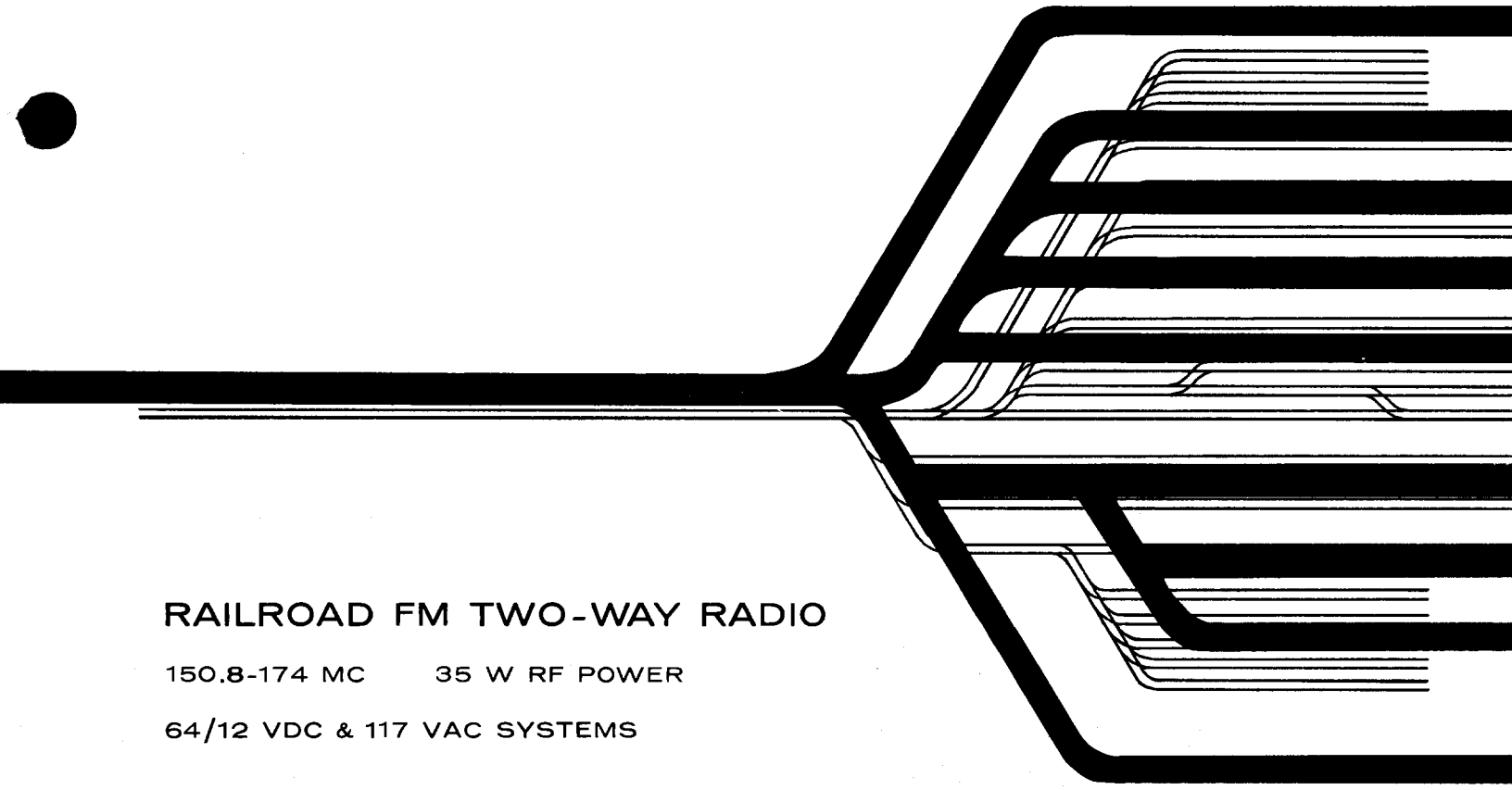
MOTRAN®



RAILROAD FM TWO-WAY RADIO

150.8-174 MC 35 W RF POWER

64/12 VDC & 117 VAC SYSTEMS

THIS MANUAL HAS BEEN
DISCONTINUED

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MOTRAN

RAILROAD FM TWO-WAY RADIO

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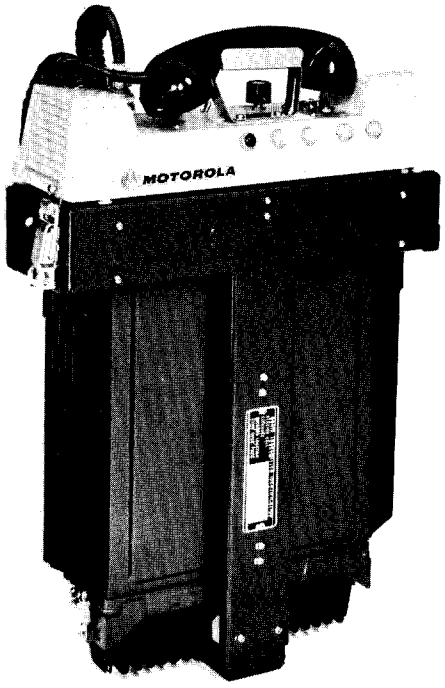
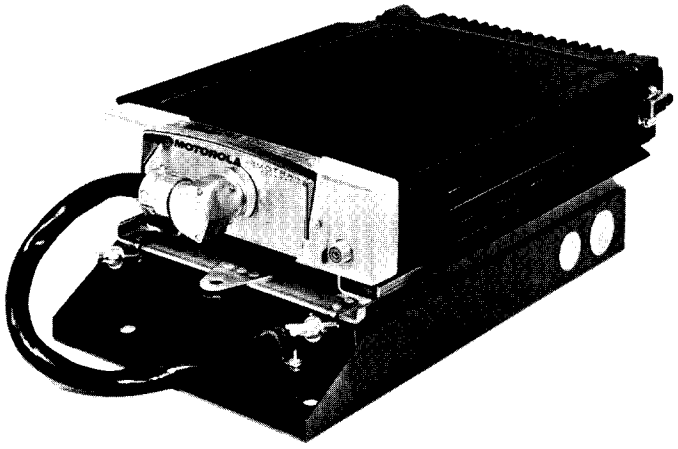


Universal "Motran"
Railroad Radio Set with
Mounting Rack and Handset



Standard AAR "Motran" Railroad
Radio Set with Mounting Rack

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

Printed in U.S.A.
4/5/73-CP

68P81041A15
Issue - G

GUARANTEED PERFORMANCE SPECIFICATIONS

GENERAL

FREQUENCY RANGE	150.8-174 mc
MAXIMUM CHANNELS	four
RF POWER OUTPUT	35 watts*
OPERATING POWER	64/12 V DC (R43MST Model Series); 117 V AC (R43MSB Model Series)
METERING	A single scale, 0-50 microampere meter or Motorola Portable Test Set can be used to measure all circuits essential to tuning and checking.
DIMENSIONS	AAR Model: 18-1/16" long x 4-7/16" high x 13-1/2" wide Universal Model: 22-3/4" long x 5" high x 16" wide
CURRENT DRAIN	12 V DC: Transmit 12.0 amp; Standby 1.0 amp 64 V DC: Transmit 2.1 amp; Standby 0.18 amp 117 V AC: Transmit 150 watts; Standby 25 watts

*rated at duty cycle exceeding AAR specifications

TRANSMITTER

OUTPUT IMPEDANCE	50 ohms
CONDUCTED SPURIOUS AND HARMONICS	more than 85 db below carrier
OSCILLATOR FREQUENCY STABILITY	Unheated elements maintain oscillator frequency within ±0.0005% of assigned center frequency from -30°C to +65°C (+25°C reference). Channel elements with stability of ±.0002% are also available.
MODULATION	16F3; ±5 kc for 100% at 1000 cps
AUDIO DISTORTION	less than 3% at 1000 cps, 2/3 system deviation

RECEIVER

CHANNEL SPACING	30 kc
SELECTIVITY	20 db quieting: -100 db at ±15 kc EIA SINAD: -85 db at ±30 kc
EIA SINAD INTERMODULATION	-80 db
EIA MODULATION ACCEPTANCE	±7 kc min.
SENSITIVITY	20 db quieting: 0.50 uv EIA SINAD: 0.35 uv
OSCILLATOR FREQUENCY STABILITY	Unheated channel elements maintain oscillator frequency within ±0.0005% of assigned center frequency from -30°C to +65°C (+25°C reference). Channel elements with stability of ±.0002% are also available.
SPURIOUS AND IMAGE REJECTION	more than 100 db
SQUELCH SENSITIVITY	0.25 uv max.
AUDIO OUTPUT	8 watts in an 8 ohm load; less than 5% distortion

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

FCC TYPE NUMBER CC3047 (transmitter using ±.0005% stability channel element)] R43MST Models
CC3047C (transmitter using ±.0002% stability channel element)] (64/12 V DC)
CC3075 (transmitter using ±.0005% stability channel element)] R43MSB Models
CC3075C (transmitter using ±.0002% stability channel element)] (117 V AC)

Note: Pages iii and iv have been omitted as irrelevant.

CONTENTS

SECTION PAGE NUMBER

MOTOROLA

MODEL CHART

"MOTRAN" RAILROAD

FM TWO-WAY RADIO SETS

CODE:

[X] = ONE ITEM SUPPLIED.

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

[Ø] - ONE ITEM REQUIRED FOR EACH OPERATING FREQUENCY UP TO FOUR. NOT PART OF BASIC RADIO SET MODEL.

NOTE:
'MODEL DESIGNATIONS APPEARING ON THE EQUIPMENT CHASSIS OR IN THE MODEL NUMBER COLUMN OF THIS MODEL CHART DO NOT REFLECT FACTORY INSTALLED ACCESSORY ITEMS.

*REPRESENTS A SERIES OF MODELS AND NOT A SPECIFIC MODEL. THE SPECIFIC MODEL, AS STAMPED ON THE CHASSIS, IS DETERMINED BY ITS APPLICATION.

MODEL	DESCRIPTION	ITEM	DESCRIPTION: RECEIVER	RECEIVER, "PRIVATE-LINE"	TRANSMITTER	TRANSMITTER, "PRIVATE-LINE"	POWER SUPPLY (DC)	POWER SUPPLY (AC)	CHANNEL ELEMENT, RECEIVER	CHANNEL ELEMENT, RECEIVER (.0002%)	CHANNEL ELEMENT, TRANSMITTER	CHANNEL ELEMENT, TRANSMITTER (.0002%)	UNIT HARDWARE KIT (AAR, DC)	UNIT HARDWARE KIT (UNIVERSAL)	UNIT HARDWARE KIT (AAR, AC)	FRONT PANEL	HOUSING AND BASE PLATE (AAR)	HOUSING (UNIVERSAL)	"VIBRASENDER" RESONANT REED	"VIBRASPONDER" RESONANT REED	SPEAKER AND CONTROL HEAD, NON-REVERTING	SPEAKER AND CONTROL HEAD, "PRIVATE-LINE" NON-REVERTING	SPEAKER AND CONTROL HEAD, REVERTING	SPEAKER AND CONTROL HEAD, "PRIVATE-LINE" REVERTING	TUNING TOOLS
	CARRIER SQUELCH MODELS																								
R43MSB-1199AA	STANDARD AAR (117 V AC)	*TRD1510AD/BD	X		X			X	O	O	O	O	O			X	X	X							/
R43MST-1199AA	STANDARD AAR (64/12 V DC)	*TRD1510AH/BH	X		X		X		O	O	O	O	O	X			X	X							/
R43MST-1199AC	UNIVERSAL NON-REVERTING	TTD1550AJ/BJ	X		X		X		O	O	O	O	O		X							X			/
R43MST-1199BC	UNIVERSAL REVERTING	TTD1550AK/BK	X		X		X		O	O	O	O	O		X				X						/
	"PRIVATE-LINE" TONE-CODED SQUELCH MODELS																								
R43MSB-3199AA	STANDARD AAR (117 V AC)	TPN1053A, B		X		X		X	O	O	O	O	O			X	X	X		X	X				/
R43MST-3199AA	STANDARD AAR (64/12 V DC)	TPN1053B		X		X	X		O	O	O	O	O	X			X	X		X	X				/
R43MST-3199AC	UNIVERSAL NON-REVERTING	TPN1056A		X		X	X		O	O	O	O	O		X					X	X	X			/
R43MST-3199BC	UNIVERSAL REVERTING	TLN1081A		X		X	X		O	O	O	O	O		X					X	X	X		X	/
		TLN1086A																							
		TLN1083A																							
		TLN1087A																							
		TLN8465A																							
		TLN8496A																							
		TLN8593A																							
		TGN6050A																							
		TTN6069A																							
		THN6070A																							
		TLN6824A Series																							
		TLN8381A																							
		TCN6067AJ																							
		TCN6067AK																							
		TCN6068AJ																							
		TCN6068AK																							
		TLN6845A																							

EPD-15367-D

NOTE

TPN1053B Power Supply (DC) is used in Models produced after April, 1973.

ACCESSORY CHART

MODEL NUMBER	DESCRIPTION
TLN1086A	Channel Element, Receiver, ±.0002% stability
TLN1087A	Channel Element, Transmitter, ±.0002% stability
TLN1007C	Mounting Rack, Standard AAR
TLN6304C	Mounting Rack, T-Frame, Universal
TLN6586A	Transient Voltage Filter Kit, 64-volt Operation
TCN6108AJ	Control Head, Non-Reverting, Standard AAR
TCN6109AJ	Control Head, Channel Reverting, Standard AAR
TCN6108AK	Control Head, "Private-Line", Non-Reverting, Standard AAR
TCN6109AK	Control Head, "Private-Line", Channel Reverting, Standard AAR
TCN1057AJ	Control Head, Single-Tone, Standard AAR
TMN6001A	Handset, Carbon Type
TMN6002C	Handset, Dynamic Type
TMN6043A	Handset, Dynamic Type with Armored Cable
TAD6010A	Antenna, Rigid Railroad
TAD6020A	Antenna, Condulet Mounted
TLN6489A	External Hang-Up Cup, Non-Reverting, Universal
TLN6490A	External Hang-Up Cup, Channel Reverting, Universal
TLN6491A	Power Plug Kit, Universal
TLN1009A	AC-DC Converter (117 volts ac to 64 volts dc)
TKN6044A	Bench Test Cable Kit
TSN6001A	Speaker, Outdoor, Standard AAR
TLN6075C	Remote Control Unit, Standard AAR
TLN6076A	Footboard Control Unit, Standard AAR
TLN1097A	Time-Out Timer
TLN8362A	Adapter for 19-inch Rack Mounting

Additional accessories may have been developed since the printing of this manual. Contact your Motorola representative for a complete listing of available accessories.

DESCRIPTION

1. INTRODUCTION

The Motorola "Motran" railroad radio sets are FM two-way radios which operate from a 12-volt dc, 64-volt dc or 117-volt ac power source. The 64/12 v dc radio sets are for installation in locomotives, cabooses, or maintenance-of-way vehicles, and the 117 v ac models are used in areas where ac power is available which permits the radio set to be used as a base station. The transmitter, receiver and power supply are fully transistorized. Solid-state circuits are used for all switching functions such as push-to-talk, receiver muting, and antenna switching. The radio sets provide single-frequency to four-frequency operation in the 150.8 to 174 mc range. A channel element (oscillator module) is merely plugged into the set for each transmitter and receiver frequency desired. Models are available with carrier squelch or "Private-Line" tone-coded squelch.

Two types of models are available---the Standard AAR model and the Universal model. The Standard AAR model provides complete interchangeability with two-way "Motrac" and "Stan-Pac" railroad equipment currently in use. The Universal model is a completely self-contained unit (no external speaker or control head required) and requires minimum accessory installations. Both Standard AAR and Universal radio sets can be equipped for "channel reverting" operation. This feature automatically returns the radio set to a preselected frequency when the handset is hung up.

2. PHYSICAL DESCRIPTION

The basic radio set consists of a receiver, power supply, transmitter and front panel, assembled together to form a drawer unit. A key lock on the front panel secures the drawer assembly from unauthorized personnel. For servicing, the major chassis are easily removable from the drawer assembly to provide ready access to all components of the radio set.

The housing has highly efficient, finned radiators to dissipate heat generated in the transmitter and power supply so that venting the housing is unnecessary. This keeps components free of dust, etc., and eliminates servicing resulting from entrance of contaminants through a vented housing.

The Standard AAR model consists of the basic radio set, a housing, a base plate, an escutcheon and a handle. The Standard AAR mounting rack, the Standard AAR control head with handset, and the antenna are required accessories. Cables from each of these units are connected into the radio set by multi-connector terminal boards in the mounting rack. Extended local control is possible, since the control head is mounted separately from the radio set.

The Universal model consists of the basic radio set, a housing and a Universal control head. The control head mates directly to the front panel, eliminating a separate control head installation and intercabling. This completely self-contained unit is mounted in the Universal T-frame mounting rack. Cables from the antenna and the primary power source are connected directly to the side receptacles of the radio set. The Universal model with the attached control head offers complete local control of the radio set. The Universal model includes the control head. It does not include the antenna, mounting rack, handset or cabling.

The Universal control head provides complete controls for the operation of the Universal radio set. The control head connects directly to the front panel. The primary power source connects through the control head to the radio set power supply. The Universal control head is an integral part of the radio set. It is not accessory item. Control heads are fully described in the CONTROL HEADS section of this manual.

3. TRANSMITTERS

The fully transistorized FM transmitters provide 35 watts r-f power. Circuits include an unheated, temperature-compensated crystal oscillator module (channel element) for each operating frequency, transistorized audio amplifier and IDC (Instantaneous Deviation Control) circuit, varactor phase modulator, and completely transistorized exciter and power amplifiers. Frequency multiplication in the exciter and power doubler produce an output frequency 12 times the crystal frequency. A high level of spurious frequency attenuation is achieved in a harmonic filter at the transmitter output.

4. RECEIVERS

The receivers used in these radio sets are crystal-controlled, dual-conversion models. RF

preselectors (tuned cavities) and a sealed, life-time guaranteed "Permakay" filter in the i-f stages determine the excellent bandwidth and selectivity characteristics of the receivers. Plug-in crystal oscillator modules (channel elements) provide stable frequency control. Disturbing noise during periods when no messages are being received is eliminated by noise actuated (carrier) squelch circuitry.

The receiver terminates in a transistorized push-pull audio output, providing 8 watts of audio output power at less than 5% distortion. Thus, messages can be heard under high ambient noise conditions.

5. "PRIVATE-LINE" TONE-CODED SQUELCH MODELS

This type of radio set is an improvement in FM two-way radio equipment especially when operating under crowded channel conditions. Several "Private-Line" networks can use the same r-f carrier frequency in the same area if each network uses a different "Private-Line" tone frequency.

The transmitters are modulated by a continuous sub-audible tone signal in addition to the voice modulation. The receivers accept only correctly tone-modulated signals when the "PL"-ON-OFF switch is in the ON position and reject all others.

Dual squelch "Private-Line" receivers also include noise-actuated squelch circuitry as previously described for carrier squelch models. This enables the operator to monitor the channel before transmissions ("PL"-ON-OFF switch in OFF position) and prevent interference with other users of the frequency.

The squelch control must be set for proper operation as described under OPERATING INSTRUCTIONS.

6. POWER SUPPLIES

The fully transistorized power supplies use long-life transistors. Silicon diode rectifiers are used to provide the greatest reliability. Heat sinks along the sides of the housing dissipate the heat from the power supply transistors. The power supply used in the R43MST Models operates from a primary power source of either 12 or 64 volts dc. For these models, the input power is applied to the 12- or 64-volt terminals of the mounting rack, as applicable. The power supply used in the R43MSB Models operates from an external power source of 117 volts ac.

7. REQUIRED ACCESSORIES

a. Standard AAR Control Heads

On Standard AAR radio sets, the control head is a separate unit. It requires separate installation and cabling.

The Motorola railroad control heads listed in the subsequent model chart provide control facilities for AAR railroad radio sets. These control heads can be used with installations operating from a primary power source of 12 volts, dc, 64 volts dc or 117 volts ac. Each unit includes a channel selector switch for four-frequency operation. A five-inch speaker is mounted in the housing. An AAR microphone receptacle is provided for a telephone type handset.

The housing consists of two hinged sections of cast aluminum. The units are ruggedly constructed to withstand shock and vibration. Threaded openings (3/4" pipe thread) are provided at the top and bottom for connection of conduit.

Automatic channel reverting models return to a pre-selected channel when the handset is hung up.

"Private-Line" models include a "PL" ON-OFF switch. With the switch in the ON position, transmissions are coded with a "Private-Line" tone and messages are received only from other transmitters sending the same "Private-Line" tone. In the OFF position, the "Private-Line" circuits are disabled and all on-frequency transmissions can be heard.

The pilot light dimmer circuit automatically controls the brilliance of the blue (transmit) pilot light and the channel indicator lights mounted on the control head. In bright daylight, the lights glow brightest to insure visibility. The lights become progressively dimmer to reduce excessive glare as daylight changes to darkness. External illumination is sampled through a panel in the upper portion of the control head and acts upon a light dependent resistor which is mounted behind the panel.

TABLE 1. TABLE OF REQUIRED ACCESSORIES

RADIO SET	MOUNTING RACK	POWER PLUG KIT	ANTENNA	CONTROL HEAD	HANDSET
Standard AAR Models	TLN1007C	NOT USED	TAD6010A or TAD6020A	TCN6108AJ (non-reverting)	TMN6043A or TMN6002C
				TCN6109AJ Automatic Channel Reverting	
				TCN6108AK (non-reverting, "Private-Line")	
				TCN6109AK Automatic Channel Reverting "Private-Line"	
				TCN1057AJ Single Tone	
Universal Models	TLN6304C	TLN6491A	TAD6010A or TAD6020A	Part of radio set (Use TLN6490A External Hang-Up Cup for reverting models)	TMN6002C, TMN6001A or TMN6043A

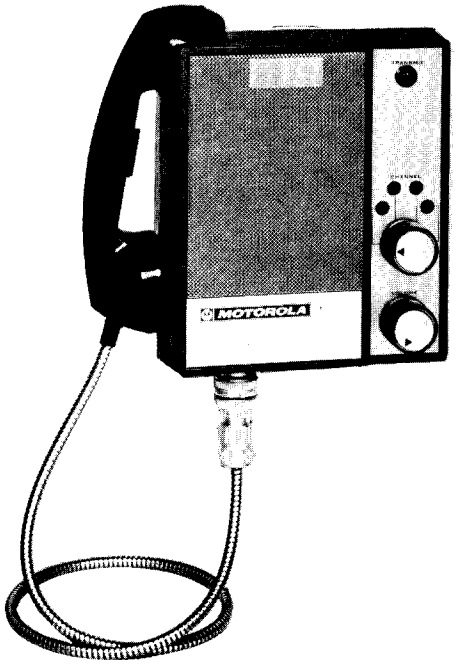


Figure 1.
TCN6108AJ Control Head
With TMN6043A Handset

The "Motran" railroad radio sets may be used in existing "Stan-Pac" or "Motrac" railroad installations using the Standard AAR control heads listed in Table 2. However, operation is limited to one-frequency or two-frequency carrier squelch installations.

TABLE 2.
EXISTING CONTROL HEAD INSTALLATIONS

CONTROL HEAD MODEL	TYPE	HANDSET REQUIRED
TCN6014AF	Non-reverting	TMN6002C (Dynamic)
TCN6015AF	Reverting	TMN6002C (Dynamic)
TCN6019AF	Non-reverting	TMN6001A (Carbon)
TCN6020AF	Reverting	TMN6001A (Carbon)

b. Handsets

(1) TMN6001A Carbon Type Handset

This handset may be used with Universal control heads and in existing Standard AAR installations which use the TCN6019AF or TCN6020AF Control Head.

(2) TMN6002C and TMN6043A Dynamic Type Handsets

The TMN6002C and TMN6043A Dynamic Handsets are exactly the same except that the TMN6043A uses an armored cord and the TMN6002C uses a standard neoprene coiled cord. Both handset models are compatible with all Universal or Standard AAR control heads except for Models TCN6019AF and TCN6020AF. The connector is an AAR specified type (AN3102-14S-6S).

A built-in transistorized pre-amplifier with a low output impedance (500 ohms at 1000 cps) is contained in the microphone cartridge. Frequency response is essentially flat between 300 and 3000 cps and the microphone will operate satisfactorily over an ambient temperature range of -30°C to +65°C. The earphone impedance is 125 ohms ±10% at 1000 cps.

The dynamic cartridge requires input power only when the push-to-talk switch is pressed. It does not load the associated power source otherwise. Contacts on the switch connect the cartridge into the circuit when the bar is pressed. The switch mounting plate is chrome plated and "Nylock" mounting screws are used.

c. Mounting Racks

(1) Standard AAR

The Model TLN1007C Mounting Rack permits mounting the radio set to a horizontal surface. It provides distribution of power and control functions by external cables which are routed to terminal board connections. A multi-conductor cable terminated in a 23-pin connector provides the necessary cabling from the terminal boards in the mounting rack to the radio equipment.

Two clevis assemblies, one on either side of the equipment at the front of the rack, provide a sturdy hold-down device for the radio set. Brackets for a padlock are used to prevent unauthorized personnel from tampering with the equipment. Plug buttons are included to cover the conduit holes not used in the installation.

Existing installations which use a Model TLN1007A, TLN1007B, TLN1008A, TLN1008B, TLN1008C, TLN6072A, or TLN6072B Mounting Rack may be used to mount the "Motran" railroad radio set. When using an existing installation, a lead must be connected from TB3-22 of the mounting rack to TB5-22 of the control head for "Private-Line" tone-coded squelch models. If a two-frequency installation is used, leads must be added from TB2-12 and TB3-13 of the mounting rack to TB5-13 and -14, respectively, of the control head for four-frequency operation. Refer to the Installation and Intercabling Diagram for details.

(2) Universal

The Model TLN6304C Mounting Rack for universal models allows greater freedom of installation of the radio set. The versatile T-frame design permits either a horizontal or a vertical installation. Three mounting holes in the rack permit attachment to any flat surface.

Nylon guides provide easy insertion of the radio set into the rack. Guide pins on the top and nylon spring-loaded guides on the bottom of the rack firmly position the radio set. Hold-down latches, one on each side of the rack, provide a sturdy clamping device for the radio set. Padlock brackets are provided on these latches to prevent unauthorized personnel from tampering with the equipment. Refer to the Installation & Intercabling Detail for details on the installation of this Universal mounting rack.

Existing installations which use the Model TLN6304A or TLN6304B Mounting Rack may be used to mount the "Motran" railroad radio sets.

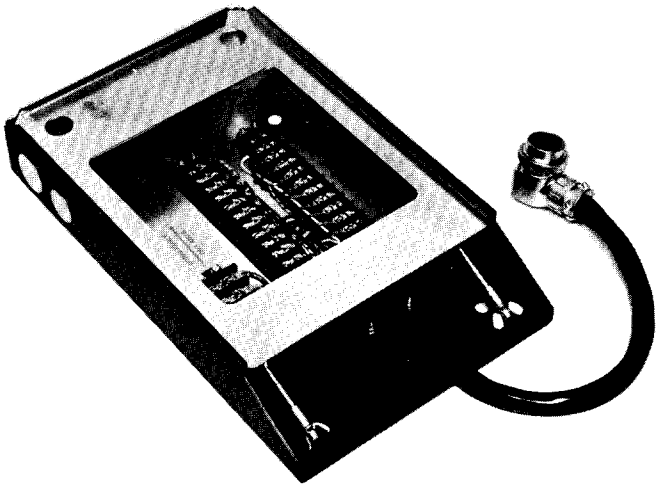


Figure 2.
TLN1007C Mounting Rack

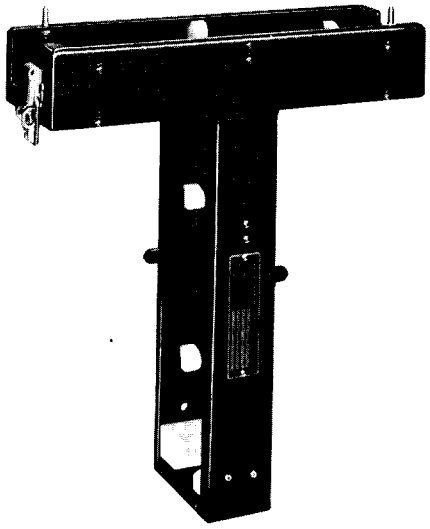


Figure 3. TLN6304C Mounting Rack

d. Antennas

Two types of mobile antennas are available for use with the radio set:

(1) TAD6010A Rigid Railroad Antenna

This item is a folded quarter-wave antenna of rugged construction. The antenna has a nominal input impedance of 52 ohms and operates at dc ground potential. The outer conductor is heavy gauge, silver plated tubing. Refer to the instructions supplied with the antenna for installation details.

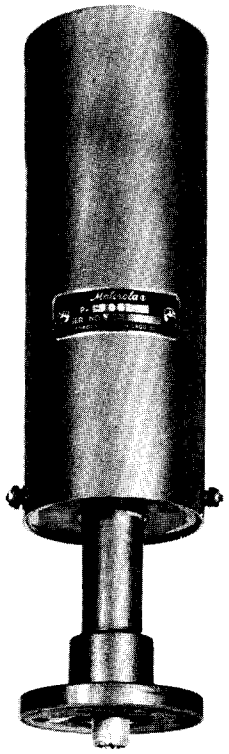


Figure 4.
TAD6010A Antenna

(2) TAD6020A Condulet Mounted Antenna

This unit is a quarter-wave whip-type antenna with a nominal input impedance of 52 ohms. The antenna base is mounted in a condulet box to permit complete weatherproof enclosure of the r-f connectors. A conical neoprene cover completely encloses the antenna base insulator assembly. This minimizes the effects of dirt or soot deposited on the insulator and increases the impedance of the leadage path from the antenna rod to ground. Any standard 52-ohm antenna may be used for land station installations. Refer to the Installation and Intercabling Detail for complete installation instructions.

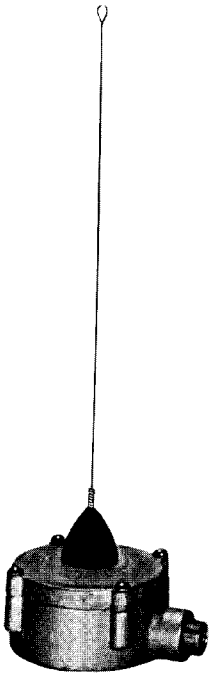


Figure 5.
TAD6020A Antenna

e. TLN6491A Power Plug Kit

The TLN6491A Power Plug Kit (for Universal radio sets) provides a convenient method of connecting and disconnecting the primary input power to the radio set. This kit consists of a ten pin receptacle and a cable clamp. The primary input power cable connects to this ten pin receptacle which in turn mates to the receptacle on the side of the control head. Refer to the installation & intercabling diagram for connection details.

f. TLN6586A Transient Voltage Filter Kit

This filter suppresses the transient voltage spikes that occur from either side of the 64-volt line to ground, which may damage the power supply transistors if permitted to enter the radio set. The filter should be used in all 64-volt installations.

g. Channel Elements

TABLE 3. CHANNEL ELEMENTS

MODEL NO.	DESCRIPTION
TLN1081A	Receiver, ±.0005% stability
TLN1083A	Transmitter, ±.0005% stability
TLN1086A	Receiver, ±.0002% stability
TLN1087A	Transmitter, ±.0002% stability

The channel elements (oscillator modules) are not supplied with the radio set, since some users require only one operating frequency while others require up to four. Therefore, channel elements must be ordered separately; one for each transmitting frequency and one for each receiving frequency desired. Channel element orders must specify the channel element model number, fundamental crystal frequency, carrier frequency, and model number of the equipment in which the channel element is to be used.

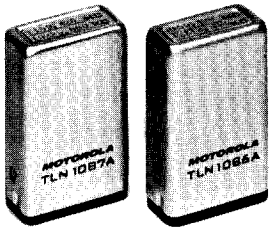


Figure 6.
TLN1086A and TLN1087A Channel Elements

8. OPTIONAL ACCESSORIES

a. TLN1097A Time-Out Timer

The time-out timer is a plug-in module which provides automatic turn-off of the transmitter after one minute of continuous operation. This action is accompanied by an alert tone from the speaker which indicates carrier turn-off.

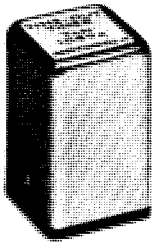


Figure 7. TLN1097A Time-Out Timer

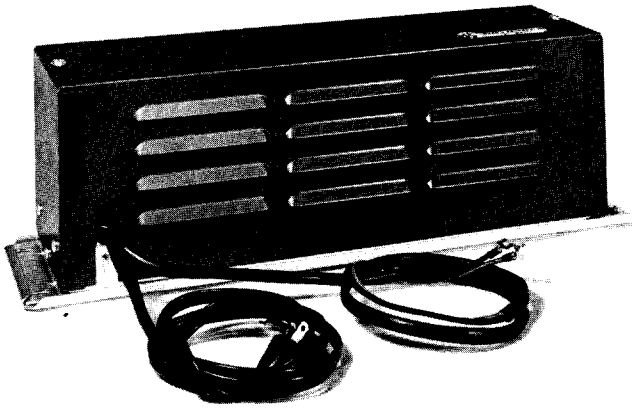


Figure 8. TLN1009A AC-DC Converter

b. TKN6044A Bench Test Cable Kit

This kit provides interconnections for bench testing of railroad radio sets. It may be used with Standard AAR models when removed from the mounting rack and with Universal models when the Universal control head is removed.

Figure 9. TKN6044A Bench Test Cable Kit

9. OPTIONAL ACCESSORIES FOR STANDARD AAR RADIO SETS ONLY

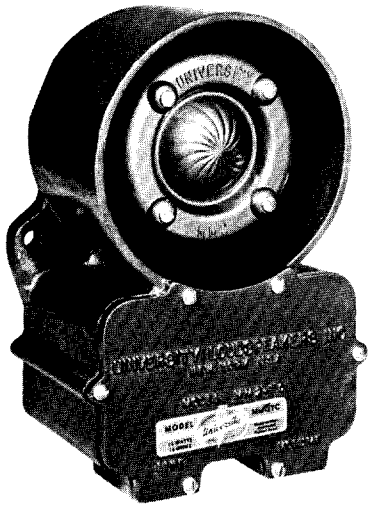


Figure 10. TSN6001A Speaker

a. TSN6001A Speaker

This unit is a rugged, outdoor type speaker. A 16-ohm speaker with a 500-ohm matching transformer is included.

b. TLN6076A Footboard Control Unit

This unit provides operation of railroad radio equipment from the exterior of a locomotive or railroad car. Push-to-talk operation via a separate combination speaker-microphone (the TSN6001A Speaker is recommended), is accomplished by foot, knee, or hand operation of the hinged cover of the control unit. Thus, a crewman stationed on the exterior of the train can control the radio equipment.

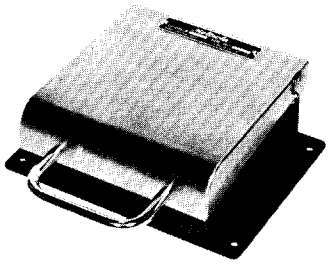


Figure 11.
TLN6076A Footboard Control Unit

c. TLN6075C Remote Control Unit

This remote control unit permits the 64/12 v dc "Motran" railroad radio set to be used as a remotely controlled base station. The unit is located at the radio set site to terminate 500/600-ohm control lines from the operator's position at a remote control console and convert dc control currents to transmitter keying, frequency selection, etc. Facilities are also provided for local control of the radio set from the remote control unit. This unit may be used with one- and two-frequency carrier squelch installations only.

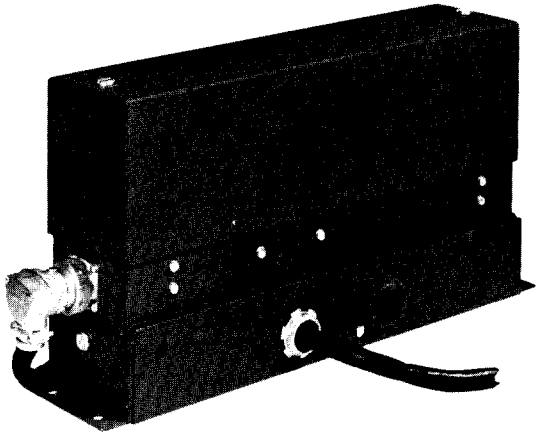


Figure 12. TLN6075C Remote Control Unit

d. TCN1057AJ Single-Tone Control Heads

The Motorola Control Heads provide control facilities for AAR railroad radio sets. It incorporates two-tone frequencies for signalling the "dispatcher" from the mobile unit. The unit includes a tone oscillator-amplifier, two switches for tone selection and transmission, and a channel select switch for up to four frequency operation. A five inch speaker is mounted in the housing and an AAR microphone receptacle is provided for a telephone type handset.

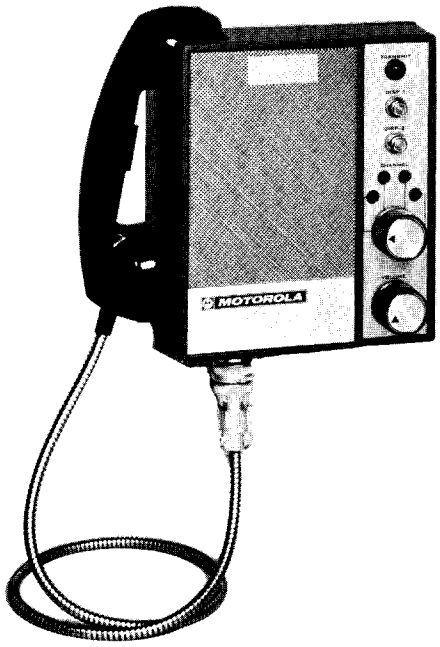


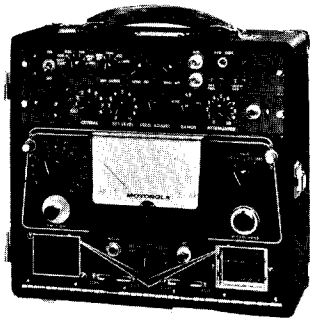
Figure 13.
TCN1057AJ Single-Tone Control Head

10. OPTIONAL ACCESSORIES FOR UNIVERSAL MODELS ONLY

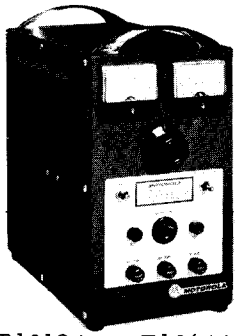
Figure 14.
Handset Hang-Up Cup
Model TLN6490A

The TLN6490A Handset Hang-Up Cup is used with the frequency reverting Universal model to provide convenient hang up of the handset. The TLN6489A Handset Hang-Up Cup is used with the non-reverting Universal models and is similar to the TLN6490A except that it does not contain a hang-up switch.

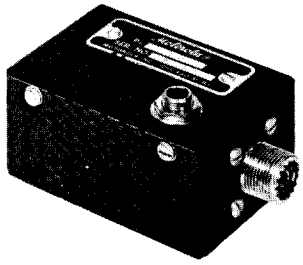
RECOMMENDED TEST EQUIPMENT



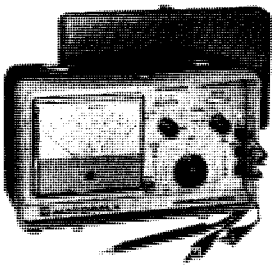
S1059A*
Portable Test Set



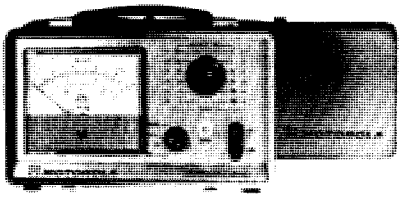
T1012A or T1064A
Power Supply



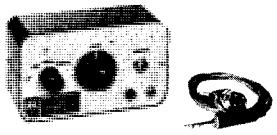
P-7208
Dummy Load



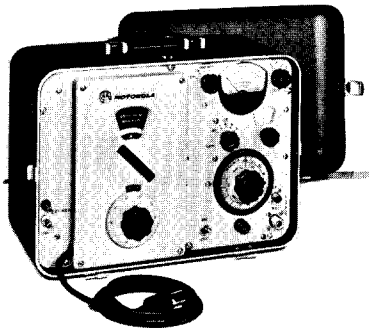
Transistorized
DC Multimeter



Transistorized AC
Voltmeter

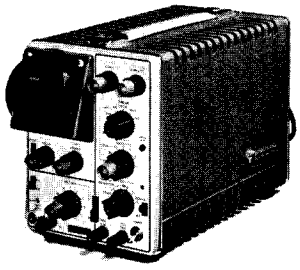


TEK-1A
Transistorized Tone
Generator



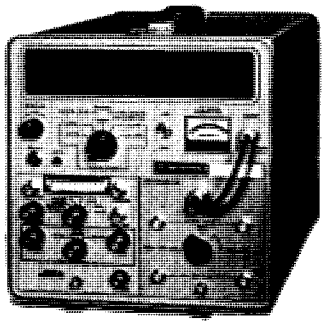
FM
Signal Generator

T1015A
General Purpose
Oscilloscope



T1014B
Precision Wide Band
Oscilloscope

T1130A Series
FM Station Monitor



S1075B Digital
Frequency Meter

*Order TKN6025A Cable Adapter also.

