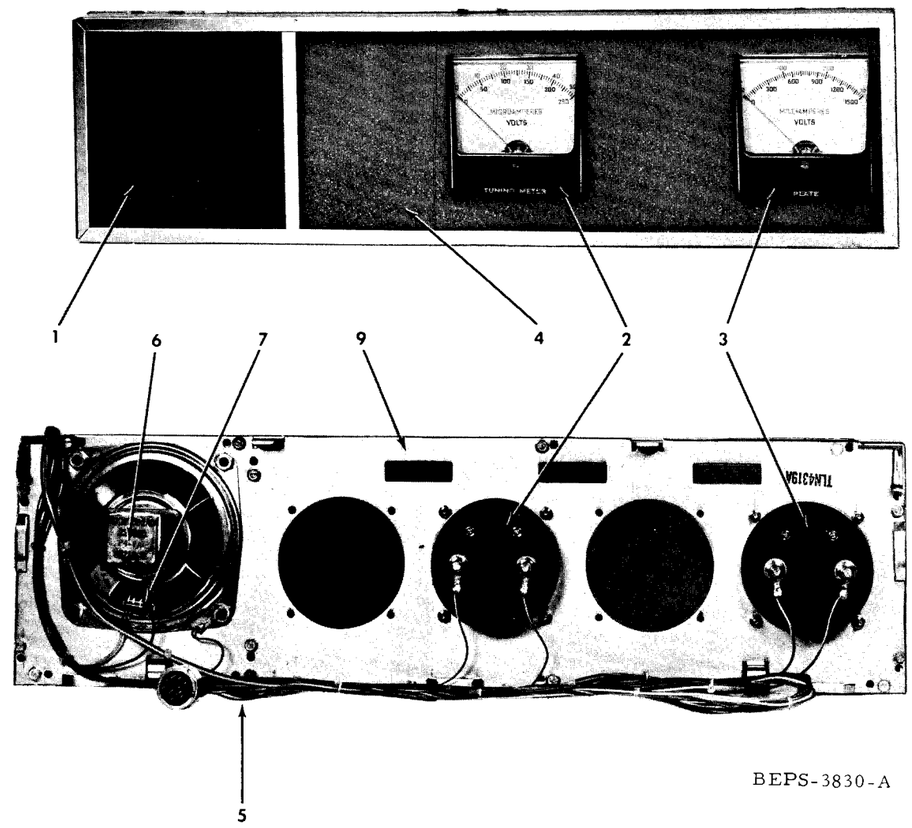




NOTE:
WIRING TO NO.1 & NO.4 IS 1000 VOLT PVC.

Model TLN4287A and TLN4319A
Meter Panel Schematic Diagram

MODEL TLN4319A



BEPS-3830-A

PARTS LIST

PL-986-C

SCHEMATIC REFERENCE	PHOTO REFERENCE	MOTOROLA PART NO.	DESCRIPTION
	1	13-83155C01	Speaker Grille
M1	2	72-84864D01	Tuning Meter (50 uA)
M2	3	72-84865D02	Plate Current and Plate Voltage Meter (500 uA)
	4	61-84056B01	Window, Meter Panel
W1	5	1-80703B70	Cable and Connector Assembly includes: 28-864669 CONNECTOR, plug: male; 12 cont. 15-84798H01 SHIELD, connector 37-10559 GROMMET, rubber (ref. P1)
LS1	6	50-83562A01	Speaker (4")
R1	7	6-48802Z	Resistor, 10 ohms ±10%; 1 W
	3	64-84046B01	Frame Wrap around
	9	64-83152C01	Frame Wrap around

EXTERNAL METER PANEL

Model TLN4287A & TLN4319A
External Meter Panels
Schematic Diagram & Parts
Identification Detail
Motorola No. PEPS-3864-B
6/5/74-NPC

MODEL TABLE

TLN1241A Emergency Reverting Kit	TLN4028A	Emergency Reverting Relay Kit
	TKN6362A	Battery Cable Kit
TLN1235A Battery Protection & Alarm	TLN4013A	Battery Charger Board
	TLN4014A	Board Mounting Plate
	TKN6426A	Cable Kit

1. APPLICATION

Emergency power operation of the station is achieved by the addition of two required accessory items to the basic station. The first item is the dc power source (the battery), which normally "floats" across the power supply output, but supplies dc power to the load when the ac primary power fails. Your Motorola sales representative will recommend the type and size of battery which best suits the application.

The battery used as the emergency source must be suitable for this type of service. It can be of either the nickel-cadmium or lead-acid type. An automotive type battery is not recommended as an emergency dc supply.

Capacity of the battery should be carefully determined before its purchase. Factors that influence the capacity are the busy hour load, the protection time desired, the final cell voltage limit and the minimum operating temperatures. For more information contact your Motorola Area Systems Engineer.

The second required item is the TLN1241A Emergency Reverting Kit. This kit is the companion accessory required for emergency operation. Its purpose is to re-route the rf signal so that it bypasses the power amplifier in the event of a primary power failure. If the ac power fails, the station continues to operate from the battery, but there is a reduction in the rf power output to conserve dc power during emergency operation.

A third item which is available for the emergency-powered station is the TLN1235A Battery Protection & Alarm kit. This is an optional additional item which interconnects with the power supply and improves the emergency power feature by providing: (a) an audible alarm when the station reverts to dc operation, (b) fast recharge of the battery when ac power is restored, (c) low battery voltage detection, which keeps the battery from being overly-discharged, and (d) the capability to "equalize charge" the station battery during maintenance.

2. DESCRIPTION

a. Emergency Reverting Kit

This kit includes the reverting relay which bypasses the power amplifier and connects the rf output of the exciter-transmitter directly to the antenna during emergency power conditions. The rf output of the transmitter "reverts" from its full value to the low power exciter-transmitter output. The relay also removes filament power from the power amplifier tube to conserve battery energy while the station is operating from the battery. Restoration of 117-volt ac primary power automatically returns the station to normal operation. The emergency reverting kit provides the following functions.

(1) With ac power present, the reverting relay is energized, which:

--connects the rf output of the exciter-transmitter to the grid of the power amplifier tube;

--connects the rf output of the power amplifier to the antenna line;

--connects +12.5 volts dc as filament voltage to the power amplifier filaments.

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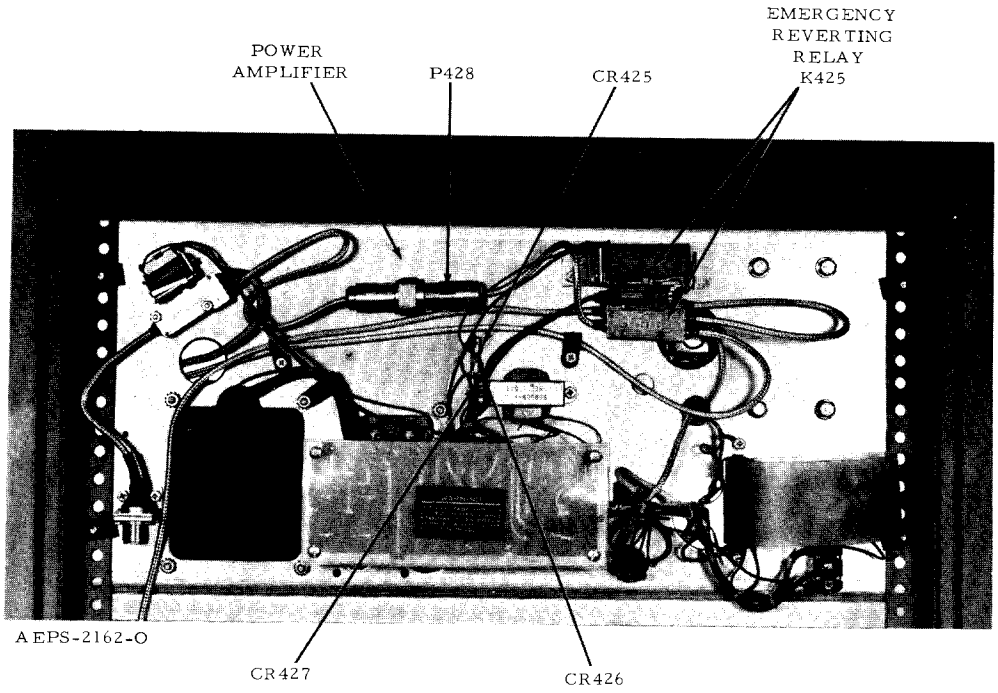

Figure 1.
Power Amplifier (Rear View) Showing
Emergency Reverting Kit

(2) If a failure of the 117-V ac power occurs, the reverting relay de-energizes and:

--re-routes the rf output of the exciter-transmitter to the antenna line, bypassing the power amplifier.

--disconnects the power amplifier filament circuit from the A+ line. (During emergency power operation, the plate, screen and bias voltages for the power amplifier are automatically removed by the absence of ac input power.)

The emergency reverting relay includes coaxial cables for the two sets of rf contacts. The relay is mounted on the power amplifier chassis to keep the coaxial cable lengths to a minimum.