INSTALLATION OF THE STANDARD AAR RADIO SET

1. UNPACKING AND INSPECTION

Use care when unpacking and handling this radio equipment. Open the shipping carton and carefully remove the individually packaged components. Check contents to be sure all items have been included.

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

2. PRE-INSTALLATION

This equipment has been accurately adjusted at the factory for optimum performance. However, it is possible that units may have been dropped or otherwise severly mishandled while in transit. Therefore, prior to making the installation, it is recommended that the transmitter and receiver be bench checked for proper meter readings. If these preliminary checks indicate that any of the circuits are out of alignment, the entire unit should be completely re-aligned.

If re-alignment is necessary, refer to the alignment procedure in this instruction manual.

FCC REGULATIONS

FCC regulations state that:

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

2. The r-f power output of a station shall be no more than required for satisfactory technical operation considering the area to be covered and the local conditions.

Before proceeding with the actual installation a definite layout for the exact location of each unit and the method to be used for mounting must be determined. Complete mounting dimensions and inter-unit cabling for the Standard AAR radio sets and accessories are illustrated on the Installation & Intercabling Detail.

a. Antenna

The antenna should be located as high as possible and still be able to clear obstacles on the right of way. A suitable ground plane must be provided--usually the metal top of a caboose or locomotive cab will serve. If the antenna is to be mounted on a wooden structure, a metal sheet at least 35 inches in diameter should be attached to the mounting surface. The metal sheet should be grounded to the antenna mounting base. The antenna should be located, if possible, at least 17 inches from any protruding structural member of the train that might cause shadow effect.

The RG-8/U transmission line from the antenna to the radio equipment should be made as short as possible. The transmission line may be enclosed in a 1/2-inch or 3/4-inch conduit to protect it from any possible damage. Refer to Cable and Connector Detail--CEPD-386--for assembly details.

b. Radio Set Housing

The mounting space requirements for radio set housing, per the proposed AAR Specifications 12-10, 2nd revision, 1956, state: "The equipment should be mounted in a location which is well ventilated and a minimum clear space of 20 inches wide, 24 inches deep, and 14 inches high should be provided with the base plate mounted in the center of the 20 inch dimension and the front of the base plate shall be two inches from the front of the opening."

The radio set and base plate must be mounted in the horizontal plane only. Base plate and housing installation and dimensional details are illustrated on the Installation & Intercabling Detail.

c. Control Head

The mounting location for the control head should be selected so that the speaker in the control head faces the operator and that the handset is within easy reach of the operator. Control head mounting dimensional details are illustrated on the Installation & Intercabling Detail.

The control heads are shipped from the factory mechanically arranged for two-frequency operation. The control head is capable of up to four-frequency operation. To restrict the use of

the control head to one-frequency operation remove the knob on the channel selector switch by loosening the "Allen" set screw using the wrench supplied. Move the channel stop screw from the center position to the threaded hole on the right. For three-frequency operation move the channel stop screw to the threaded hole on the left. For four-frequency operation, remove the stop screw. When the channel selector knob is replaced, place the knob in a position so the set screw contacts the flat spot on the shaft when it is tightened. Refer to Figure 15.

The reverting type control heads are wired at the factory for channel 1 reverting. If another channel is desired for reverting, the white wire connected to terminal TB1-11 and the red-green wire connected to terminal TB2-21 should both be relocated to change the reverting channel. Make the connections as shown in Table 4.

TABLE 4.
REVERTING CONNECTIONS (STANDARD AAR)

Reverting Channel	White Wire Terminal	Red-Green Wire Terminal
F1	TB1-11	TB2-21
F2	TB1-12	TB2-22
F3	TB2-13	TB2-23
F4	TB2-14	TB2-24

d. 12- or 64-Volt Power Connections

It is recommended that the power input leads to the mounting rack be connected as closely to the battery terminals as possible on the battery side of the locomotive main power switch. To further protect the radio equipment and power input leads, it is recommended that a double-pole, double-throw switch be placed in series with both primary input leads. This is especially important to protect the radio set against megger tests and inductive field decay voltage which may appear when the main battery switch is operated.

A 25-ampere circuit breaker or 25-ampere fuse should be connected in series with each primary power input lead for 12-volt operation to further protect the radio equipment and power leads. For 64-volt operation, the TLN6586A Transient Voltage Filter Kit provides the required fusing. The filter (not supplied) should be used to protect power supply transistors from transient voltage spikes for 64-volt operation.

CAUTION

Polarity of the power input leads must be observed. Reverse polarity protection diodes are located in the radio set; the one used in the 12-volt input causes a 20-ampere line fuse to blow, and the one used in the 64-volt input causes the 6-ampere line fuse to blow. The line fuses are located in the power supply. Refer to the Installation and Intercabling Diagram for proper polarity of power connections.

e. 117 Volt Power Connections

The power input connections required for the 117 vac models are illustrated on the installation and intercabling diagram.

3. INSTALLATION

A multi-conductor cable, terminating in a 23-pin cable connector provides the necessary cabling from the terminal boards in the mounting rack to the radio set. This multi-conductor cable (W1) is supplied with the mounting rack.

As shown on the Installation & Intercabling Detail, 12 leads are required to interconnect the mounting rack terminal boards TB2 and TB3 to the associated control head. The 12 leads (not supplied) should be routed from the mounting rack to the control head via conduit (not supplied) as shown on the pictorial illustration. A 12-conductor vinyl-jacketed cable recommended for these connections is available on separate order. This inter-unit radio cable can be obtained from the Motorola Parts Department, 1875 Greenleaf Ave., Elk Grove Village, Illinois 60007 by ordering Motorola Part No. 30C850298. Length required must be specified.

If the "Motran" Railroad Radio Set is to be mounted in an existing two-frequency installation, the intercabling between the mounting rack and control head must be expanded to 12 conductors to utilize four-frequency and "Private-Line" tone-coded squelch operation.

For further details on the installation of this radio set, see the Standard AAR Installation & Intercabling Detail.

4. PROVISIONS FOR MULTIPLE-FREQUENCY OPERATION

a. General

"Motran" Railroad Radio is capable of operation on one to four frequencies. To increase the number of operating frequencies, two steps are required:

(1) Plug in the additional channel elements.

(2) Move the frequency selector switch stops to allow it to rotate to more positions.

b. Channel Elements

Formulas for determining the correct crystal frequency for a specific carrier frequency are given in the THEORY OF OPERATION section of this manual. Refer to the circuit board diagrams for correct locations of the channel elements for each frequency. Frequency and deviation must be checked for each new transmitter frequency and the radio should be netted for optimum performance. Refer to the ALIGNMENT PROCEDURES and IDC ADJUSTMENT PROCEDURE in this manual for procedures to accomplish these checks.

c. Frequency Selector Switch

A mechanical stop on the frequency selector switch on the control head should be set to prevent rotation to unused positions. For example, if a radio set is equipped with enough channel elements for two-frequency operation, the switch stop should be set to prevent rotation to the F3 and F4 positions. When a frequency is added, the mechanical stop must be reset to permit rotation to an additional position. Use the following procedure:

Refer to Figure 15.

(1) Rotate the switch to the F1 position.

(2) Loosen the set screw and remove the knob.

(3) Unscrew the stop (Motorola Part No. 46B82187H01) and re-install as shown in Figure 15. Remove the stop entirely for four-frequency operation.

(4) Replace the knob.

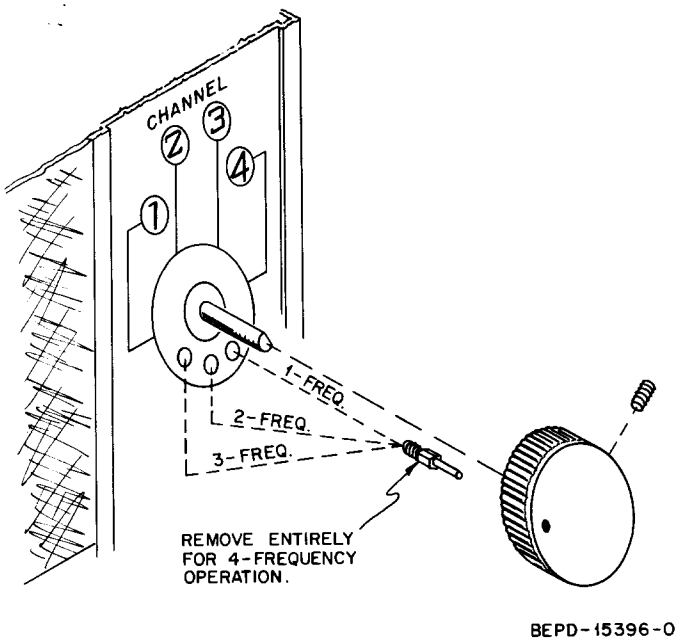


Figure 15.
Standard AAR Control Head
Frequency Selector Switch Stop Detail

d. Four-Frequency Board Jumpering

If a radio set has more transmitting frequencies than receiving frequencies or vice versa, jumpers must be connected on the four-frequency circuit board to prevent "dead" position of the frequency selector switch. When adding frequencies, remove any previously installed jumpers that would cause more than one channel element to operate at one time. If the additional frequency causes an unequal number of transmitter and receiver frequencies, connect jumpers as instructed in the following procedures. The procedures and examples will permit calculation of proper jumpering for non-standard type of operation.

To receive the same frequency on more than one position of the frequency selector switch, jumper the corresponding "R" points on the four-frequency board.

EXAMPLE 1

Condition desired:

161.370 mc on F1 and F4 selector switch positions
161.520 mc on F2 selector switch position
161.550 mc on F3 selector switch position

Procedure:

Jumper point R1 (refer to the four-frequency circuit board detail) to point R4 on the four-frequency board. Plug the 161.370 mc channel element into the receiver F1 or F4 position; the F2 and F3 receiver channel elements are installed in the normal manner.

EXAMPLE 2

Condition desired:

161.370 mc on F1 and F3 selector switch positions
161.520 mc on F2 and F4 selector switch positions

Procedure:

Jumper point R1 to R3 and plug the 161.370 mc channel element into receiver F1 or F3 position. Jumper point R2 to R4 and plug the 161.520 mc channel element into receiver F2 or F4 position.

To transmit the same frequency on more than one position of the frequency selector switch, jumper the corresponding "T" points together on the four-frequency board.

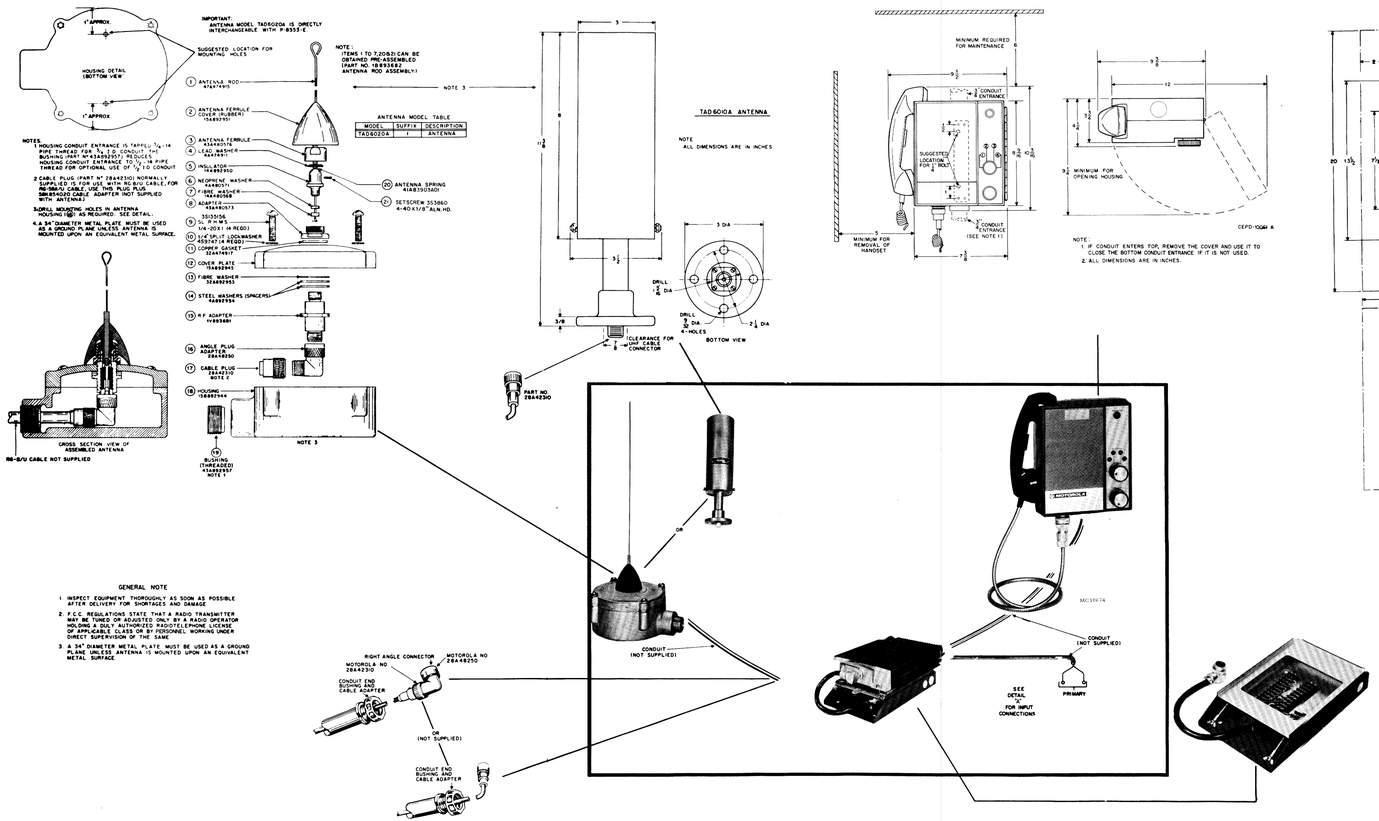
EXAMPLE 3

Condition desired:

161.370 mc on F1 selector switch position
161.520 mc on F2 and F4 selector switch positions
161.550 mc on F3 selector switch position

Procedure:

Jumper point T2 to T4 on the four-frequency board. Plug the 161.520 mc channel element into the transmitter F2 or F4 position. The transmitter F1 and F3 channel elements are installed in the normal manner.



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Standard AAR "Motran" Railroad Radio Installation & Intercabling Detail
Motorola No. PEPD-13510-D
8/25/67-CP

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN1007A, B, C Mounting Rack EPD-17096-O

P1	9B948776	CONNECTOR, plug; female; 23 cont.
TB1	31K848767	BOARD, term; 2 screw term.
TB2, 3	31K50355	12 screw term.
W1	1V848810	CABLE ASSY, special purpose: incl.; ref. part P1 & the following items: 30C848744 CABLE, 22 conductor; 29" length req'd 42B850816 CLAMP, cable; 29K848901 LUG, term; #8 stud; coded RED; 19 req'd; 29K848902 LUG, term; #8 stud; coded BLU; 3 req'd 29K848903 LUG, term; #10 stud; coded YEL, 2 req'd
NON-REFERENCED ITEMS		
	7D82469C04	RACK, mtg.
	13B848775	MARKER, term. board: (1-12)
	13K813242	MARKER, term. board: (13-24)
	13K82470C01	MARKER, term. board: (1-2)
	42A82471C01	CLAMP, cable
	38A848944	BUTTON, plug: for 1-3/8" hole 2 req'd
	38K863351	BUTTON, plug: for 1-3/32" hole; 2 req'd
	1V80714A90	CLEVIS ASSY. incl 72A851005 BRACKET, clevis; 3A82472C01 BOLT, clevis; 2A851001 NUT, wing 43A850115 BUSHING; 22A851007 ROLLPIN

INSTALLATION OF THE UNIVERSAL RADIO SET

1. UNPACKING AND INSPECTION

Use care when unpacking and handling this radio equipment. Open the shipping carton and carefully remove the individually packaged components. Check contents to be sure all items have been included.

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

2. PRE-INSTALLATION

This equipment has been accurately adjusted at the factory for optimum performance. However, it is possible that units may have been dropped or otherwise severely mishandled while in transit. Therefore, prior to making the installation, it is recommended that the transmitter and receiver be bench checked for proper meter readings. If these preliminary checks indicate that any of the circuits are out of alignment, the entire unit should be completely re-aligned.

If re-alignment is necessary, refer to the applicable alignment procedure in this instruction manual.

FCC REGULATIONS

FCC regulations state that:

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

2. The r-f power output of a station shall be no more than required for satisfactory technical operation considering the area to be covered and the local conditions.

Before proceeding with the actual installation a definite layout for the exact location of each unit and the method to be used for mounting must be determined. Complete mounting dimensions and inter-unit cabling for the Universal radio sets and accessories are illustrated on the Installation & Intercabling Detail.

a. Antenna

The antenna should be located so as to extend as high as possible and still be able to clear obstacles on the right of way. A suitable ground plane must be provided--usually the metal top of a caboose or locomotive cab will serve. If the antenna is to be mounted on a wooden structure, a metal sheet at least 35 inches in diameter should be attached to the mounting surface. The metal sheet should be grounded to the antenna mounting base. The antenna should be located, if possible, at least 17 inches from any protruding structural member of the train that might cause shadow effect.

The RG-8/U transmission line from the antenna to the radio equipment should be made as short as possible. The transmission line may be enclosed in a 1/2-inch or 3/4-inch conduit to protect it from any possible damage. Refer to Cable and Connector Detail--CEPD-386--for assembly details.

b. Radio Set Housing

The equipment should be mounted in a location which is well ventilated and which provides adequate clearance for the unit. The radio set may be mounted in either the horizontal or the vertical plane. Refer to Installation & Intercabling Detail for exact minimum clearance and mounting dimensions.

c. Power Connections

It is recommended that the power input leads to the radio set be connected as closely to the battery terminals as possible on the battery side of the locomotive main power switch.

To further protect the radio equipment and power input leads, it is recommended that a double-pole, double-throw switch be placed in series with both primary power input leads.

CAUTION

Polarity of the power input leads must be observed. Reverse polarity protection diodes are located in the radio

CAUTION (Cont'd)

set; the one used in the 12-volt line causes the 20-ampere line fuse to blow, and the one used in the 64-volt line causes the 6-ampere line fuse to blow. The line fuses are located in the power supply (see Figure 45). Refer to the Installation and Intercabling Diagram for proper polarity power connections.

A 25-ampere circuit breaker or 25-ampere fuse should be connected in series with each primary power input lead for 12-volt operation to further protect the radio equipment and power leads. For 64-volt operation, the TLN6586A Transient Voltage Filter Kit provides the required fusing. The filter (not supplied) should be used to protect power supply transistors from transient voltage spikes for 64-volt operation.

d. Power Cable

The power plug (part of the TLN6491A Power Plug Kit) that mates to the receptacle on the control head will accept a cable with a maximum output diameter of 5/8 inch. This cable is not supplied. The largest wire size that can be soldered to each pin is #16 gauge; therefore, the power cable length should not be more than ten feet. In the case of a 12-volt dc installation a cable with six #16 gauge wires should be used for the power and ground leads. Connect one pair to the positive terminal of the primary power, one pair to the negative terminal, and one pair to the vehicle ground. If the power cable must be longer than 10 feet, use a junction box. Locate the junction box close to the radio set, and use #8 or larger wire between the junction box and the battery to keep the cable voltage drop as low as possible. For installations using frequency reverting Universal Models with TLN6490A Hang-Up Cup, connect two wires, #18 or #20 gauge, from terminals J and I of P501 to the terminals of the TLN6490A Hang-Up Switch.

NOTE

In both the 64- and 12-volt installations, a vehicle ground must be provided at pins "D" and/or "E" of the power plug. If one side of the primary power is grounded to the vehicle, a separate ground lead is not necessary. However, a jumper must be installed in the power plug from the grounded power lead to pins "D" and/or "E".

e. Control Head (Channel Reverting Models)

The channel reverting control head is factory wired for channel 1 reverting. If another channel is desired for reverting, connect the GRAY-RED lead from relay K501 and the GRAY-GRN lead from TB502-14 as shown in Table 5.

TABLE 5.

REVERTING CONNECTIONS (UNIVERSAL)

REVERTING CHANNEL	GRAY-RED Wire Terminal	GRAY-GRN Wire Terminal
F1	TB501-1	TB502-9
F2	TB501-2	TB502-10
F3	TB501-3	TB502-11
F4	TB501-4	TB502-12

3. INSTALLATION

For instructions on the installation of this radio set, see the Universal Installation & Intercabling Diagram.

4. PROVISIONS FOR MULTIPLE-FREQUENCY OPERATION

a. General

"Motran" Railroad Radio is capable of operation on one to four frequencies. To increase the number of operating frequencies, two steps are required:

(1) Plug in the additional channel elements.

(2) Move the frequency selector switch stops to allow it to rotate to more positions.

NOTE

If a radio set has more transmitter frequencies than receiving frequencies or vice versa, there are jumpers connected on the four-frequency circuit board. Refer to the INSTALLATION OF THE STANDARD AAR RADIO SET section of this manual for complete jumpering information.

b. Channel Elements

Formulas for determining the correct crystal frequency for a specific carrier frequency are

given in the THEORY OF OPERATION section of this manual. Refer to the circuit board diagrams for correct locations of the channel elements for each frequency. Frequency and deviation must be checked for each new transmitter frequency and the radio should be netted for optimum performance. Refer to the ALIGNMENT PROCEDURES and IDC ADJUSTMENT PROCEDURE in this manual for procedures to accomplish these checks.

c. Frequency Selector Switch

As shipped from the factory, a mechanical stop on the frequency selector switch on the control head is set to prevent rotation to an unused position. For example, if a radio set is ordered with enough channel elements for two-frequency operation, the switch stop is set to prevent rotation of the frequency selector switch to the F3 and F4 positions. When a frequency is added, the mechanical stop must be reset to permit rotation to an additional position. Use the following procedure:

Refer to Figure 16.

(1) Rotate the switch to the F1 position.

(2) Loosen the set screw and remove the knob (item 1).

(3) Loosen the hex nut (item 2).

(4) Position the mechanical stop (item 3) as shown in Figure 16 for the number of frequencies desired. For two-frequency operation, the tab extends forward at the bottom center. For one-frequency operation, it is rotated one position counterclockwise. For three-frequency operation it is rotated one position clockwise. For four-frequency operation, it is removed entirely.

NOTE

It is very important that the switch (item 5) and the washer (item 4) remain indexed as shown in Figure 16 when the hex nut is loosened. It may be necessary to remove the control head from the radio set and hold the switch during assembly to assure correct indexing.

(5) Replace hex nut and knob.

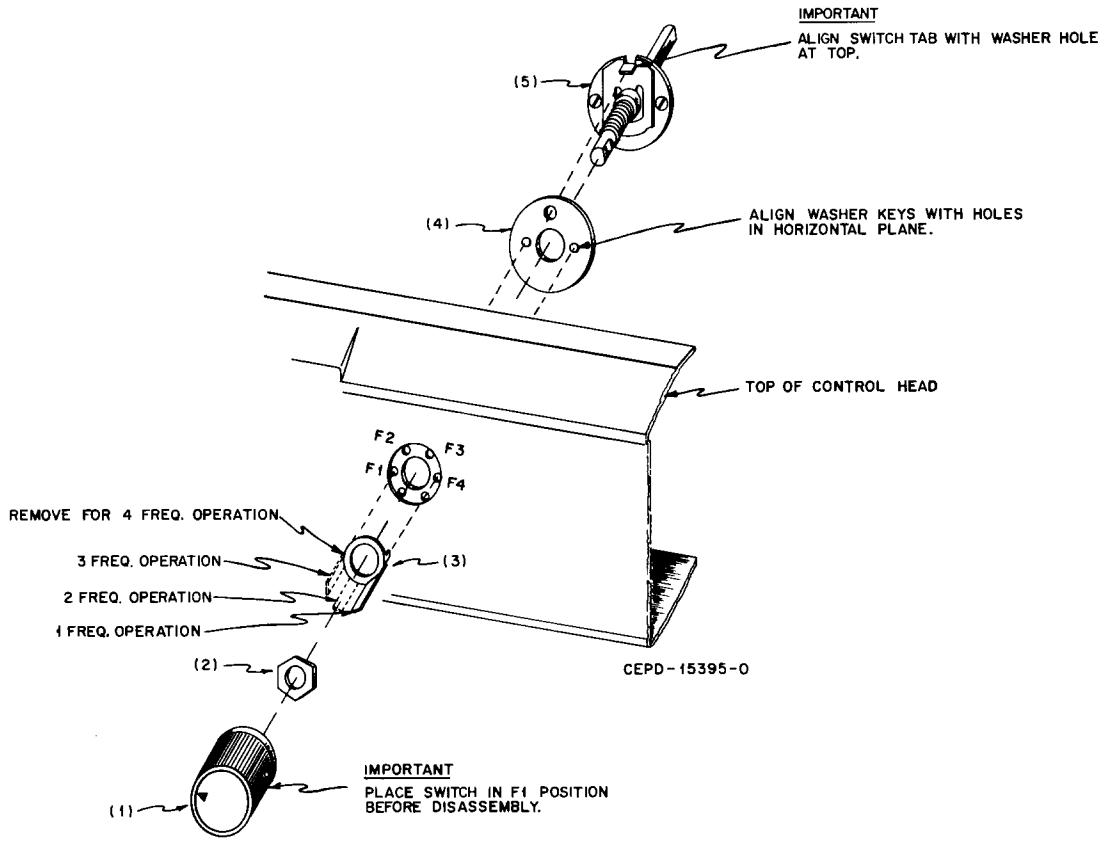


Figure 16.
Universal Control Head Frequency Selector Switch Stop Detail

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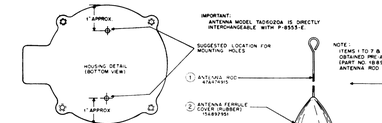


IMPORTANT:
ANTENNA MODEL TAD6020A IS DIRECTLY INTERCHANGEABLE WITH P-8553-E

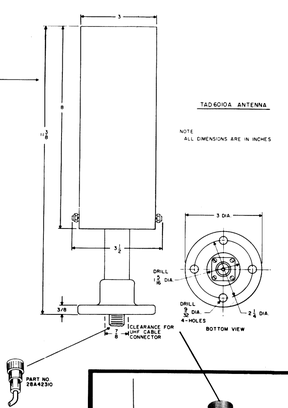
SUGGESTED LOCATION FOR MOUNTING HOLES

NOTE:
ITEMS 1 TO 7 & 20,21 CAN BE OBTAINED PRE-ASSEMBLED (PART NO. 18853582 ANTENNA ROD ASSEMBLY)

NOTES:
1 HOUSING CONDUIT ENTRANCE IS TAPPED 3/4-14 PIPE THREAD FOR 3/4 I.D. CONDUIT. TWO BUSHINGS ARE SUPPLIED TO REDUCE HOUSING CONDUIT ENTRANCE TO 1/2 PIPE THREAD FOR OPTIONAL USE OF 1/2 I.D. CONDUIT
2 CABLE PLUG (PART N° 28A4251) NORMALLY SUPPLIED IS FOR USE WITH RG-8/U CABLE FOR RG-58A/U CABLE, USE THIS PLUG PLUS 58A85402D CABLE ADAPTER (NOT SUPPLIED WITH ANTENNA)
3 DRILL MOUNTING HOLES IN ANTENNA HOUSING (3) AS REQUIRED. SEE DETAIL.
4 A 34" DIAMETER METAL PLATE MUST BE USED AS A GROUND PLANE UNLESS ANTENNA IS MOUNTED UPON AN EQUIVALENT METAL SURFACE.

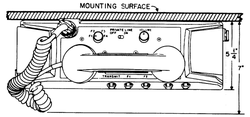
ANTENNA MODEL TABLE

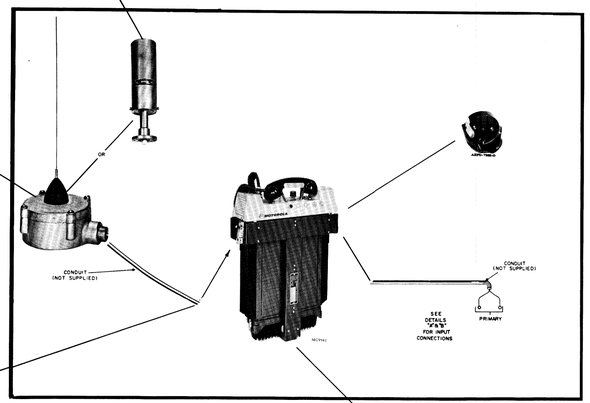
MODEL	SUFFIX	DESCRIPTION
TAD6020A	1	ANTENNA

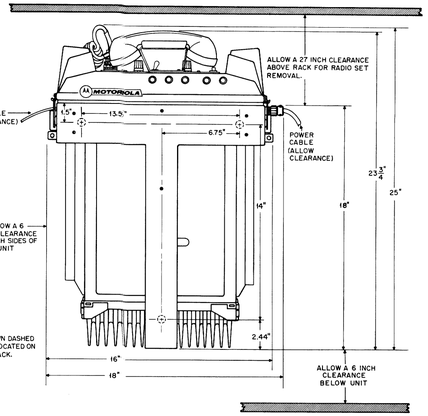


TAD6010A ANTENNA

NOTE
ALL DIMENSIONS ARE IN INCHES





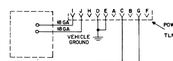


NOTE
MOUNTING HOLES SHOWN DASHED ARE FOR 5/16" BOLTS LOCATED ON MOUNTING SIDE OF RACK.

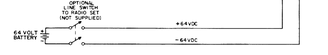
GENERAL NOTE

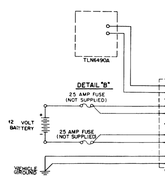
1 INSPECT EQUIPMENT THOROUGHLY AS SOON AS POSSIBLE AFTER DELIVERY FOR SHORTAGES AND DAMAGE
2 F.C.C. REGULATIONS STATE THAT A RADIO TRANSMITTER MAY BE TUNED OR ADJUSTED ONLY BY A RADIO OPERATOR HOLDING AN APPROPRIATE RADIOTELEPHONE LICENSE OF APPLICABLE CLASS OR BY A CHANNEL WORKING UNDER DIRECT SUPERVISION OF THE SAME
3 A 34" DIAMETER METAL PLATE MUST BE USED AS A GROUND PLANE UNLESS ANTENNA IS MOUNTED UPON AN EQUIVALENT METAL SURFACE

DETAIL "A"



TLN6586A TRANSIENT VOLTAGE FILTER KIT (NOT SUPPLIED)





NOTE

The power plug that mates to the receptacle on the control head will accept a cable with a maximum outer diameter of 5/8". This cable is not supplied. The largest wire size that can be soldered to each pin is #16 gauge; therefore, the power cable length should not be more than ten feet. In the case of a 12 volt d-c installation a cable with six, #16 gauge wires should be used for the power and ground line. Connect one pair to the positive terminal of the primary power, one pair to the negative terminal, and one pair to the vehicle ground. If the power cable must be longer than ten feet, use a junction box. Locate the junction box close to the radio set, and use #8 or larger wires between the junction box and the battery to keep the cable voltage drop as low as possible.

For installations using frequency reverting Universal models with Handset Hang Up Cup connect two wires, #18 or #20 gauge, from terminals J and I of P501 to terminals of the TLN6490A hang-up switch.

In both the 64 and 12 volt installations a vehicle ground must be provided at pins "D" and/or "E" of the power plug. If one side of the primary power is grounded to the vehicle, a separate ground lead is not necessary. However, a jumper must be installed in the power plug from the grounded power lead to pins "D" and/or "E".

EPD-6400-B

PARTS LIST

TLN6304C Mounting Rack Frame EPD-17463-O

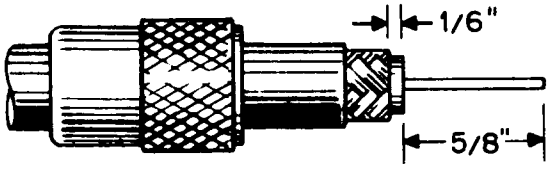
QUANTITY	MOTOROLA PART NO.	DESCRIPTION
1	7D82748D03	FRAME, mounting rack
2	5SB8235OC01	CATCH, hold-down
4	3S131958	SCREW, machine: 10-32 x 5/8"; "Phillips" binder head
4	2A82976C02	NUT, lock: 10-32
4	58A82363C01	GUIDE (large)
6	58A82362C01	GUIDE (small)
20	3S131959	SCREW, tapping: #6 x 1/2"; Pan head
2	4S7670	LOCKWASHER: 1/4" int.
2	2ZA82021D01	PIN, guide
2	2A82976C01	NUT, lock: 1/4"-28
1	33A8341Z9	NAMEPLATE, FCC data
2	3S129676	SCREW, tapping #4 "Phillips" Pan head
2	54B82370C01	LABEL, warning
1	7A820119D01	SUPPORT, top mounting frame
1	7A82020D01	SUPPORT, bottom mtg. frame
1	41A82023D01	SPRING, hold-down
2	3S132158	SCREW, machine: 8-32 x1-3/8" "Phillips" binder head
2	43C82377B05	SPACER
2	4S7562	WASHER, flat: 7/16 x .187 x .033"; steel
2	2K840706	NUT, elastic stop: 8-32
2	3S132161	SCREW, tapping #8 x 5/8"; "Phillips" Pan head

Universal "Motran" Railroad Radio Installation & Intercabling Diagram
Motorola No. EPD-15431-A
1/6/67-CP

STEP 1

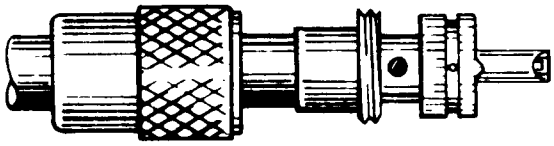
CUT END OF CABLE EVEN. REMOVE VINYL JACKET 1 1/8".

STEP 2



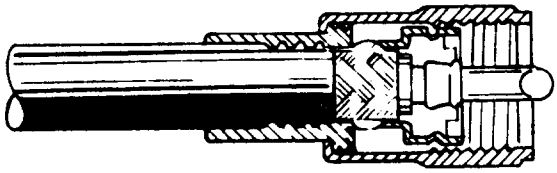
BARE 5/8" OF CENTER CONDUCTOR. TRIM BRAIDED SHIELD. SLIDE COUPLING RING ON CABLE. TIN EXPOSED CENTER CONDUCTOR AND BRAID.

STEP 3



SCREW THE PLUG SUB-ASSEMBLY ON CABLE. SOLDER ASSEMBLY TO BRAID THROUGH SOLDER HOLES. *CAUTION - DO NOT USE EXCESSIVE HEAT OR SOLDER.* USE VERY HOT IRON, SOLDER QUICKLY AND IMMEDIATELY CHILL WITH COLD, WET CLOTH.

STEP 4



FOR FINAL ASSEMBLY, SCREW COUPLING RING ON PLUG SUB-ASSEMBLY.

Antenna Cable & Connector Assembly Detail
Motorola No. CEPD-386-O
6/17/66-CP

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OPERATING INSTRUCTIONS

1. PRE-OPERATIONAL CHECKS AND ADJUSTMENTS

Before placing the equipment in operation, the following procedures should be performed:

a. General

Check all lugs, cable connections, fuses, and bolted connections.

b. Power

(1) Place the system power switch in the "ON" position.

(2) One of the white channel indicator lamps should light to indicate "power on". On non-reverting models, the lamp must correspond with the position of the frequency selector switch. On channel reverting models, hang up the handset. The lighted lamp indicates the frequency to which the radio set reverts when the handset is hung up, regardless of the position of the frequency selector switch.

c. Transmitter

(1) Load the transmitter to the antenna as described in the TRANSMITTER ALIGNMENT PROCEDURE.

(2) Check the transmitter for proper operating efficiency by comparing the meter readings as listed on the TRANSMITTER ALIGNMENT PROCEDURE.

d. Receiver

The receiver VOLUME and SQUELCH controls are located on the bottom of the receiver chassis. Locate these controls and adjust as described in the RECEIVER ALIGNMENT PROCEDURE in this manual. On "Private-Line" tone-coded squelch models, set the "PRIVATE LINE" switch to the OFF position during the adjustment.

2. OPERATING PROCEDURE

Refer to Figures 17 and 18.

a. Turn the Equipment "ON"

Primary power "on-off" facilities must be provided since they are not incorporated in the radio equipment.

b. To Transmit

(1) Remove the handset from the hang-up bracket.

(2) Turn the frequency selector switch to the desired channel. On channel reverting models, also press the PUSH TO CHANGE CHANNEL button to select any channel other than the reverting channel.

(3) Note that the channel indicator lamp for the desired channel is lighted.

(4) Monitor the channel to make sure it is not in use. On "Private-Line" tone-coded squelch models, it is necessary to momentarily set the "PRIVATE LINE" switch to the OFF position to monitor the channel.

(5) Press the push-to-talk switch on the handset. The blue TRANSMIT indicator lamp glows while the transmitter is keyed.

(6) Speak directly into the mouthpiece of the handset at a normal voice. Motorola transmitters cannot be overmodulated due to the limiting action of the IDC ("Instantaneous Deviation Con-

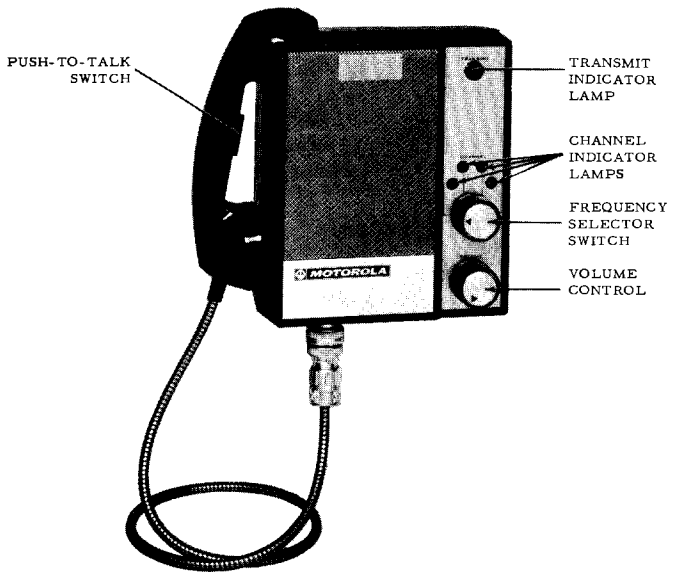


Figure 17.
Non-Reverting Standard AAR Control Head

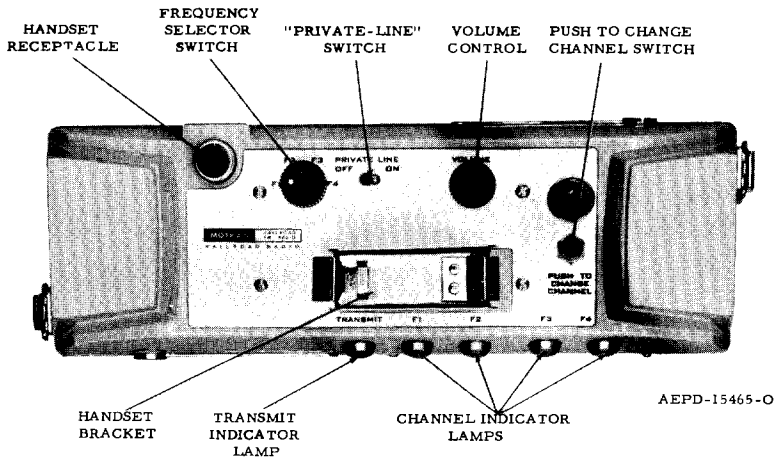


Figure 18.
Channel Reverting Universal Control Head With
"Private-Line" Tone-Coded Squelch

trol"). **Release** the handset "push-to-talk" button upon **completion** of the transmission.

(7) If the radio set is equipped with an optional time-out timer, the transmitter shuts off after one minute of continuous operation. This is indicated by an alert tone from the control head speaker. To reset the time-out timer for another minute of transmission, merely release the push-to-talk switch momentarily.

c. To Receive

The receiver operates normally when the "push-to-talk" button is released. When signals are heard, adjust the VOLUME control on the control head for the desired listening level.

On channel reverting models, the receiver operates only on the reverting channel when the handset is hung up. To receive another channel, lift the handset, select the desired channel with the frequency selector switch, and press the PUSH TO CHANGE CHANNEL button.

THEORY OF OPERATION

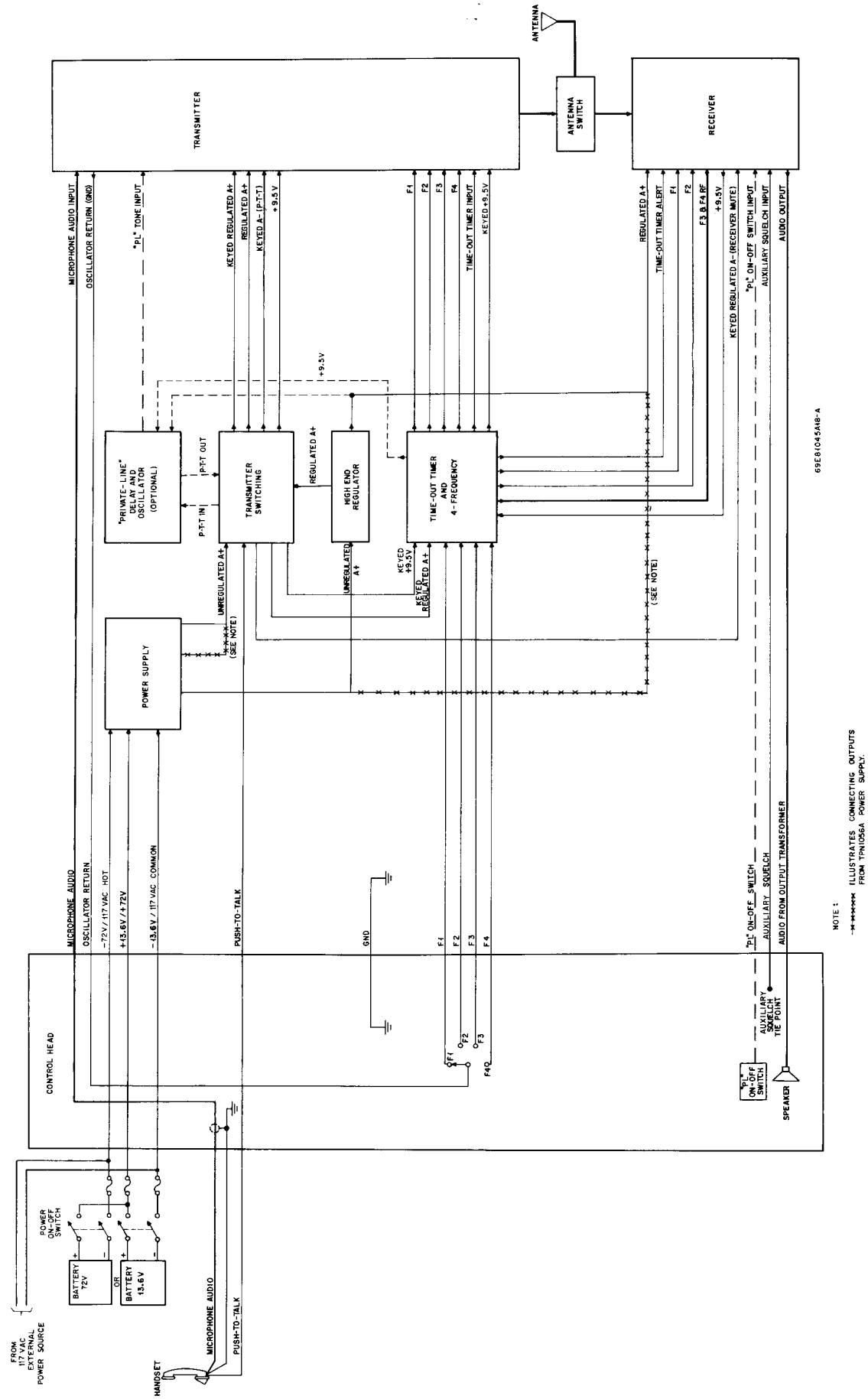


Figure 19. Functional Block Diagram

1. FUNCTIONAL OPERATION

The overall operation of the radio set is illustrated in the functional block diagram in Figure 19. This diagram applies to both Standard AAR and Universal installations.

When the external power on-off switch is on, voltage is applied through the mounting rack and connector to the power supply. For 64-volt dc operation, the battery voltage is 72 volts. In 12-volt dc operation, the battery voltage is 13.6 volts. In either case, the power supply output is 13.8 volts for transmit and 15.5 volts for receive. The output from the power supply is applied to the high end regulator which regulates the output to a constant 14.3 volts.

In a 117 v ac installation, the output is a constant 14.3 volts which is used for both receiver and transmitter operation.

The transmitter switching circuit provides distribution for the various A+ voltages to all of the transmitter and the receiver muting circuitry. Part of these outputs are present only when the transmitter is keyed, while the remainder are provided constantly. When the handset push-to-talk switch is pressed, transistor switches provide the keyed outputs; keyed regulated A+ and keyed A-. These keyed outputs are applied to the transmitter as collector voltage for the power stages and ground return for all exciter and power doubler stages to activate the transmitter. Keyed regulated A+ is also applied as a starting voltage to the time-out timer (if installed), and as a muting voltage to the receiver. A regulated +9.5 volts is provided for the transmitter second audio amplifier stage, channel elements, and modulator by a diode in the four-frequency board in series with a zener diode in the transmitter.

The four-frequency board contains switching diodes which are controlled by a frequency selector switch in the control head. These diodes complete the circuit for one of the four possible transmitter and receiver channel elements. Two of the channel elements for the receiver, F3 and F4, are also located on this circuit board. In addition to the switching diodes, the time-out timer is plugged into this circuit board. The time-out timer turns off the transmitter one minute after keyed regulated A+ is applied and provides an alert tone to the receiver audio circuit to notify the operator that the transmitter is shut off.

The "Private-Line" ("PL") delay and oscillator circuit provides a "PL" tone output to modulate the transmitter signal. This tone is used as a signal to unsquelch the distant receiver. Receivers equipped with a "Private-Line" decoder and the proper reed are capable of being unsquelched only by this tone. This type of operation is referred to as "Private-Line" tone-coded squelch. The "PRIVATE LINE" switch (on the control head) controls the type of squelch used; the ON position provides "Private-Line" tone-coded squelch operation and the OFF position provides conventional carrier squelch operation. An auxiliary squelch input provides a connection for special squelch applications.

2. RECEIVER

The receiver is a completely transistorized double-conversion superheterodyne type. Refer to the receiver block diagram, Figure 20. It receives FM signals on one to four fixed, crystal-controlled frequencies in the 150.8-174 mc band. One channel element (oscillator module) is used for each frequency to be received. Only one frequency can be received at a time. A switch on the control head selects the frequencies. In selecting F1, the switch completes the dc path to ground for the #1 oscillator, which permits the stage to operate. At the same time, it opens the dc ground path to disable the other oscillator stages. Other frequency selector switch positions close the ground path to the selected oscillator while breaking it for the others.

a. RF Preselector

The r-f section of the receiver contains an r-f preselector. The preselector consists of five low loss, highly selective helical resonant cavities. The preselector has a bandpass having a flat acceptance bandwidth and a steep skirt response to provide rapid attenuation of signals outside the acceptance bandwidth. The carrier signals received at the antenna are coupled to the gate of the first mixer through the preselector cavities.

b. First Oscillator - Multiplier

The first oscillator circuitry is housed in a factory-sealed, temperature-compensated, plug-in module (channel element). The oscillator uses an unheated crystal in a Colpitts circuit with the channel element output at the third harmonic of the fundamental crystal frequency. This signal is then applied to a two-stage transistorized multiplier circuit. Each of these stages doubles the input frequency which results in an output frequency which is four times the channel element output frequency. Consequently, the injection signal to the first mixer is twelve times the fundamental frequency of the crystal.

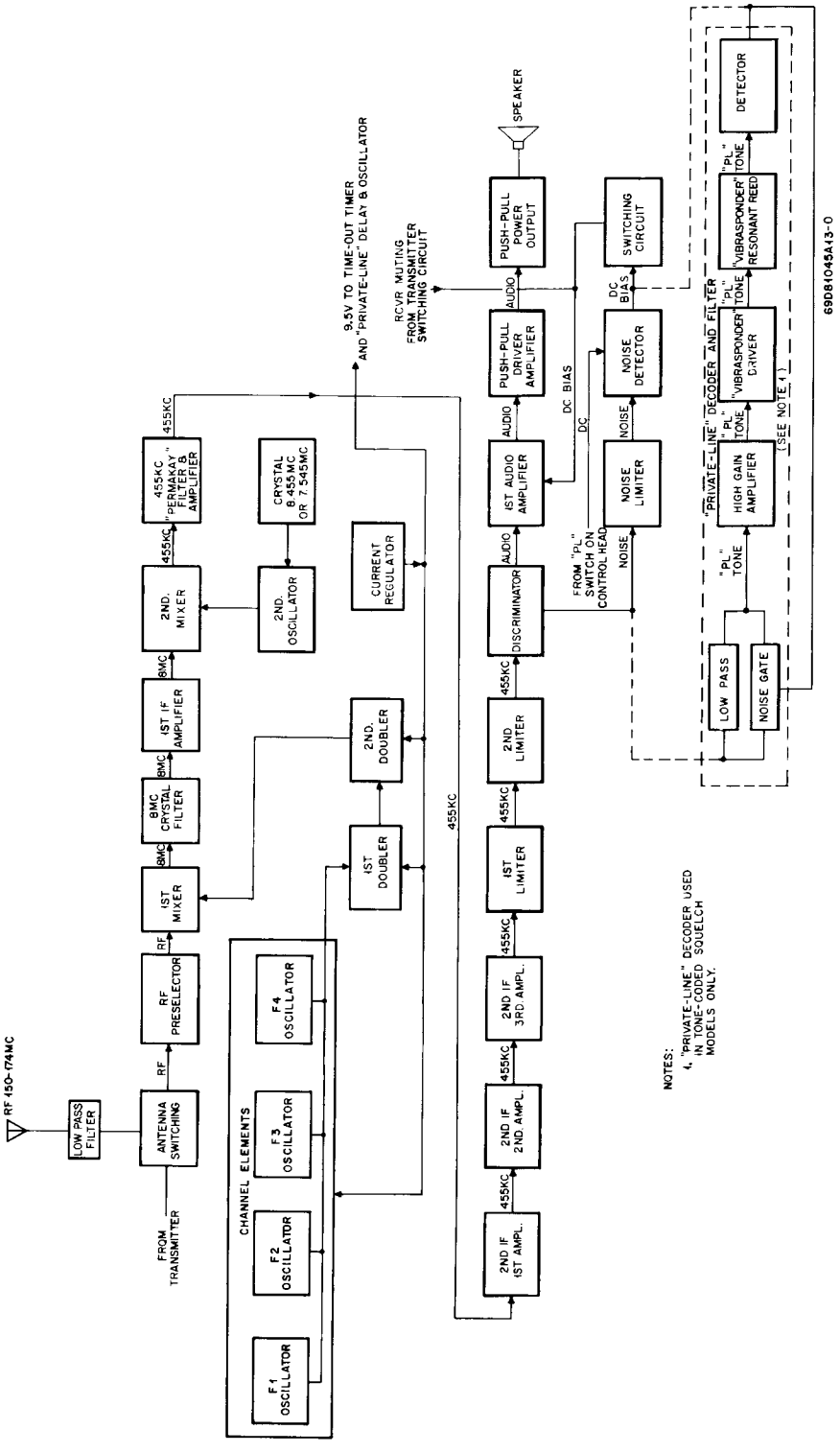


Figure 20.
Receiver Block Diagram

A current regulator stage feeds a Zener diode which provides regulated +9.5 volts to the first oscillator and the two doubler stages. The output from the current regulator is also routed to the "Private-Line" delay and oscillator circuit.

c. First Mixer

The field effect transistor first mixer heterodynes the signal from the r-f preselector with the signal from the first oscillator to produce the first intermediate-frequency (1st i-f) of 8 mc.

The frequency relationships can be expressed as follows:

$f_c - 12f_1 = 8$ mc

r-f carrier input	mult. factor	chan. element crystal freq.	1st mixer output (1st i-f)

$$f_1 = \frac{f_c - 8 \text{ mc}}{12}$$

d. First IF and Second Mixer

The first i-f consists of five tuned circuits, a common emitter amplifier, a second mixer and the second oscillator. The frequency of the first i-f is 8 mc. The output of the first mixer is coupled to the base of the 8 mc amplifier through a triple-tuned crystal filter circuit.

The output of the i-f amplifier is coupled to the base of the second mixer through a highly selective triple-tuned circuit. Also applied to the base of the second mixer is the injection frequency of the second oscillator. The second oscillator frequency is controlled by an 8.455 or 7.545 mc crystal. The frequency of the second oscillator and the first i-f is maintained constant for all incoming signals at the antenna. The difference between the second oscillator frequency and the first i-f frequency is the second mixer output. This output is a 455 kc signal. The frequency relationships of these three stages are as follows:

1st i-f	8000 kc
2nd local osc. freq.	7545 kc
Difference freq. (2nd i-f)	455 kc

OR

2nd local osc. freq.	8455 kc
1st i-f	8000 kc
Difference freq. (2nd i-f)	455 kc

e. Second IF

A "Permakay" i-f filter containing a transistor amplifier stage is used in the second i-f circuit. The filter sections are permanently sealed in polyesterstyrene and the filter is unconditionally guaranteed for the life of the receiver, provided the seal is not broken and the housing is not tampered with. The amplifier circuitry is mounted to an eyelet board within the filter and is accessible for servicing. This filter is the major factor in determining the bandwidth and selectivity of the receiver. It greatly attenuates the signal outside the pre-determined bandpass. Three i-f amplifier stages follow the 455 kc filter to saturate the limiter.

f. Limiter Stages

The two limiter stages are 455 kc amplifiers arranged so that an increase in input signal produces no change in the amplitude of the output signal. The limiters are in full saturation at all times, that is, with weak or strong signals or noise only.

When a signal is applied to the N-P-N first limiter, the base is driven negative with respect to the emitter during the negative alternation of the signal. This places a reverse bias at the emitter-base junction causing the collector current to drop to zero. During the positive half of the input signal, the base becomes more positive, increasing the emitter-to-collector current to its maximum value. Thus with a signal, the collector current is driven between cut-off and saturation. Operation of the second limiter is essentially the same except that the signal undergoes a phase reversal in the first limiter and the P-N-P transistor performs the same functions when its input signal is of opposite polarity. The output of the limiter is a signal of constant amplitude.

g. Discriminator

The discriminator used is a phase discriminator, that is, the operation is dependent upon a 90° phase shift which occurs at resonance between the primary and secondary voltages of the tuned transformer.

The discriminator recovers the audio from the 455 kc i-f signal. A typical discriminator response curve is shown in Figure 21.

The i-f signal varies in frequency at the audio rate. This is shown below the curve. The corresponding audio output is drawn to the right of the curve.

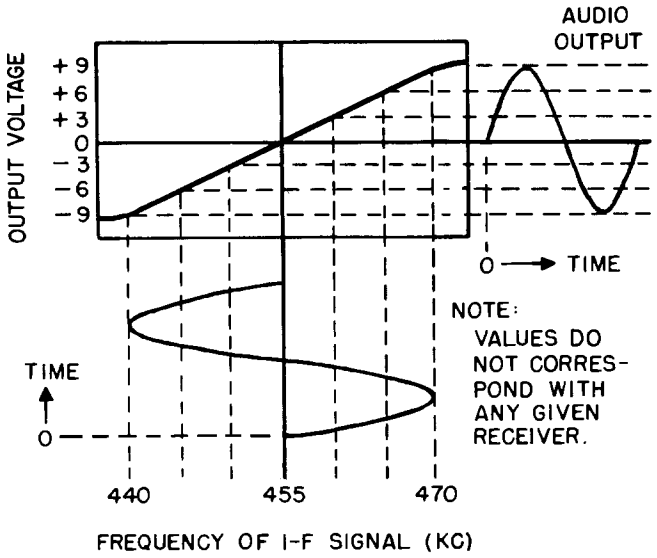


Figure 21.
Typical Discriminator Response

h. Noise-Actuated Squelch Circuit

The purpose of the squelch circuit is to eliminate disturbing noise which would otherwise be heard at the speaker during intervals between received messages.

The noise-actuated squelch circuit consists of a SQUELCH control, noise limiter, noise detector (rectifier) and transistorized dc control stage (switching circuit).

In the absence of a received r-f carrier (SQUELCH control at threshold), noise from the discriminator is amplified by the noise amplifier limiter. This noise voltage is rectified in the form of drawing more or less current in the noise detector stage. More current is drawn when the receiver is fully squelched (SQUELCH control fully clockwise); less current is drawn when the receiver is in the unsquelched condition.

When the noise detector is drawing heavy current, a less positive voltage is developed at the emitter element of the detector. This causes a heavy forward bias to be applied to the switching transistor which results in a heavy current through the transistor. This, in turn, reverse biases the first audio amplifier stage, cutting off the stage. Therefore, the following audio stages do not receive signals and the speaker is quiet.

When an on-frequency signal is received, the noise reaching the squelch circuit diminishes entirely, so that there is little or no output from the noise detector. As a result, the dc control stage appears as an open switch and the audio amplifier is biased normally. Under these conditions, the incoming signals reach the speaker.

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

The "Private-Line" ("PL") squelch circuit consists of a low-pass filter network, high-gain amplifier, "Vibrasponder" driver-limiter, "Vibrasponder" resonant reed, and a detector circuit.

The output from the discriminator is connected to the low-pass filter network, which passes frequencies below the audio range, that is, below 300 cps. The low-frequency signals ("PL" tone) are amplified and coupled to the input of the "Vibrasponder" driver. The driver stage provides the output required for driving the resonant reed. Thus, in "Private-Line" operation the r-f carrier is always modulated by the assigned "PL" tone, which after being detected and amplified, energizes the resonant reed. If a different tone is present with the r-f carrier, the reed will not respond due to its highly selective design. The driver output is applied to the resonant reed coil through a capacitor to complete the "PL" tone path. The resonant reed is permanently tuned and sealed at the factory. The reed vibrates in response to the incoming tone signal from the transmitter. The vibrating reed causes the detector to respond and charges a capacitor to provide a steady dc voltage for biasing the switching transistor. The low-pass filter is paralleled by a high-pass circuit to keep low frequency noise from activating the "Vibrasponder" resonant reed detector circuitry. When the proper tone signal is received and the audio amplifier is "turned on", the high-pass path is shorted to A- through a diode that is forward biased by current flow from the "PL" detector output.

j. Switching Transistor Stage

The base of the switching transistor is the control point of the squelch circuit. The output of the noise squelch circuit, the auxiliary squelch (if used), the output of the "PL" squelch circuit (in "Private-Line" models), and the "PL" ON-OFF switch input (in "Private-Line" models) are connected to this point. When squelched, the switching transistor is biased into heavy conduction and appears as a closed switch. The closed switch shunts the A+ source to the audio amplifier and prevents signals from being applied to the speaker. When unsquelched, the switching transistor is biased to cutoff and appears as an open switch, which permits A+ to be applied to the audio amplifier.

In "Private-Line" tone-coded squelch models, the "PL" squelch circuit is operative at all times. The "PRIVATE-LINE" switch on the control head actually switches the noise squelch circuit in or out. With the "PRIVATE-LINE" switch in the ON position and the jumper across diode CR755 in place, ground is applied through resistor R334 to the base of the switching transistor. The ground inhibits the noise-actuated squelch circuitry so that quieting and resultant noise detector cut-off 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. However, if the jumper across diode CR755 is removed and the "PRIVATE-LINE" switch is placed in the ON position, an "AND" gate situation is produced as a result of diode CR755 now in series with the base of the switching transistor. This "AND" gate condition exists because an incoming "Private-Line" signal must have a tone that will activate the "Private-Line" decoder circuit as well as sufficient signal strength to unsquelch the noise-activated squelch circuit. Removing the jumper allows the noise-activated squelch circuit to have partial control over the "PL" squelch circuit. The received "PL" signal requires a 14 db signal to noise ratio or greater to override the preset level. This level can be changed by adjusting the squelch control.

With the "PRIVATE-LINE" switch in the OFF position, ground is removed from the divider resistors to permit the switching transistor to operate from the noise-actuated squelch circuit or the "Private-Line" tone-coded squelch circuit. This permits an operator to monitor all on-frequency transmissions, including those outside his own "Private-Line" network, to determine that the channel is clear before beginning his transmission.

k. Audio Circuit

Audio signals from the discriminator are coupled to the first audio stage through the VOLUME control and a high pass filter. The VOLUME control varies the signal level applied to the base of the first audio amplifier. The filter effectively blocks signals below 300 cps, including "Private-Line" tones, and passes the desired audio range of 300-3000 cps.

The first audio amplifier is reverse biased when the radio set is squelched or the transmitter is keyed (receiver muted). The emitter voltage drops below the base voltage to produce the reverse bias condition. In the normal receive condition, the first audio amplifier is forward biased and the output signal is applied to the driver. The drivers are connected in an emitter coupled phase splitter configuration. The capacitor in the base of one driver transistor provides the 6 db pre-emphasis characteristic from 300 to 3000 cps. As the frequency of the signal increases, the impedance across the capacitor decreases and the resultant signal amplitude decreases. The push-pull output amplifiers provide 8 watts of audio power to an 8-ohm speaker.

3. TRANSMITTER

The solid-state transmitter is phase-modulated and operates on one to four crystal controlled frequencies. One channel element is used for each frequency to be transmitted. The crystal frequency is modulated, multiplied 12 times, and applied to the high power r-f stages. The r-f output is in the 150.8-174 mc range.

The transmitter block diagram, Figure 22, shows the stage-by-stage signal flow and operating frequencies.

a. Microphone and Pre-Amplifier Circuit

A Motorola dynamic microphone (mounted in a handset) with a built in transistorized pre-amplifier is usually used with this transmitter. The handset is connected into the radio set control head; the circuit from the control head is connected to the transmitter. The microphone connects between ground and the shielded lead of the audio amplifier input circuit. A dc voltage on the shielded lead provides operating power for the transistorized microphone. The microphone cartridge and pre-amplifier act like a variable voltage generator. The output voltage varies with the intensity and frequency of the sound waves which strike the diaphragm.

b. Deviation Limiting Circuit

In the incoming signal from the microphone, the wavefront slope depends on both amplitude and frequency. The overall effect of the deviation limiting circuit is to place a barrier upon the maximum wavefront slope which can pass into the modulator.

The deviation limiting circuit consists of components for pre-emphasizing, amplifying and limiting, and then de-emphasizing the audio modulation signal. Components in the input to the deviation limiting circuit form a 6 db/octave pre-emphasis circuit. The pre-emphasis circuit output is amplified in the first audio amplifier and then limited through series diode limiters. The limited audio signal is applied to the second audio amplifier through a low pass filter. The second audio amplifier operates as an emitter follower and develops an output signal across the IDC (Instantaneous Deviation Control) control. The setting of the IDC control determines the audio signal amplitude applied to the de-emphasis circuit to control the transmitter deviation. Except for slope limiting, the output waveform is identical to the input waveform and by controlling the slope of the signal wavefront, the transmitter maximum deviation is also controlled.

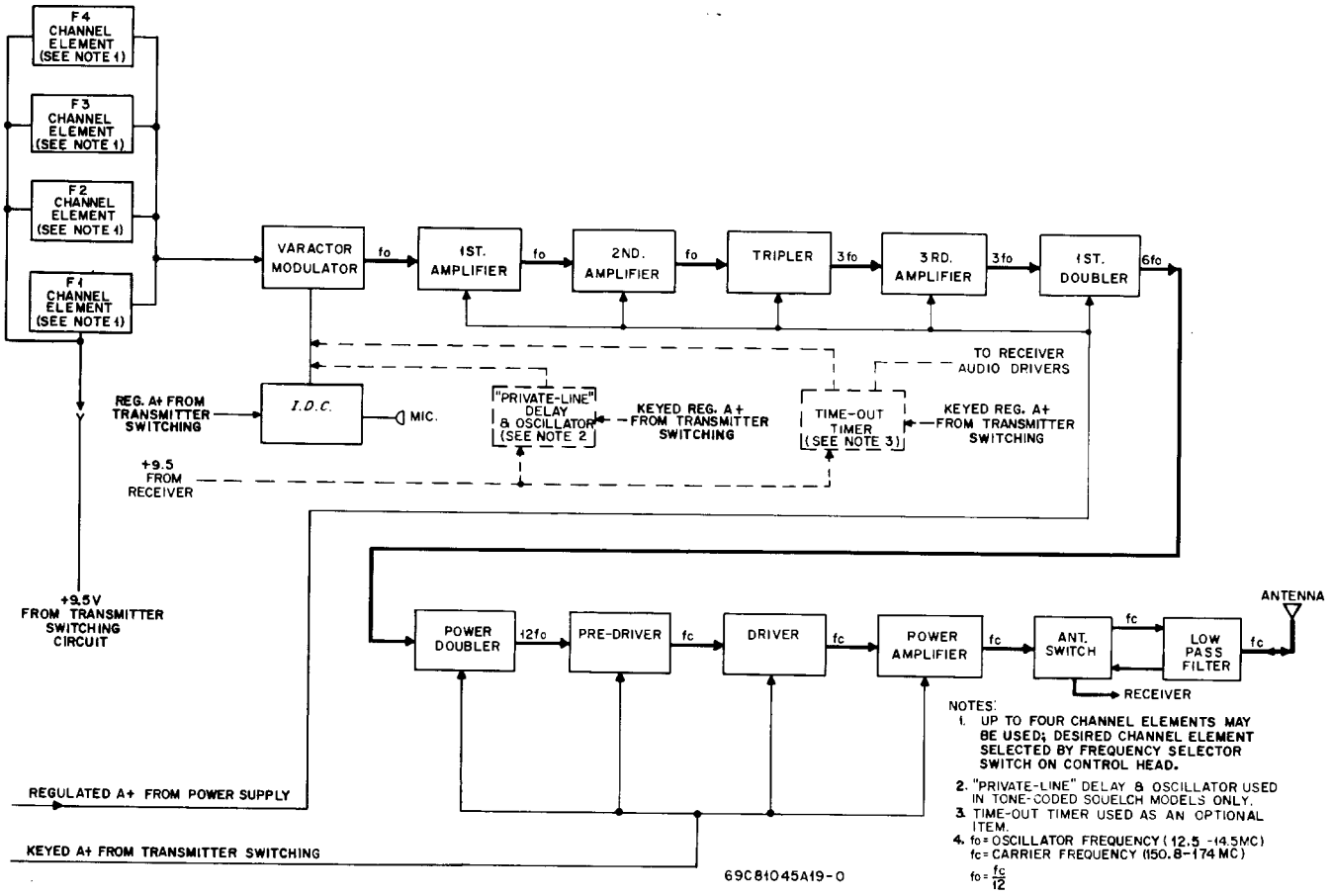


Figure 22.
Transmitter Block Diagram

c. Oscillator (Channel Element)

Since the crystals in the channel elements are unheated, each transistorized oscillator is individually compensated for frequency stability over the entire temperature range, and the whole assembly is housed in a factory sealed plug-in unit. For multiple-frequency radio sets, additional channel elements are used; one for each frequency. The frequency selector switch on the control head completes the dc ground path for the desired oscillator. Variable "warp" capacitors are mounted in the base of each channel element for fine frequency adjustment. The "warp" capacitors are accessible through holes in the exciter circuit board where the channel elements are inserted. Each oscillator operates on a specific frequency in the 12.500 to 14.500 mc range.

d. Modulator

The audio output of the deviation limiting circuit is applied to the modulator which phase modulates the output of the oscillator. The tuning elements of the modulator tank circuits are varactor diodes. The capacitance of these special back biased diodes is a function of the potential across the diodes. The audio signal is applied to the varactor diodes which changes this potential at an audio rate and varies the capacitance in the modulator tank circuit. This changes the phase angle of the r-f signal, producing modulation.

e. Multipliers and Amplifiers

The output signal of the modulator is amplified by two transistor stages, applied to a frequency tripler, amplified once more, then multiplied in a frequency doubler. The circuitry is located on the exciter circuit board. All stages except the second amplifier, which is common base, are of the conventional common emitter configuration. The output of the exciter is 300 to 400 mw at a frequency one-half of the final transmitter frequency (75 to 87 mc).

f. High Power Stages

The power doubler, pre-driver, driver, and power amplifier stages are all common emitter

amplifiers. The power doubler operates as a frequency doubler while providing a current gain. Its output is at the final r-f output frequency of 150.8 to 174 mc. Each of the additional stages provides additional current gain and the nominal power output of the stages is 1.5 watts, 5 watts, 13 watts and 40 watts respectively. The output of the final stages, at the final frequency, is matched to the antenna switching network by tunable LC components. The output of the antenna switching network is applied to the antenna through a harmonic filter to reduce second harmonic current.

The antenna switching network provides a low impedance path between the transmitter output and the harmonic filter during transmit, and at the same time provides a high impedance path between the transmitter output and the receiver input. During the receive condition, the input to the receiver is matched to the harmonic filter and a high impedance path is placed between the transmitter output and the harmonic filter. Switching action of the four-layer diodes in the antenna switching network provides the necessary impedance levels for proper matching. These diodes are in a low impedance state during the transmit condition and in a high impedance state during the receive condition.

g. "Private-Line" Delay and Oscillator Circuit ("Private-Line" Tone-Coded Squelch Models Only)

Refer to the schematic diagram at the back of the manual. As the name implies, this circuitry includes an oscillator (Q704 and Q705) and a delay circuit (Q701, Q702 and Q703). The oscillator produces the sub-audible "PL" tone which modulates the transmitter signal for "Private-Line" operation. The delay circuit provides a 150 millisecond delay after the push-to-talk switch is released before the transmitter shuts off. During this period, the phase of the "PL" tone is reversed to eliminate the noise burst in listening receivers at the end of the transmission.

(1) Oscillator

The oscillator is activated by the "PRIVATE LINE" switch on the control head and oscillates as long as the switch is in the ON position. Regeneration from the collector of Q705 to the base of Q704 sustains oscillation. A Motorola "Vibrasender" resonant reed determines the frequency of oscillation. The device is an electro-mechanical equivalent of a parallel tuned high Q tank circuit. The reed is a sealed, plug-in unit. The highly stable frequency is not adjustable. "PL" tones are assigned by Motorola to prevent interference from other "PL" networks in the same geographical area.

The oscillator output may be taken from the emitter or the collector of Q705, depending upon which of the diode switches, CR710 or CR711, is reverse biased. When the transmitter is keyed, CR710 is reverse biased to block the output from the collector of Q705; thus, the output is taken from the emitter during transmit operation. The reverse bias, which results in a high impedance across CR710, is developed as follows. The first P-T-T switch (Q210) turns on Q701 and the resultant current flows through R729 to drop the anode voltage of CR710 below the cathode voltage. When the transmitter is unkeyed, CR711 is reverse biased to block the output signal from the emitter of Q705 and CR710 becomes forward biased so the collector signal may be used. Q701 turns off when the push-to-talk switch is released and the reduced current through R729 permits the anode voltage of CR710 to rise above the cathode voltage. The diode now presents a low impedance path and permits the collector signal of Q705 to modulate the transmitter. The same rise in voltage that forward biased CR210 is applied through resistor networks to the cathode of CR211, which reverse biases the diode and presents a high impedance path to signals from the emitter of Q705.

The emitter and collector signals from Q705 are 180° out of phase. This out-of-phase signal modulates the carrier during the 150 milliseconds that the transmitter is kept on, and it is of the proper phase to damp the "Vibrasponder" resonant reed in the listening receiver. Since this occurs before the quieting signal in the receiver is lost, the characteristic burst of noise at the end of each transmission is eliminated.

(2) Delay Circuit

When the transmitter is unkeyed, Q702 is normally on and Q703 is off. Thus, no output is applied to the second P-T-T switch (Q211) in the transmitter switching circuit. However, when the transmitter is keyed, the first P-T-T switch (Q210) conducts and turns on Q701. Q701, in turn, allows C701 to charge rapidly and turn off Q702. Now, Q703 is forward biased and conducts to saturation, coupling A+ to the second P-T-T switch and turning on the transmitter. Switching action is almost instantaneous and no detectable delay occurs between pressing the push-to-talk switch on the handset and transmission of the r-f carrier.

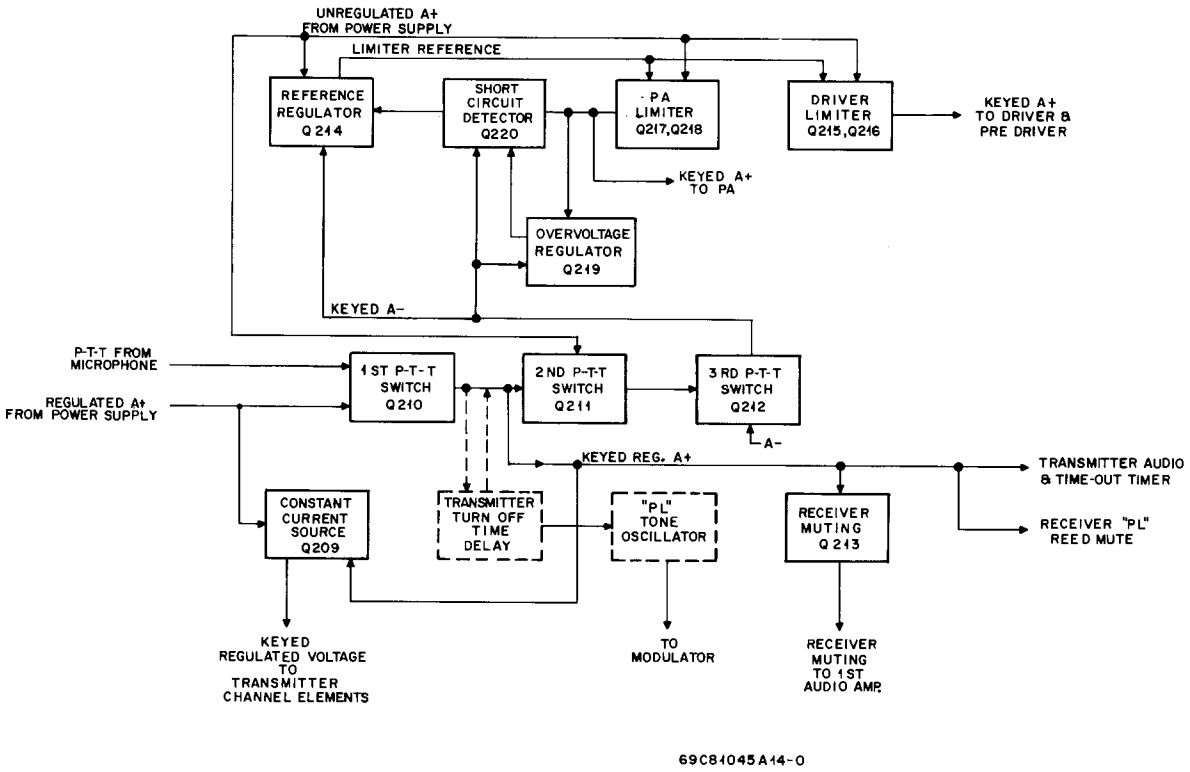


Figure 23.
Transmitter Switching Circuits Block Diagram

When the transmission has been completed and the push-to-talk switch on the handset is released, the first P-T-T switch (Q210) and Q701 are immediately shut off. However, C701 must discharge approximately 150 milliseconds before Q702 becomes forward biased and again turns on. With Q702 conducting, forward bias for Q703 is removed, thereby cutting it off. Q703, in turn, removes A+ from the second P-T-T switch and turns off the transmitter.

(3) PL Switching Circuit

This circuit basically consists of transistor Q706 which is used to inhibit the "PL" tone output when the "Private-Line" switch on the control head is placed to the OFF position and permits the tone to pass to its respective output when the switch is placed to the ON position. Assuming that the switch is in the OFF position, the original ground path from the cathode side of diode CR712 through the switch is broken. With the ground input to the diode removed, current is applied to the base of transistor Q706 via resistor R735, causing it to conduct. With this transistor forward biased, any "PL" tone existing at the junction of CR711 and C710 is shunted to ground via the conducting transistor.

However, if the "Private-Line" switch is placed in the ON position, the base of transistor Q706 is connected to ground through diode CR712, which removes the base bias from the transistor and thereby causing it to cut-off. When the transistor is cut-off, the "PL" tone is allowed to pass to its respective output terminal.

4. TRANSMITTER SWITCHING

The transmitter switching circuits control the voltages applied to the transmitter and receiver. When the transmitter is keyed, the transmitter switching circuits provide voltages for transmitter operation, control and reference voltages for the power amplifier and limiter stages, and muting voltage for the receiver. When the transmitter is unkeyed, the transmitter switching circuits return the radio set to the receive condition. However, if "Private-Line" tone-coded squelch is used with the radio set, an additional circuit delays transmitter turn-off for approximately 150 milliseconds. Refer to the transmitter switching circuits block diagram, Figure 23.

a. Push-To-Talk Circuits

Regulated A+ is applied continuously to the first P-T-T switch (Q210), and unregulated A+ is applied continuously to the second P-T-T switch (Q211) whenever power is applied to the radio set. When the push-to-talk button on the handset is pressed, a forward bias path is completed for the first P-T-T switch. This causes Q210 to conduct which, in turn, also causes the second P-T-T switch (Q211) to turn on. The output from Q211 turns on the third P-T-T switch (Q212) which applies keyed A- to the first doubler, power doubler, reference regulator, driver and final limiter stages, short circuit detector, and over voltage regulator. Regulated or unregulated A+ is applied continuously to each of these stages and the application of keyed A- energizes the stages.

b. Transmitter Current Limiting And Protection Circuit

Since the circuit operation for the final limiter and the driver limiter is basically the same, the following explanation of the final limiter circuit also applies to the driver limiter circuit.

Transistor Q218 functions as a current limiter and Q217 controls the base current to the limiter. Reference regulator Q214 establishes a reference voltage level for current limiter operation. This reference voltage is established by Zener diode CR222, which provides a constant base voltage. When the Q218 current decreases below that of the preset (limiting) level, Q217 is cut off and Q218 becomes saturated. If current through Q218 increases above that of the preset level, the voltage drop across the emitter resistor increases and causes the base voltage of Q217 to decrease to a level slightly less than that of the emitter voltage (constant reference from Q214). This condition forward biases Q217 causing a decrease in forward bias for Q218, thus insuring that the output current does not exceed the preset level.

If a short circuit occurs in the power amplifier section of the transmitter, the keyed A+ voltage drops sufficiently to cut off short circuit detector Q220. With Q220 cut off, current through the zener diode in the collector circuit drops below the regulating region and permits the base voltage of Q214 to rise toward A+. Q214 is then cut off which removes the drive to the driver limiter and final limiter. Therefore, the limiters are cut off and A+ is removed from the driver and power amplifier stages of the transmitter.

The over voltage regulator circuit (Q219) prevents the voltage applied to the power amplifiers from rising above a pre-determined value that could possibly damage the transistors. There is no base current to the over voltage regulator until the power amplifier keyed A+ voltage exceeds approximately 14 volts, since the Zener diode in the base circuit is below the regulating region and presents a high impedance. When the voltage exceeds 14 volts, the Zener diode conducts, supplies base current to Q219 and causes the transistor to conduct. When Q219 conducts, it shunts the bias to Q220 (the short circuit detector) and decreases its conduction. As a result, the drive to reference regulator Q214 is reduced to near cut-off, which, in turn, reduces the drive to the limiters. The impedance of the limiters increases to control the power amplifier voltage.

5. MULTIPLE-FREQUENCY CIRCUITS

a. Standard Applications

All "Motran" railroad radio sets are capable of receiving and transmitting on four different frequencies. This permits operation on one, two, three or four frequencies depending upon the number of channel elements installed. In standard applications, the receiver and transmitter have an equal number of frequencies. Normally, when less than four frequencies are used, a mechanical stop prevents the frequency selector switch from being rotated to all four positions.

All channel elements for the transmitter are located on the exciter circuit board. The receiver F1 and F2 channel elements are located on the multiplier circuit board in the receiver, but the F3 and F4 channel elements are located on the four-frequency circuit board located in the power supply. The channel elements operate from a regulated +9.5-volt source which is simultaneously applied to all channel elements. The oscillator return (ground) is applied to one receiver and one transmitter channel element from the frequency selector switch on the control head. When the switch is in the F1 position, the oscillator return is routed to the F1 channel elements. Similarly, when the switch is in the F2, F3 and F4 positions, the oscillator return is routed to the corresponding channel elements. In each case, the oscillator return is routed through two isolation diodes which are located on the four-frequency circuit board. The isolation diodes prevent dc interaction between channel elements.

b. Other Applications

When a radio set is equipped with an unequal number of transmitting and receiving frequencies, jumpers may be connected on the four-frequency circuit board to prevent a "dead" transmitter or receiver on certain positions of the frequency selector switch. For example, a radio set may be equipped with two transmitting frequencies and four receiving frequencies (T2-R4 operation). Without the jumpers on such a radio set, the transmitter will be "dead" in the F3 and F4 positions of the frequency selector switch. By adding a jumper at the appropriate point, transmitter frequency T1 (or T3) can be activated when the frequency selector switch is in the F3 position. Another jumper will permit selection of T1 (or T2) in the F4 switch position. No additional channel elements are required for such operation. The isolation diodes in the frequency switching leads of the oscillator return path prevent dc interaction between channel elements.