The emergency reverting relay is mounted on the power amplifier chassis (see Figure 1). Connections to the relay coil are made on terminal strip TB1 on the power amplifier. The diodes which are part of the emergency reverting kit are also mounted on TB1.

b. Battery Protection & Alarm Kit

The major components of the Battery Protection and Alarm Kit (battery charging board, EQUALIZE-FLOAT switch and low voltage dropout relay) are located on a mounting plate which is attached to the right side of the station equipment rack adjacent to the exciter-transmitter (see Figures 3 and 4). The "ambient temperature sensing" components are located in the junction box (see Figure 5).

This optional accessory provides the following functions (refer to Figure 2).

● Generates an audible alarm tone to indicate that the station is operating on emergency power and continues to produce the tone until emergency power operation ceases. The emergency power signal is a short tone burst (approximately 1/4-second long) repeated at 2-1/2-second intervals with a tone frequency of approximately 1400 Hz. On local control stations, the alarm tone is clearly heard in the station speaker (except when transmitting). On remote control stations, the alarm tone is injected into the audio line and heard at the console (except when transmitting). On repeater stations, the tone is transmitted whenever the transmitter is keyed, so that anyone receiving signals from this station will know that it is operating on emergency power.

● Controls the charging rate for recharging the battery after ac power is restored. When ac power is first applied, this circuit assumes a "fast charge" state and forces the power supply to increase its A+ output voltage. Another circuit senses the charging rate of the battery by monitoring its charging current, which decreases gradually

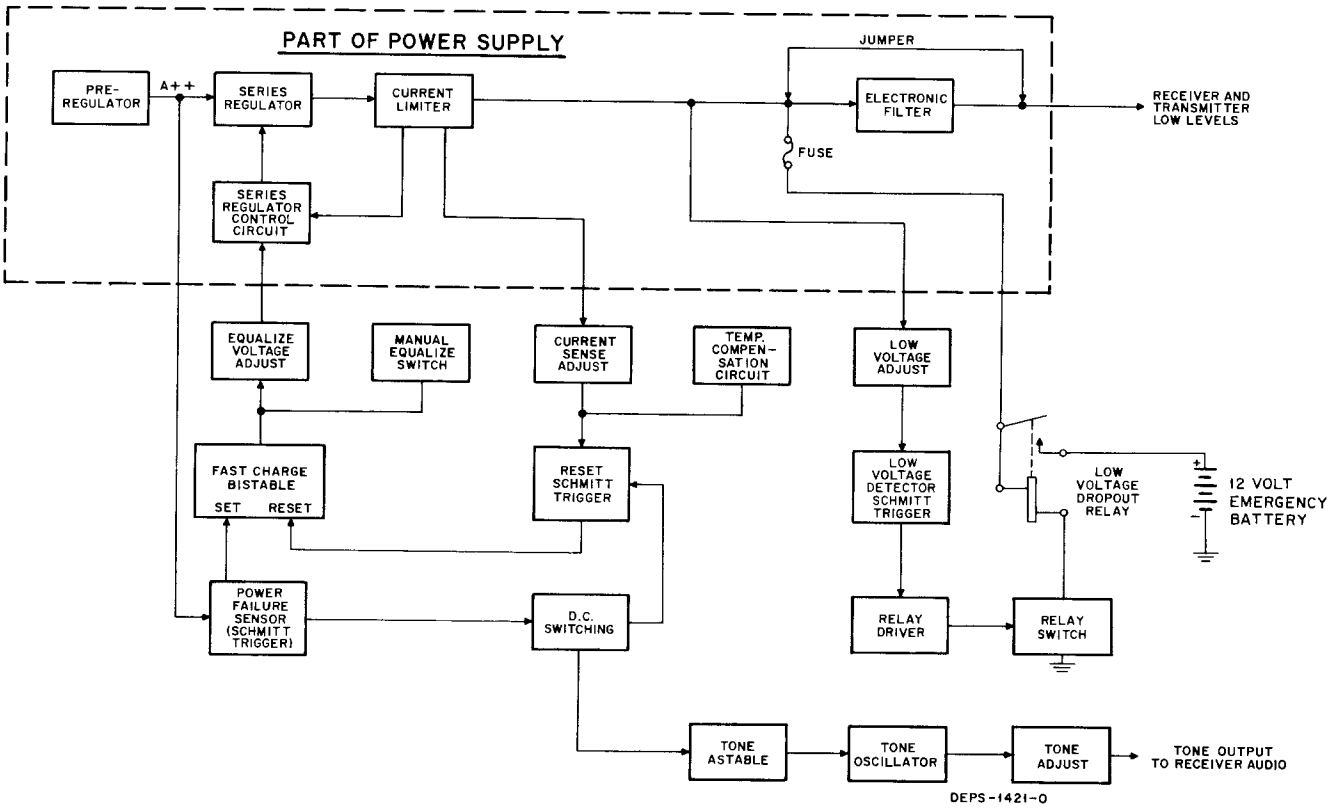

Figure 2.
Battery Protection & Alarm Circuit
Block Diagram

as the battery charges. When the charging current drops below a certain level, this circuit is triggered and causes the power supply to reduce its output voltage to the normal (float voltage) value.

● Completely disconnects the battery from the station load when it has discharged to a certain level, to prevent possible damage to the battery resulting from a complete discharge. This critical level (the "low voltage dropout point") is sensed by the low-voltage detector, which causes the low-voltage dropout relay to de-energize and disconnect the battery completely from the station.

● Permits an "equalizing charge" to be applied to the battery.

NOTE

The storage capacity of battery cells changes over a period of time. This change occurs in varying degree for each cell, resulting in unequal capacity of the cells.

NOTE (Cont'd.)

These changes are the result of internal cell losses (standing losses) due to impurities in the grid materials, temperature differential between cells, and poor intercell connections.

This unequal condition in the battery can be corrected by applying an "equalizing voltage" (a specific higher-than-normal voltage) for a period of time specified by the battery manufacturer.

Operation of the EQUALIZE switch causes an increase in the power supply A+ output voltage for this purpose. This value of A+ (known as the "equalizing voltage") is the same as the "fast charge" voltage. If desired, the EQUALIZE switch may be replaced by the contacts of a remotely operated relay to allow on and off control from a remote point.