The principles explained in the preceding paragraph apply to the jumpers for other operation with unequal transmitting and receiving frequencies, such as T3-R2, T1-R4, T2-R3, etc. Additionally, variations are possible within each type of operation by changing the position of the

channel elements. The procedures and examples given in the INSTALLATION section of this manual will permit calculation of jumper connections for any non-standard operation.

6. TPN1053B POWER SUPPLY

This power supply has a floating primary circuit for both 64- and 12-volt operation. This allows either a positive or negative ground, or a floating input voltage as long as the proper polarity is observed at the input terminals on the mounting rack.

NOTE

Refer to the INSTALLATION section of this manual for the proper polarity connections.

a. Polarity Protection

Diodes CR209 and CR210 provide polarity protection for the power supply if connections to the primary power source are reversed. If reverse polarity power is applied, CR209 in the 72-volt line, or CR210 in the 13.6-volt line becomes forward biased and causes the line fuse to blow. The filter capacitors across the input line reduce line-to-line transients that may occur in the primary power source. Transients must be reduced to prevent damage to converter transistors.

b. Converters

The power supply includes a 64-volt converter (Q201 and Q202) and a 12-volt converter (Q203, Q204, Q205, and Q206). Each converter changes its respective dc input to a square wave ac output which is transformer coupled to a rectifier-filter circuit.

(1) 12-Volt Converter

The output of the 13.6-volt line filter is applied to the center tap of T202 (negative) and the emitters of Q203, Q204, Q205, and Q206. Circuit action is started by a slight unbalance in current through one of the transistor pairs. Assuming the Q203-Q204 pair begins conduction first, the action is regenerative and causes the transistors to saturate and the alternate transistor pair (Q205-Q206) to cut off. Regeneration is coupled from the secondary of output transformer T202 to feedback transformer T201. Collector current continues to increase (due to regenerative feedback) until the core of the feedback transformer saturates. Once this core is saturated, feedback to the base of the saturated transistor pair decreases and causes the collector current to decrease. Again the action is regenerative, and quickly drives the transistor pair to cut-off. The magnetic field collapses and reverses the polarity across feedback transformer T201 to turn on transistor pair Q205-Q206. The sequence is repeated for the second transistor pair and the cycle is completed. The switching cycle repeats approximately 5000 times per second to produce a square wave ac output across transformer T202.

(2) 64-Volt Converter

Operation of the 64-volt converter is similar to that of the 12-volt converter. In this case only one feedback winding is used in the secondary of T201. However, this winding is center tapped and the center tap is connected to a point common to both switching transistors. Since the current requirement is much less than in the 12-volt converter, a single transistor in the 64-volt converter performs the function of each parallel connected transistor pair in the 12-volt converter.

c. Rectifier-Filter Circuit

A positive dc voltage of approximately 13.6 volts during transmit and 15.5 volts during receive is supplied from the full-wave rectifier and LC filter. The output consists of an unregulated A+ for the transmitter and external equipment and an unregulated input to the high end regulator.

d. High End Regulator

The high end regulator circuit limits the regulated A+ output when the output tends to exceed 14.3 volts. The main components of the circuit are control transistor Q208, series regulator transistor Q207, and Zener diode CR218. When the unregulated A+ exceeds 15 volts, the Zener diode conducts and establishes a constant voltage at the base of control transistor Q208. Any further increase in the unregulated A+ voltage increases the collector current of Q208. Consequently, the base current of Q207 is reduced and the impedance of the series regulator transistor increases to maintain the regulated A+ voltage at 14.3 volts. When the unregulated A+ voltage drops below the regulating region of the Zener diode, Q208 cuts off and Q207 conducts heavily. The impedance of Q207 is very low and the regulated A+ approaches the unregulated A+ voltage.

e. Power Supply Protection

Operating characteristics of the converters provide self-protection in case a short circuit

develops in the power supply load. A short circuit causes a heavy current demand and the converter circuit stops switching due to loss of feedback. When switching action stops, the capacitors (which provided a low impedance path for initial start up) will charge up and limit the base current in each of the switching transistors to a safe level. The converter circuits are not self-starting after a short circuit has been removed. To re-start the converters, primary power must be turned off, then turned on again.

7. TPN1056A POWER SUPPLY

This power supply is completely transistorized and operates from an external power source of 117 v ac. The output voltage, which is 14.5 volts dc, is used as the A+ voltage for transmitter and receiver operation. Refer to Schematic Diagram (page 114 during the detailed discussion that follows.

a. Rectifier and Filter Circuit

The secondary voltage from transformer T250 is rectified by the full-wave bridge rectifier (CR251-CR254) and filtered by capacitor C251, resulting in a positive dc voltage of 17.5 volts. This filtered voltage is used as collector and bias voltage for the remaining stages of the power supply. The filtered output is also regulated by the series regulator consisting of transistors Q253 and Q254.

b. First and Second Driver

The 17.5 volts developed by the bridge rectifier is dropped to approximately 13.4 volts by the voltage divider network consisting of resistors R251 and R252 before being applied to the base of transistor Q251 (first driver). Q251 starts to conduct and establishes the base current path for the second driver transistor, Q252, (the current path is from ground through resistor R254, diode CR255, and conducting transistor Q251). Transistor Q252 becomes forward biased, coupling approximately 15.2 volts to the bases of the series regulator transistors, Q253 and Q254.

c. Series Regulator

Resistor R256 connected to the bases of transistors Q253 and Q254, develops the base bias voltage for the transistors, causing them to conduct. With the transistors conducting, the filtered dc voltage existing at the bridge rectifier output is first decreased to 14.5 volts by the internal impedance of the transistors and then applied to the transmitter and receiver circuitry as the A+ voltage.

d. Reference Amplifier

If the power supply loading is such that the output voltage starts to increase, the base bias voltage at the reference amplifier transistor (Q255) is also increased. This rise in base bias voltage drives the transistor towards saturation which causes its collector voltage to approach ground potential. The collector output is fed back to the base of the first driver transistor to reduce its base bias voltage. Consequently, transistor Q251 conducts less which, in turn, causes the second driver transistor (Q252) and the series regulator transistors (Q253 and Q254) to be driven towards cut-off. When this happens, the impedance of the series regulator transistors increases proportionately, thereby decreasing the output voltage applied to the transmitter and receiver back to its initial level of 14.5 volts.

If the output voltage should decrease, the circuit action previously described is reversed causing the output voltage to increase to its normal operating point.

8. TIME-OUT TIMER

Refer to the separate schematic diagram for this item.

When the radio set is in the receive condition, keyed regulated A+ is removed. Therefore, diode CR251 is reverse biased and transistor Q251 is saturated by the bias applied to its base via resistors R253 and R254. When the transmitter is keyed, the keyed regulated A+ forward biases diode CR251 and reverse biases the base emitter junction of Q251, turning it off. With Q251 cut-off, capacitor C251 starts to discharge through resistor R255. During this discharge time the emitter of transistor Q252 is held at approximately 2.7 volts by the combination of resistors R256 and R257. This emitter voltage holds Q252 at cut-off. After a one minute period, the voltage across capacitor C251 drops to approximately 1.6 volts. At this time, diode CR252 becomes forward biased, turning on transistor Q252 which supplies sufficient gate current to fire the silicon controlled rectifier, (SCR) SCR251. When the SCR conducts, the base-collector junction of transistor Q253, which serves as a diode, becomes forward biased causing current flow through R143 which is part of the modulator. This decreases the voltage on the varactor modulator diodes, thereby detuning the modulator and stopping

transmitter output. When the SCR conducts, the unijunction transistor (Q255) oscillates at an audio frequency. The output from oscillator Q255 is fed through capacitor C255 and R252 to the audio drivers in the receiver as the alert tone. The amplitude of the alert tone may be changed by changing the value of R252 (at no time should R252 be less than 47K ohms). Table 6 shows the amplitude variations in speaker output, for different selected values of R252. Biasing voltages for these stages are supplied via resistor R251 and diode CR253 when the keyed regulated A+ is applied.

TABLE 6. TIME-OUT TIMER TONE LEVEL

R252 VALUE	SPEAKER OUTPUT VARIATIONS IN DB
47K	+10.1
56K	+ 8.4
68K	+ 7.2
120K	+ 2.8
180K	Reference (100 mv)
270K	- 2.8
330K	- 6
470K	- 9.8
680K	-13.8

REMOTE CONTROL UNIT

1. APPLICATION

The Motorola Model TLN6075C Remote Control Unit is used in remotely-controlled railroad base station installations. It can be used with the "Motran" 64/12 v dc or 117 v ac radio equipment in both single-frequency and two-frequency applications. This unit serves as the terminal facility for the 500/600 ohm control line between the operator's position at the remote control console and the radio set.

2. DESCRIPTION

The remote control unit, in addition to providing the termination functions, also contains the control relays required to energize the transmitter. The relays are actuated by dc voltages impressed on the control line from the remote control console.

A control is incorporated for adjustment of the audio input to the transmitter modulator. A pre-amplifier provides approximately 20 db of gain to restore line loss. A REMOTE-LOCAL switch, an F1-F2 switch and microphone plug-in facilities are included to permit local control of the transmitter.

The remote control unit is used with a remote control console which is located at the operator's location. The Motorola Model T1205A Remote Control Console, or equivalent, should be used.

3. INSTALLATION

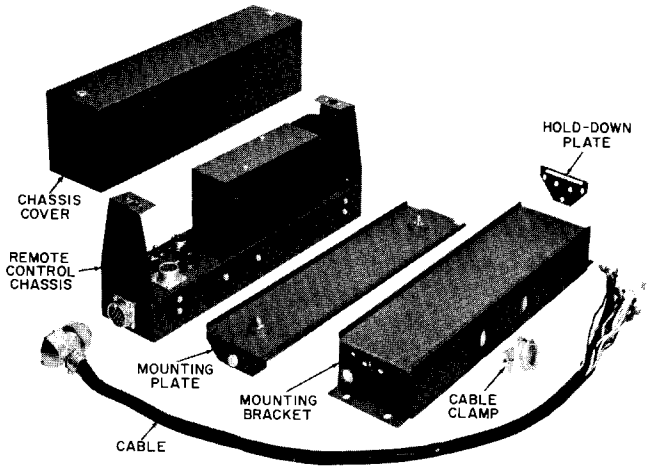


Figure 1.
Disassembled View

The "Motran" radio set mounts on a TLN1007C Mounting Rack. The remote control unit cannot be mounted to the mounting rack with this radio set due to the overhang of the side radiators of the radio. The remote control unit must be mounted along side of the mounting rack with a minimum distance of three (3) inches between the unit and the mounting rack. This space is required to allow for air circulation around the side radiators of the radio. The following steps outline the procedure for this installation.

a. Procedure

The following procedures apply when mounting on either side.

(1) Punch out the plug button of the smaller hole in the side of the mounting rack.

(2) Loosen the lock nut on the cable clamp and remove the cable clamp from the remote control unit mounting bracket.

(3) Insert the threaded portion of the cable clamp through the hole in the mounting rack. Replace the lock nut on the cable clamp and tighten it.

(4) Place the remote control unit along side of the mounting rack in the position it is to be mounted and secure it to the mounting surface.

NOTE

Be sure to allow a minimum distance of three (3) inches between the remote control unit and mounting rack.

(5) Remove the cable from the hole in the end of the remote control unit mounting bracket.

(6) Insert the cable through the cable clamp which is attached to the side of the mounting rack and tighten the clamp on the cable. Be sure the cable is long enough to reach the terminal boards.

(7) Place the cable hold-down clamp included with the hardware kit on the cable about an inch from the end of the cable insulation (where the wires come out of the insulation).

(8) Secure the cable hold-down clamp with one of the terminal board screws that is convenient.

b. Cable Connections

Connect the remote control cable to the proper terminals on terminal boards TB2 and TB3 on the mounting rack, as listed in the following chart. Refer to Schematic Diagram (page 111) for additional information.

NOTE

Before connecting the remote control cable to the mounting rack, locate the WHITE lead. Trace this lead back towards the cable and note that it and a BLACK lead are double shielded. These double shielded leads are in the microphone circuit. There are two BLACK leads: Do not confuse the double shielded BLACK lead connected to pin 4 of P1 with the single shielded BLACK lead connected to pin 3 of P1. It is suggested that the BLACK and WHITE double shielded leads be connected first.

LEAD COLOR	TERMINAL CONNECTION
ORANGE	1
SLATE	2
CABLE SHIELD	5
BLACK	5
BLACK SHIELDED	6
WHITE SHIELDED	7
TAN	8
BROWN	9
YELLOW	10
GREEN	11
PINK	18
RED	21
BLUE	24

Connect the 500/600 ohm control line from the remote console to terminals 1 and 2.

NOTE

For single frequency operation of the radio equipment, connect a jumper between terminals 10 and 18 on the mounting rack. Omit this jumper for two-frequency operation.

4. PRE-OPERATIONAL ADJUSTMENTS

a. Remote Consolette Adjustments

When a Motorola remote control console is used in conjunction with the TLN6075C Remote Control Unit for remote control of a radio installation, make the following adjustments:

(1) Connect a milliammeter in series with the 500/600 ohm control line that connects the console to the radio equipment.

(2) Adjust the appropriate control on the remote console for a control current output of 5 milliamperes for frequency 1 and a current of 12.5 milliamperes for frequency 2.

b. Audio Level Adjustments

(1) Transmit Level

Connect a Motorola Transistorized ac voltmeter to terminals 6 and 7 of the TLN1007C Mounting Rack, terminals E2-1 and E2-2 on the TLN6082A Rack or terminals E1-4 and E1-5 on the TLN6081A Rack. Transmit a voice signal from the remote control console. Adjust the TRANS AUDIO control on the TLN6075C Remote Control Unit for about 0.36 volt as indicated by the meter on voice peaks.

(2) Receive Level

Connect a Motorola transistorized ac voltmeter across the 500/600 ohm control line terminals on the mounting rack. Obtain a modulated r-f signal from an associated transmitter. Adjust the receiver VOLUME control to obtain 1.73 volts on peaks as indicated by the voltmeter as connected above. Set SQUELCH control on the receiver to the desired point between threshold squelch (point at which noise just cuts out) and maximum clockwise rotation of control.

5. LOCAL OPERATION

Two microphone receptacles are provided on the remote control chassis for local operation or testing of the radio equipment. For local operation place the F1-F2 switch in the desired position. Hold the REMOTE-LOCAL switch on the remote chassis in the LOCAL position and key the transmitter by pressing the push-to-talk switch on the handset.

6. REMOTE CONTROL OPERATION

The REMOTE-LOCAL switch on the remote control unit is of the spring return type and will always be in the REMOTE position except when local control is used. The F1-F2 switch is effective only for local control of receiver and transmitter frequencies.

a. To Transmit on Frequency #1

Refer to Schematic Diagram, (page 111).

For transmission on frequency #1, place the frequency selector switch on the remote control console in the F1 position. Depressing the microphone push-to-talk switch at the operator's location causes a dc voltage from the remote control console power supply to be impressed on the control line. This voltage produces a 5 ma current flow through the hold-in coils of relays K1 (5 ma) and K2 (12.5 ma). Thus relay K1 becomes energized. Actuation of relay K1 completes the push-to-talk circuit and turns on the transmitter. Relay K2 will not energize because its coil requires 12.5 ma. A set of contacts of relay K3 grounds the frequency #1 cathode circuit of the transmitter and receiver, thereby permitting the station to transmit and receive on the #1 channel.

b. To Transmit on Frequency #2

Refer to Schematic Diagram, (page 111).

For transmission on frequency #2, place the frequency selector switch on the remote control console in the F2 position. Depressing the microphone push-to-talk switch at the operator's location causes a dc voltage from the remote control console power supply to be impressed on the control line. This voltage produces a 12.5 ma current flow through the hold-in coils of relays K1 (5 ma) and K2 (12.5 ma). Relays K1 and K2 are both energized by the 12.5 ma current, but the opening of contacts 1 and 2 on relay K2 (when K2 becomes energized) de-energizes relay K1 and inserts the 5600 ohm resistor in series with the coil of relay K2. The 5600 ohm resistor serves as a holding circuit keeping relay K2 energized after relay K1 drops out. The charging current of the capacitor connected to the coil of relay K1 keeps K1 energized for a short interval to prevent relay "chattering". Contacts 9 and 10 of relay K2 complete the push-to-talk circuit thus turning on the transmitter. Contacts 7 and 8 of relay K2 complete the hold-in coil circuit of relay K3, thus relay K3 becomes energized. Relay K3 energizes and (1) electrically locks itself in through contacts 2 and 3 of relay K1, and (2) grounds the frequency #2 cathode circuits of the transmitter and receiver, thereby permitting the station to transmit and receive on the #2 channel.

The receiver will continue to operate on the #2 channel until the remote operator places the console frequency selector switch in the F1 position and depresses the microphone push-to-talk switch. Keying the transmitter de-energizes frequency changeover relay, K3.

CONTROL HEADS

TABLE 6.
CONTROL HEAD MODEL CHART

RADIO SET	CONTROL HEAD	DESCRIPTION
R43MSB-1199AA	TCN1057AJ	Single-Tone
	TCN6108AJ	Non-Reverting
R43MSB-3199AA	TCN6109AJ	Channel Reverting
	TCN6108AK	Non-Reverting
	TCN6109AK	Channel Reverting
R43MST-1199AA STANDARD AAR	TCN6108AJ	Non-Reverting
	TCN6109AJ	Channel Reverting
R43MST-3199AA STANDARD AAR	TCN6108AK	"Private-Line" Non-Reverting
	TCN6109AK	"Private-Line" Channel Reverting
R43MST-1199AC UNIVERSAL	TCN6067AJ	Non-Reverting
R43MST-1199BC UNIVERSAL	TCN6068AJ	Channel Reverting
R43MST-3199AC UNIVERSAL	TCN6067AK	"Private-Line" Non-Reverting
R43MST-3199BC UNIVERSAL	TCN6068AK	"Private-Line" Channel Reverting

1. DESCRIPTION

There are two types of control heads -- the Universal and the Standard AAR. The Universal control head is an integral part of the Universal radio set. It is not an accessory item. The Standard AAR control head is an accessory item, used with the Standard AAR radio set.

The Universal models connect directly to the front panel of the radio set. The primary power source connects through the control head to the radio set power supply. The Standard AAR control head is a separate unit, requiring both separate installation and control head intercabling.

Standard AAR control heads can be used in an installation operating from a primary power source of 64 volts dc, 12 volts dc or 117 volts ac. Universal control heads can be used in an installation operating from a primary source of 64 or 12 volts dc only. Each unit includes a frequency selector switch (F1-F2-F3-F4) for multiple-frequency operation. A mechanical stop on the switch prevents rotation to all positions when the radio set is not equipped for operation on all four channels. Instructions for setting or readjusting the mechanical stop are given in the INSTALLATION section of this manual. A white lamp for each channel indicates which channel is in operation. A blue lamp glows when the transmitter is keyed. Control heads with the automatic channel reverting feature provide return to any of the four channels (as pre-selected by jumpers in the control head) upon replacement of the handset in the handset hang-up bracket. "Private-Line" models include a "PRIVATE-LINE" ON-OFF switch that permits the operator to enable or disable the "Private-Line" circuits. The circuits must be disabled immediately before transmission to determine whether or not the channel is in use and prevent breaking in on someone else's transmission. The VOLUME control adjusts the audio level at the speaker. The Universal models include dual 3-inch speakers; one mounted on each side of the housing. The Standard AAR models include a single 5-inch speaker. A handset receptacle is provided on both. All units are dust resistant and ruggedly constructed to withstand abnormal shock and vibration.

2. AUDIO ADJUSTMENTS

Refer to the pertinent schematic diagram.

The audio output level is controlled by a pad (volume control) located in the speaker input circuit. The audio output level minimum setting may be changed by replacing the resistor R504 in the Universal control heads or R2 in the Standard AAR models with a resistor of a lower or higher value. This resistor is connected directly to the pad control. Increasing the resistance of this resistor raises the minimum level.

The audio from the handset is taken from the input to the pad and speaker circuit. Therefore,

adjustment of the speaker level pad control has no effect on the handset level.

To change the handset audio level, replace resistor R503 in the Universal control head or R1 in the Standard AAR models with a resistor of higher or lower value. Increasing the resistance will decrease the output.

3. OPERATION OF CHANNEL REVERTING

As the handset is removed from the hang-up bracket, the contacts of the hang-up switch are grounded. The ground is applied to the coil of the frequency reverting relay. However, no voltage is applied to energize the relay until the PUSH TO CHANGE CHANNEL button is momentarily pushed. The relay then energizes and "locks up". The relay contacts break the oscillator return path to the reverting channel and route it through the frequency selector switch to the selected oscillator. Another set of contacts removes voltage from the channel indicating lamp for the reverting channel and routes it through the frequency selector switch to light the lamp for the selected channel. This condition remains until the handset is replaced on the hang-up bracket. The hang-up switch opens the ground path and de-energizes the frequency reverting relay. The oscillator return path is returned to the reverting channel and the voltage is returned to the reverting channel indicator lamp. Any channel may be selected for reverting by connecting the two spade lugs to proper terminals as explained on the schematic diagram.

4. UNIVERSAL CONTROL HEAD PILOT LIGHT CIRCUIT

Refer to (page 117) Schematic Diagram.

The channel indicator and transmit pilot lamps are operated from the unregulated A+ voltage with a resistor placed in series with each lamp. This reduces the voltage to a nominal operating voltage for the lamps (6 volts dc). The brilliance of the lamps can be changed if desired. Increasing the value of series resistors decreases the brilliance of the lamps. Do not use resistances less than 33 ohms in series with the transmit lamp or less than 47 ohms in series with the channel indicator lamps.

5. STANDARD AAR CONTROL HEAD PILOT LIGHT DIMMER

Refer to Diagram, (page 105).

The automatic light dimmer circuit includes a voltage regulator which insures constant pilot light brilliance with A+ voltages of 11.3 volts to 20.1 volts. The main components of the regulator are Q101, Q102, Q103 and Zener diode CR105. When the unregulated A+ varies, the change is felt across R106. This changes the sampling voltage at the base of Q103. If the A+ voltage decreases, Q103 conducts less and the current through Q102 and Q101 is increased. This causes the voltage drop across R106 to decrease and the voltage at Point A decreases.

This control head can be used with either negative or positive ground systems. When being used with a positive ground system, the voltage regulator is excluded from the circuit by diodes CR101, CR102, CR103, CR104, CR106 and CR107. This prevents the transistors from being damaged by improper biasing. The light dependent resistor network is also bypassed during positive ground operation. For these reasons, there will be no light intensity control by the regulator or the LDR during positive ground operation. Refer to Schematic Diagrams (pages 107, 108 and 109) for wiring details.

6. TONE OSCILLATOR CIRCUIT IN SINGLE-TONE CONTROL HEAD

The tone oscillator circuit (Q1) is basically a modified Hartley oscillator. Amplifier Q2 increases the oscillator output to a level sufficient to modulate the transmitted r-f signal. The tone oscillator and amplifier circuits are mounted on a printed circuit board in the control head. Refer to Diagram (page 106) for component location.

The "dispatcher" signalling operation is performed with the two pushbutton type switches (labelled DISP 1 and DISP 2) located on the front panel. Depressing switch DISP 1 keys the transmitter and modulates the r-f signal with a 2600 cps tone. Switch DISP 2 performs the same function but modulates the r-f signal with a 2200 cps tone.

7. BULB REPLACEMENT

To replace the channel indicator lights, remove the screw in the socket mounting plate. Pull the socket mounting plate away from the castings to reveal the bulb. Insert a new bayonet type bulb and replace the socket mounting plate.

SERVICE AIDS

1. HOUSING REMOVAL AND REPLACEMENT

a. Removal of Standard AAR Housing
Refer to Figure 24.

(1) Disconnect the antenna cable plug.

(2) Disconnect the power and control cable plug from the front of the radio set.

(3) Remove the padlock (if used) that secures the base plate to the mounting rack.

(4) Loosen the wing nuts on the mounting rack and pull the collars outward to free the base plate catches.

(5) Remove the radio set from the mounting rack and place it on a bench or similar horizontal surface.

(6) Release the latches at both sides of the radio set.

(7) Unlock the radio set by inserting one of the keys provided into the lock and turning the key counterclockwise to the horizontal position.

(8) Hold the base plate or brace it against a solid object and pull the radio set from the base plate by the handle.

(9) Slide the top panel rearward from under the edge of the front panel and lift off the top panel.

b. Replacement of Standard AAR Models into Housing
Refer to Figure 24.

(1) Be sure the radio set is unlocked with the key in the horizontal (counterclockwise) position.

NOTE

The key cannot be removed except in the locked position.

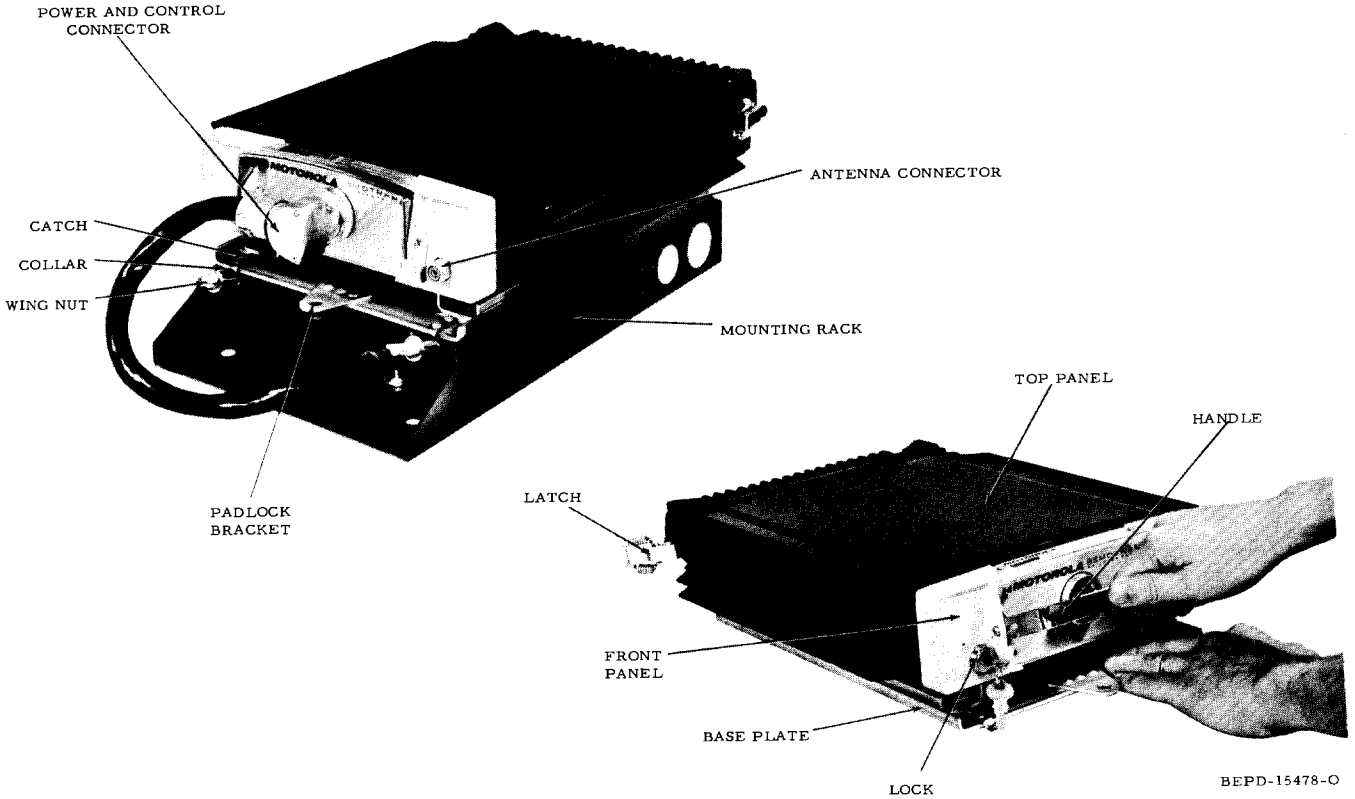


Figure 24.
Identification of Parts for Standard AAR Housing Removal and Replacement

(2) Slide the top panel into place under the edge of the front panel.

(3) Slide the radio set into the base plate.

(4) Fasten the latches on each side of the radio set.

(5) Lock the radio set by turning the key clockwise to the vertical position. Remove the key.

(6) Return the radio set to the mounting rack. Set the collars over the base plate catches and tighten the wing nuts.

(7) Lock the base plate to the mounting rack with a padlock if desired.

(8) Reconnect the power and control cable plug and the antenna cable plug.

c. Removal of Universal Housing
Refer to Figure 25.

(1) Disconnect the antenna cable plug.

(2) Disconnect the power cable plug.

(3) Remove the padlock from a mounting rack latch (if used).

(4) Unfasten the two mounting rack latches; one at each side of the control head.

(5) Using the handset bracket as a handle, pull the radio set from the mounting rack.

(6) Unlock the radio set by inserting one of the keys provided into the lock and turning the key counterclockwise to the horizontal position.

(7) Place the radio set vertically on its rear fins on a solid surface.

(8) Unfasten the two housing latches; one at each side of the radio set near the rear fins.

(9) Grasp the housing latches and pull downward to free the bottom panel from under the edge of the control head. Once free, lift the radio set from the housing and place it on a bench in the horizontal position.

(10) Slide the top panel rearward from under the edge of the control head and lift off the top panel.

d. Replacement of Universal Models into Housing
Refer to Figure 25.

(1) Be sure the radio set is unlocked with the key in the horizontal (counterclockwise) position.

NOTE

The key cannot be removed except in the locked position.

(2) Slide the top panel into place under the edge of the control head.

(3) Slide the radio set into the housing with the bottom panel under the edge of the control head.

(4) Fasten the housing latches on each side of the radio set near the rear fins.

(5) Lock the radio set by turning the key clockwise to the vertical position. Remove the key.

(6) Return the radio set to the mounting rack and fasten the mounting rack latches on each side of the control head.

(7) Install a padlock through the padlock bracket on one of the mounting rack latches if desired.

(8) Reconnect the power and antenna cable plugs.

2. RECEIVER SERVICING

NOTE

The Motorola S1056A-9A Series Test Set with its associated TKN6025A Adapter Cable, should be used to perform stage measurements in "Motran" radio equipment. Refer to the receiver alignment chart for information on the use of these items.

The 20 db quieting sensitivity measurement will indicate that the receiver has sufficient gain and all circuitry is working properly.

The quieting signal is that r-f signal input necessary to reduce the audio output, at the speaker, by 20 decibels. The measurement should be made in the absence of extraneous noise. Since the receiver squelch circuitry is designed to

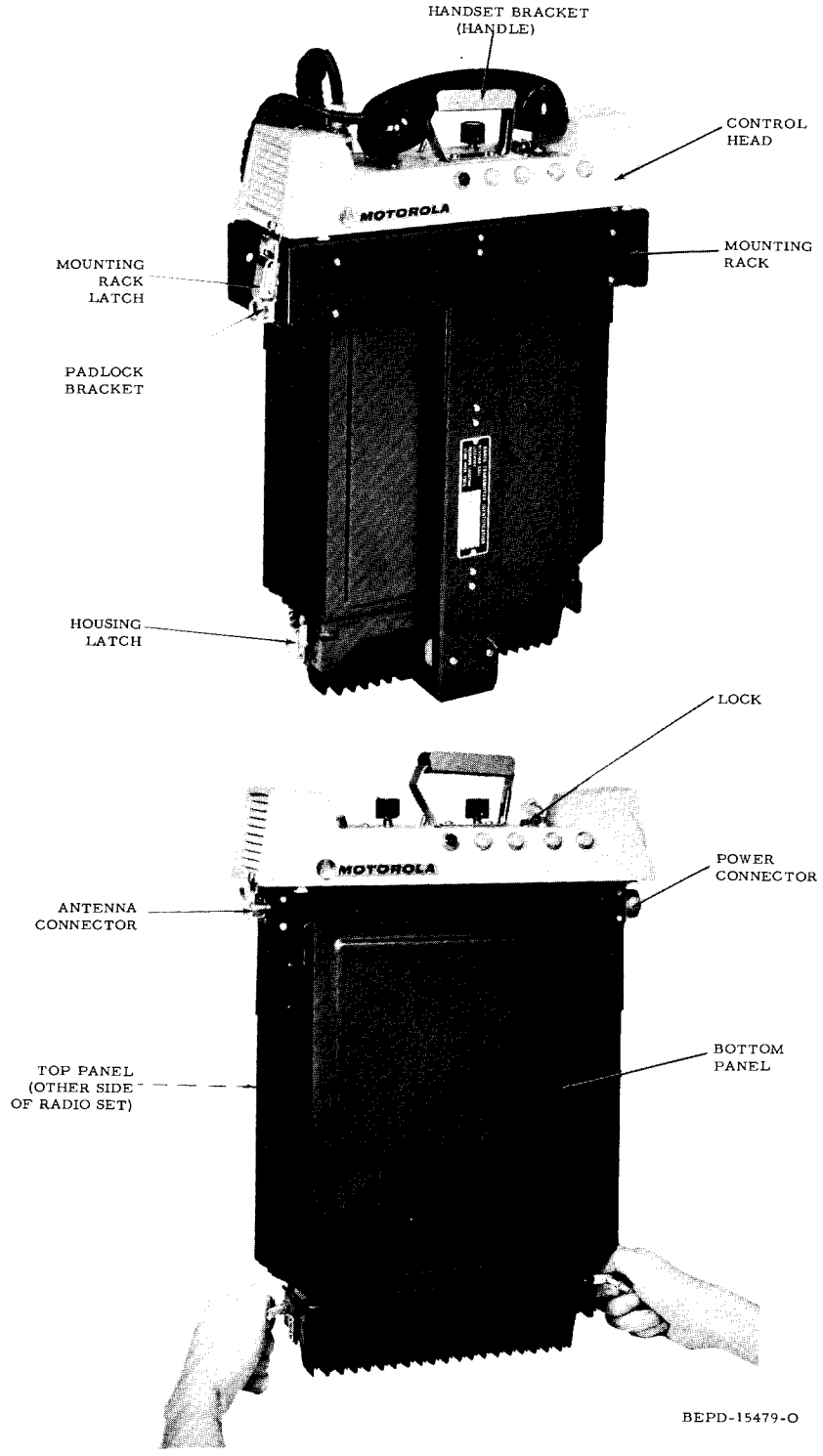


Figure 25.
Identification of Parts for Universal
Housing Removal and Replacement

reduce the noise in the handset or speaker when no signal is present at the input of the receiver, the squelch control should be opened (turned completely counterclockwise) before the 20 db quieting measurement is made.

The actual measurement is made by observing the noise voltage on an ac voltmeter (Motorola Transistorized AC Voltmeter or equivalent) at the speaker with no r-f signal received at the antenna. Sufficient on-frequency carrier signal from a Motorola FM Signal Generator or equivalent is then introduced at the antenna terminal to reduce the noise output voltage to 1/10 of the previous reading. If all circuitry is properly operating, the quieting signal should be 0.5 microvolt or less.

If the reading is greater than 0.5 uv, all dc and ac noise voltages shown on the schematic diagram for the receiver should be checked. Replacement of faulty parts or repair of printed circuits should be made where incorrect voltage readings indicate faulty circuitry. A break in a printed circuit can be repaired as described in the instructions accompanying the Printed Circuit Repair Kit, TEK-4A, which is available upon order from any of the Motorola Parts Depots located throughout the country (see FOREWORD).

The serviceman is cautioned not to replace transistors before a thorough check is made. The transistor is a dependable component and is not subject to replacement as frequently as tubes. The transistor terminal voltage should be checked first. If not reasonably close to the schematic values, the associated bias components should be checked. Since the transistors are low impedance elements, the signal gain can be traced through each stage with an ac voltmeter (Motorola Transistorized AC Voltmeter or equivalent).

If all dc voltages are correct, a signal should be traced through the circuit to show any possible breaks in the signal path.

3. RECEIVER PRINTED CIRCUIT BOARD REMOVAL

Complete removal of the printed circuit boards for access to components is not always necessary. They may be partially disconnected and folded out. For access to all receiver circuit boards mounted on the top side of the radio set, remove the receiver cover shield. Six screws mount this shield. Replace the screws while troubleshooting with the shield removed to assure good grounding of the circuits. Figures 26 through 30 outline procedures to prepare various parts of the receiver for servicing. Observe standard servicing practices such as tagging of leads and identification of connecting points.

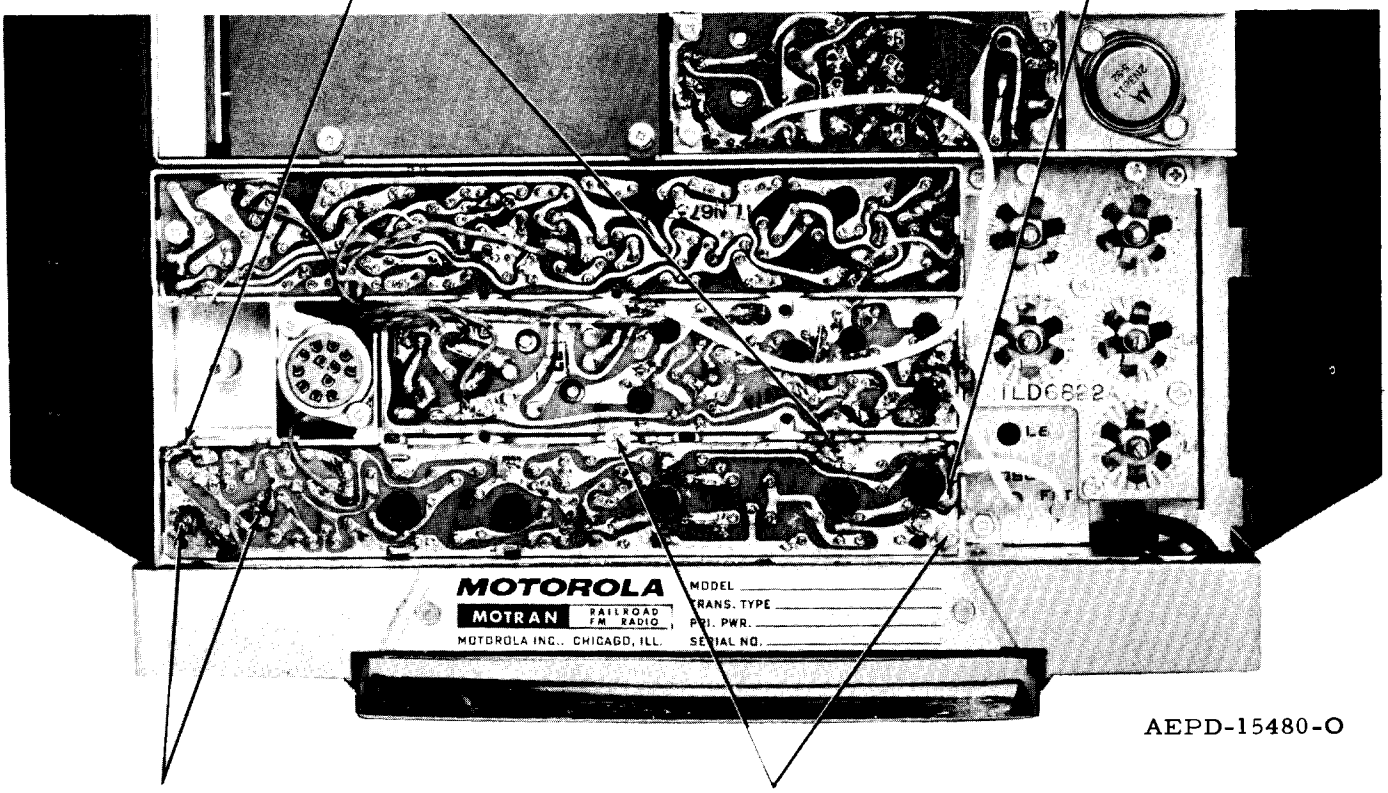


Figure 26. Access to 8 MC IF & 2nd Oscillator Circuit Board

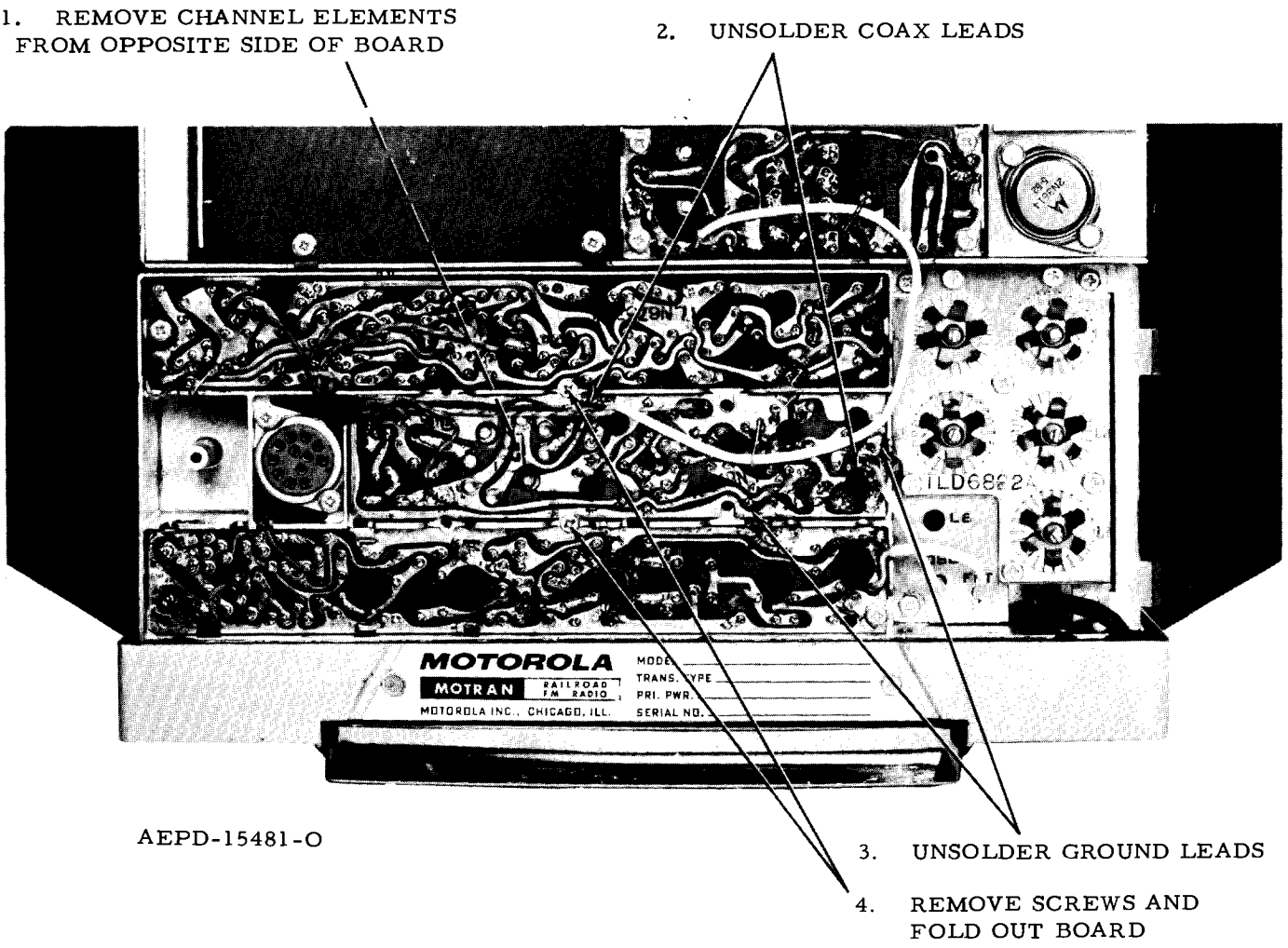


Figure 27. Access to Multiplier Circuit Board

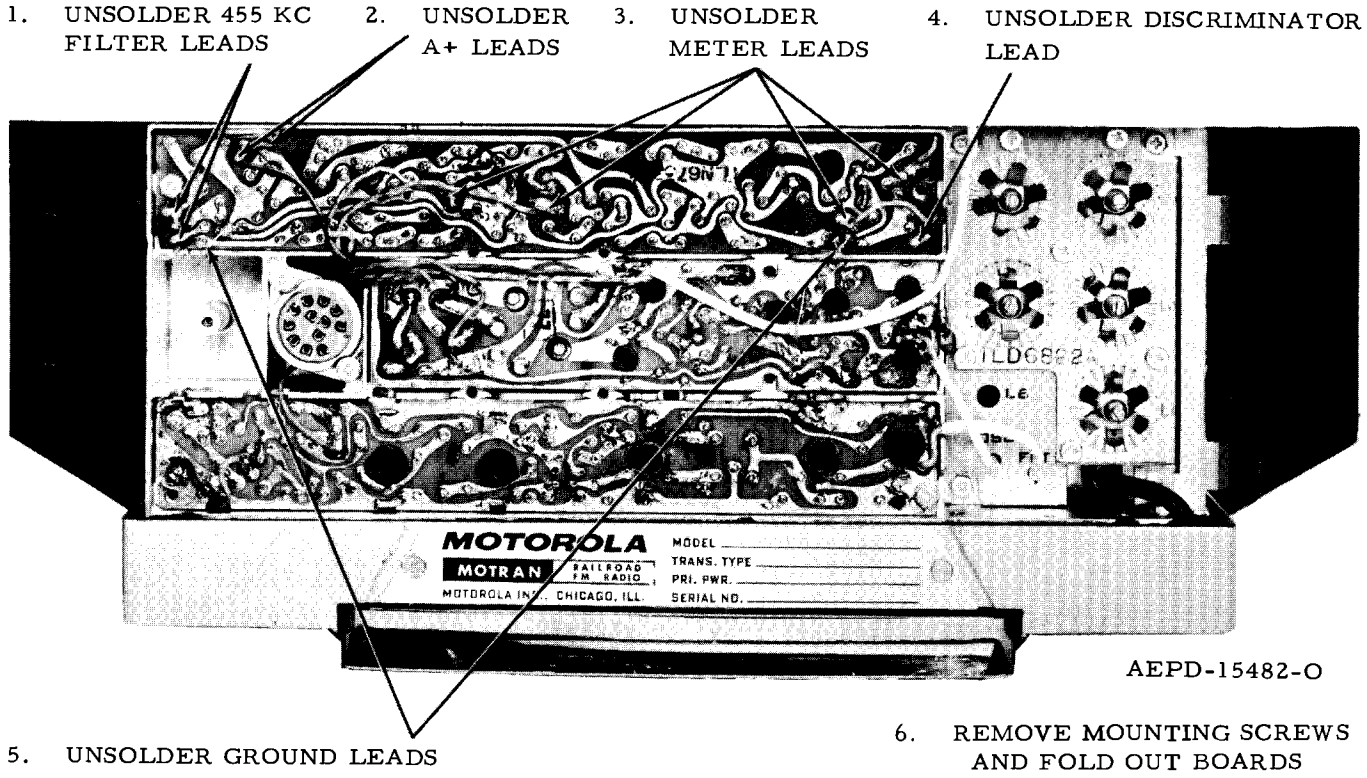
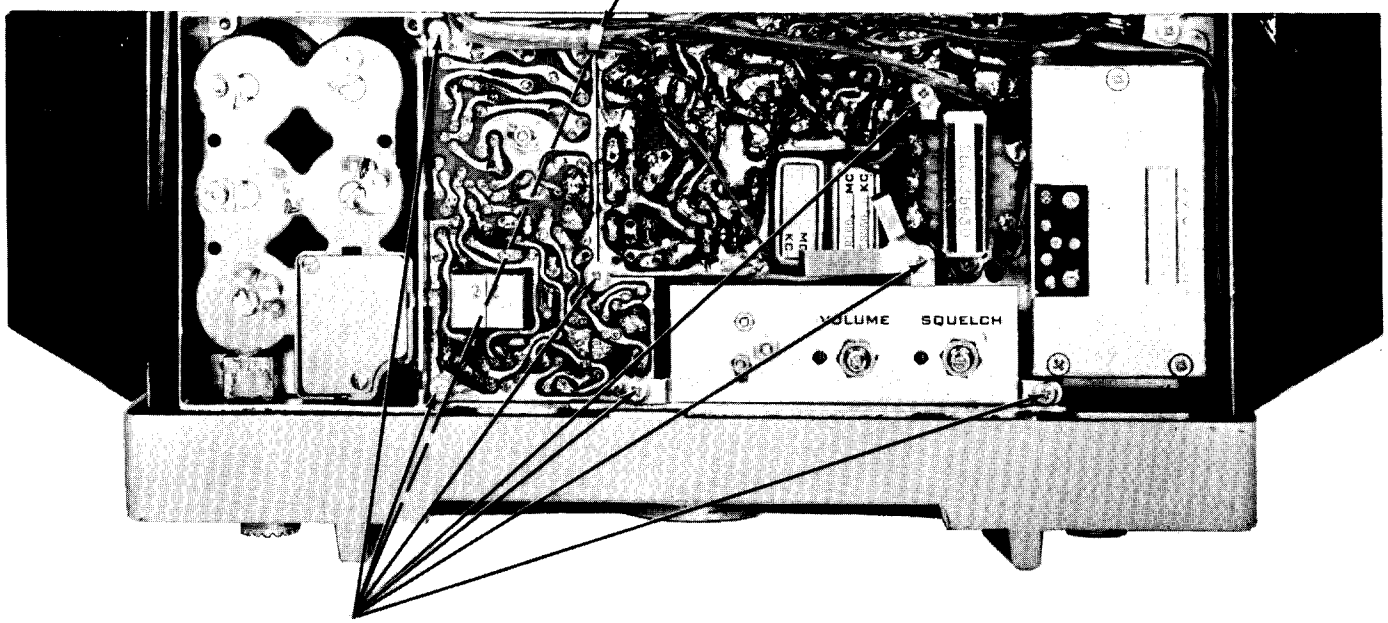


Figure 28. Access to 455 KC Amplifier Circuit Board

1. UNFOLD CABLE CLAMP



2. REMOVE MOUNTING SCREWS AND CAREFULLY FOLD OUT BOTH BOARDS TOGETHER. ALSO FOLD OUT VOLUME AND SQUELCH DECK. USED CARE WHEN FOLDING OUT BOARDS TO ASSURE INTERCONNECTING LEADS ARE NOT BROKEN.

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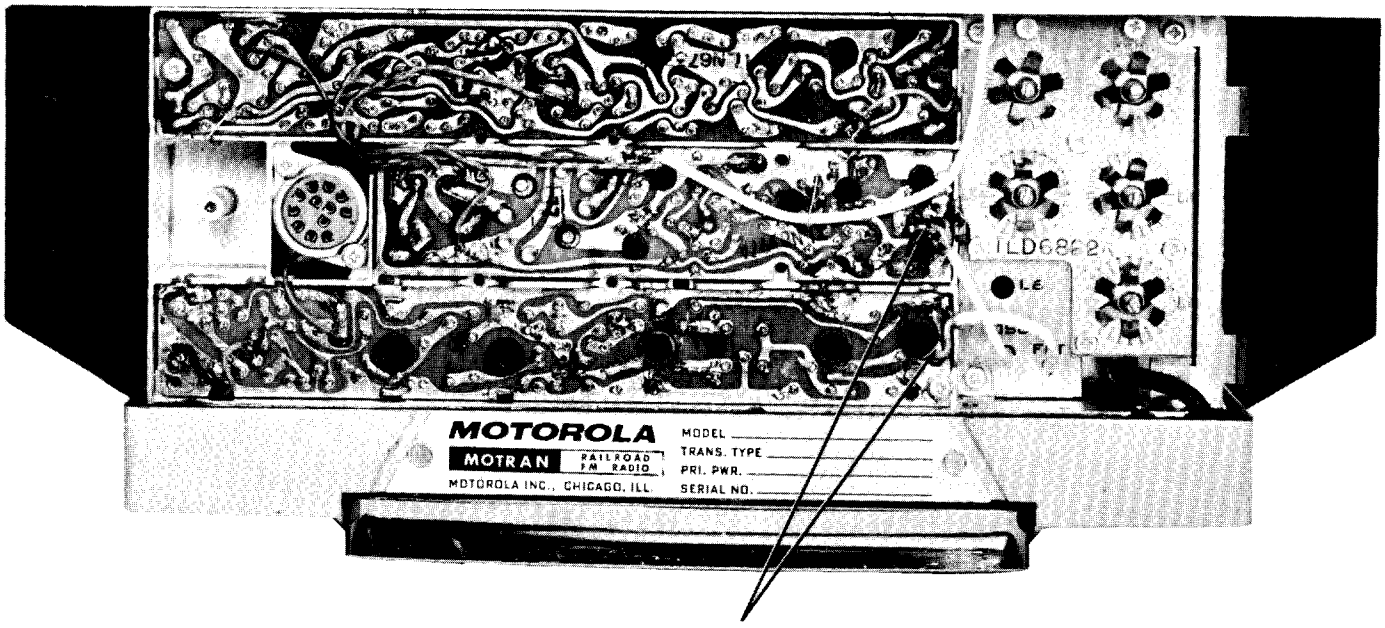
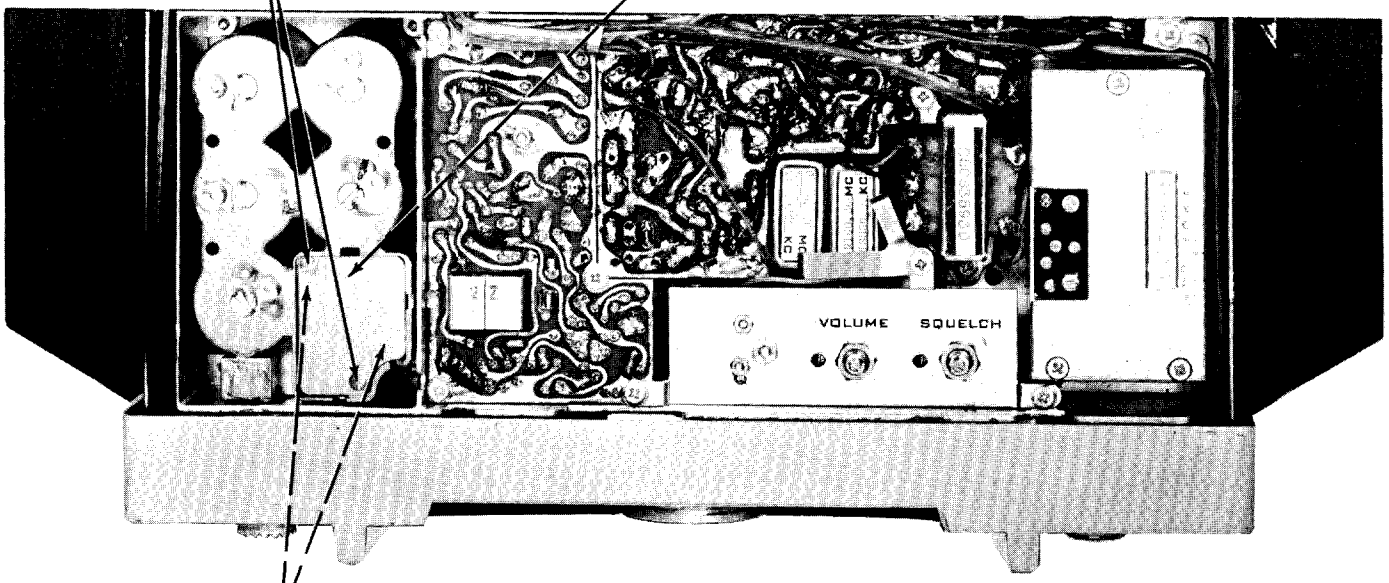
Figure 29.
Access to Audio & Squelch Circuit Board and "Private-Line" Decoder and Filter Circuit Board



1. UNSOLDER COAX LEADS

2. REMOVE SCREWS AND LIFT OFF COVER

3. UNSOLDER LEAD TO RF CAVITY (UNDER COVER)



4. REMOVE TWO MOUNTING SCREWS AND LIFT OUT CIRCUIT BOARD (UNDER COVER)

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Figure 30. Access to 1st Mixer Circuit Board

4. AUDIO TRANSISTOR CHECKS

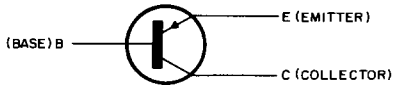
Whenever it is suspected that a transistor is faulty it should be replaced by a new one.

When trouble is detected in a transistor and its associated circuitry the transistor can be checked for normal operation with an ohmmeter. If the check is satisfactory, the rest of the circuit should be tested for faulty wiring or components.

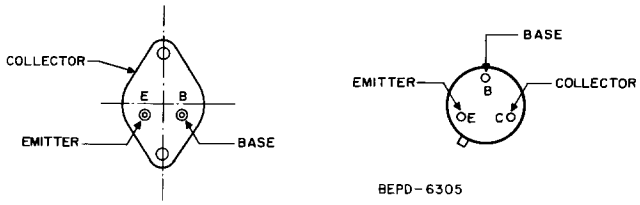
Transistors can be checked as follows:

A coarse check of the transistor may be made with an ohmmeter (to prevent damage to the transistor, use an ohmmeter with an internal battery voltage less than 16 volts). The following chart outlines a procedure to measure the ability of the transistor to conduct current in one direction, and to resist current flow in the opposite direction (Check Nos. 1 thru 6). The resistance in the conductive direction is low in relation to the resistance in the non-conductive direction. The remaining check is made to simulate the operation of the transistor in the actual operating circuit. A transistor that does not meet all checks should not be used.

The transistor must be disconnected from its operating circuit in order to make the checks listed in Table 7. Remove any screws which secure the transistor so that it can be removed from its socket.



TRANSISTOR SCHEMATIC DRAWING



TRANSISTOR BOTTOM VIEWS

Figure 31.

TABLE 7.
TRANSISTOR TEST TABLE

Check No.	Ohmmeter Connections*			Relative Resistance (PNP)	Relative Resistance (NPN)
	B	C	E		
1	-		+	Low	High
2	+		-	High	Low
3		-	+	High	High
4		+	-	High	High
5	-	+		Low	High
6	+	-		High	Low
7 (Connect Base to Emitter)		-	+	Resistance should increase from that obtained in check No. 3	Resistance should decrease from that obtained in check No. 3

*The "minus" and "plus" signs in the table indicate the polarity of ohmmeter leads for each check. Note that in some ohmmeters the indicated ground terminal may be positive. A check of meter circuitry may be necessary to determine actual polarity of ohmmeter terminals of leads.

5. TRANSMITTER SERVICING

NOTE

The Motorola Model S1056A-9A Series Portable Test Set, with its associated TKN6025A Adapter Cable, should be used to perform measurements in "Motran" radio equipment. Refer to the transmitter alignment chart for information on the use of these items.

Operation of all transmitter stages except the modulator and audio circuitry can be easily checked by observing r-f power output of the transmitter and meter readings. This one check indicates proper operation of the oscillator stage, the multiplier stages and the power output stage.

This check can be made by connecting a Motorola Model P-7208 Dummy Load or equivalent to the antenna terminal. The power output for the transmitter should be 35 watts minimum.

If there is no indication of power output, A+ voltages should be checked to be sure that proper supply voltages are being supplied to the transmitter stages.

If the power output is less than the indicated values, the dc voltage readings shown on the transmitter schematic diagram should be checked and the circuitry corrected where necessary.

If the transmitter does not modulate properly, the audio circuit should be checked to be sure that the audio modulating voltages are reaching the modulator. When it is determined that the audio voltage is at the modulator, the modulator stage dc voltage reading should be checked.

6. TRANSMITTER COMPONENT REMOVAL AND REPLACEMENT

Figures 32 through 40 illustrate the procedures for removal and replacement of circuit boards, transistors, the harmonic filter and the antenna switching network in the transmitter. For access to the power amplifier circuitry, remove the cover shield. Four screws secure this shield. Some components on the exciter circuit board can be removed and replaced with the circuit board in place. For access to the exciter circuit board, remove the exciter cover shield. Four mounting screws secure this shield. The shield must be replaced before any operating adjustments are made.

NOTE

Before making any circuit measurements on the exciter, replace the mounting screws to provide proper grounding of the circuits. Improper grounding may result in erratic readings.

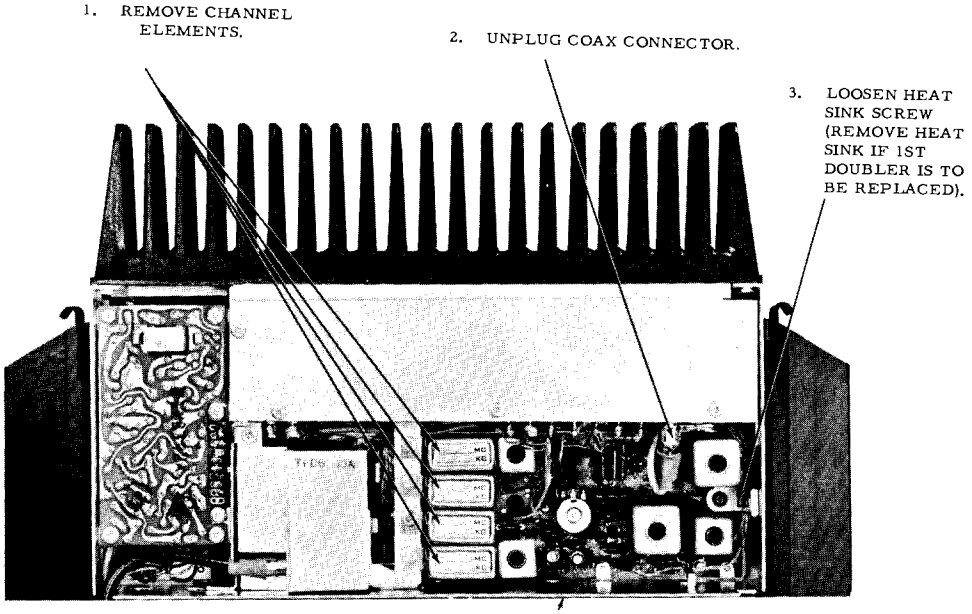


Figure 32. Access to Exciter Components

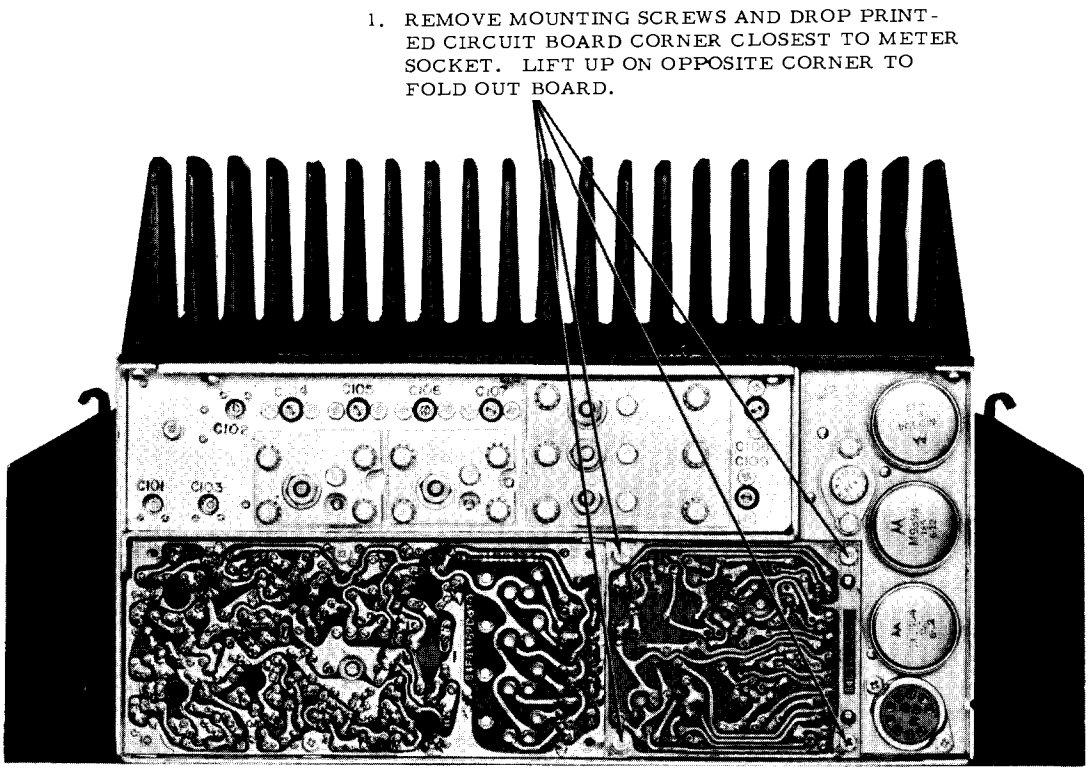
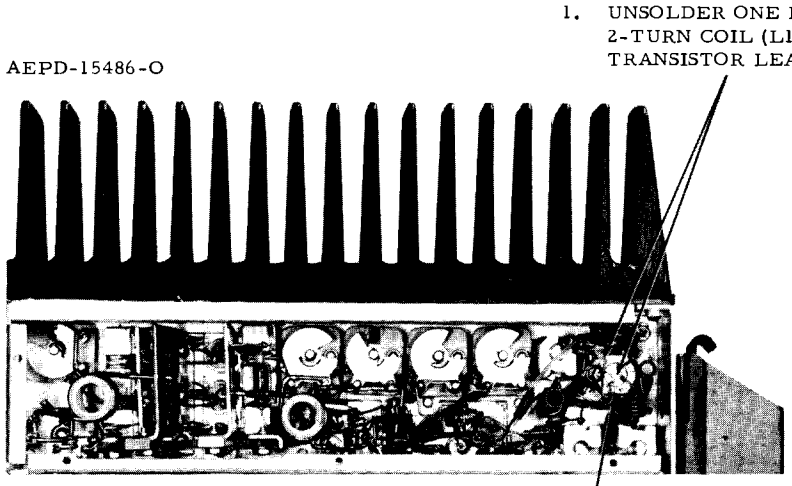


Figure 33. Access to Components on Transmitter Switching Circuit Board



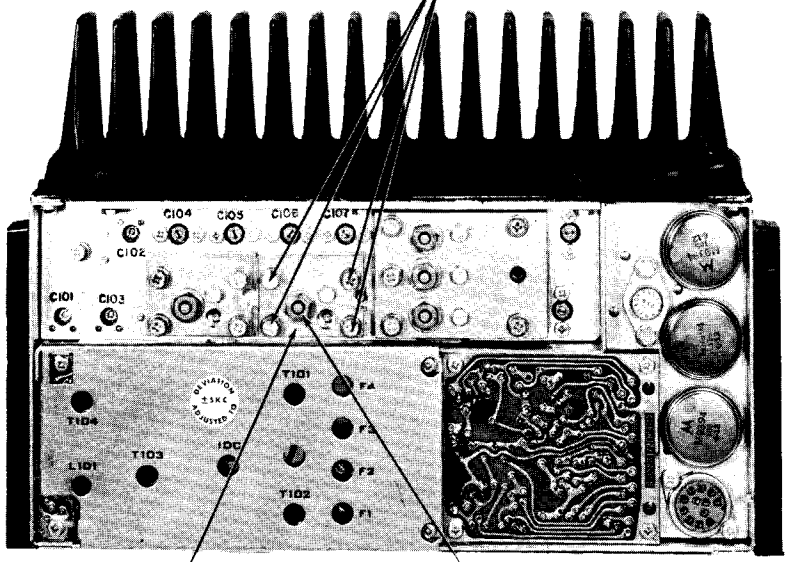
REPLACEMENT

1. PLACE TRANSISTOR IN HEAT SINK AND THREAD LEADS THROUGH GLAND NUT.

2. SCREW ON GLAND NUT AND SOLDER TRANSISTOR LEADS AND 2-TURN COIL (L109) IN PLACE.

Figure 34. Removal and Replacement of Power Doubler Transistor

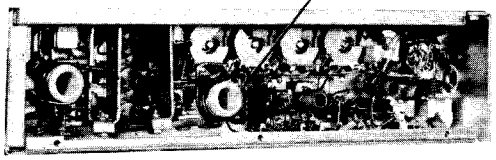
2. REMOVE SCREWS FROM MOUNTING PLATE.



3. REMOVE MOUNTING PLATE AND MICA INSULATOR.

1. REMOVE NUT FROM TRANSISTOR STUD.

4. UNSOLDER TRANSISTOR LEADS AND REMOVE TRANSISTOR.



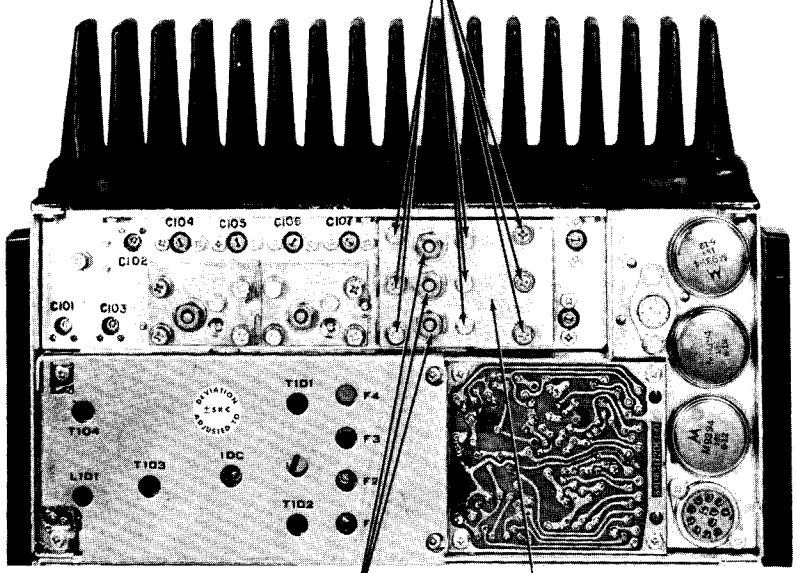
REMOVAL OF DRIVER (USE SAME PROCEDURE FOR PRE-DRIVER)

PERFORM STEPS 1 THRU 4.

REPLACEMENT OF DRIVER (USE SAME PROCEDURE FOR PRE-DRIVER)

1. PLACE WASHER AND NUT ON TRANSISTOR STUD AND TIGHTEN NUT.
2. COAT BOTH SIDES OF MICA INSULATOR WITH SILICONE GREASE AND LAY INSULATOR IN PLACE (SEE STEP 3 OF REMOVAL).
3. LAY MOUNTING PLATE ON TOP OF MICA INSULATOR AND SECURE WITH 5 SCREWS.
4. SOLDER TRANSISTOR LEADS.

Figure 35. Removal and Replacement of Driver and Pre-Driver Transistors



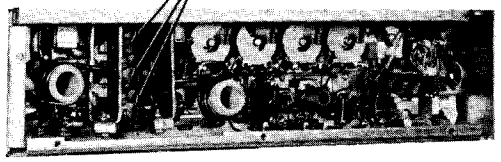
1. REMOVE SCREWS FROM COVER PLATE.

2. REMOVE NUT FROM TRANSISTOR STUD.

3. REMOVE MOUNTING PLATE AND MICA INSULATOR.

Figure 36. Removal and Replacement of Power Amplifier Transistors

4. UNSOLDER PA TRANSISTOR LEADS AND REMOVE TRANSISTOR.



REMOVAL

PERFORM STEPS 1 THRU 4

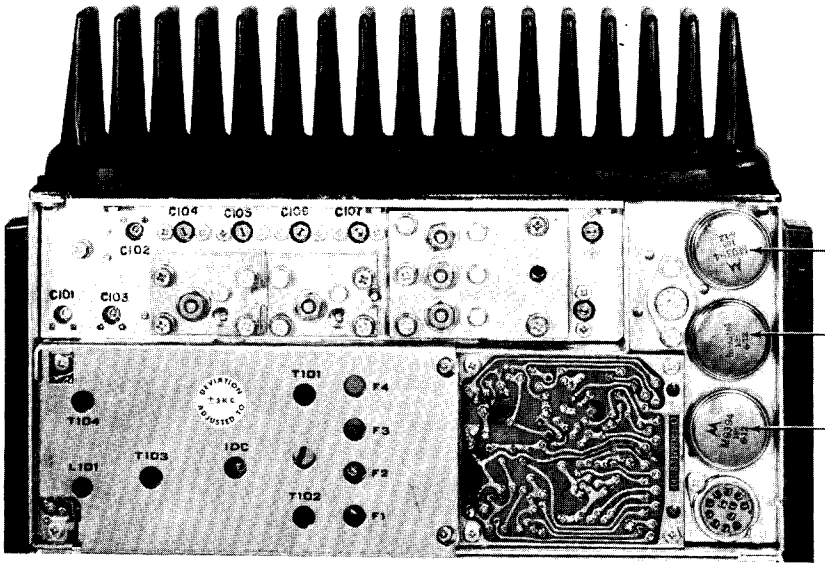
REPLACEMENT

1. PLACE WASHERS AND NUTS ON PA TRANSISTOR STUDS AND TIGHTEN NUTS.

2. COAT BOTH SIDES OF MICA INSULATOR WITH SILICONE GREASE AND LAY INSULATOR IN PLACE (SEE STEP 3 OF REMOVAL).

3. LAY MOUNTING PLATE ON TOP OF MICA INSULATOR AND SECURE WITH 9 SCREWS.

4. SOLDER TRANSISTOR LEADS.



REMOVAL

1. REMOVE "PRIVATE-LINE" DELAY AND OSCILLATOR CIRCUIT BOARD (IF SO EQUIPPED).
2. UNSOLDER LEADS FROM LIMITER TRANSISTOR.
3. REMOVE NUT FROM TRANSISTOR STUD (SAVE BOTH MICA INSULATORS AND FLAT WASHER).

REPLACEMENT

1. COAT BOTH SIDES OF THICKER MICA INSULATOR WITH SILICONE GREASE AND PLACE ON TRANSISTOR.
2. INSERT TRANSISTOR STUD IN MOUNTING HOLE.
3. PLACE SECOND MICA INSULATOR AND FLAT WASHER OVER TRANSISTOR STUD AND SECURE TRANSISTOR IN PLACE.
4. SOLDER TRANSISTOR LEADS AND REPLACE "PRIVATE-LINE" DELAY AND OSCILLATOR CIRCUIT BOARD.

Figure 37. Removal and Replacement of Limiter Transistors

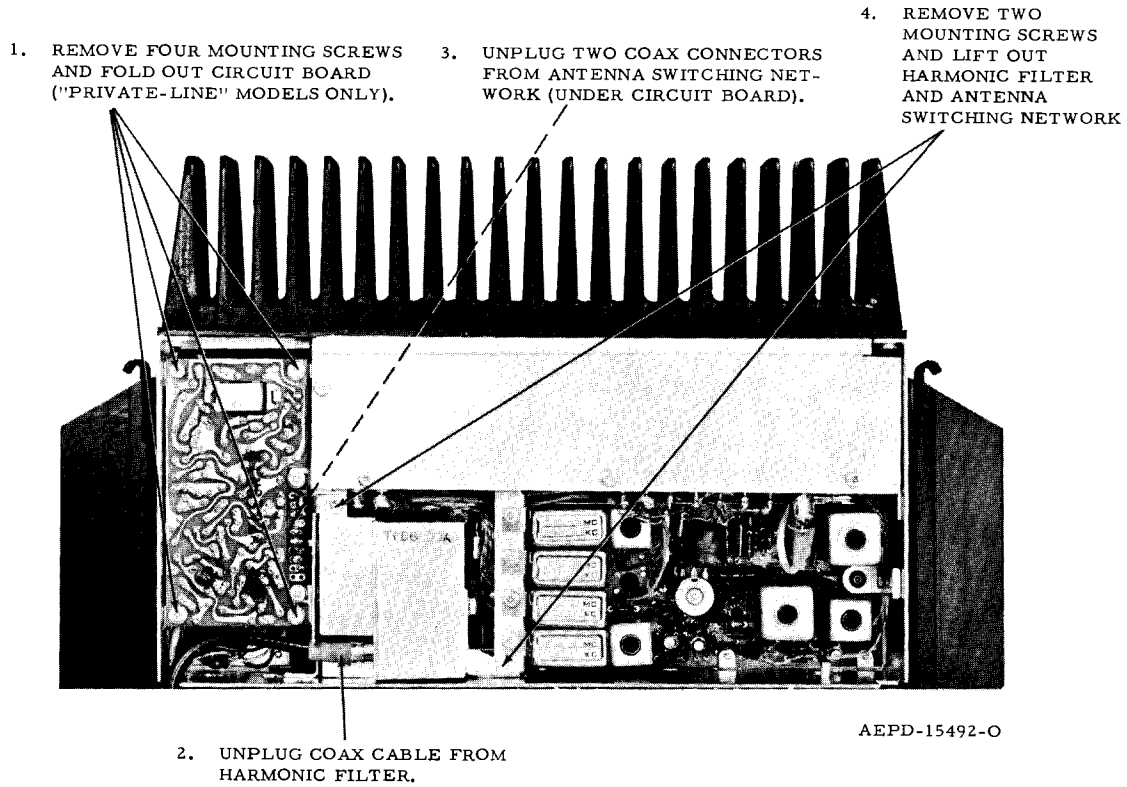
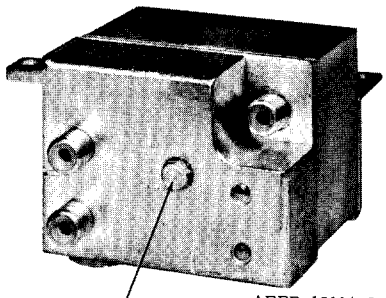


Figure 38. Removal of Harmonic Filter and Antenna Switching Network



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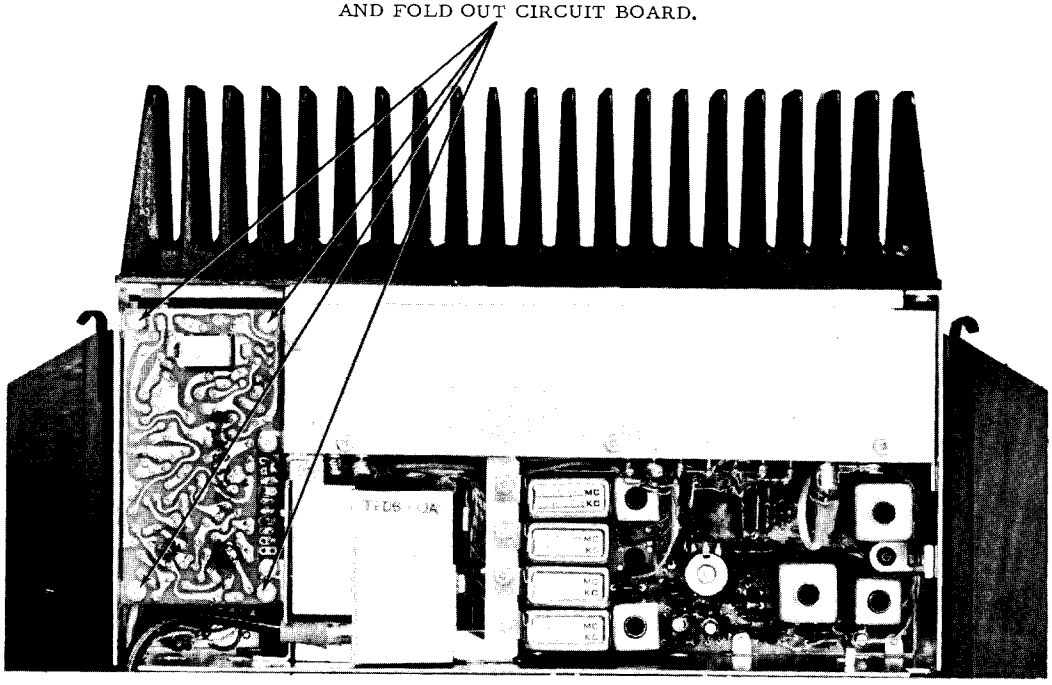
1. REMOVE SECURING SCREW AND PULL ANTENNA SWITCHING NETWORK FROM HARMONIC FILTER.