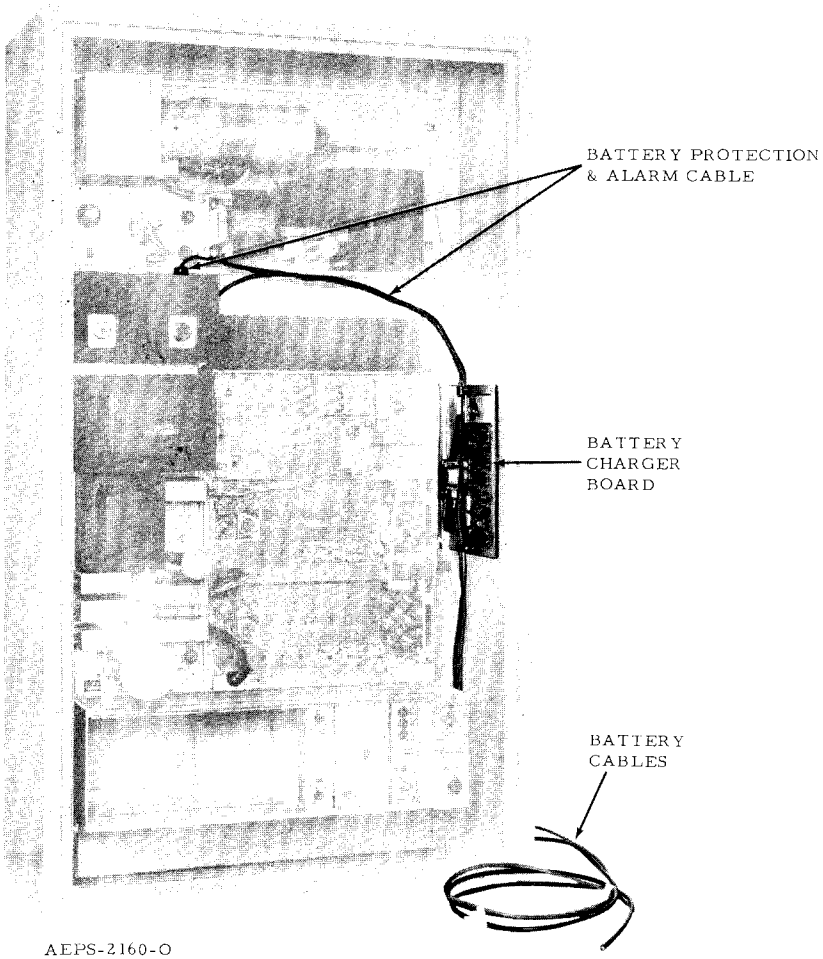

Figure 3.
Typical Emergency
Power Installation

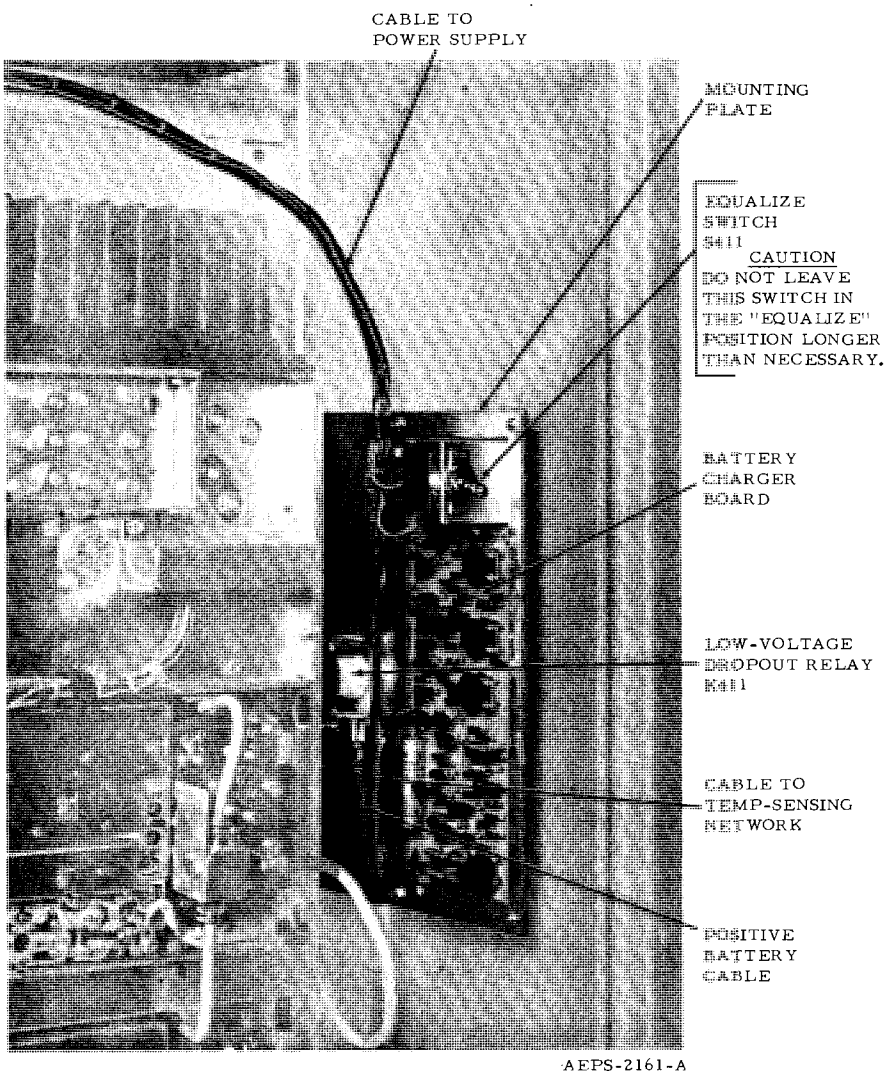

Figure 4.
Battery Protection & Alarm
Parts Location

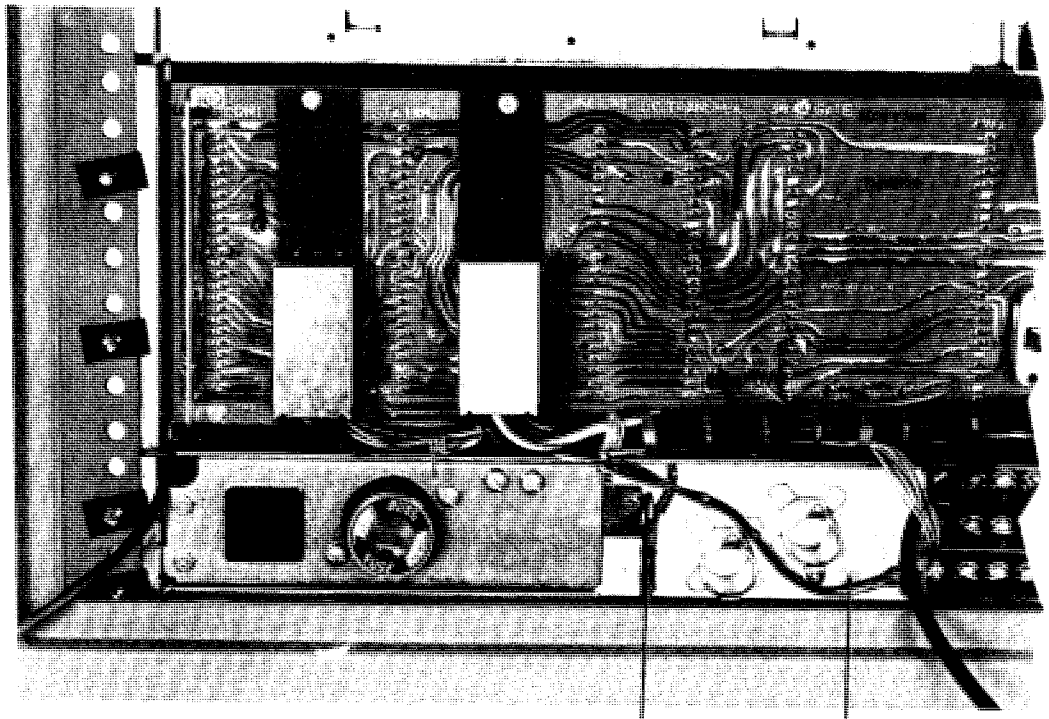

Figure 5.
Temperature-Sensing
Element Parts Location

3. INSTALLATION

a. Installation Planning

Locate the battery in a secure place, and as close to the station as possible. The cable length must be kept as short as practical, because of the voltage drop in the battery cable. A substantial voltage drop can be developed in this low resistance cable due to the high currents drawn from the battery while transmitting.

Select a battery location that has unobstructed air circulation, preferably a cool dry place with aisles sufficiently wide to permit easy access to all cells for installation, taking readings, adding water and cleaning. The battery must not be placed near radiators, boilers, or other heat-producing devices.

There are three steps required for installation:

(1) battery installation.

(2) adjustment of the power supply voltage to match the type of battery installed.

(3) adjustment of the battery protection and alarm circuit (if used).

b. Battery Cable Installation

Battery cables are provided with the emergency reverting kit and with the battery protection and alarm option. In any station which includes both accessories, the emergency reverting kit battery cable is not used.

The battery cables are to be connected to the station at one end as follows:

EMERGENCY REVERTING KIT		BATTERY PROTECTION & ALARM	
BLK	Power Supply TB1-3	BLK	Power Supply TB1-3
RED	Power Supply TB1-2	RED	Low Voltage Drop-out Relay K411 (see Figure 4).

Prepare the cables as follows:

(1) Place the battery in position, selecting a location as close to the station cabinet as possible.

(2) Route the battery cables along the inside of the station cabinet and outward through the bottom. If it will improve the installation (by shortening the cable runs), a 7/8-inch diameter hole can be cut through the side of the cabinet as a "feed-thru" for the battery cables. If this is done, a matching rubber grommet should be installed in the hole to prevent damage to the insulation on the battery cables.

(3) Extend the cables to their respective battery terminals, allowing enough slack to provide for moving the battery while servicing the equipment. Cut off any excess cable.

(4) Remove 5/16-inch of insulation at the end of each cable and install one of the circular crimp-type terminals provided with the equipment. Be sure that the conductive surface of the cable is clean at the point where the terminal is installed. Crimp the terminal lug in place on the cable, applying enough pressure to provide a tight, solid connection.

(5) Connect and tighten the battery terminals.

(6) Perform all adjustments as described in the following ADJUSTMENTS paragraphs.

NOTE

It is very important to have clean, solid battery connections, and to keep the battery cables as short as possible.

c. Electronic Filter Jumper

Make sure the electronic filter jumper is connected (see Figure 6 and the schematic diagram). All stations equipped for emergency power operation -- with emergency reverting only or both reverting and battery protection -- require this jumper. The jumper eliminates the voltage drop across the electronic filter transistor in order to utilize the full battery power during emergency power operation.