Figure 39.
Removal of Antenna Switching Network from Harmonic Filter

1. REMOVE FOUR MOUNTING SCREWS AND FOLD OUT CIRCUIT BOARD.



AEPD-15491-O

Figure 40.
Access to Components on "Private-Line" Delay and Oscillator Circuit Board ("Private-Line" Models Only)

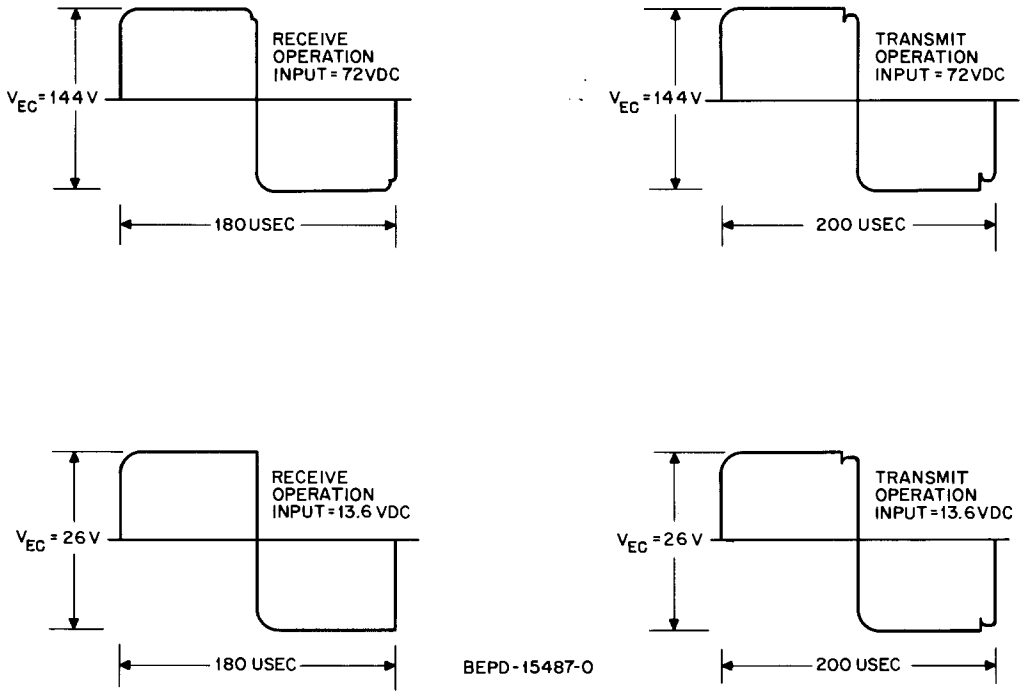


Figure 41.
Power Supply Converter Waveforms

7. POWER SUPPLY SERVICING

a. TPN1053B Power Supply

The power supply converter stages switch at approximately 5000 cps with proper input voltage and output loading. For most people, the 5000 cps switching or "singing" can be detected by ear. Since the "singing" varies with input voltage and output loading, it can provide a clue to a malfunction.

When bench testing, the primary power source should be adjusted to 13.6 volts dc (commonly called 12-volt operation) or 72 volts dc (commonly called 64-volt operation) with the transmitter keyed. The primary power source from which the radio set normally operates should be checked to assure proper input voltage.

If the power supply has no output, first check the fuses. If a fuse is blown, check to determine that the correct polarity voltage was applied. If the polarity is correct, check for a shorted power transistor in the converter section supplied by the line with the blown fuse. If the output is incorrect, the converter stages should be checked for a correct waveform with an oscilloscope (see Figure 41 for the correct waveform). The rectifier and high end regulator can be checked with a dc voltmeter. Refer to voltages on the schematic diagram.

b. TPN1056A Power Supply

The following checks are for typical problems that may be encountered when troubleshooting the 117 v ac power supply for a no output condition and are not intended to be used as a complete troubleshooting procedure. Before bench testing the power supply, the external power source must be adjusted to 117 v ac with the transmitter keyed.

(1) Check transformer T250 for an open or short condition.

(2) Check for blown fuse. If fuse is open, ascertain that diodes CR251 through CR254 of the bridge rectifier circuit and filter capacitor C251 are not shorted.

(3) Make a voltage measurement across capacitor C251. If voltage is normal, check for a short in subsequent stages of the power supply using dc voltmeter and power supply schematic diagram.

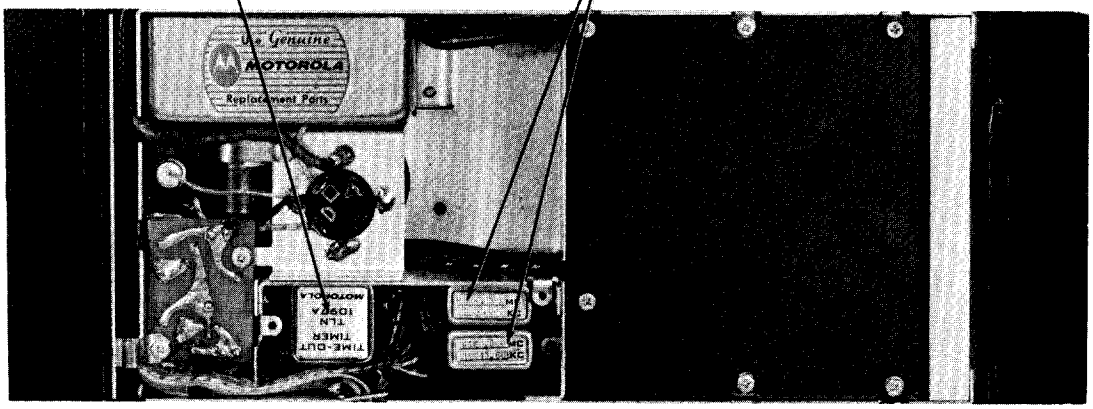
(4) Check for other excessive loading of power supply.

8. REMOVAL AND REPLACEMENT OF POWER SUPPLY COMPONENTS

Figures 42 through 45 illustrate the procedures used to gain access to components mounted on circuit boards and the location of miscellaneous parts not mounted on circuit boards for the TPN1053B Power Supply. For access to fuses and converter transistors, remove the power supply cover on the top side of the radio set. For access to the sockets of the converter transistors, remove the power supply cover on the bottom side of the radio set and fold out the transmitter switching circuit board. To remove any components within the TPN1056A Power Supply, first refer to figure 46 and then to figures 47 through 49. When removing items from either power supply, observe standard practices such as tagging of leads and identification of connecting points.

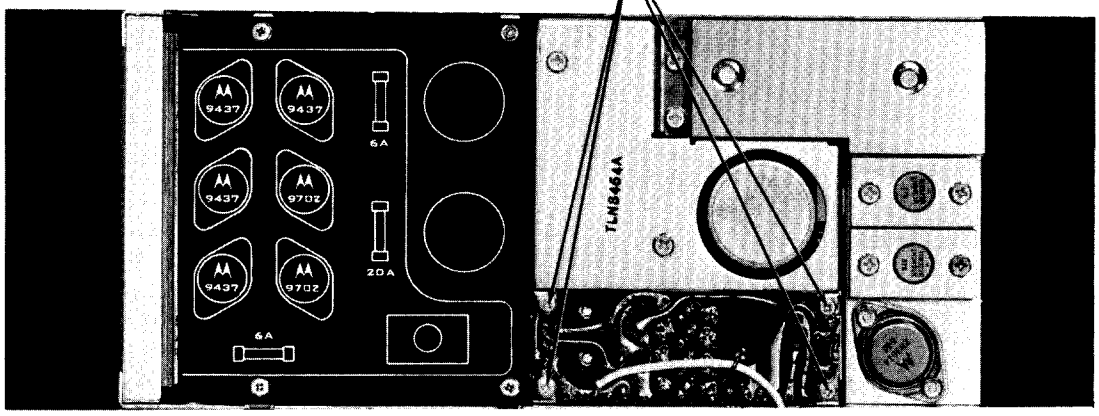
1. UNPLUG TIME-OUT TIMER (IF USED).

2. UNPLUG CHANNEL ELEMENTS (IF USED).



BOTTOM OF RADIO SET

3. REMOVE MOUNTING SCREWS AND FOLD OUT BOARD.



TOP OF RADIO SET

BEPD-15493-A

Figure 42.
Access to Components on Four-Frequency Circuit Board

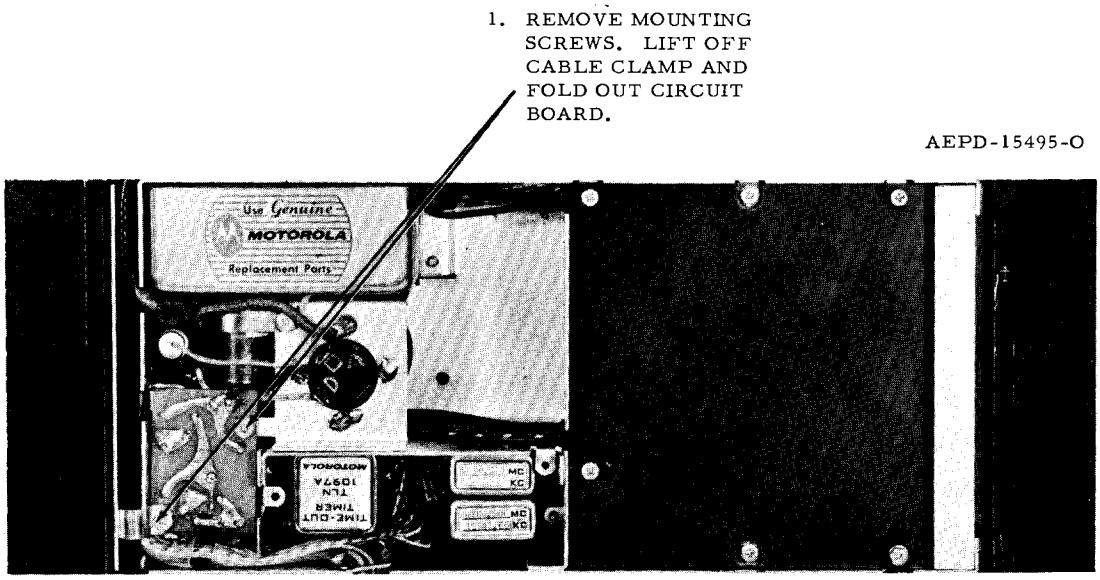


Figure 43.
Access to Components on TPN1053B Power Supply High End Regulator Circuit Board

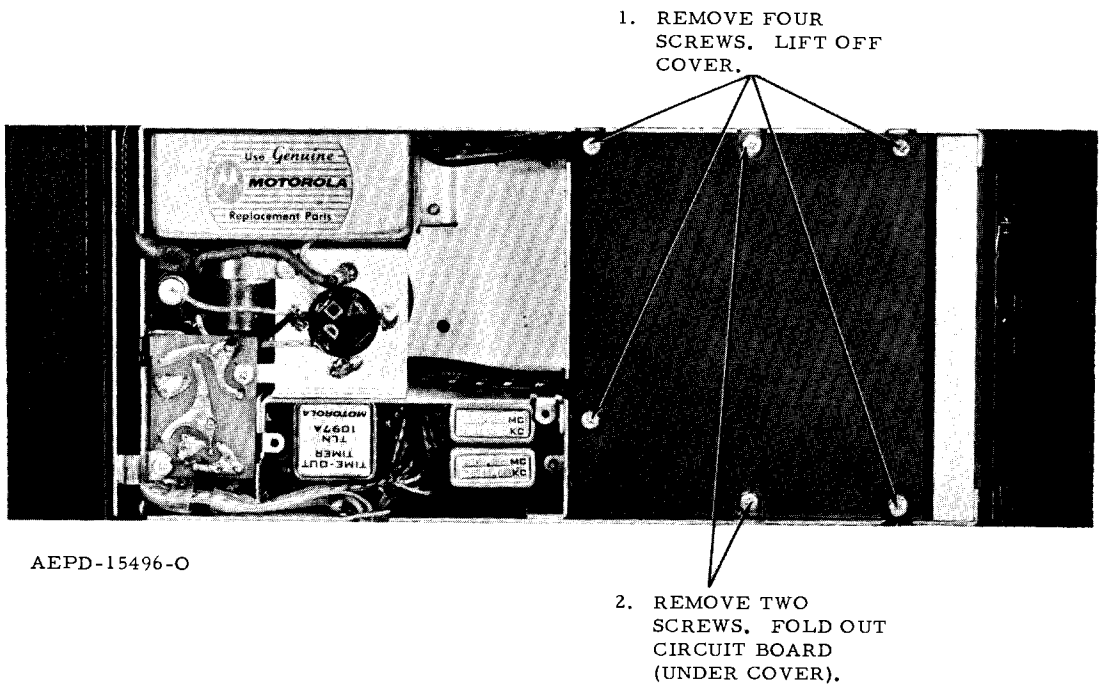


Figure 44.
Access to Components on Switching Circuit Board

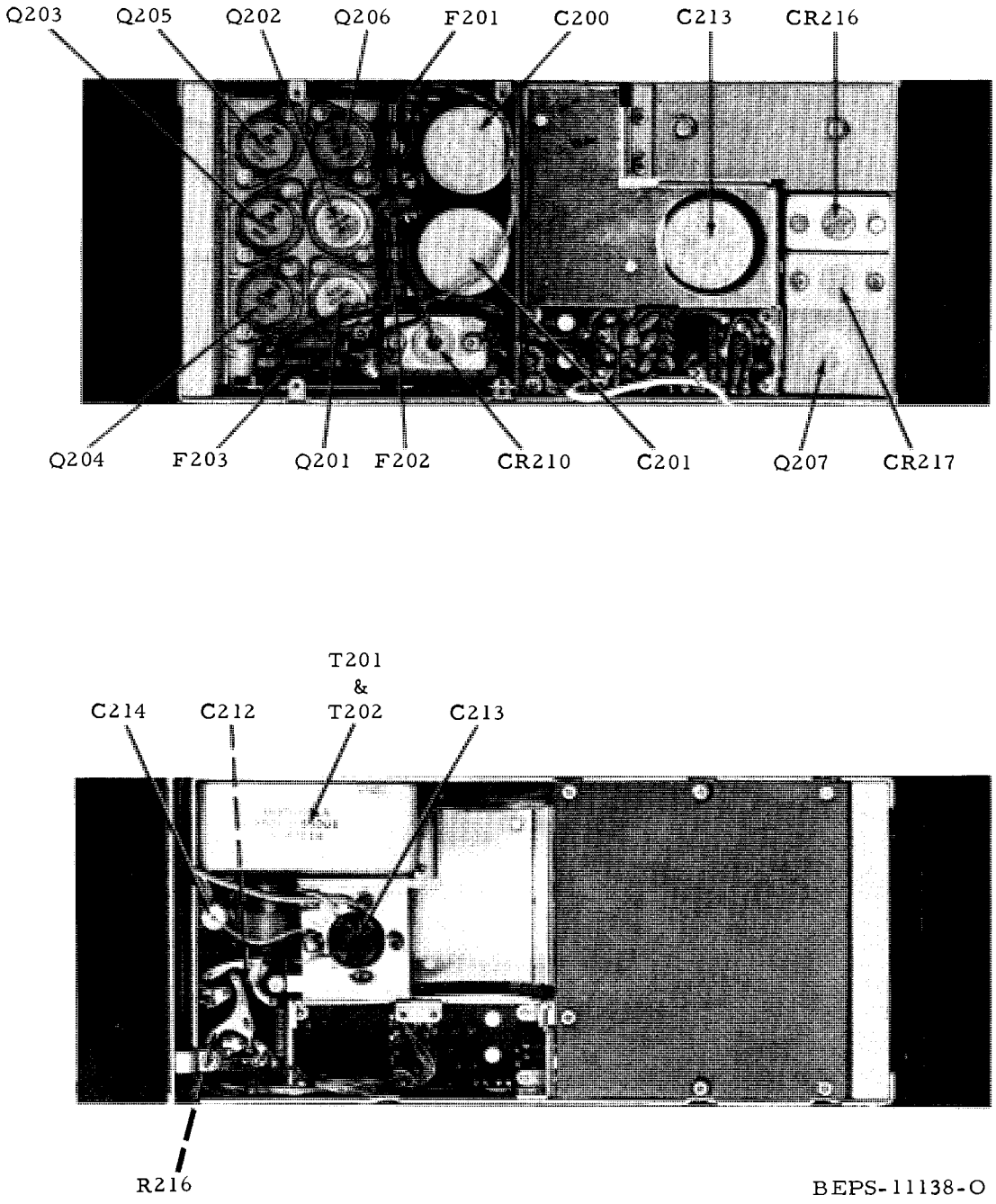


Figure 45.
Power Supply Miscellaneous Parts Location

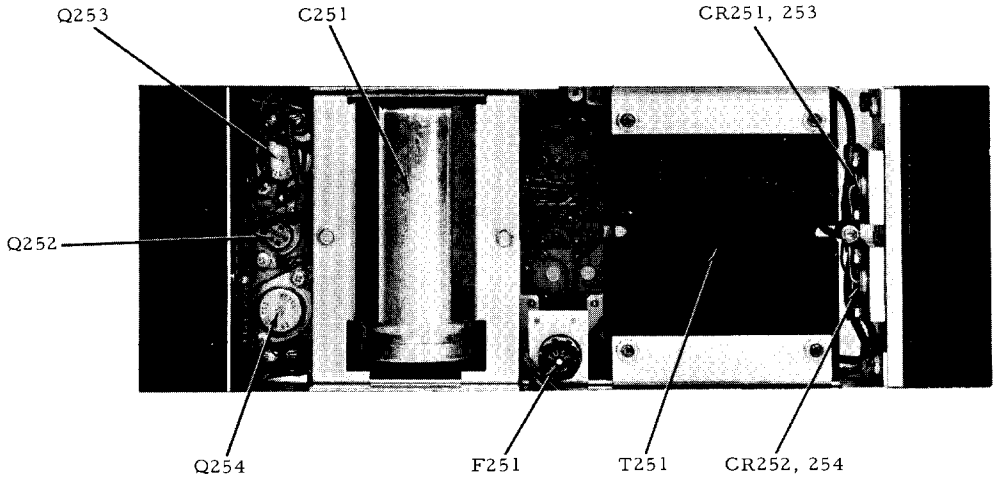
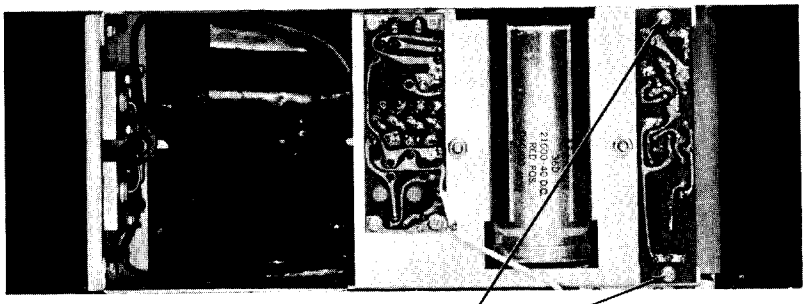


Figure 46.
TPN1056A Power Supply
Component Location Detail



1. REMOVE TWO(2) MOUNTING SCREWS AND FOLD OUT PRINTED CIRCUIT BOARD.

Figure 47.
Access to Components on
Printed Circuit Board

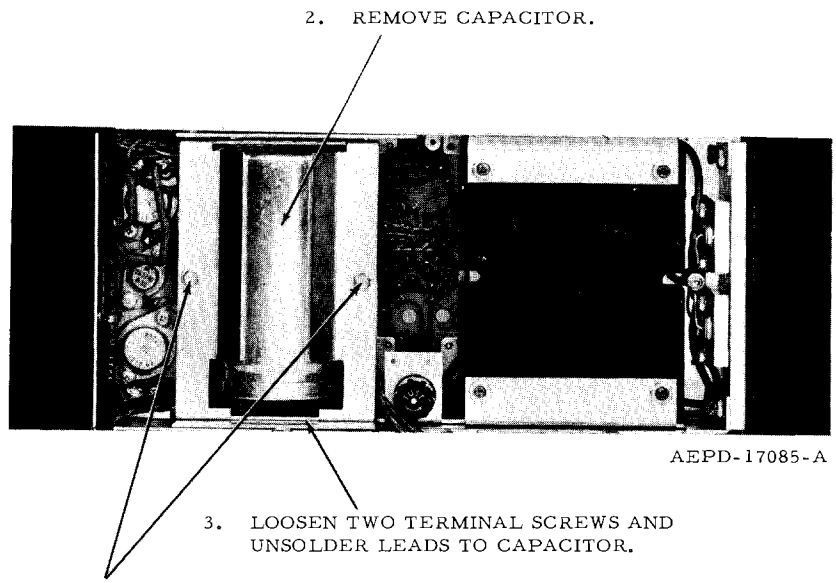


Figure 48.
Removal of Electrolytic Capacitor in
TPN1056A Power Supply

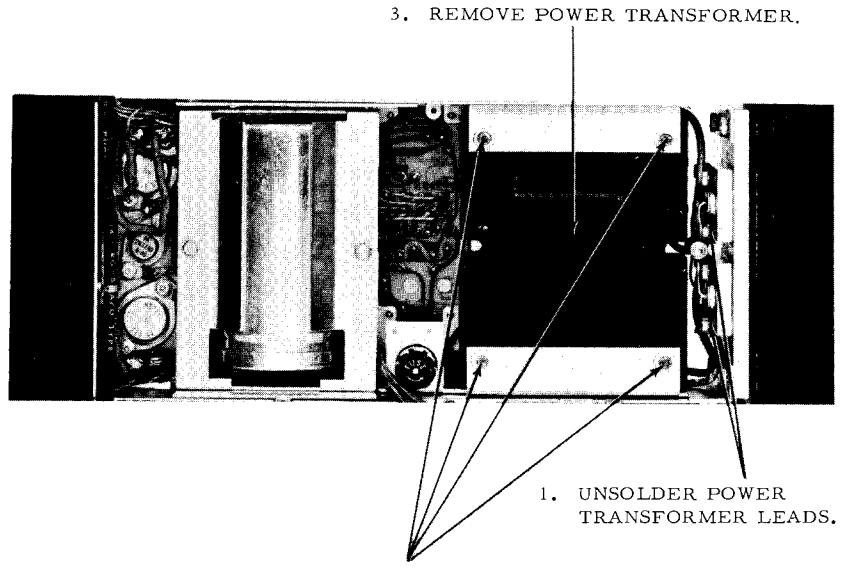


Figure 49.
Removal of Power Transformer in
TPN1056A Power Supply

9. "PRIVATE-LINE" TONE-CODED SQUELCH MAINTENANCE

a. Operation

(1) "Vibrasender" Resonant Reed

The "Vibrasender" resonant reed is the frequency-determining element of the "Private-Line" oscillator for the transmitter. It maintains the oscillator frequency accurate within ±0.15% of the required frequency. The oscillator generates the "Private-Line" tone which is connected to the transmitter modulator through an isolation resistor. The output level of the oscillator is stable and fixed to hold the tone deviation of the transmitted carrier between 1/2 and 1 kc through normal variations of input voltage, temperature, transistor characteristics, component values and modulator sensitivity.

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.

The "PL" oscillator operates when the "Private-Line" switch (in the control head) is in the ON position. No adjustments are required. The design of the "Vibrasender" resonant reed eliminates the need for servicing throughout its useful life.

(2) "Vibrasponder" Resonant Reed

The "Vibrasponder" resonant reed serves as the frequency sensitive switching device in the receiver "Private-Line" squelch circuit.

The tone-actuated squelch circuit begins with a low-pass audio amplifier in the "PL" decoder which receives its input directly from the discriminator. The output of the amplifier is coupled to a driver stage and then to 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 a diode.

The diode output supplies bias to the squelch switch. When the squelch switch is on, the audio amplifier operates to convey audio information to the speaker. In the absence of the proper tone signal, the squelch switch is biased to cut off the audio amplifier and open the audio path to the speaker.

The basic design and construction of the "Vibrasponder" resonant reed is similar to that previously described for the "Vibrasender" resonant reed. The sensitivity of the resonant reed if 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.

b. 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.

(1) Recommended Test Equipment

(a) Motorola Transistorized AC Voltmeter

(b) Motorola DC Multimeter

(c) Motorola Model T1015A General Purpose Oscilloscope

(2) Transmitter "PL" Oscillator Voltage Measurement

Locate and check the voltages for the "PL" oscillator circuit by referring to the appropriate schematic diagram. Adverse effects on oscillator performance can occur if the measured voltage is not up to the level indicated on the diagram.

(3) "Vibrasponder" Resonant Reed Drive Voltage

Measure the driving voltage on the coil of the "Vibrasponder" resonant reed by connecting the ac voltmeter across terminals B-B at the reed base. Make the measurement under the following conditions.

(a) Received carrier is modulated with correct "Private-Line" tone.

(b) Absence of voice modulation.

(c) Receiver voltages at proper level.

Under the previous conditions, the driving voltage should be above 0.35 v ac. This reading will vary if the receiver voltages are above or below normal.

If the receiver voltages are correct and the driving voltage is below 0.35 v ac, check voltages and resistances in the "PL" oscillator circuit to locate the defective component. If no defective components are located, replace the "Vibrasponder" resonant reed.

NOTE

Transistors are highly dependable components and do not normally require replacement.

(4) Transmitter Tone Deviation

The IDC ("Instantaneous Deviation Control") Adjustment Procedure included in this manual may be used to determine proper operation of the "PL" oscillator in the transmitter. Refer to this procedure for detailed information concerning measurement of "Private-Line" tone deviation. If this procedure indicates insufficient (or lack of) tone deviation and the transmitter modulates normally with an audio input, check the "PL" oscillator circuit for incorrect voltages or resistances to locate the defective component.

If all voltage and resistance readings are correct, replace the "Vibrasender" resonant reed.

(5) Symptoms, Causes and Remedies

(a) Symptom: Mobile receiver audio signal spasmodic or intermittent.
Cause: (1) Defective mobile "Vibrasponder" resonant reed. (2) Low transmitting station "PL" tone deviation.
Remedy: (1) Replace defective "Vibrasponder" resonant reed. (2) Check transmitting station tone deviation.

(b) Symptom: One mobile radio set (Normal r-f power output) has difficulty contacting a station while others do not.
Cause: Insufficient (or lack of) tone deviation in mobile transmitter.
Remedy: Check transmitter tone deviation as previously described and replace defective component.

(c) Symptom: All units in network have difficulty contacting a particular unit.
Cause: Defective receiver in particular unit.
Remedy: Check "PL" decoder and "Vibrasponder" resonant reed in defective receiver as previously described.

(d) Symptom: Units hear squelch tail noises from particular unit but not from all units.
Cause: Defective squelch tail eliminator circuitry in transmitting unit.
Remedy: Check reverse burst output from "PL" oscillator in transmitting station.

10. TIME-OUT TIMER SERVICING

If the radio set is equipped with a time-out timer, it should be checked for proper operation when the radio set is serviced. Check the elapsed time beginning when the transmitter is keyed and ending when the alert tone sounds from the speaker. The time should be one minute. The level of the alert tone may be set by changing the value of a resistor as described in the THEORY OF OPERATION section of this manual. Components are accessible by removing two screws and lifting off the can.

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 r-f 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 every year thereafter.

B. TEST EQUIPMENT REQUIRED

1. 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 TLN6845A Tuning Tool Kit.
3. Motorola Model P-7208 Dummy Load or RF wattmeter.
4. Motorola Model T1012A or T1064A Power Supply (or equivalent).
5. Motorola T1130A Series FM Station Monitor or Model S1075B Digital Frequency Meter (or equivalent).

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

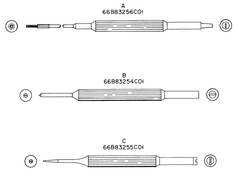
1. Set function switch to XMTR. position.
2. Place the oscillator and meter reversing switch in the OFF position.
3. Connect the 20-pin meter cable plug to the test set; connect the adapter cable to the cable coming from the test set; connect the other end of the adapter cable to the transmitter metering 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 dummy load or r-f wattmeter to the front panel antenna receptacle.
2. Key the transmitter with XMTR. ON switch on the test set or key and modulate the transmitter with a microphone plugged into the test set or radio set control head.

E. CRYSTAL FREQUENCY CALCULATIONS

xtal freq. in mc ⟵ $f_o = \frac{f_c}{12}$ ⟵ carrier freq. in mc (known)



F. TRANSMITTER ALIGNMENT PROCEDURE

NOTES:

1. To properly align multiple-frequency transmitters refer to the following table:

FREQUENCY SEPARATION	POWER OUTPUT	TUNE-UP CRYSTAL FREQUENCY	PA CURRENT
Less than 500 kc	35 watts	Use lowest frequency	42 ua
500-700 kc	35 watts	200 kc above lowest frequency	42 ua
700-1400 kc	30 watts	350 kc above lowest frequency	40 ua

2. The complete alignment procedure need be followed only when a frequency change or complete misalignment occurs. For minor adjustments, use the SHORT FORM ALIGNMENT procedure. For a complete alignment, reduce the input voltage to 10% less than nominal. For the final PA adjustment (Step 15) return the input voltage to the nominal level. Do not exceed the 42 ua maximum PA current.
3. During alignment, C108 or C109 may be adjusted to a point which presents a mismatched load to the final amplifier transistors and the short circuit protection detector will turn off the final limiter and the power output will drop to zero. When this happens, change the adjustment of C108 or C109, rekey the transmitter, and continue the alignment.

SHORT FORM ALIGNMENT

NOTES:

1. For Steps 1 through 6, set input voltage to 10% less than nominal.
2. For Step 7, set input voltage to the nominal level.

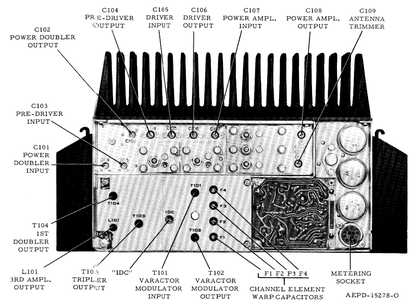
STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
1	T101, T102	1	Varactor Modulator. Use hex end of tuning tool. Adjust T101 and T102 for maximum meter reading.
2	T103, L101	2	Tripler Output - 3rd AMP Output. Use hex end of tuning tool. Adjust bottom and top slugs of T103 and slug of L101 (in that order) for maximum meter reading.
3	T104	3	1st Doubler Output. Use hex end of tuning tool. Adjust bottom and top slugs of T104 (in that order) for maximum meter reading. Repeat.
4	C101, C102, C103	5	Power Doubler Input-Power Doubler Output - Pre-Driver Input. Use screwdriver end of tuning tool. Tune C101, C102 and C103 (in that that order) for maximum meter reading. Repeat.
5	C104, C105	6	Pre-Driver Output-Driver Input. Use screwdriver end of tuning tool. Tune C105 first and then C104 for maximum meter reading. Repeat.
6	C105, C106, C107, C108, C109	None	Use screwdriver end of tuning tool. Tune C105, C106, C107, C108 and C109 (in that order) for maximum wattmeter reading. Repeat until no further increase can be obtained.
7	C108, C109	PA	Adjust input voltage to the nominal level. Use screwdriver end of tuning tool. Repeak C108 and C109 for maximum wattmeter reading. Observe if PA meter reading is exceeding 42 ua. If so, retune C108 until PA meter indicates a maximum of 42 ua. (Do not retune C109 after PA current has been set by retuning C108.)

COMPLETE ALIGNMENT PROCEDURE

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
1	T101, T102, L101, T103, T104	None	EXCITER BOARD COILS. Use hex end of tuning tool. Set slugs in T101 and T102 to top of can (away from printed circuit board). Set slug in L101 to bottom of can. Set upper and lower slugs of T103 and T104 to top and bottom of can respectively.
2	---	None	OSCILLATOR. FCC regulations require a periodic frequency check. If the check is due at this time, follow the procedure on this sheet; OTHERWISE NO ADJUSTMENT SHOULD BE MADE.
3	T101, T102	1	VARACTOR MODULATOR. Use hex end of tuning tool. Adjust T101 and T102 for maximum meter reading.
4	T103, L101	2	TRIPLER OUTPUT -- 3RD AMP OUTPUT. Use hex end of tuning tool. Adjust bottom and top slugs of T103 and slug of L101 (in that order) for maximum meter reading.
5	T104	3	1ST DOUBLER OUTPUT. Use hex end of tuning tool. Adjust bottom and top slugs of T104 (in that order) for maximum meter reading. Repeat.
6	C101, C102, C103	5	POWER DOUBLER INPUT - POWER DOUBLER OUTPUT - PRE-DRIVER INPUT. Use screwdriver end of tuning tool. Tune C101, C102 and C103 (in that order) for maximum meter reading. Repeat.
7	C104, C105	6	PRE-DRIVER OUTPUT - DRIVER INPUT. Use screwdriver end of tuning tool. Tune C105 first and then C104 for maximum meter reading. Repeat.

F. TRANSMITTER ALIGNMENT PROCEDURE (CONT'D)

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
8	C108, C109	PA	POWER AMP. OUTPUT - ANT. TRIMMER. Observe meter. If reading is less than 15 ua proceed to step 9. If reading is exceeding 15 ua tune C108 and C109 (in that order) for maximum wattmeter reading.
9	C106, C107	PA	DRIVER OUTPUT - POWER AMP INPUT. Use screwdriver end of tuning tool. Tune C106 and C107 for maximum meter reading.
10	C108, C109	None	POWER AMP OUTPUT - ANT TRIMMER. Use screwdriver end of tuning tool. Tune C108 and C109 (in that order) for maximum wattmeter reading.
11	C105, C106, C107	None	Use screwdriver end of tuning tool. Tune C105, C106, and C107 (in that order) for maximum wattmeter reading.
12	C102, C103	6	Use screwdriver end of tuning tool. Tune C103 and C102 (in that order) for maximum meter reading.
13	C101, T104	5	Use hex end of tuning tool and adjust top slug of T104 for maximum meter reading. Use screwdriver end of tuning tool and tune C101 for maximum meter reading. Repeat both adjustments. Place test set switch in position 3. If meter reading is less than 12 ua, turn top slug T104 five turns toward circuit board. Return test set switch to position 5 and repeak C101 and top slug of T104.
14	T104, L101	3	Use hex end of tuning tool. Adjust bottom slug of T104 and slug of L101 for maximum meter reading.
15	C108, C109	PA	Adjust input voltage to the nominal level. Use screwdriver end of tuning tool. Repeak C108 and C109 for maximum wattmeter reading. Observe if PA meter reading is exceeding 42 ua. If so, retune C108 until PA meter indicates a maximum of 42 ua. (Do not retune C109 after PA current has been set by retuning C108.)



G. OSCILLATOR FREQUENCY ADJUSTMENT

NOTE

Discriminator output can be monitored in position 4 of the test set from either the receiver or transmitter metering socket.

Setting the oscillator "on frequency" is the only oscillator adjustment necessary. This can be accomplished by performing one of the three following procedures. The standard procedure may be performed when either the standard or the 0.0002% stability channel elements are used. However, in order to utilize the full capability of the 0.0002% stability channel element, it is advisable to use the precision method. The alternate procedure may be used only when the transmitter and receiver frequencies are identical. For best performance, the channel element should be set "on frequency" when ambient temperature is 60° to 80°F.

1. Standard Method:

a. Set up the frequency monitor as described in the frequency monitor instruction manual. Place the monitor antenna within a few feet of the transmitter.
b. Plug the selected channel crystal into the socket and set MON. CHANNEL SELECTOR to corresponding position. Follow standard monitoring procedure.
c. With the radio set operating on the F1 frequency, adjust the transmitter F1 warp capacitor for zero reading on the monitor CARRIER FREQUENCY meter (use screwdriver end of tuning tool). For multiple-frequency models adjust the appropriate trimmer when operating on each frequency.
d. After setting the transmitter "on-frequency" remove the transmitter channel element. The frequency monitor should indicate no transmitter output. Replace channel element and proceed with alignment.

2. Precision Method:

a. Set up the S1075B Digital Frequency Meter as described in the instruction manual.
b. Read the frequency indication displayed on the digital frequency meter.
c. If the proper indication is not observed, adjust the F1 warp capacitor using the screwdriver end of the tuning tool and obtain new reading. For multiple-frequency models adjust the appropriate trimmer when operating on each frequency.

3. Alternate Method:

a. Align the receiver or check for proper receiver alignment by transmitting the frequency normally received to produce 0 ua reading on the discriminator metering (position 4 of test set).
b. Key the transmitter with the microphone or transmit switch on the test set if it is plugged into the transmitter metering receptacle. Zero ua should still be registered at position 4 of test set.
c. If meter deviation occurs, adjust the F1 warp capacitor for 0 ua reading. For multiple frequency applications, adjust the appropriate trimmer for 0 ua reading for each operating frequency. Discriminator metering is possible at the transmitter and receiver meter receptacles in position 4.

H. 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 table following are minimum except PA which is maximum. DO NOT exceed the value given for the PA current. Multiply the microampere scale reading by 1/10 to obtain actual PA collector current in amperes.
3. Readings 1 through 6 are purely relative and do not give actual current or voltage measurement.

CIRCUIT METERED	Tripler Base	1st Doubler Collector	Exciter Output	Predriver Base	Driver Base	PA Current
SWITCH POSITION	1	2	3	5	6	7
METER READING	17	20	12	12	8	42

"IDC" ADJUSTMENT (PREFERRED METHOD USING OSCILLOSCOPE)

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 T1130A Series FM Station Monitors are leaders in the field with respect to sensitivity, accuracy under conditions of variation in r-f signal level, line voltage, and environmental conditions. In common with most other meters, these meters have characteristic of responding differently to different wave shapes. Therefore, the use of most present-day deviation meters can lead to confusion and errors in deviation setting, if the pitfalls are unknown or disregarded.

The ideal deviation indicator would be one which would respond instantaneously to the peak value of the modulation deviation regardless of waveform. The only device which meets all these requirements is an oscilloscope. It responds instantaneously and it shows the peak value of any waveform, no matter how complex. Properly calibrated, an oscilloscope is the most accurate and reliable instrument for measuring and setting transmitter deviation.

The oscilloscope must be used in conjunction with a receiver which has a stable discriminator characteristic, since the oscilloscope displays the demodulated signal. In addition to the oscilloscope and receiver, a means to accurately calibrate the system is required. The Motorola monitor fills these requirements, since it provides both a sensitive receiver with the proper discriminator characteristic and a reliable means of calibrating the oscilloscope. It has convenient terminals on the front panel for connection of the oscilloscope. Also, the Motorola FM Station monitor has two modulation meter scales, 0-20 kc for wide-band systems, and 0-10 kc for split-channel systems.

Split-channel conversion kits are available for modification of older models. When converted, the older models have convenient oscilloscope terminals and can be more accurate measurement devices for such systems.

2. TEST EQUIPMENT REQUIRED

a. Motorola T1130A Series FM Station Monitor (or equivalent).

b. Motorola Transistorized AC Voltmeter (or equivalent).

c. Motorola Model TEK-1A Transistorized Tone Generator, 1000 cps (or equivalent).

d. Motorola Model T1014B Precision Wide Band Oscilloscope or Motorola Model T1015A General Purpose Oscilloscope (or equivalent).

e. Motorola Model S1056A-9A Series Portable Test Set with a Motorola Model TKN6025A Adapter Cable.

3. OSCILLOSCOPE CALIBRATION

The first step in the measurement of transmitter deviation is to calibrate the oscilloscope. This can be done by using the transmitter which is to be measured.

Proceed as follows:

a. Remove the "Vibrasender" resonant reed in "Private-Line" tone-coded squelch models.

b. Connect the oscilloscope to the monitor oscilloscope terminals and set up the monitor controls in accordance with the monitor instruction manual.

c. Turn the IDC control on the transmitter chassis to the full clockwise position.

d. Feed a 1000 cps test tone into the transmitter audio input (at mike receptacle). Modulate the transmitter with this tone so adjusted that the deviation as read on the FM monitor deviation meter is 2 kc. An audio oscillator must be used for generation of this tone, since a sinusoidal waveform is very important. The Motorola TEK-1A Transistorized Tone Generator is excellent for this purpose.

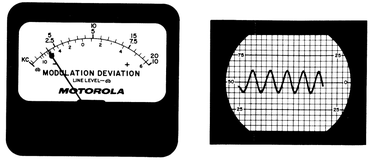


Figure 1.
Oscilloscope Calibration for Split-Channel Transmitter

e. Adjust the vertical gain of the oscilloscope so that the total recovered audio pattern occupies some convenient height, e.g., four small squares (figure 1).

Having calibrated the oscilloscope, there is no further need for the modulation deviation meter. Ignore its reading from this point on. It has already performed its important function of calibrating the oscilloscope.

With the oscilloscope calibrated as indicated, a recovered signal which occupies 10 squares (peak-to-peak) is equivalent to ±5 kc deviation.

4. MEASUREMENT AND SETTING OF TRANSMITTER DEVIATION

Once the oscilloscope has been calibrated the transmitter deviation can be properly adjusted by the following method.

a. Carrier Squelch Models

(1) Adjust the 1000 cps input signal to 3 volts. This should drive the IDC circuit to the full clip. See figure 2.

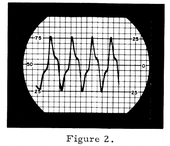


Figure 2.
5 KC Peak Deviation as seen on the Oscilloscope
(NOTE: Waveform is clipped fully)

(2) With this input signal level, adjust the IDC control on the transmitter to provide a 10-square peak-to-peak recovered signal on the oscilloscope. This is equivalent to ±5 kc deviation as shown in figure 2.

(3) Reduce 1000 cps input to 0.75 volt. Essentially full deviation should still be observed on the oscilloscope. Less than 3/4 full deviation may indicate a weak audio stage or other lack of audio gain.

b. "Private-Line" Tone-Coded Squelch Models

(1) Replace the "Vibrasender" resonant reed and check the "Private-Line" tone deviation with the "Private-Line" switch on. This may be read directly from the oscilloscope by pressing the transmitter push-to-talk switch on the test set. The tone deviation should be 0.5 to 1 kc.

NOTE

Due to a slight increase in discriminator response at the lower frequencies, the oscilloscope will read high, thus, an indication of 1.4 to 2.8 squares (peak-to-peak) is equivalent to 0.5 to 1 kc. This slight variation is only important when checking tone deviation. When setting maximum transmitter deviation as described below, it may be ignored.