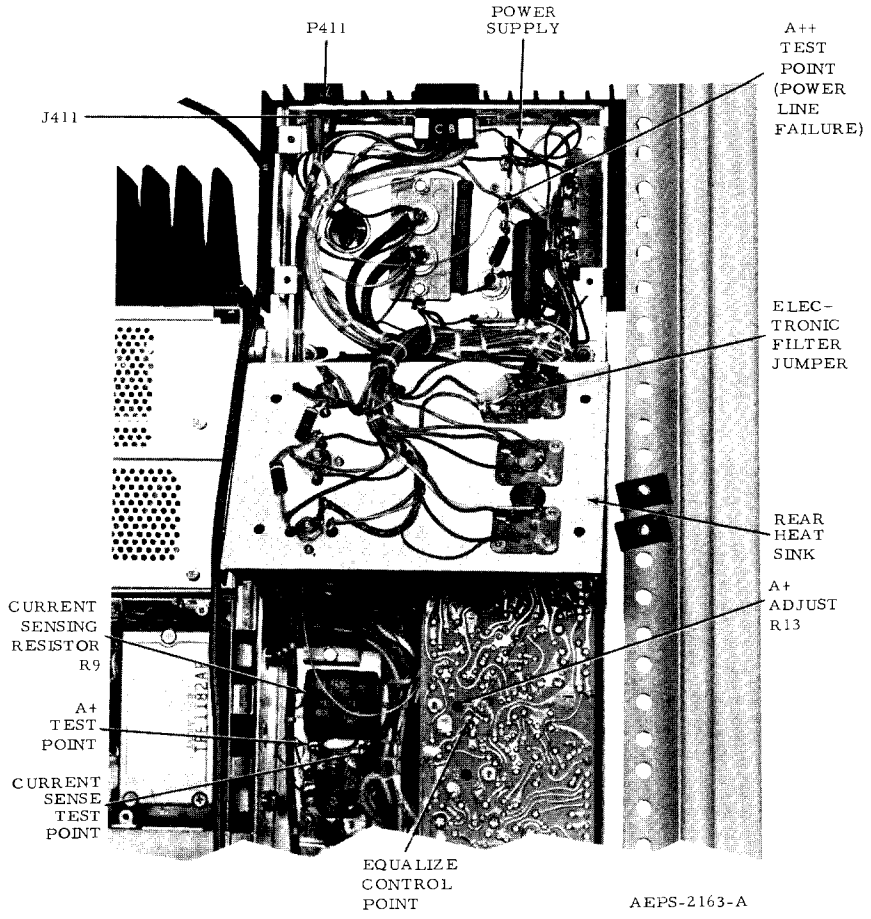

Figure 6.
Power Supply (rear view) Showing Battery Protection & Alarm Circuit

4. ADJUSTMENTS

Adjustment procedures for the emergency power equipment are described as follows for stations having both the emergency reverting and battery protection and alarm kits, and stations having the emergency reverting kit only. These procedures are required at the time of installation and at any future time when appropriate, such as after replacing any parts in the battery protection and alarm circuit, or when replacing the battery with a different type.

Two types of meters are recommended for use in these adjustment procedures: (1) a Weston Model 281 voltmeter (100 ohms/volt sensitivity), and (2) a 20,000 ohms/volt sensitivity voltmeter with an accuracy of 3% or better.

a. Stations with Emergency Reverting and Battery Protection Options

(1) A+ Adjustment

Adjustment of the "float voltage" of the station power supply is required at the time the battery is installed. The "float voltage" is the value of the A+ output voltage of the power supply with a fully-charged battery connected across the A+ output terminals. The float voltage adjustment varies with the type of battery being installed and with the ambient temperature.

(a) Nickel-Cadmium Battery

The 10-cell nickel-cadmium battery requires a float voltage of 14.3 volts dc (for a battery operated at the reference temperature of 77°F). This voltage may be as low as 14.0 volts or as high as 14.5 volts, to compensate for ambient temperatures above or below the 77°F reference value. For example, a float voltage of 14.5 volts is appropriate for an average ambient temperature of 40°F, whereas a float voltage of 14.0 volts is correct at 90°F.

If possible, the average ambient temperature at which the battery will be operated should be predicted at the time of installation and the A+ voltage adjusted accordingly. If it is not possible to predict the approximate ambient temperature, adjust the A+ voltage to the reference value of 14.3 volts, with a possible corrected setting to be made later after the average ambient temperature has been established.

The A+ output is factory adjusted for 13.6 volts. Set the "A+ adjust" control (R13 in the station power supply) for the desired float voltage, as follows:

1. Connect a dc voltmeter with 3% accuracy (or better) between terminals TB1-2 (+) and TB1-3 (-) on the power supply.

2. Set the A+ control R13 for 14.3 volts on the voltmeter.

3. Check the battery to see that it is fully charged, or almost so. (In a nickel-cadmium battery the specific gravity of the electrolyte is not an indication, because it stays at a constant level throughout the normal discharge cycle of the battery.)

Charge the battery for several hours before the final float voltage adjustment is made.

4. Place the station in "standby mode" (transmitter unkeyed).

5. Readjust A+ control R13 until the A+ voltage reads 14.3 volts (or other value between 14.0 and 14.5 volts, if temperature compensation factor has been applied). Using the Weston 281 meter (if available), measure the voltages across all of the individual cells and add them together to get the battery voltage (set the voltmeter on the lowest range which will measure the cell voltages). This is a more accurate check than measuring the battery voltage with one overall reading taken at its terminals.

(b) Lead-Acid Battery

The six-cell lead-acid battery normally requires a float voltage of 13.0 volts. This voltage may vary slightly, depending on the characteristics of the particular battery to be used (consult the battery manufacturer's literature for the recommended float voltage). One value of float voltage is usually correct for the normal ambient temperature range of 60 to 90 degrees Fahrenheit, eliminating the necessity for temperature compensation within the range. The adjustment procedure for the A+ (float) voltage is the same for the lead-acid battery as for the nickel-cadmium battery (except for the value of float voltage).

(c) Automotive Battery

No adjustments are required when this station is used with the standard automotive battery.

NOTE

The automotive battery is recommended for use in temporary or emergency installations only.

(2) Pre-Regulator Adjustment

(a) Nickel-Cadmium Battery

1. Connect a dc voltmeter (sensitivity of 20,000 ohms/volt or higher) to read the collector-to-emitter voltage of series regulators Q1 and Q2, as follows (refer to Figure 6): Connect the negative meter lead to the "current sense" test point, which connects via a brown-yellow lead to the emitters of Q1 and Q2. Place the positive meter probe on the case (collector) of either Q1 or Q2; use care so as not to short the case to the heat sink.

2. Place the station in "transmit" mode (key the transmitter).

3. Adjust R.I. (regulator input) potentiometer R29 until the voltmeter reads 4.75 volts.

4. Unkey the transmitter and carefully remove the test leads.

(b) Lead-Acid (Stationary) and Automotive-Type Batteries

No adjustment of the pre-regulator (regulator input) potentiometer R29 is required when a lead-acid battery is used.

(3) Final Adjustments

After completing all of the power supply adjustments, retune the entire transmitter into its normal load. Also readjust all operating levels (Line, Repeater, Squelch and Trigger) at this time.

(4) Battery Protection & Alarm Option Adjustments

Two adjustments are to be made on the battery charging control board when the battery is installed in the station. Make these adjustments ONLY AFTER ALL POWER SUPPLY ADJUSTMENTS HAVE BEEN COMPLETED. These adjustments include: (1) an adjustment of the equalizing voltage to match the type of battery being installed, and (2) a level adjustment of the emergency power alarm tone to fit individual station requirements.

Adjustment procedures for the Low-Voltage Detector and the Current-Sensing circuit are also given, but they are to be performed only following repair of their respective circuits; (they are not part of a routine installation procedure).

Adjustment procedures are as follows:

(a) Equalizing Voltage Adjustment with a Nickel-Cadmium Battery

1. Connect a dc voltmeter across the A+ output of the power supply, between TB1-2 (+) and TB1-3 (-).

2. Place the station in the standby mode (transmitter unkeyed).

3. Locate the EQUALIZE voltage adjustment (R479 on the charging control board. Preset R479 to the maximum counterclockwise position.

4. Operate EQUALIZE switch S411 to the ON position.

5. Rotate EQUALIZE control R479 on the charging control board clockwise until the meter reads 15.0 volts. This is the "equalizing voltage" to be used with this station.

6. Using the Weston 281 meter (if available) on the lowest appropriate voltage range, measure the voltages across all of the individual cells and add them together to get the battery voltage. (This should be a more accurate indication of the total battery voltage than the reading taken in step 5.)

7. If the battery voltage calculation in step 6 does not equal 15.0 volts, adjust the EQUALIZE control slightly, as needed, until the total of the cell voltage readings does equal 15.0 volts.

NOTES

1. All of the individual cell voltage readings must be retaken, each time EQUALIZE control R479 is readjusted.
2. With the EQUALIZE switch ON, a higher charging voltage is applied to the battery, causing it to take on an additional charge. Allow sufficient time for the charging current to stabilize, in order to avoid erroneous voltage readings.

8. Return EQUALIZE switch S411 to the OFF position.

CAUTION

Do not leave the EQUALIZE switch in the EQUALIZE position longer than necessary because the higher-than-normal A+ voltage could shorten the life of the battery.

(b) Equalizing Voltage Adjustment with Lead-Acid Battery

Perform the equalizing voltage adjustment for the nickel-cadmium battery, with the following exceptions:

EQUALIZE control R479 does not have to be preset.

The "equalizing voltage" value for the lead-acid battery is 14.0 volts.

(c) Alarm Tone Level Adjustment

In remote control stations, and in repeaters with a wire line control option, the "tone level" control (R477 on the charging control board) is factory preset to provide a level of -6 dBm on the audio control line. In "repeater only" stations, this control is set for a deviation of ±0.5 kHz.

The tone level control may be reset to suit the needs of a particular installation by the following procedure.

1. Disconnect the station from the ac power line and allow it to operate on its battery. (This should turn on the alarm tone oscillator.)

2. Set the volume control at a normal comfortable operating level with a received signal.

3. Adjust TONE ADJ control R477 until the alarm tone is clearly discernible, but not loud enough to affect the intelligibility of the audio signals on the line. (R477 is a finger-operated potentiometer at the bottom of the battery-charging control board.) The tone may be turned on continuously (instead of in bursts) to facilitate adjustment by connecting a temporary jumper wire from the negative side of capacitor C416 to the station chassis.

(d) Low-Voltage Detector Adjustment

LOW VOLT control R426 is factory preset, but may need resetting if any components in the low-voltage detector or associated circuits have been replaced. If necessary to readjust the low-voltage detector control, use the following procedure.

1. Disconnect both ac and battery power from the station.

2. Connect the output of a variable dc power supply (such as the Motorola TEK-23) to TB1-2 (+) and -3 (-) in the power supply.

3. Preset low-voltage control R426 in the fully counterclockwise position.

4. Set the output of the variable power supply at 10.0 volts.

5. Rotate LOW VOLT control R426 clockwise until "low voltage dropout relay" K411 de-energizes. Read the power supply output voltage just before the point of dropout.

6. Check the relay operation by increasing the supply voltage until the relay pulls in and then reducing it until the relay drops out. Read the supply voltage at the point just before dropout. The relay should drop out when the supply voltage is between 10.0 and 10.5 volts.

7. If the measured dropout voltage was outside the 10.0- to 10.5-volt range, readjust control R426 and recheck until it is within these limits. Clockwise rotation of R426 increases the dropout voltage; counterclockwise rotation decreases it.

8. Turn off the variable power supply and completely disconnect it from TB1.

(e) Current Sense Control Adjustment

CURRENT SENSE control R441 is factory preset, but may need resetting when components in the current sensing or associated circuits have been replaced as a result of corrective maintenance. If necessary to adjust the current sensing level control, use the following procedure.

1. Disconnect the station from the ac power source.

2. Disconnect the power amplifier by removing connector P7 from J7 on the power supply.

3. Connect a "dummy load" resistor (across TB1-2 and -3). Select the proper dummy load by the battery it is replacing, as follows:

Nickel-Cadmium battery (10 cells)	3.75 ohms, 75 watts

Lead-Acid battery (6 cells)	3.50 ohms, 75 watts

4. Preset CURRENT SENSE control R441 to the fully counterclockwise position.

5. Apply ac power to the station, then disconnect the battery.

6. Measure the A+ output voltage across TB1-2 and -3. It should be at the "equalize voltage" level for the type of battery represented by the dummy load resistor. The proper equalize voltages are:

Nickel-Cadmium battery	15.0 volts
Lead-Acid battery	14.0 volts

7. Rotate CURRENT SENSE control R441 clockwise until the A+ output voltage returns to the normal "float voltage" level. The proper float voltage levels are:

Nickel-Cadmium battery	14.3 volts (plus or minus a possible correction factor for temperature compensation)
Lead-Acid battery	13.0 volts (no correction factor)

8. Remove ac power from the station and remove the dummy load from the terminals of TB1.

9. Reconnect the battery.

b. Stations with Emergency Reverting Option Only

(1) Connect the dc voltmeter across the A+ output of the power supply, TB1-2 (+) and TB1-3 (-).

(2) Adjust the A+ potentiometer R13 in the power supply to the recommended "float voltage" for the particular type of battery used.

NOTE

Refer to the A+ and pre-regulator adjustment procedures for stations with both emergency reverting and battery protection for complete adjustment procedures. It is very important to follow these instructions closely.

(3) Retune the transmitter into its normal load.

(4) Reset the operating levels (line, repeater, squelch, triggers) with the new A+ level.

5. OPERATION

Operation of the emergency power equipment is entirely automatic. The equipment will undergo a power failure and automatically return to service at full rf power output without requiring the attention of any personnel.

6. DETAILED CIRCUIT DESCRIPTION

a. Emergency Reverting Kit

All of the emergency reverting circuit action depends upon emergency reverting relay K425. Its power is derived from the 117 volts ac present in the power supply, keeping it energized whenever ac power to the station is turned on. Whenever the ac power fails or is turned off, the emergency reverting relay de-energizes.

(1) Relay Coil

(Refer to the station power supply schematic diagram and to the emergency reverting kit schematic diagram.)

The voltage applied to the coil of K425 is approximately 35 volts dc, developed by a bridge rectifier circuit composed of CR1, CR2, and the secondary winding of T1 in the power supply, plus CR425 and CR426 in the emergency reverting kit. The positive voltage at the junction of CR425 and CR426 (TB1-5 in the power amplifier) is applied to one coil terminal of the relay. The negative side of the relay coil connects to ground. Diode CR427 is connected "in reverse" across the relay coil to limit the inductive surge ("inductive kick") developed by the coil when power is removed.

(2) Relay Contacts

Emergency reverting relay K425 has three sets of contacts; one set of "Form A" contacts for completing the V1 power amplifier filament circuit, and two sets of "Form C" contacts with shielded leads for completing the transmitter rf output circuits. The two sets of form C contacts are in sealed units with short lengths of coaxial cable attached.

The contacts which complete the V1 filament circuit are connected to TB1-1 and TB1-2

in the power amplifier. With K425 energized, the V1 filament circuit is completed between A+ and ground. Resistor R16 in the power amplifier provides a voltage drop sufficient to reduce the dc voltage across the V1 filament to approximately 12.5 volts. If the ac power fails, reverting relay K425 de-energizes removing the filament voltage from V1.

Another set of relay contacts normally connects the rf output signal of the exciter-transmitter to the power amplifier input. If the ac power fails, K425 de-energizes and disconnects the exciter-transmitter rf output from the power amplifier. The rf signal is then routed from the exciter-transmitter to the antenna relay.

NOTE

In repeater stations, which have no antenna relay, the rf signal is connected directly to the antenna.

A third set of relay contacts normally connects the output of the power amplifier to the antenna relay. In the event of an ac power failure, the release of relay K425 disconnects the antenna from the power amplifier output. The rf output at J31 of the exciter-transmitter is then routed via P426, the contacts of de-energized K425, and P428 to the antenna relay.

b. Battery Protection & Alarm Circuit

(Refer to Battery Protection & Alarm Circuit Schematic Diagram.)

In normal operation with 117 volts ac power applied, the battery is connected to the station through the contacts of low-voltage dropout relay K411 which is energized from the A+ output of the power supply. The negative end of the relay coil completes its path to ground through relay switching transistor Q418, which is held in saturation by a positive voltage from the collector of relay driver Q417.

The A++ voltage (unregulated dc voltage in the station power supply) is sensed constantly by the battery protection circuit at J411-6. The resultant positive voltage at the base of Q411 keeps Q411 turned on and Q412 turned off. This represents the "off" or "reset" state of Schmitt trigger Q411-Q412, signifying that normal (ac) power is present.

(1) Primary Power Failure

If the ac power fails, the A++ voltage in the power supply decays toward zero as filter capacitor C2 discharges. When the decreasing A++ voltage reaches a critical level (approximately 6 volts), Q411 in the Schmitt trigger turns off, turning on Q412. The resultant decrease in positive voltage at the collector of Q412 drives the base of dc switch Q423 negative, turning it on. Q423 conducts through R459, developing a positive voltage at its collector, which turns on dc switch Q424. Q424 is driven into saturation, providing a ground return for astable multivibrator Q425-Q426. This allows the astable to operate at a repetition rate of once every 2-1/2 seconds. During each portion of the astable cycle in which Q426 is on, it provides a ground return for the base of Q427 via resistor R466. At this time, Q427 is properly biased to permit the Q427-Q428 phase-shift oscillator to oscillate at a frequency of approximately 1.4 kHz. During the portion of the astable cycle when Q426 is off, Q427 is saturated and the phase shift oscillator is inoperative. The gating provided by the astable multivibrator allows the tone to be generated for approximately 1/4 second during each 2-1/2 second interval. This intermittent 1.4 kHz tone is routed through TONE ADJ control R477 into the station audio lines. The tone is generated as long as the station operates on battery power.

(2) Low-Voltage Dropout

During emergency power operation, the terminal voltage of the battery will eventually decrease. Q415 and Q416 form a Schmitt trigger to detect when the battery voltage has fallen to the level beyond which it is not safe to discharge the battery without causing irreparable damage to it.

As the battery terminal voltage drops, it reaches the point where the emitter-base junction of Q415 becomes forward-biased. Q415 turns on, turning off Q416 and developing an abrupt increase in positive voltage at its collector. This positive-going voltage turns off relay driver Q417, which turns off relay switch Q418, removing the ground return for low-voltage dropout relay K411. The relay de-energizes and its contacts open, disconnecting the battery completely from the station. The trip point of the Schmitt trigger can be set by adjustment of low voltage adjust control R426. This control is factory-adjusted to operate between 10.0 and 10.5 volts dc.

(3) Primary Power Restored

(a) Low Voltage Detector Circuit

When ac power is restored, a normal A+ voltage is again applied to the battery protection

and alarm circuit and the low-voltage detector Schmitt trigger resets itself with Q415 off and Q416 on. The positive emitter voltage on Q415 equals the voltage drop across R425, which is stabilized by the drop across Zener diode CR414. The Q415 base voltage is determined by the setting of LOW VOLT control R426 (part of a voltage divider including R427 and R428 between A+ and ground). This control is set so the positive voltage on the base of Q415 is slightly less than the emitter voltage, keeping Q415 in cutoff.