(2) Adjust the 1000 cps input signal level for 3 volts and note the resultant combined deviation of the 1000 cps modulation and tone signal modulation on the oscilloscope.

(3) Adjust the IDC control on the transmitter for a peak-to-peak combined signal of 10 squares, equivalent to full 5 kc as shown in figure 3.

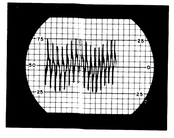


Figure 3.
5 KC Peak Deviation for Combined "PL" Tone and 1000 cps Modulation
(NOTE: "PL" Tone Superimposed on 1000 cps tone)

(4) Reduce the 1000 cps input to 0.25 volt. Essentially full combined 1000 cps tone and "Private-Line" tone deviation should still be observed on the oscilloscope. Less than 3/4 full combined deviation may indicate a defective audio stage.

5. 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 cps tone as previously indicated. The calibration of the oscilloscope should always be performed with a steady controlled signal. Do not attempt to calibrate the oscilloscope with a sustained whistle as waveform distortion will prevent an accurate calibration.

6. OTHER MEANS FOR MEASUREMENT OF DEVIATION

Another accurate means of measuring transmitter deviation is to use the Motorola S1058A Portable Test Set (with deviation meter) and Motorola FM Signal Generator or Motorola S1059A Portable Test Set (with deviation meter and peaking generator). These units, properly used, permit the accurate measurement and setting of transmitter deviation from a peak-reading meter, which is unaffected by waveform. An oscilloscope is not required. With these devices transmitter deviation can be measured accurately evenly with voice modulation.

7. MICROPHONE

If the modulation level in the system still appears to be too low after setting deviation, check the handset microphone.

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

The importance of the correct deviation setting can not 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.

A. TEST EQUIPMENT REQUIRED

1. 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 T1034C, T1035A or T1036A Signal Generator (or equivalent).
3. Motorola Model TLN6845A Tuning Tool Kit. A small screwdriver may be used for some of the alignment.
4. Motorola Model T1012A or T1064A Power Supply (or equivalent).
5. Motorola Transistorized AC Voltmeter (or equivalent).

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

1. Set function selector switch to RCVR position.
2. Switch on 455 kc 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 r-f extension cable to the test set; connect the r-f probe cable to the r-f extension cable.

C. HOW TO SET UP 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 connector on the radio.
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 r-f carrier frequency. Watch the test set meter. The pointer should swing above and below the zero reading as the dial is rotated. Set the dial for exact zero meter reading. Be sure the generator frequency is kept at zero meter reading.

D. FREQUENCY CALCULATIONS

$$f_1 = \frac{f_c - 8\text{ mc}}{12} \qquad f_2 = 7.545\text{ mc or }8.455\text{ mc}$$

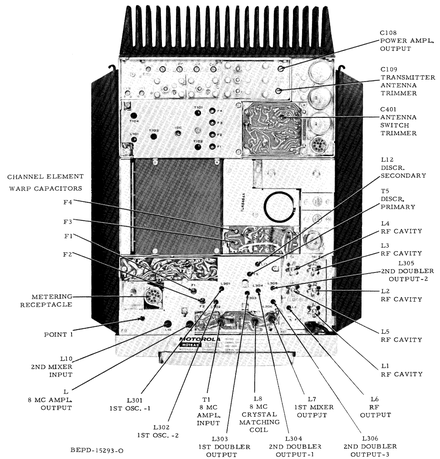
where f_1 = channel element frequency

f_c = carrier frequency

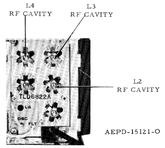
f_2 = 2nd oscillator frequency

E. TEST SET SELECTOR SWITCH POSITIONS

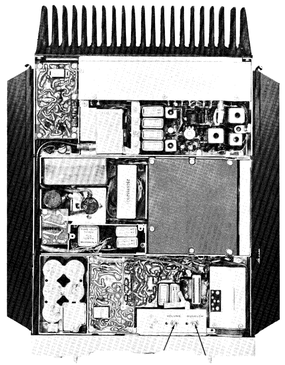
S1056A-9A TEST SETS	1	2	4	5	6	11
CIRCUIT METERED	455 KC IF Ampl. #2	455 KC IF Ampl. #3	Discrim. Secondary	Discrim. Primary	1st. Osc.	Audio



BEPD-15293-O



AEPD-15121-O



AEPD-15294-O

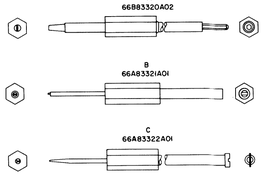


DIAGRAM NO. BEPD-13560-O

F. RECEIVER ALIGNMENT

NOTE

Refer to the following table for special instructions for multiple frequency receivers with a frequency separation greater than 350 kc.

FREQUENCY SEPARATION	RECEIVER SENSITIVITY	ALIGNMENT SPECIAL INSTRUCTIONS
350-700 KC	0.5 uv	Use center frequency tune-up crystal
350-700 KC	0.7 uv	Use either of the receiver frequencies
700-1400 KC	0.7 uv	Use center frequency tune-up crystal

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
1	L12, T5	5	DISCRIMINATOR PRIMARY -- Set up the test set as described in paragraph B. Insert a 2 uuf capacitor in series with the r-f probe. Place the r-f probe on the input to the 455 kc i-f filter (POINT 1). Use screwdriver end of tuning tool B. Adjust L12 so that the slug is very close to the top of the coil. Adjust T5 for a maximum indication on meter.
2	L12	1 and 4	DISCRIMINATOR SECONDARY -- Use the "0" center scale on the test set. Use a signal input to produce an indication on meter position 1, reading between 5 and 20 ua. Adjust L12 for an absolute zero on the "0" center (top) scale with the switch in position 4. Use screwdriver end of tuning tool B. This is a critical adjustment and should be exactly on zero. Remove the r-f probe and switch off 455 kc crystal oscillator.
3	L301 thru L306	6 and 1	MULTIPLIER -- Set up the signal generator as described in paragraph C. Position frequency selector switch on control head to position F1. Adjust coils L301, L302, L303 for maximum indication on meter position 6, (use small screwdriver end of tuning tool B). Repeak coils L301, L302 and L303. Apply as much signal as is required for a small indication on meter position 1. Align coils L304, L305, and L306 (in that order) for maximum indication on meter position 1. Repeak L303 thru L306. NOTE When tuning coils L301 thru L306, two peaks may occur. Use the lower peak.
4	L1 thru L6	1	RF DECK -- Use slotted end of tuning tool B. Detune L1 thru L6 by turning slugs counterclockwise to the end of tuning range. Increase output of signal generator until small indication is observed on meter position 1. Tune L1 thru L6 (in that order) for maximum indication on meter position 1.
5	L7, L8, T1 L10, L9	1 and 4	8 MC IF -- Recheck meter position 4 for exact zero reading. Use a signal input to produce a reading of approximately 10 ua on meter position 1. Use screwdriver end of tuning tool C. Detune L7, L8 and T1 by turning slugs counterclockwise to the top of coil forms. Tune L10, L9 and L8 (in that order) for a maximum indication on meter position 1. Repeak L10, L9, and L8. (Do not attempt to repeak L8 during the subsequent adjustments.) Peak T1 and L7 (in that order) for maximum indication on meter position 1. Repeak T1 and L7 adjustment several times. NOTE Do not noise balance.

ALIGNMENT CONTINUED ON REVERSE SIDE

STEP	ADJUSTMENT	TEST SET SWITCH POSITION	STAGE AND TUNING PROCEDURE
6	C401, C109, C108	1	ANTENNA SWITCH -- If the transmitter has been aligned, do not adjust C108 and C109. If the transmitter has not been aligned, adjust C108 and C109 for best 20 db quieting sensitivity. Readjust C108 and C109 as required during transmitter alignment.
7	L1 thru L6, L306	1	Repeak L1 through 6 (in that order) for maximum indication on meter position 1. Repeat. Retune L306 for peak indication on meter position 1. Reduce signal generator output to 20 db. Retouch L5 & L6 for best quieting. Disconnect signal generator and reconnect the antenna.
8	F1, F2, F3, F4	1, 2, 4	ON FREQUENCY ADJUSTMENT -- Transmit a carrier from the transmitter which this receiver is normally intended to receive. If the transmitter and receiver are on the same frequency and the transmitter is known to be on frequency the test set meter should indicate a rise with the test set switch in positions 1 and 2 when the transmitter is keyed. Check the meter reading with the switch in position 4. Zero indicates an on frequency condition. NOTE The receiver discriminator output can be metered from position #4 of either the receiver or transmitter test metering sockets. Set the F1 warp capacitor for exact zero meter reading on the F1 frequency. On multiple frequency models, set the appropriate warp capacitor for zero meter reading on each frequency. DO NOT READJUST COILS L301 and L302.
9	VOLUME		Set up the signal generator as described in paragraph C and modulate the carrier signal with a 1000 cps tone for 3.3 kc deviation. Connect an a-c voltmeter across the speaker and set the VOLUME control on the control head to maximum. Set the VOLUME control on the radio set for 8 volts indication on the a-c voltmeter. (This is 8 watts audio output).
10	SQUELCH		On "Private-Line" receivers place the "PL" ON-OFF switch on the control head in the OFF position. Connect the signal generator cable to the antenna connector on the radio. Set the signal generator off frequency with no output. Turn the SQUELCH control to the extreme counterclockwise position. Adjust the VOLUME control to obtain a suitable listening level. Connect an ac voltmeter across the speaker leads and note the reading. After observing the voltage level do not change the volume control setting until the squelch level has been set. Set the signal generator on the frequency being used and increase the output until there is a 14 db decrease in the receiver noise level measured on the ac voltmeter. Turn the squelch control slowly clockwise until the noise just quiets. A small increase of the generator output should open the squelch.

G. AVERAGE STAGE MEASUREMENTS WITH RADIO SET PROPERLY ADJUSTED

APPROXIMATE MICROVOLT INPUT	INPUT TO		FREQUENCY	METER POSITION	TEST SET METER READING
No Signal	Antenna Disconnected			1	2.0 ua
No Signal	Antenna Disconnected			2	26 ua
No Signal	Antenna Disconnected			4	0
No Signal	Antenna Disconnected			5	20 ua
No Signal	Antenna Disconnected			6	12 ua
0.5	Antenna Connector		Carrier Freq.		20 DB Quieting
1.5	Antenna Connector		Carrier Freq.	1	10 ua
2.1	Base	1st Mixer (Q1)	Carrier Freq.		20 DB Quieting
400	Collector		8 mc	1	10 ua
12	Base	8 mc IF Transistor (Q2)	8 mc	1	10 ua
70	Collector				
25	Base	2nd Mixer (Q3)	8 mc	1	10 ua
450	Collector		455 kc	1	10 ua
110	Base	455 kc Ampl. Transistor (Q9) in 455 kc filter	455 kc	1	10 ua
4500	Collector				
1600	Base	1st 455 kc IF Transistor (Q10)	455 kc	1	10 ua
60000	Collector				

STAGE MEASUREMENT NOTES

1. All measurements made with signal generator tuned to the required frequency.
2. All measurements, except antenna input taken with 50 ohm terminated cable with a 0.003 uf capacitor in series.

H. HOW TO MEASURE 20 DB QUIETING SENSITIVITY

Test Equipment Required

1. Motorola Model T1034C, T1035A or T1036A Signal Generator
2. Motorola Model S1056A-9A Portable Test Set

Procedure

1. Turn on the signal generator and allow it to warm up for at least one hour.
2. Connect the meter cable and adapter cable from the test set to the receiver METER receptacle on the chassis.
3. Set the RCVR-XMTR-ACCESS switch to the RCVR position. Set the position selector to position 4.
4. Connect the signal generator output through a 6 db pad to the ANT jack on the radio set.
5. Turn up the generator output and rotate the generator dial back and forth near the assigned r-f carrier frequency. The test set meter pointer should swing above and below the zero mark as the generator dial is rotated. Set the dial for exact zero reading.
6. Reduce the signal generator output to zero (i.e., no signal input). Set the position selector switch to position 11 (AUDIO).
7. Unsquelch the receiver by turning the SQUELCH control fully counterclockwise.
8. Adjust the VOLUME control for a 1.0 volt reading on the test set meter.
9. Now, turn up the signal generator output until the test set meter reading drops to 0.1 volt. Note the setting of the signal generator output control and subtract 6 db for the pad. This value in microvolts is the 20 db quieting sensitivity for the receiver.

I. INTERFERENCE REJECTION TUNING PROCEDURE

Introduction

The r-f preselector renders a bandpass having a wide acceptance bandwidth and steep skirt selectivity to provide rapid attenuation to signals outside the acceptance bandwidth. Since the "nose" of the receiver r-f bandwidth is flat, it is possible to retune the r-f preselector to reject interfering signals with virtually no effect on normal radio operation. These interfering signals may be located above or below the desired carrier frequency.

An approximation to the change in r-f selectivity when retuning the r-f preselector can be obtained from the RF PRESELECTOR SELECTIVITY CURVES. The graph of these curves shows the center frequency response of the preselector versus the shift in skirt attenuation.

As an example, suppose that interference is being experienced from a frequency 1 mc above the carrier frequency (f_c). Curve A shows the attenuation of the interference to be approximately -4 db. If the procedure outlined below is followed and selectivity curve B is obtained, the attenuation of the interference would be approximately -20 db, or an increase of 16 db. The improvement in rejection is the difference between the two curves as read on the vertical db scale. In this case, 20 db from curve B, minus 4 db from curve A, equals a 16 db improvement.

Test Equipment Required

1. Motorola Model S1056A-9A Portable Test Set with Motorola Model TKN6025A Adapter Cable (available on separate order), or equivalent.
2. Motorola Model T1034C, T1035A or T1036A Signal Generator, or equivalent.
3. Motorola Model T1012A or T1064A Power Supply, or equivalent.
4. Motorola TLN6845A Tuning Tool Kit.

Procedure

1. Determine the location of the interfering signals with respect to the carrier frequency.

   (a) If the interfering signals are above the desired frequency, the preselector must be tuned to a lower frequency. To tune the preselector lower, turn the tuning section screws (L2, L3, L4) clockwise into the top plate.

   (b) If the interfering signals are below the desired frequency, the preselector must be tuned to a higher frequency. To tune the preselector higher, turn the tuning section screws counterclockwise away from the top plate.

2. Set up the portable test set as described in paragraph B and the signal generator as described in paragraph C.
3. Set the signal generator input level for 10 microamperes meter indication at position 1.
4. Detune L4 in the direction determined in step 1 for a reduction of approximately 1 microampere, maximum. Reset the generator for 10 microamperes indication.
5. Detune L3 and L2, in that order, using the above procedure. Be sure to reset the signal generator for 10 microamperes after detuning L3.

NOTE

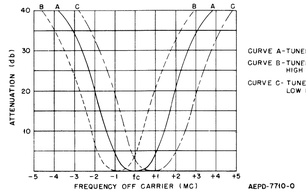
Do not tune L1, L5 or L6 at all in this procedure.

6. A decrease of approximately 1 microampere for a tuning change in each adjustment represents a shift in the center frequency of the preselector of approximately 1 megacycle. If the frequency of the interfering signals can be determined, and the amount of shift desired is known, the preselector can be retuned for a shift less than 1 megacycle by detuning L4, L3 and L2 from peak tuning, each for a decrease in meter indication which is the same portion of 1 microampere as the desired frequency shift is a portion of 1 megacycle.

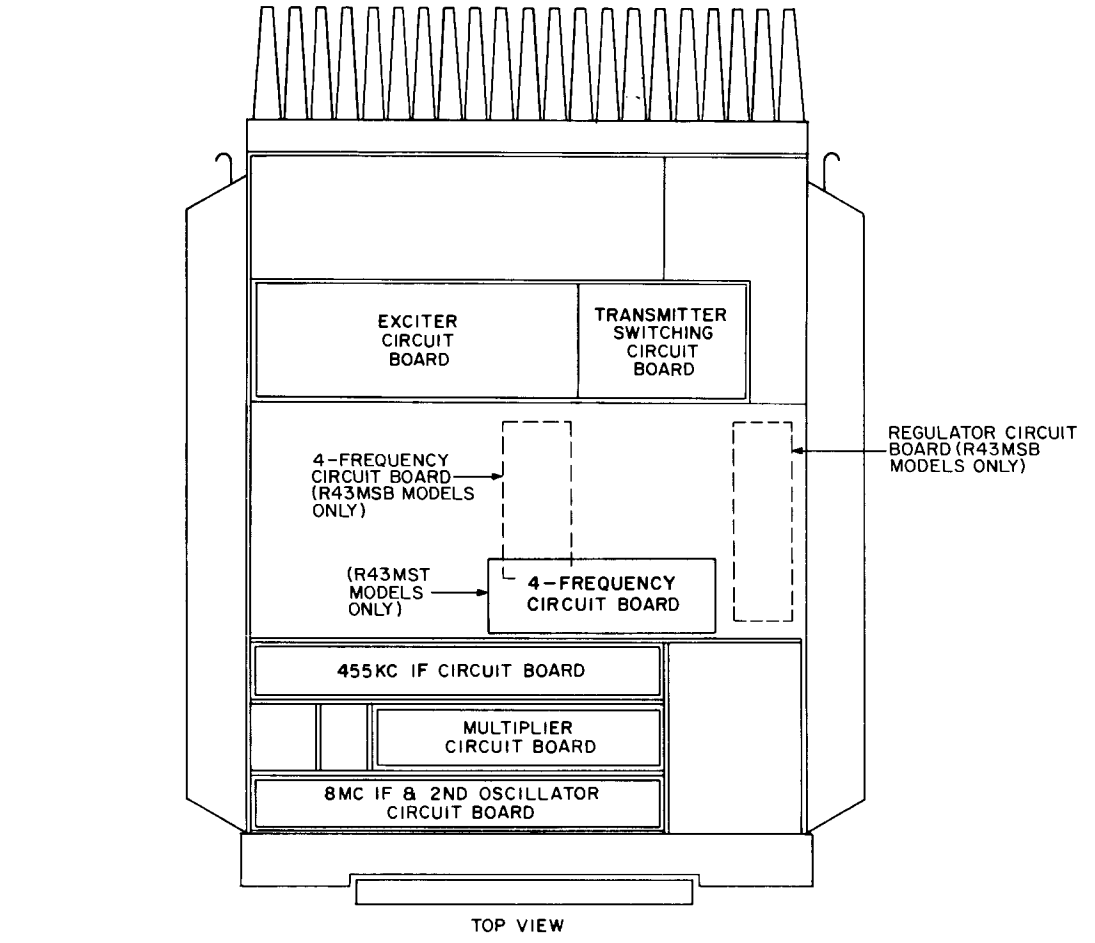
Examples:

(a) For a frequency of 0.25 mc, detune L4, L3 and L2, in that order, to reduce the 10 microamperes indication by 0.25 microampere for each section.

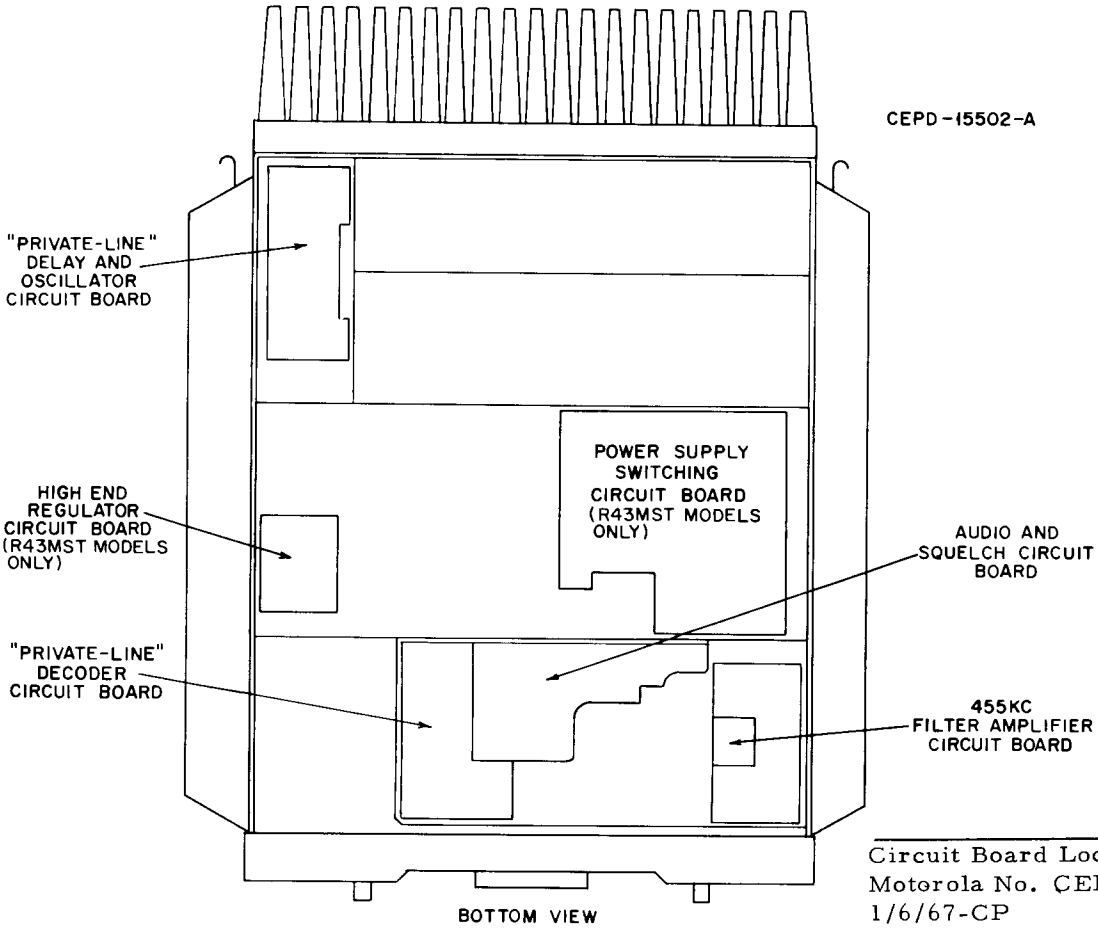
(b) For a frequency shift of 0.5 mc, detune each section by 0.5 microampere.



R-F PRESELECTOR SELECTIVITY CURVES
SHOWING THE EFFECT OF RETUNING FOR INTERFERENCE REJECTION



CEPD-15502-A



Circuit Board Location Detail
Motorola No. CEPD-15502-A
1/6/67-CP

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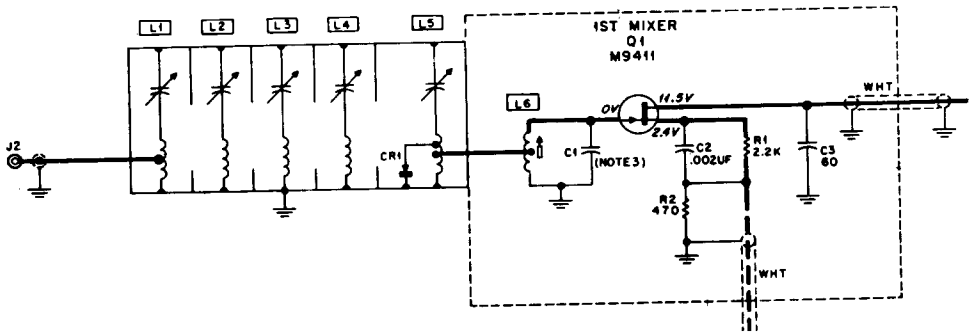
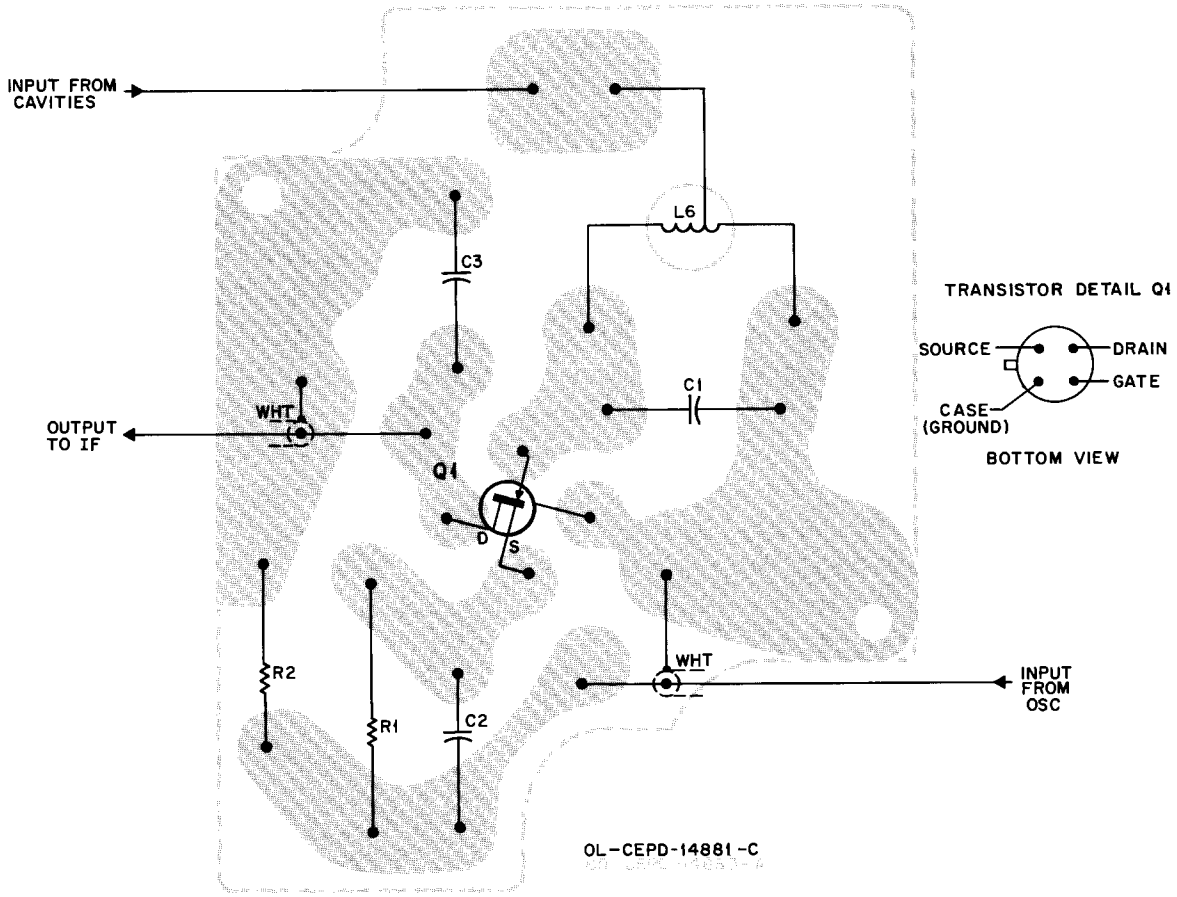




PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

TLD6821A, 22A, 23A RF Deck
Circuit Board Detail
Motorola No. EPD-14882-G
8/28/70-CP

REVISIONS

PEPD-14882-G

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLD6821A	C1	WAS 21D82133G41, 4.7 uuf	PARTS LIST
TLD6821A-1	R1	WAS 6S185B83, 1/8 W	PARTS LIST
TLD6822A-1 TLD6823A-1	L1	WAS 24B82890D02, 136-174 MHz	
	L2, 3, 4	WERE 24B82890D01, 136-174 MHz	
	L5	WAS 24B82890D07, 136-174 MHz	

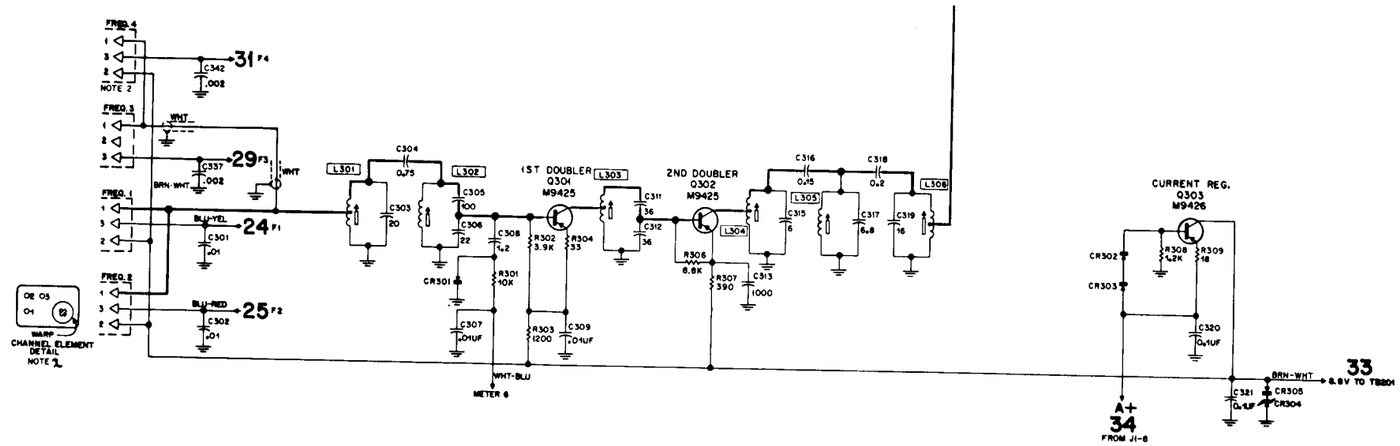
PARTS LIST

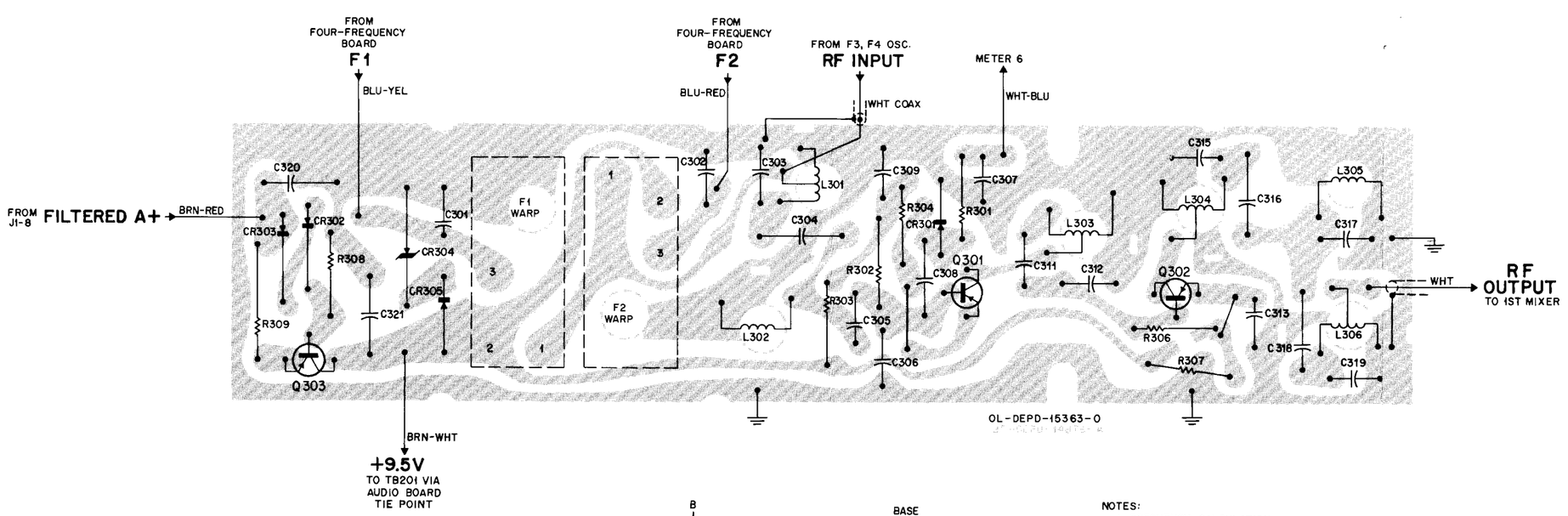
TLD6821A RF Deck (136-150.8 MHz)
TLD6822A RF Deck (150.8-162 MHz)
TLD6823A RF Deck (162-174.8 MHz) EPD-15186-E

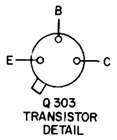
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C1	21D83406D10	6.8 pF ±0.25 pF; 500 v; NP0 (136-150.8 MHz)
	or21D82133G41	4.7 pF ±0.25 pF; NP0 (150.8-162 MHz)
	or21K868910	3.3 pF ±0.25 pF; NP0 (162-174.8 MHz)
C2	21D82428B28	.002 uf ±10%; 200 v
C3	21E82537B19	60 pF ±5%; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1	48C82617C01	silicon; p/o L5
		CONNECTOR, receptacle:
J2	9B82323G01	female; single contact
		COIL, RF:
L1	24C82890D02	coded CB4 (136-150.8 MHz)
	or24C82890D04	coded CB6 (150.8-162 MHz)
	or24C82890D06	coded CB8 (162-174 MHz)
L2	24C82890D01	coded CB3 (136-150.8 MHz)
	or24C82890D03	coded CB5 (150.8-162 MHz)
	or24C82890D05	coded CB7 (162-174 MHz)
L3	24C82890D01	coded CB3 (136-150.8 MHz)
	or24C82890D03	coded CB5 (150.8-162 MHz)
	or24C82890D05	coded CB7 (162-174 MHz)
L4	24C82890D01	coded CB3 (136-150.8 MHz)
	or24C82890D03	coded CB5 (150.8-162 MHz)
	or24C82890D05	coded CB7 (162-174 MHz)
L5	24C82890D07	coded CB9 (136-150.8 MHz); includes CR1
	or24C82890D08	coded CC1 (150.8-162 MHz); includes CR1
	or24C82890D09	coded CC2 (162-174 MHz); includes CR1
L6	24V80905A45	4-3/4 turn; does not include 76B82572G04 CORE, tuning
		TRANSISTOR: (SEE NOTE)
Q1	48R869411	P-N-P; field-effect; type M9411
		RESISTOR, fixed:
R1	6K128689	2.2K ±10%; 1/4 w
R2	6S127801	470 ±10%; 1/4 w

NOTE:

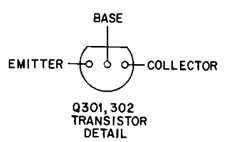
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.







Q303 TRANSISTOR DETAIL



Q301, 302 TRANSISTOR DETAIL

NOTES:

1. FREQUENCY CALCULATION
   $f_1 = \frac{f_c - 8mc}{12}$ f_1 = 1ST OSC. FREQ.
   f_c = CARRIER FREQ.
2. PIN NUMBERS ARE FOR REFERENCE ONLY. PINS ARE PART OF CIRCUIT BOARD.

MODEL TABLE

MODEL	SUFFIX
TLN8505A	NONE

FOR UNITS SUFFIXED LATER THAN INDICATED IN THIS TABLE, REFER TO CIRCUIT BOARD DETAIL EPD-15769.

EPD-16155-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8505A Multiplier
Circuit Board Detail
Motorola EPD-15542-B
6/6/69-CP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TLN8505A	C313	WAS 21D82610C44, 100 uuf	PARTS LIST
		CR304	ADDED	
B	TLN8505A		NOTE 2 WAS NOTE 1 (CHANNEL ELEMENT DETAIL)	PARTIAL SCHEMATIC
		CR304	ADDED VOLTAGE	PARTS LIST

PARTS LIST

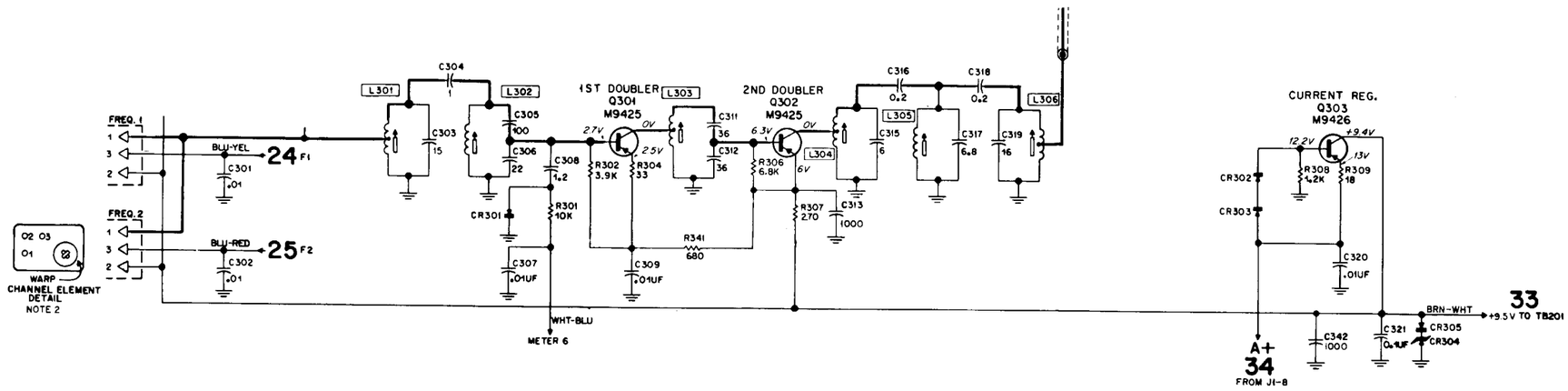
TLN8559A Multiplier Kit
TLN8505A Multiplier Kit

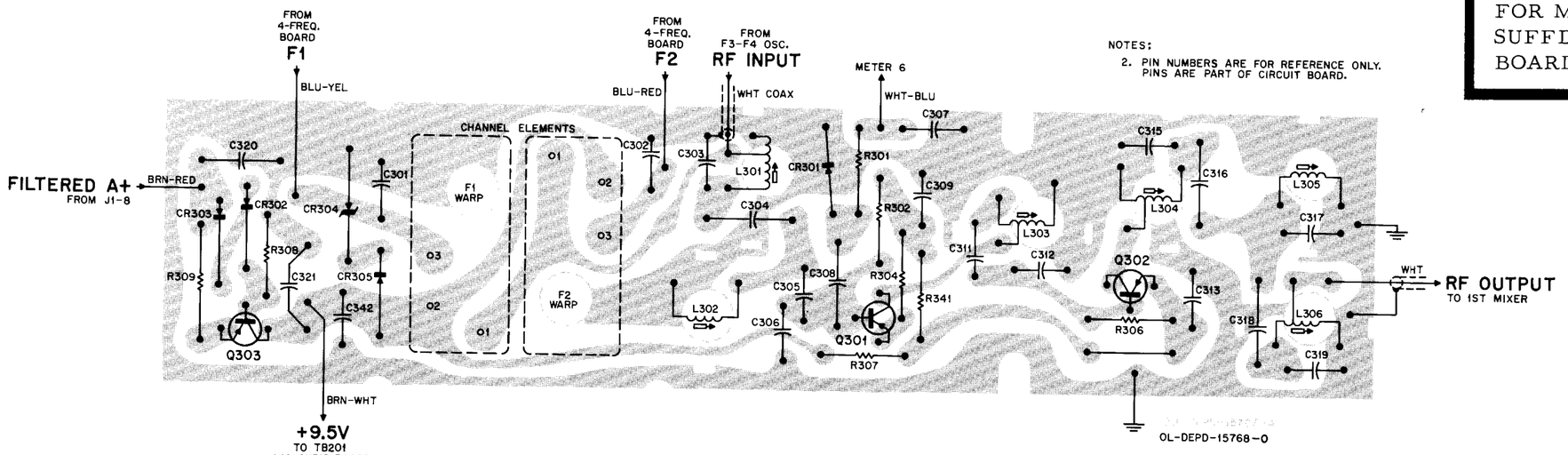
EPD-15375-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf; ±5%; 500 v; unl stated
C301, 302, 307, 309	21D82428B59	.01 uf ±20%; 200 v
C303	21D83406D11	15; N150 (TLN8505A Only)
	or21D82133G77	18; N150 (TLN8559A Only)
C304	21K864518	1 uuf ±10%
C305	21D82610C44	100; N220
C306	21D82133G62	22; N150
C308	21C82450B08	1.2
C311, 312	21D82133G39	36; N150
C313	21D82187B29	1000 ±10%; 100 v
C315	21D82133G72	6; N150
C316	21K830200	0.2 uf
C317	21D82133G76	6.8; N150
C318	21D82450B35	0.2 ±10%
C319	21D82133G49	16; NP0
C320	21D82428B35	.01 uf +80-20%
C321	8D82905G22	0.1 uf ±10%; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR301	48D82139G01	germanium
CR302, 303, 305	48C82392B03	silicon
CR304	48D82533D10	silicon; zener type; 8.8 v
		COIL, RF: incl. 76B82572G03 core, tuning
L301	24C80905A41	13-3/4 turn
L302	24A82430H03	13-1/4 turn
L303	24B83365E01	6-3/4 turn
L304	24V80905A44	4-3/4 turn
L305	24B82075C02	4-3/4 turn
L306	24V80905A42	2-3/4 turn
		TRANSISTOR: (SEE NOTE)
Q301, 302	48R869425	P-N-P; type M9425
Q303	48R869426	P-N-P; type M9426
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R301	6S129225	10K
R302	6K129232	3.9K
R304	6K129754	33
R306	6S128687	6.8K
R307	6S129752	270
R308	6S128689	2.2K
R309	6S114262	12 ±5%; 1/2 w
R341	6S128599	680
NON-REFERENCED ITEMS		
	26A82076C01	SHIELD, coil (used with L301, L303, L304, L305, L306)
	26A82221H01	SHIELD, coil (used with L302)

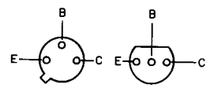
NOTE:

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





TRANSISTOR DETAILS



NOTES:

2. PIN NUMBERS ARE FOR REFERENCE ONLY. PINS ARE PART OF CIRCUIT BOARD.

FOR MODEL TLN8505A WITH NO SUFFIX, REFER TO CIRCUIT BOARD DIAGRAM EPD-15542.