The positive voltage at the Q416 collector is applied to the base of relay driver Q417, holding it in saturation. The positive voltage at the collector of Q417, in turn, holds relay switch Q418 in saturation, providing a ground for low voltage dropout relay K411, energizing the relay. (If the discharge period was not long enough to cause the battery voltage to drop below the trip point of the low voltage detector, relay K411 would have remained energized and the battery remained connected to the load.)

(b) Tone Generator Circuit

When ac power is restored, A++ voltage reappears at J411-6, resetting Q411 in the "on" state and Q412 "off". The positive voltage from the collector of Q412 holds dc switch Q423 cut off, and the zero volts at the Q423 collector holds Q424 cut off. With Q424 cut off, the ground return for tone astable Q425-Q426 is removed, causing it to stop oscillating. Due to non-conduction of Q426, a positive voltage from its collector is applied to the base of Q427, disabling the 1.4 kHz tone oscillator.

(c) Fast Charge Circuit

The positive voltage which appears at the collector of Q412 when ac power is restored is also used to turn on equalize bistable Q413-Q414. This positive voltage transition is differentiated by C411 and R418, and the positive spike is coupled via Zener diode CR411 to the base of Q413. Q413 turns on, turning off Q414, and the positive collector voltage of Q414 turns on equalize switching transistor Q429, causing it to saturate. This action causes a low-resistance path to ground from the negative end of R13 and R14 in the power supply. (See power supply schematic.) The voltages in the R12 through R16 voltage divider are consequently redistributed causing a decrease in positive voltage at the arm of A+ potentiometer R13. The power supply senses this as a decrease in A+ output voltage and turns on the series regulators to compensate, resulting in an increased A+ output voltage.

NOTE

The foregoing description of the fast charge circuit action is based on the assumption that the battery has been discharged sufficiently to require fast (equalizing) charge. If the discharge has been a minor one and the amount of recharging current small enough, equalize bistable Q413-Q414 will be immediately reset, turning off Q429 and taking the power supply out of the "fast charge" state. (See next paragraph for development of the reset pulse.)

(d) Current Sensor and Fast Charge Bistable Reset Circuits

The total current from the series regulator in the power supply passes through a .08 ohm resistor (R9). Q419 acts like a differential amplifier, with its collector voltage being a function of the voltage across R9. The charging current to the battery is the total current through R9 minus the station drain. The trip point of Schmitt trigger Q420-Q422 is therefore a function of the charging current, with an adjustment provided by current-sensing adjust control R441. When the current through R9 drops to the predetermined value (4.0 to 4.4 amperes) which indicates that the battery is sufficiently charged, Schmitt trigger Q420-Q422 trips, sending a positive reset pulse to the base of Q414 in the equalize bistable. The bistable changes states, with Q414 turning on. Insufficient current now flows to the base of switch Q429, turning it off and thereby causing the power supply output to drop back to the "float voltage".

(e) Temperature-Sensing Circuit

In addition to the control provided by the current sensor circuit, the trip point of the reset Schmitt trigger is also controlled by a temperature-sensing network. At temperatures below 25°C, the trip point remains relatively unchanged. Above 25°C, the current at the trip point rises slowly until, at approximately 45°C, it increases rapidly to 15 amperes, which is the charging current limit. At temperatures above approximately 45°C, the battery will always be charged only at the "float voltage" rate. This is to prevent damage to the battery which would result from charging at the "equalize" rate at high temperatures. Temperature is sensed by thermistor RT411, which is mounted in the junction box at the bottom of the station, exposed to the air. It is used to vary the bias at the input of transistor Q420 in the reset Schmitt trigger, so that Q420 turns on at a

higher-than-normal charging current when the ambient temperature is above normal. The reset Schmitt trigger is disabled during battery operation by dc switch Q421, which is turned on by dc switch Q423. This action insures that a reset pulse will always be generated after ac power is restored.

7. MAINTENANCE

a. Routine Maintenance

The battery or batteries used for emergency power require certain routine maintenance procedures to assure long trouble-free operation. Persons servicing the batteries should refer to the manufacturer's recommendations for routine maintenance. In addition, certain maintenance procedures are appropriate following each interval of emergency power operation, especially if the battery voltage dropped low enough in the interval to cause the "low-voltage dropout" relay to de-energize and disconnect the battery.

Routine battery maintenance procedures for the two most common battery types are given (nickel-cadmium and lead-acid). The importance of keeping good battery maintenance records cannot be over-emphasized. A chart or table is needed, listing cell voltage readings, temperature and hydrometer readings (where applicable), versus the dates on which the readings were taken. To be most effective, the battery report charts should be kept at the battery location for ready reference.

(1) Nickel-Cadmium Batteries

Perform the following routine maintenance procedures at six-month intervals.

(a) Clean the battery and inspect it for damage.

(b) Measure cell voltages and enter the voltage readings on your maintenance report. Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for 48 hours or until three consecutive cell measurements show no change (readings to be taken at 1/2-hour intervals). The terminal voltage of the battery should then read 15.0 volts.

(c) Add water as required to keep the electrolyte solution in each cell above minimum. Use distilled water only. Check the battery manufacturer's service literature for instructions on filling.

CAUTION

Do not use any tool on a nickel-cadmium battery which may have been used with lead-acid batteries. To do so may destroy the nickel-cadmium battery due to chemical contamination by electrolyte or other foreign matter from the lead-acid battery existing on the tool in question.

If frequent replacement of water is required, the charging rate may be too high. In this case, carefully check the A+ voltage with the EQUALIZE switch in the OFF position for the specified 14.3 volts. Under certain high ambient temperature conditions, the battery may require water even though the charging voltage is correct. In this case, the charging voltage should be reduced until infrequent addition of water is required. The EQUALIZE voltage setting of 15.0 volts is not changed.

(2) Lead-Acid Batteries

Perform the routine maintenance procedures monthly.

(a) Clean the battery and inspect it for damage.

(b) Measure cell voltages and enter the voltage readings on your maintenance report. Most maintenance schedules require voltage readings of every cell each time maintenance is performed. If a difference of .05 volt or more exists between any two cells, apply an "equalizing charge" to the battery for the number of hours recommended by the manufacturer for a terminal voltage of 14.0 volts.

(c) Take specific gravity readings with a hydrometer calibrated for the type of electrolyte used.

1. Observe the necessary precautions to see that the readings are accurate, that no chemical contamination of the cells occurs, and to prevent bodily injury from contact with the electrolyte.

2. After taking a reading, always return the electrolyte in the hydrometer syringe to the cell from which it came. (Failure to do so will decrease the specific gravity of the cell when water is added to fill up the cell.)

3. For an accurate comparison with "standard" specific gravity readings, as

published in manufacturer's specifications, a correction factor must be applied to all readings to normalize them with the standard values, when taken at temperatures other than 77° Fahrenheit. However, if the battery temperature tends to be the same each time specific gravity readings are taken, a trend toward a change in specific gravity will be apparent without having to apply the correction factor to the readings.

The correction factor is easily applied, due to a linear relationship between changes in temperature and specific gravity above and below 77°F. For each three degrees above 77°F, add .001 (known as "1 point") to the "standard" value of specific gravity. Conversely, for each three degrees below 77°F, subtract 1 point.

4. Take a specific gravity reading of the "pilot cell" monthly. It is not necessary to continually check the specific gravity of all cells, because any gradual changes usually occur simultaneously in all cells. One cell is therefore chosen and designated the "pilot cell", and the monthly routine specific gravity readings are always taken from this one cell. (Be sure to indicate on the maintenance chart which cell is the pilot cell.)

Take specific gravity readings of all the battery cells every three months, and record them on the maintenance chart.

(d) Add water as required to keep the electrolyte solution in each cell up to a minimum level. In some batteries, the electrolyte level should be between the high- and low-level marks on the inside of each cell. If the cells have no such markers, check the manufacturer's literature. Use distilled water only.

NOTE

Do not use any tool on a lead-acid battery which may have been used with nickel-cadmium batteries. To do so may destroy the lead-acid battery, due to chemical contamination by electrolyte or other foreign matter from the nickel-cadmium battery existing on the surface of the tool in question.

If frequent replacement of water is required, the charging rate may be too high. In this case, carefully check the A+ voltage for the specified 13.0 volts with the EQUALIZE switch in the OFF position. Under certain high ambient temperature conditions, the battery may require frequent water replacement even though the correct charging voltage is maintained. In this case, the specified 13.0 volts may be reduced until infrequent addition is required. The EQUALIZE voltage setting of 14.0 volts is not changed.

(e) Equalize charging of a lead-acid battery should be performed under any one of the following conditions:

1. Following each known use (or discharge) of the battery.

2. If the specific gravity of the pilot cell or any other cell is more than ten-thousandths (10 points) below its full-charge value.

3. If the difference in voltage between any two cells is .05 volt or more.

4. As part of each Monthly Routine Maintenance Procedure, independent of any of the conditions stated above.

Equalize charging should continue for (a) the number of hours specified by the battery manufacturer, which will vary according to temperature, charging voltage and the manufacturer's recommendations; or (b) until three successive readings of cell voltage and specific gravity show no change (readings to be taken at 1/2 hour intervals).

b. Relay Maintenance

(1) Contacts

No maintenance action is recommended for relays unless the contacts become pitted. Use Burnishing Tool, Motorola Part No. ST-563, for relay contact maintenance. DO NOT attempt to adjust, reshape or otherwise change the tension on the armature spring.

c. Cable Connections

All dc and coaxial cable connections to the emergency power equipment must be clean and firmly made at all times. Tighten all bolted connections yearly. If any lugs, cables, etc, are bent, worn or frayed to prevent them from making solid connections, those items should be repaired or replaced. Clean and remake any corroded connections.

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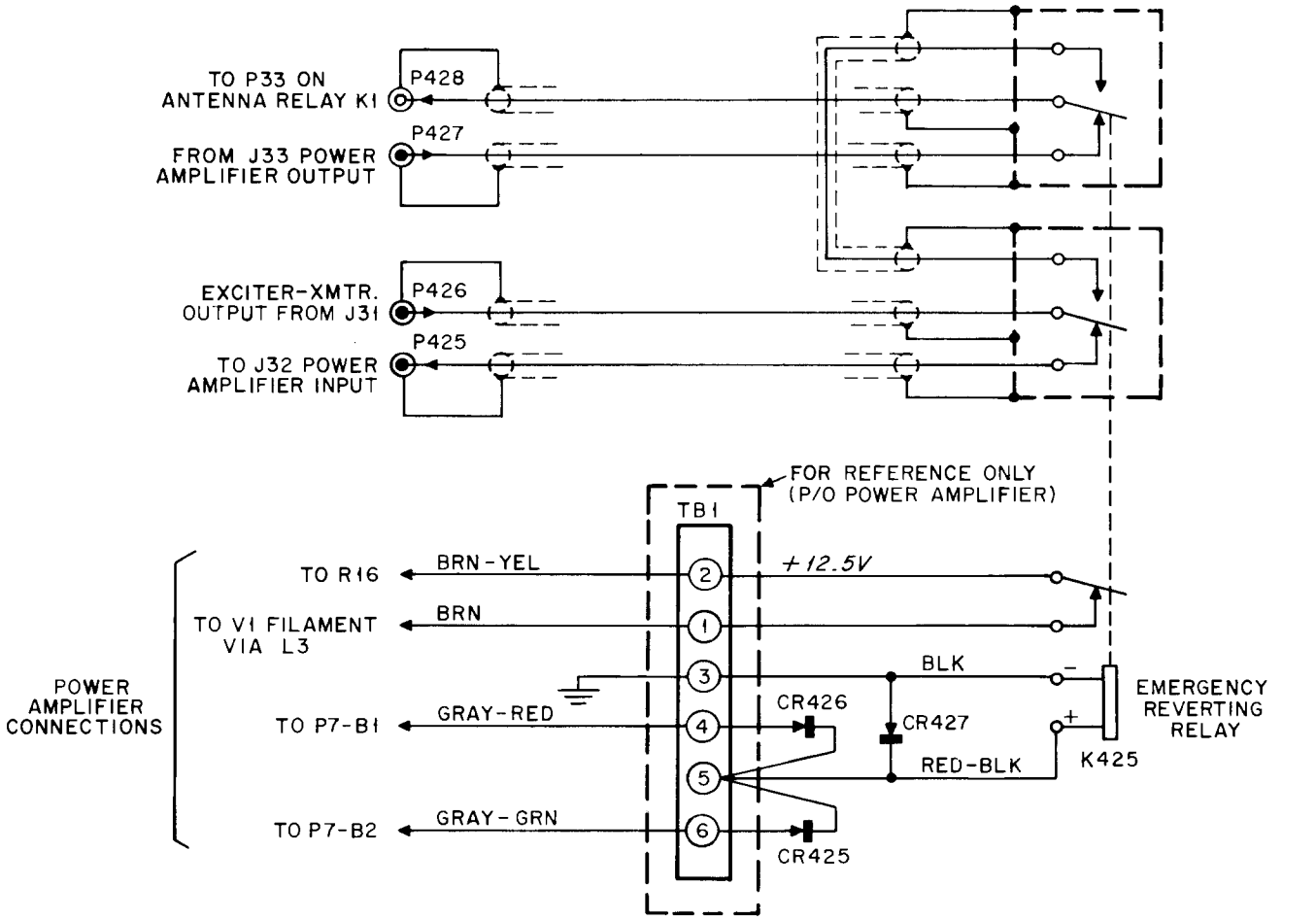
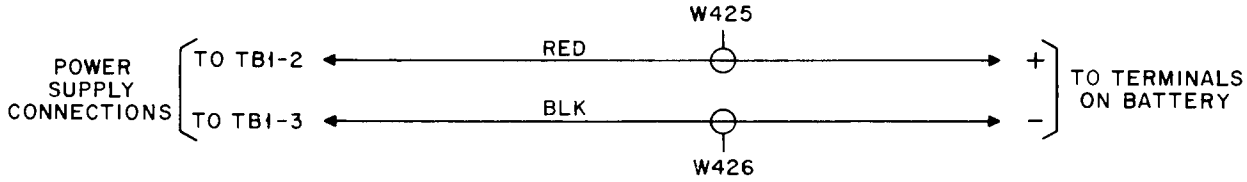


NOTE:
RELAY SHOWN IN ENERGIZED STATE (NORMAL 117VAC INPUT POWER).

BATTERY CABLE KIT TKN6362A



63C81002E38-B

EMERGENCY POWER

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1241A Emergency Reverting Kit
Schematic Diagram
Motorola No. 63C81002E38-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN4028A Emergency Reverting Kit PL-383-O

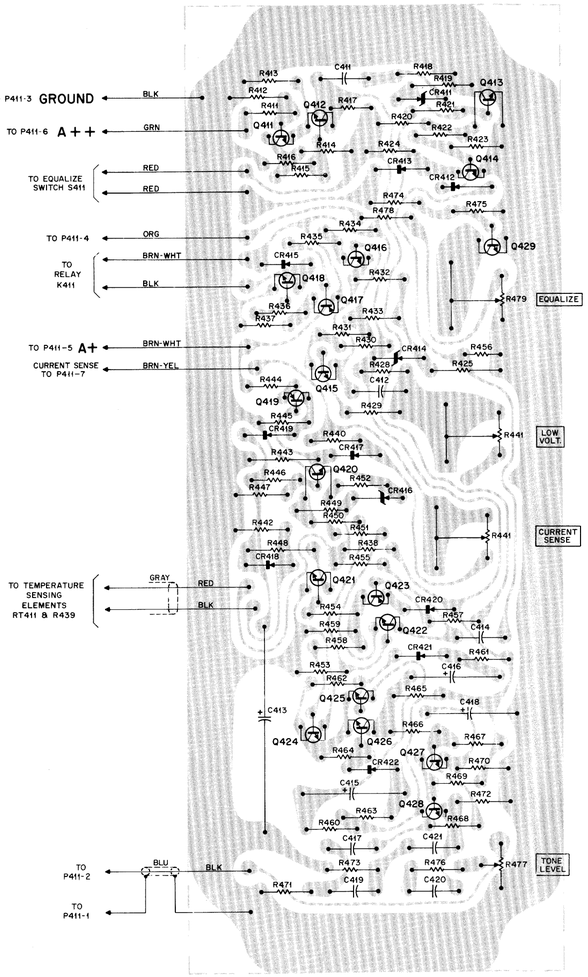
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR425, 426, 427	48C82466H02	silicon
		RELAY, armature:
K425	80D83332H01	1 form "A" (non-coaxial) and 2 form "C" (coaxial); coil res 540 ohms ±10%
		CONNECTOR, plug: coaxial:
P425, 426	28B82331G02	male; min.
P427	28K852527	male; type "N"
P428	9B82443E01	female; type "N"
	NON-REFERENCED ITEM	
	42A858778	MOUNTING CLIP (for mounting P4)

TKN6362A Battery Cable Kit PL-529-O

		CABLE, power: single-conductor; str;
W425	30K812505	No. 8 ga; RED; 8 ft. length req'd.
W426	30K851875	No. 8 ga; BLK; 8 ft. length req'd.
	NON-REFERENCED ITEMS	
	29B84649A01	LUG, slotted tongue: 2 req'd.
	37S134371	TUBING, heat shrinkable: 3/8"; BLK; 2" length req'd.
	1V80704B80	PARTS KIT, includes: 37K107997 GROMMET, rubber 29K847817 LUG, ring-tongue: for No. 8 cable; 2 req'd. 42S10217A01 STRAP, cable harnessing: 3 req'd. 29K832116 LUG, ring tongue: for No. 10 and No. 12 cable; 2 req'd.

NOTE:

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



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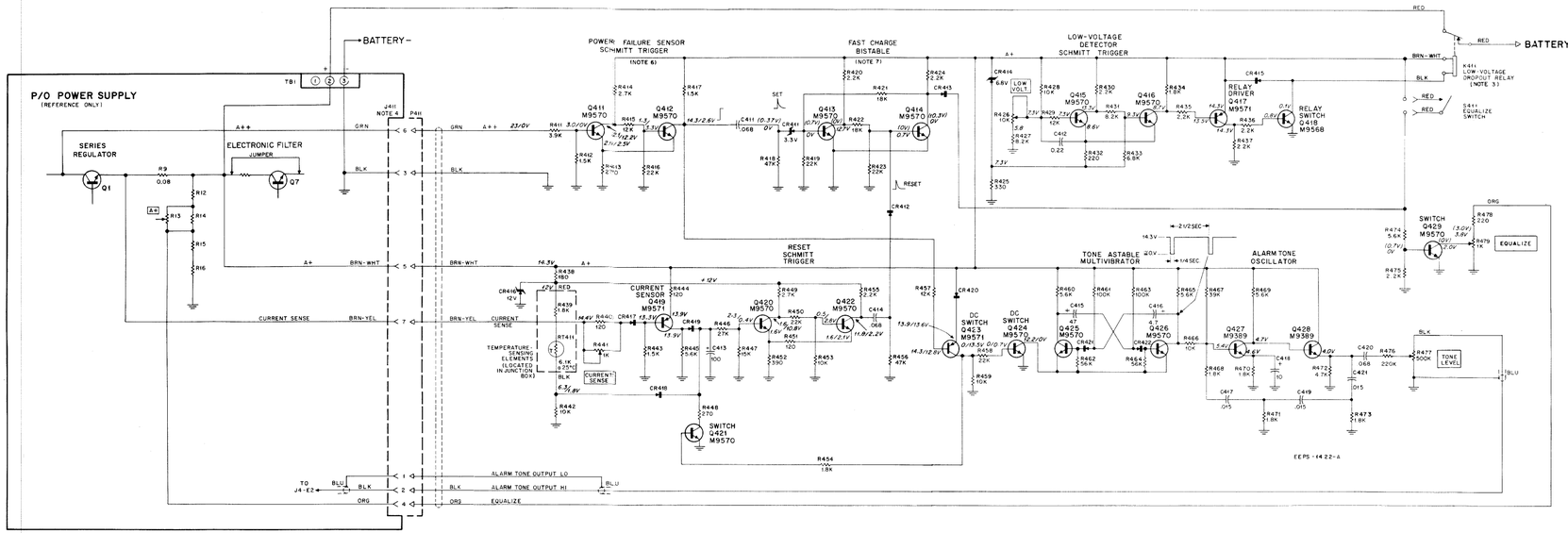
TRANSISTOR DETAIL



NOTES:

1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS (K = 1000).
3. RELAY SHOWN IN ENERGIZED STATE (BATTERY VOLTAGE NORMAL).
4. J411 IS PART OF BATTERY PROTECTION & ALARM KIT.
5. ALL VOLTAGES SHOWN WITH UNIT IN STANDBY CONDITION AND A− = 14.5 V.
6. WHERE TWO VOLTAGES ARE INDICATED THE "AC POWER ON" CONDITION IS TO THE LEFT, AND THE EMERGENCY POWER MODE IS TO THE RIGHT.
7. VOLTAGES IN ( ) INDICATE THE FAST CHARGE CONDITION; LOWER VOLTAGES INDICATE FLOAT VOLTAGE CONDITION.

EPS-2165-O

EMERGENCY POWER

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1235A Battery Protection & Alarm Schematic Diagram and Circuit Board Detail
Motorola No. 63P81005E57-B
6/5/74-NPC

PARTS LIST

TLN4014A Board Mounting Kit — PL-499-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		RELAY, armature:
K411	80D84197A01	9 v dc; 1 form "X" (SPSTNODB) coil res. 150 ohms
		THERMISTOR:
RT411	6S864427	6.1K @ 25°C
		SWITCH, toggle:
S411	40A482097	spst
NON-REFERENCED ITEMS		
	1V80704B80	PARTS KIT: incl. 37K107997 GROMMET, rubber; 42S10217A01 STRAP, cable harness: 3 req'd.; 29K832116 LUG, ring tongue: for 3/8" stud; 2 req'd.; 29K847817 LUG, ring tongue: 2 req'd.
	1V80704B79	CABLE ASSEMBLY: incl. ref. part RT411 and 31S121702 STRIP, terminal; 30C83128H01 CABLE, 2-cond. 29" long 37S131756 TUBING, heat-shrink (3/4" clear) 2" long; 37S134165 TUBING, heat-shrink (3/8" clear) 1" long
	7C84664A01	BRACKET, board mtg. (screened)
	42K861179	CLAMP, cable: 2 req'd.

TKN6426A Cable Kit — PL-500-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J411	9C87123	CONNECTOR, receptacle: female; 7 contact
P411	28B82332D01	CONNECTOR, plug: male; 7 contact; does not incl. 15A82181D01 COVER, plug
NON-REFERENCED ITEMS		
	30K813233	CABLE, battery: #10 RED; 178" req'd.
	30K824273	CABLE, shielded: BLU; 24" req'd
	37K800655	SLEEVE, neoprene: 3 req'd.
	37S134371	TUBING, heat-shrink (3/8" BLK) 1" req'd.
	30K851875	CABLE, battery: #8 BLK; 136" req'd.

TLN4013A Battery Charger Board — PL-498-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; unl. stated
C411	8D82905G04	.068; 50 v
C412	8D82905G11	0.22; 50 v
C413	23D83210A08	100 +150-10%; 25 v
C414	8D82905G04	.068; 50 v
C415	23D82783B31	47; 20 v
C416	23D83214C15	4.7 ±20%; 25 v
C417	8D82905G15	.015; 100 v
C418	23D83214C20	10 ±20%; 20 v
C419	8D82905G15	.015; 100 v
C420	8D82905G04	.068; 50 v
C421	8D82905G15	.015; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR411	48D82256C26	zener type (3.3 v)
CR412	48C82392B03	silicon (SG3182)
CR413	48C82392B03	silicon (SG3182)
CR414	48D82256C02	zener type (6.8 v)
CR415	48C82466H01	silicon (SR1160)
CR416	48D82256C25	zener type (12 v)
CR417 thru 422	48C82392B03	silicon (SG3182)
		TRANSISTOR: (SEE NOTE)
Q411 thru 416	48R869570	N-P-N; M9570
Q417	48R869571	P-N-P; M9571
Q418	48R869568	N-P-N; M9568
Q419	48R869571	P-N-P; M9571
Q420	48R869570	N-P-N; M9570
Q421	48R869570	N-P-N; M9570
Q422	48R869570	N-P-N; M9570
Q423	48R869571	P-N-P; M9571
Q424	48R869570	N-P-N; M9570
Q425	48R869570	N-P-N; M9570
Q426	48R869570	N-P-N; M9570
Q427	48R869389	N-P-N; M9389
Q428	48R869389	N-P-N; M9389
Q429	48R869570	N-P-N; M9570
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R411	6S129232	3.9K
R412	6S127803	1.5K
R413	6S129752	270
R414	6S128688	2.7K
R415	6S129230	12K
R416	6S128685	22K
R417	6S127803	1.5K
R418	6S128902	47K
R419	6S128685	22K
R420	6S128689	2.2K
R421	6S128904	18K
R422	6S128904	18K
R423	6S128685	22K
R424	6S128689	2.2K
R425	6S6022	330; 1/2 w
R426	18C83083G13	variable; 10K
R427	6S129983	8.2K ±5%
R428	6S129225	10K
R429	6S129230	12K
R430	6S128689	2.2K
R431	6S129983	8.2K ±5%
R432	6S127800	220
R433	6S128687	6.8K
R434	6S129269	1.8K
R435	6S128689	2.2K
R436	6S128689	2.2K
R437	6S128689	2.2K
R438	6S129431	180 ±5%
R439	6S129320	1.8K ±5%
R440	6S124A27	120 ±5%
R441	18C83083G14	variable; 1K
R442	6S129668	10K ±5%
R443	6S6038	1.5K; 1/2 w
R444	6S124A27	120 ±5%
R445	6S129433	5.6K
R446	6S127806	27K
R447	6S127805	15K
R448	6S6432	270; 1/2 w
R449	6S128688	2.7K
R450	6S128685	22K
R451	6S124A27	120 ±5%
R452	6S124A39	390 ±5%
R453	6S129225	10K
R454	6S129269	1.8K
R455	6S129804	2.2K ±5%
R456	6S128902	47K
R457	6S129230	12K
R458	6S128685	22K
R459	6S129225	10K
R460	6S129433	5.6K
R461	6S129226	100K
R462	6S129242	56K
R463	6S129226	100K
R464	6S129242	56K
R465	6S129433	5.6K
R466	6S129225	10K
R467	6S128903	39K
R468	6S129820	1.8K ±5%
R469	6S129433	5.6K
R470	6S129269	1.8K
R471	6S129820	1.8K ±5%
R472	6S127804	4.7K
R473	6S129820	1.8K ±5%
R474	6S129433	5.6K
R475	6S128689	2.2K
R476	6S129147	220K
R477	18C83083G02	variable; 500K
R478	6S127800	220
R479	18C83083G14	variable; 1K

NOTE:

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

END OF DOCUMENT