EPD-16156-A

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Multiplier Circuit Board Detail
Motorola No. EPD-15769-E
6/6/69-CP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TLN5805A-2	C303	WAS 21D82133G67, 20 uuf	RF INPUT
		L303	WAS 24V80905A43	PARTS LIST
B	TLN8505A-2		VOLTAGE READINGS ADDED	PARTIAL SCHEMATIC
C	TLN8505A-2	C313	WAS 21D82610C44, 100 uuf	PARTS LIST
		C342	ADDED	
		CR304	ADDED	
D			NOTE 2 WAS NOTE 1 (CHANNEL ELEMENT DETAIL)	PARTIAL SCHEMATIC
E	TLN8505A-3	C306	WAS 21D82133G62, 22 uuf	MIDDLE OF BOARD
		C311	WAS 21D82133G39, 36 uuf	

PARTS LIST

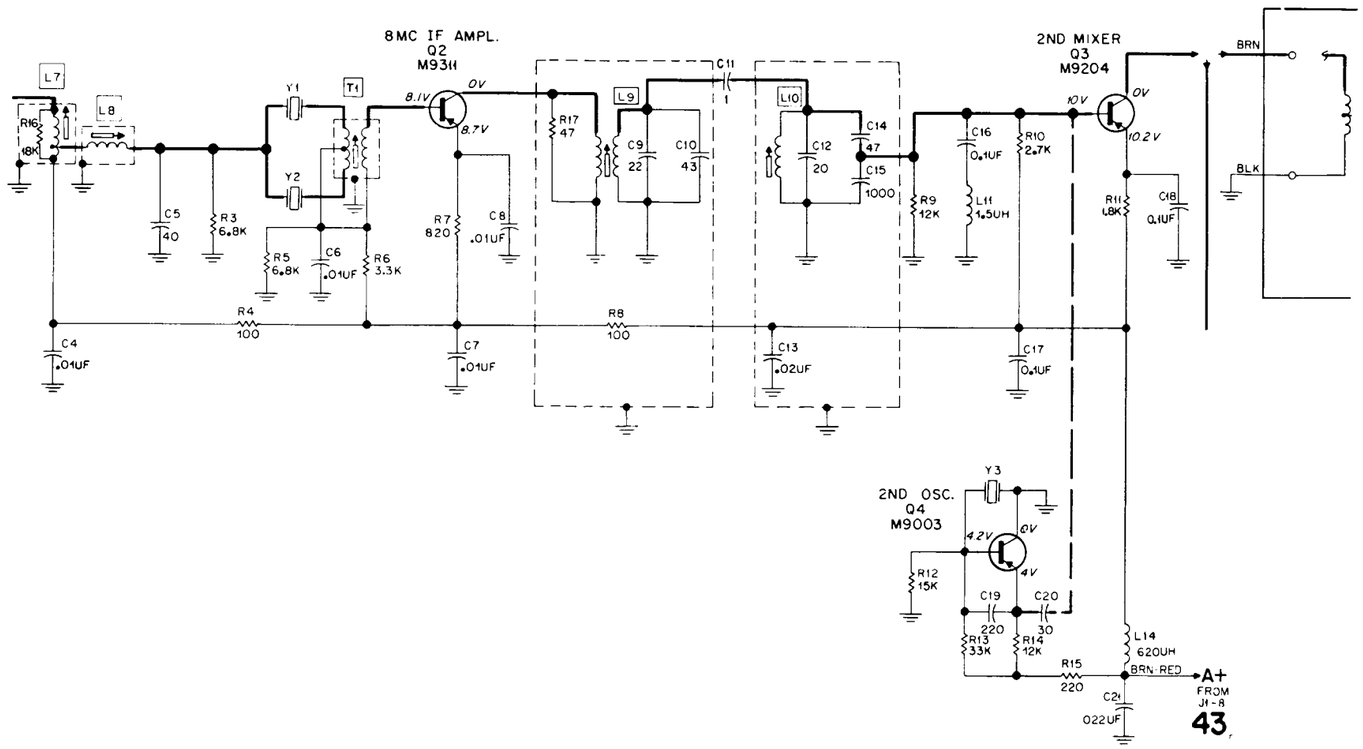
TLN8559A Multiplier Kit
TLN8505A Multiplier Kit

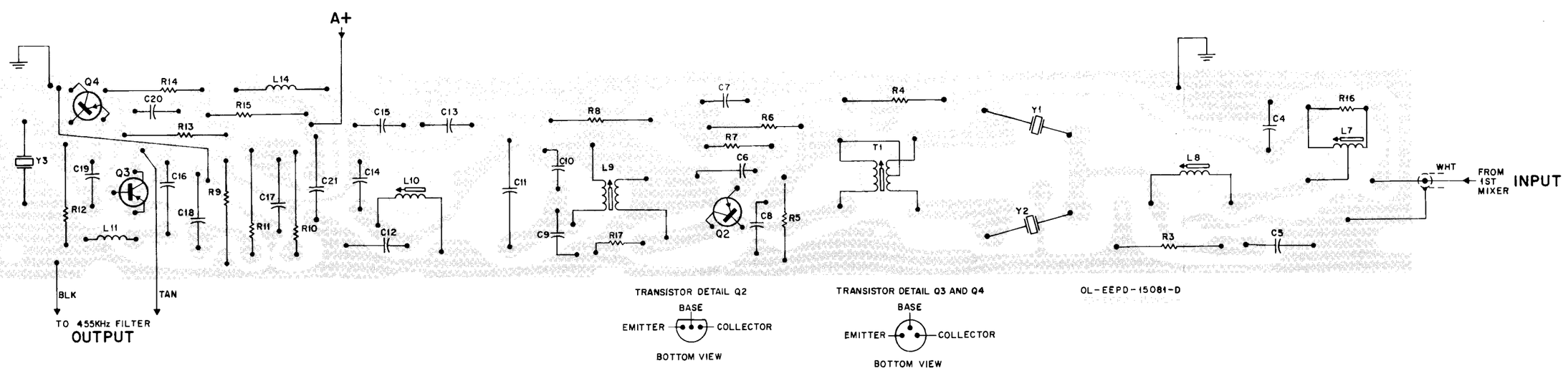
EPD-20835-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf; ±5%; 500 v; unl. stated
C301, 302, 307, 309	21D82428B59	.01 uf ±20%; 200 v
C303	21D83406D11 or 21D82133G77	15; N150 (TLN8505A Only) 18; N150 (TLN8559A Only)
C304	21K864518	1 uuf ±10%
C305	21D82610C44	100; N220
C306	21D82133G77	18; N150
C308	21C82450B08	1.2
C311	21D82133G83	33; N150
C312	21D82133G39	36; N150
C313, 342	21D82187B29	1000 ±10%; 100 v
C315	21D82133G72	6; N150
C316	21K830200	0.2 uf
C317	21D82133G76	6.8; N150
C318	21D82450B35	0.2 ±10%
C319	21D82133G49	16; NP0
C320	21D82428B35	.01 uf +80-20%
C321	8D82905G22	0.1 uf ±10%; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR301	48D82139G01	germanium
CR302, 303, 305	48C82392B03	silicon
CR304	48D82533D10	silicon; zener type; 8.8 v
		COIL, RF: incl. 76B82572G03 core, tuning
L301	24C80905A41	13-3/4 turn
L302	24A82430H03	13-1/4 turn
L303	24B83365E01	6-3/4 turn
L304	24V80905A44	4-3/4 turn
L305	24B82075C02	4-3/4 turn
L306	24V80905A42	2-3/4 turn
		TRANSISTOR: (SEE NOTE)
Q301, 302	48R869425	P-N-P; type M9425
Q303	48R869426	P-N-P; type M9426
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R301	6S129225	10K
R302	6K129232	3.9K
R304	6K129754	33
R306	6S128687	6.8K
R307	6S129752	270
R308	6S129708	1.2K
R309	6S114262	12 ±5%; 1/2 w
R341	6S128599	680
NON-REFERENCED ITEMS		
	26A82076C01	SHIELD, coil (used with L301, L303, L304, L305, L306)
	26A82221H01	SHIELD, coil (used with L302)

NOTE:

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





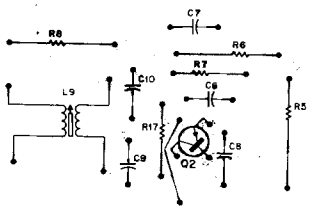
PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

136-174 MHz "Motran" FM Radio
8 MHz IF & 2nd Oscillator
Circuit Board Detail
Motorola No. EPD-14966-K
8/11/71-CP

REVISIONS

EPD-14966-K

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8510A		ADDED WIDE CHANNEL BOARD	PARTS LIST
TLN8398AL TLN8510AL		ADDED 7.545 MC MODELS	
TLN8398A TLN8398AL TLN8510A TLN8510AL		REVISED CIRCUIT BOARD PLATING. CIRCUIT WAS AS SHOWN BELOW	CENTER OF BOARD



TLN8398A-1 TLN8398AL-1 TLN8510A-1 TLN8510AL-1	L7, 8	TUNING CORE WAS 76B82888D02	PARTS LIST
	L9	WAS 24C82073G05	
	L10	WAS 24C82073G04	
	T1	TUNING CORE WAS 76B82888D02	
TLN8398A-1 TLN8398AL-1 TLN8510A-1 TLN8510AL-1		VOLTAGE READINGS ADDED	PARTIAL SCHEMATIC
TLN8398A-1 TLN8398AL-1 TLN8510A-1 TLN8510AL-1	L7	WAS 24B83377D01	PARTS LIST
	L8	WAS 24B83379D01	
	L9	WAS 24C82073G13	
	L10	WAS 24C82073C12	
	T1	WAS 24B83378D02	
TLN8398AL-2 TLN8510AL-2	C19	WAS 21K859944, 300 uuf FOR 7.545 MC IF	PARTS LIST
	C20	WAS 21D82133G36, 68 uuf FOR 7.545 MC IF	
TLN8398AL-2 TLN8510AL-2 TLN8398A-1 TLN8510A-1	L11	ADDED	PARTS LIST
	L14	ADDED	
TLN8398A-1 TLN8398AL-2 TLN8510A-1 TLN8510AL-2	L1	WAS 24D82135G04, 2.6 uh	PARTS LIST

PARTS LIST

TLN8398A 8 MC IF & 2nd. Osc. (8.455 mc) split channel
TLN8398AL 8 MC IF & 2nd. Osc. (7.545 mc) split channel
TLN8510A 8 MC IF & 2nd. Osc. (8.455 mc) wide band
TLN8510AL 8 MC IF & 2nd. Osc. (7.545 mc) wide band

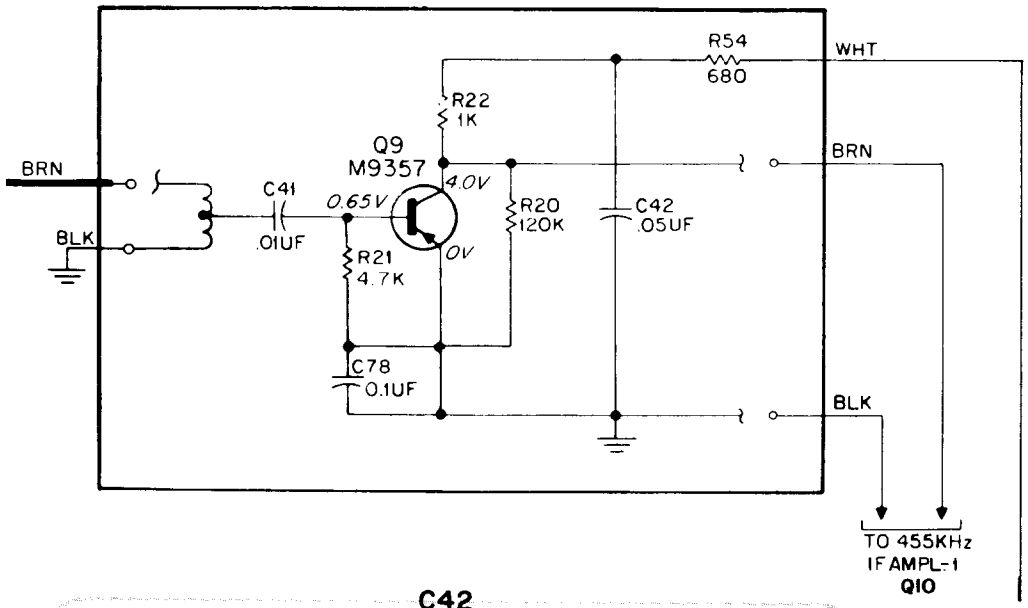
EPD-15187-G

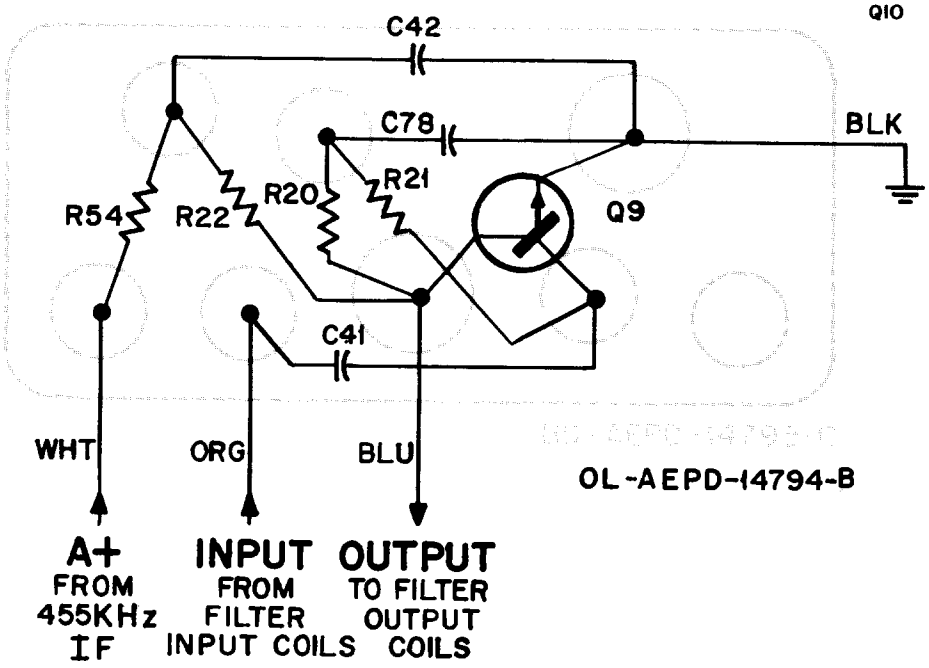
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf ±5%; 500 v; unl. stated
C4, 6, 7, 8	21D82428B59	.01 uf ±20%; 200 v
C5	21D83406D07	40; NP0
C9	21D82133G20	22; N330
C10	21D82537B07	43
C11	21K83959	1 ±20%
C12	21D82133G24	20; N330
C13	21D82428B18	.02 uf +40-60%; 100 v
C14	21K868681	47
C15	21D82537B16	1000; 100 v
C16	21C82372C01	0.1 +80-20%; 25 v
C17, 18	8C82095G06	0.1 uf ±10%; 200 v
C19	21K859942	220
C20	21D82133G17	30; N1500
C21	8D83818H08	.022 uf ±10%; 100 v
	or8D82905G02	.022 uf ±10%; 50 v
		COIL, RF:
L7	24V80905A47	coded GRAY; incl. 76B82888D06 CORE, tuning
L8	24V80905A55	coded ORG; incl. 76B82888D06 CORE, tuning
L9	24V80905A86	coded BRN, RED; incl. 76B82888D06 CORE, tuning
L10	24V80905A85	coded BLK, RED; incl. 76B82888D06 CORE, tuning
L11	24C82835G04	choke; 1.5 uh
L14	24D82135G08	choke; 620 uh
		TRANSISTOR: (NOTE)
Q2	48R869311	P-N-P; type M9311
Q3	48R869204	P-N-P; type M9204
Q4	48R869003	P-N-P; type M9003
		RESISTOR, fixed: ±10%; 1/2 w unl. stated
R3	6S6428	6.8K
R4, 8	6S6326	100
R5	6S128687	6.8K; 1/4 w
R6	6S5581	3.3K
R7	6S129432	820; 1/4 w
R9, 14	6S6394	12K
R10	6S5577	2.7K
R11	6S2089	1.8K
R12	6S5726	15K ±5%
R13	6S6410	33K
R15	6S6270	220
R16	6K128904	18K; 1/4 w
R17	6S129233	47; 1/4 w
		TRANSFORMER:
T1	24V80905A65	coded RED; incl. 76B82888D06 CORE
		CRYSTAL UNIT, quartz:
Y1, 2		receiver filter (IF); refer to following information:
	FSA	two crystals in one assembly
	or FSB	one crystal (2 req'd)
	or FSC	one crystal (2 req'd)
		NOTE: when ordering Y1 and/or Y2, specify the frequency (ies) required (see below)
Y1		7.99600 mc (TLN8398A) or 7.99150 mc (TLN8510A)
Y2		8.00725 mc (TLN8398A) or 8.00950 mc (TLN8510A)
Y3	G09	receiver IF (2nd osc.) 8.455 mc
	or G11	receiver IF (2nd osc.) 7.545 mc

NOTE:

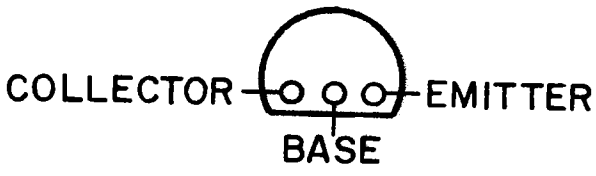
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

Z1
TFN6017CS
455KHz FILTER
(USED FOR SPLIT CHANNEL ONLY)





OL-AEPD-14794-B



TRANSISTOR DETAIL

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

455 kHz Filter Amplifier Circuit Board Detail
P/O Model TFN6017CS (Split-Channel) IF Filter
Motorola No. PEPD-14793-D
6/6/69-CP

REVISIONS

PEPD-14793-D

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TFN6017CS		ADDED WIRE COLOR CODES	PARTIAL SCHEMATIC
TFN6017CS		REMOVED REF TO NOTE 17	PARTIAL SCHEMATIC
TFN6017CS		TRANSISTOR BASE DETAIL ADDED	CIRCUIT BOARD DETAIL

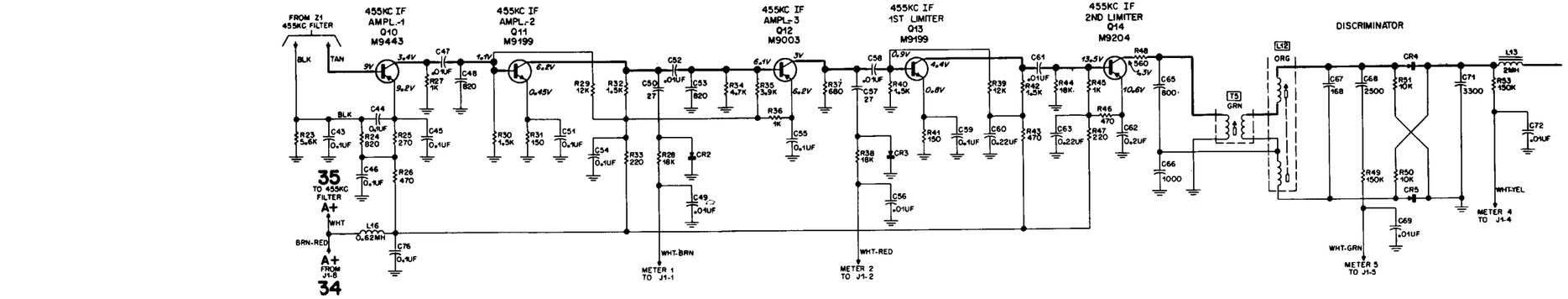
PARTS LIST

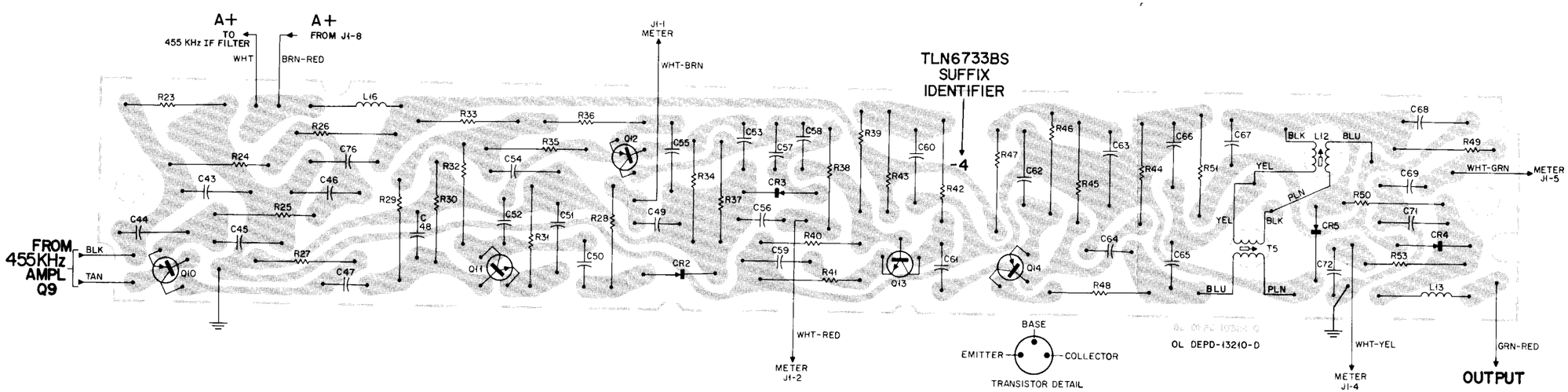
1V80763A41 455 kHz Filter Amplifier Board PL-302-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF
C41	21C82428B06	.01 +70-30%; 100 v
C42	21C82372C07	.05 +80-20%; 25 v
C78	21C82372C01	0.1; 25 v
		TRANSISTOR (SEE NOTE)
Q9	48R869357	P-N-P; type M9357
		RESISTOR, fixed: ±10%; 1/4 w
R20	6S128987	120K
R21	6S127804	4.7K
R22	6S127802	1K
R54	6S128599	680
NON-REFERENCED ITEM		
	1V80763A42	CIRCUIT BOARD ASS'Y. (eyeleted)

NOTE:

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





PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

455 kHz IF Circuit Board Detail
Model TLN6733BS-4 (Split-Channel)
Motorola No. EPD-13211-L
8/11/71-CP

REVISIONS

EPD-13211-L

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN6733BS-2	Q10	WAS 48R869003, M9003	IF AMPL. - 1
TLN6733BS-2		USE IN "MOTRAC" RECEIVERS ADDED	
TLN6733BS-3	C47, 52, 58, 61	WERE 21C82428B33, .01 uf +70-30%; 100 V; X5V5	PARTS LIST
	C49, 56, 69, 72	WERE 21D82428B32, .01 uf +70-30%; 100 V; X5U9	
TLN6733BS-4	C67	WAS 21D82133G61, 168 uuf	ACROSS L12
	C60, 63	WERE 8D82905G11, .22 uf; 25 V	PARTS LIST
	C43, 44, 45, 51	WERE .01 uf	SCHEMATIC DIAGRAM
	C67	WAS 21D82133G28	PARTS LIST
TLN6733BS-4 TLN6733BW-3	C47, 49, 52, 56, 58, 61, 69, 72	WERE 21D82428B59, .01 uF, 500 V	PARTS LIST

PARTS LIST

TLN6733BS 455 kHz Board (Split Channel)
TLN6733BW 455 kHz Board (Wide Channel) PL-327-C

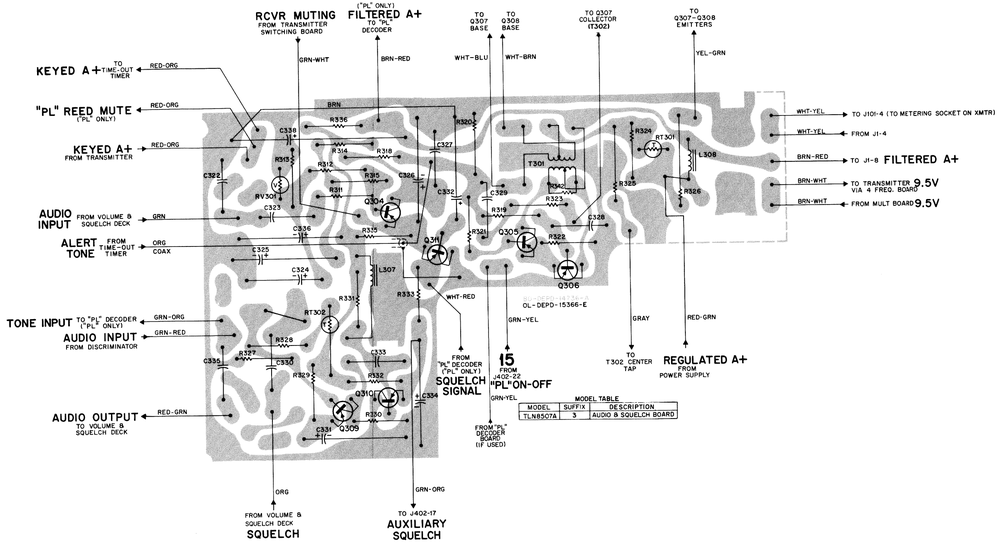
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: pF; 500 v; unl stated
C43, 44, 45, 51, 55, 59	21C82372C01	0.1 uF +80-20%; 25 v
C46, 54, 76	8C82095G06	0.1 uF ±10%; 200 v
C47, 49, 52, 56, 58, 61, 69, 72	21D82428B58	.01 +80-20%
C48, 53	21C82187B23	820 ±10%
C50, 57	21D82133G23	27 ±10%; NP0
C60, 63	8D83813H11	0.2 uF ±10%; 75 v
	or8D83293B14	0.22 uF ±10%; 50 v
C62	21C82372C02	0.2 +80-20%; 25 v
C64	21K859178	270 ±5%; 300 v; split channel
C65	21K840049	800 ±5%; 300 v; split channel
	or21K859945	390 ±5%; wide channel
C66	21K847601	1000 ±5%; split channel
	or21K864736	1300 ±5%; wide channel
C67	21D82133G82	80±10%; 500 v; N1500
C68	21K859773	2500 ±5%
C71	21C82187B25	3300 ±10%
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR2, 3	48C82921G01	germanium
CR4, 5	48C82139G01	germanium
		COIL, discriminator:
L12	24C82619C05	455 kHz; ORG incl. 1K867236 CORE, tuning
L13	24D82135G07	choke; 2 mH; sleeved
L16	24D82135G08	choke; 0.62 mH; sleeved
		TRANSISTOR: (SEE NOTE)
Q10	48R869003	P-N-P type M9003 wide channel only)
	or48R869443	P-N-P; type M9443 (split channel only)
Q11, 13	48R869199	N-P-N; type M9199
Q12	48R869003	P-N-P; type M9003
Q14	48R869204	P-N-P; type M9204
		RESISTOR, fixed: ±10%; 1/2 w; unl stated
R23	6R6117	5.6K
R24	6R6269	820
R25	6R6432	270
R26, 43, 46	6R6090	470
R27, 36, 45	6R6229	1K
R28, 38, 44	6R5591	18K
R29, 39	6R6394	12K
R30, 32, 40, 42	6R6038	1.5K
R31, 41	6R6373	150
R33, 47	6R6270	220
R34	6R6080	4.7K
R35	6R5659	3.9K
R37	6R6040	680
R48	6R6291 or	560; split channel
	6R6229	1K; wide channel
R49	6R6398	150K
R50, 51	6R5556 or	10K ±5%; split channel
	6R3924	4.7K ±5%; wide channel
R53	6R6398 or	150K; split channel
	6R6074	68K; wide channel
		TRANSFORMER, discriminator:
T5	24C82619C06 or 24C82619C07	GRN; incl. 1K867236 CORE, tuning; split channel VIO; incl. 1K867236 CORE, tuning; wide channel
NON-REFERENCED ITEMS		
	1V80744A80	455 kHz Printed Circuit Board
	26B82679C01	SHIELD, coil: used on L12 & T5

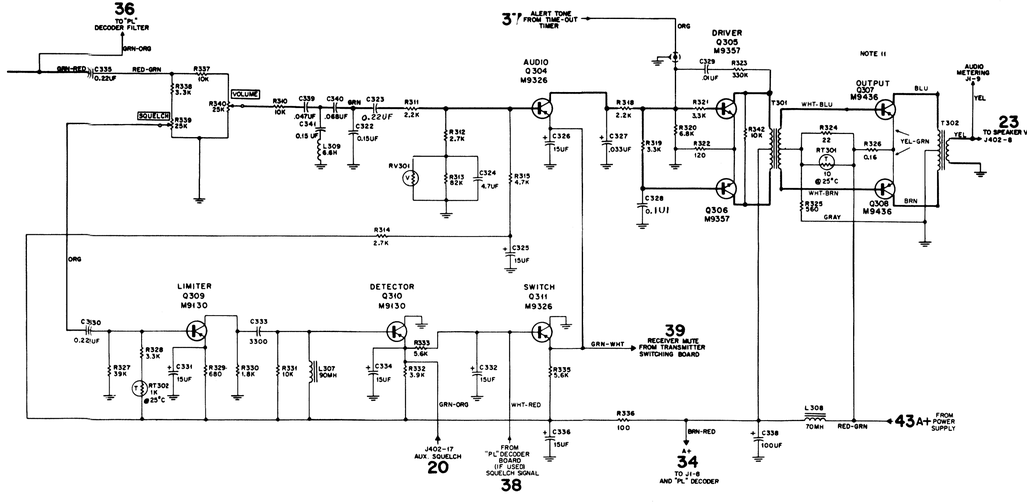
NOTE:

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

FOR MODEL TLN8507A SUFFIX -4 OR LATER, REFER TO CIRCUIT BOARD DETAIL PEPD-17469.

EPD-17481-O



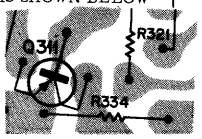


PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8507A Audio and Squelch Circuit Board Detail
Motorola No. EPD-15543-H
6/6/69-CP

REVISIONS

EPD-15543-H

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8507A-1	C327	WAS 8D82905G03, .047 uf ±10%; 50 V	UPPER MIDDLE OF BOARD
	C328	WAS 8D82905G05, 0.15 uf ±10%; 50 V	RIGHT SIDE OF BOARD
	Q305	WAS 48K869418, TYPE M9418	
	Q306	WAS 48R869325, TYPE M9325	
TLN8507A-2	R318	WAS 6S129981, 3.3K	Q304 COLLECTOR
	R342	ADDED 10K	Q305 COLLECTOR
TLN8507A-3	R334	REMOVED 6S129225, 10K CIRCUIT WAS AS SHOWN BELOW 	Q311 BASE
TLN8507A-4		PRINTED CIRCUIT BOARD REVISED.	REFER TO PEPD-17469-O
	C328	WAS 8D82905G11, .022 uf	Q306 BASE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8507A Audio and Squelch Board — EPD-15474-E

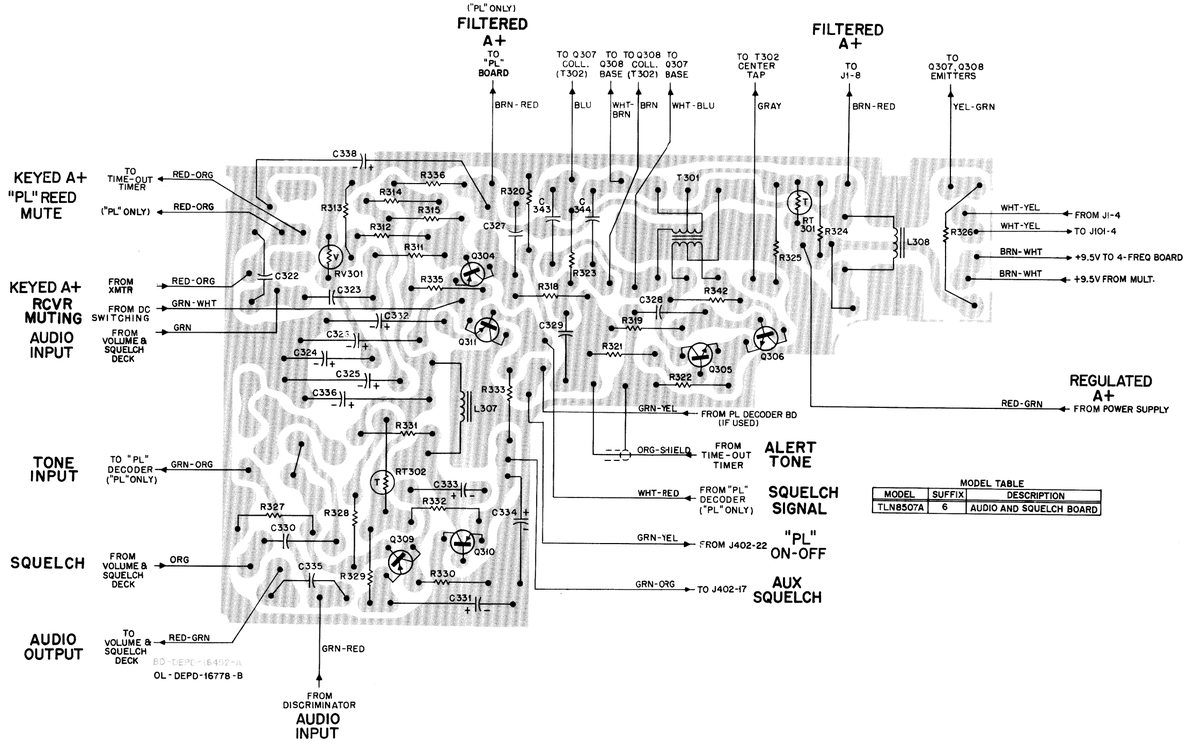
		CAPACITOR, fixed:
C322	8D82905G05	0.15 uF ±10%; 50 v
C323, 330, 335	8D82905G11	.022 uF ±10%; 50 v
C324	23K865137	4.7 uF ±20%; 25 v
C325, 326, 331, 332, 334, 336	23K865136	15 uF ±20%; 25 v
C327	8D82905G16	.033 uF ±10%; 100 v
C328	8D82905G07	0.1 uF ±10%; 50 v
C329	8D82905G01	.01 uF ±10%; 50 v
C333	8D82905G25	.0033 uF ±10%; 100 v
C338	23D82601A25	100 uF +150-10%; 20 v
		COIL, audio: choke:
L307	25B82878A03	90 mH
L308	25B82738C01	70 mH
		TRANSISTOR: (SEE NOTE)
Q304, 311	48R869326	P-N-P; type M9326
Q305, 306	48R869357	N-P-N; type M9357
Q309, 310	48R869130	P-N-P; type M9130
		RESISTOR, fixed: ±10%; 1/4 w: unl. stated
R311, 318	6S129804	2.2K ±5%
R312, 314	6S128688	2.7K
R313	6S129145	82K
R315	6S127804	4.7K
R319, 321, 328	6S129981	3.3K ±5%
R320	6S129237	6.8K ±5%
R322	6S129617	120
R323	6S129473	330K ±5%
R324	6S131641	22
R325	6S6291	560; 1/2 w
R326	17C82350A05	0.16; 1 w
R327	6S128903	39K
R329	6S128599	680
R330	6S129269	1.8K
R331, 342	6S129225	10K
R332	6S129232	3.9K
R333, 335	6S129433	5.6K
R336	6S129753	100
		THERMISTOR:
RT301	6C82769A01	10 @ 25°C
RT302	6B858402	1K @ 25°C
		VARISTOR:
RV301	6B858401	17.2K ±10%; 8.8 v
		TRANSFORMER, AF:
T301	25C82058H01	pri: pins 1 & 3 with center tap at pin 4 total res. 670 ohms sec: pins 4 & 6 with center tap at pin 5; total res. 13 ohms

NOTE:

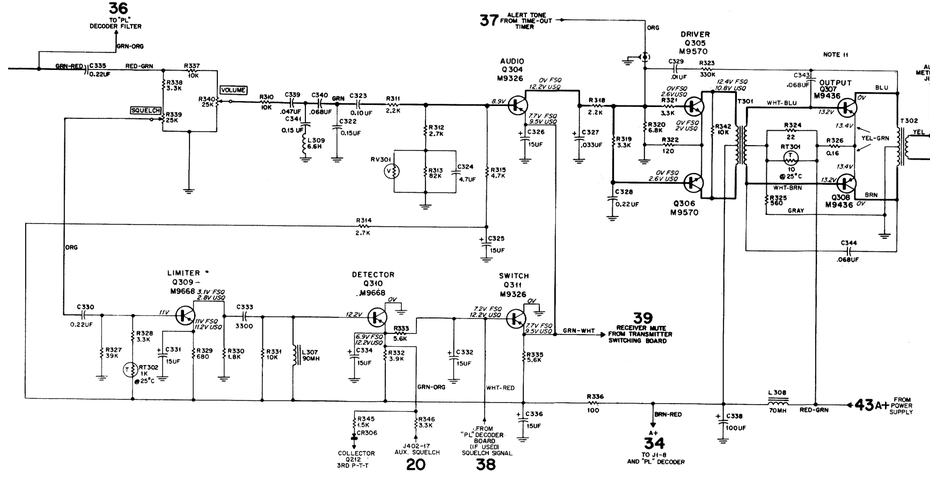
Replacement transistors must be ordered by Motorola part number only for optimum performance.

FOR MODEL TLN8507A SUFFIX -3 OR EARLIER, REFER TO CIRCUIT BOARD DETAIL EPD-15543.

EPD-17480-O



MODEL TABLE		
MODEL	SUFFIX	DESCRIPTION
TLN8507A	6	AUDIO AND SQUELCH BOARD



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8507A Audio and Squelch Circuit Board Detail
Motorola No. PEPD-17469-E
8/28/70-CP

REVISIONS

PEPD-17469-E

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8507A-4	C322	WAS 8D82905G05	PARTS LIST
	C327	WAS 8D82905G16, .033 uF ±10%; 100 V	
	C328, 330, 335	WERE 8D82905G11	
	C343, 344	ADDED	
	Q305, 306	WERE 48R869357 M9357	
TLN8507A-5	Q305, 306	WERE 48R869357, TYPE M9357	DRIVER
TLN8507A-6	Q309	WERE 48R869130, TYPE M9130	LIMITER
	Q310		DETECTOR

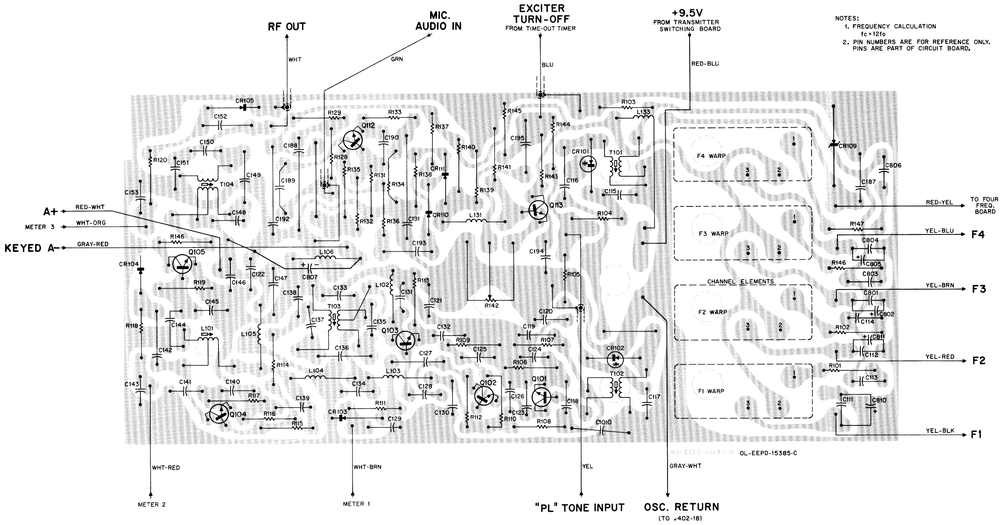
PARTS LIST

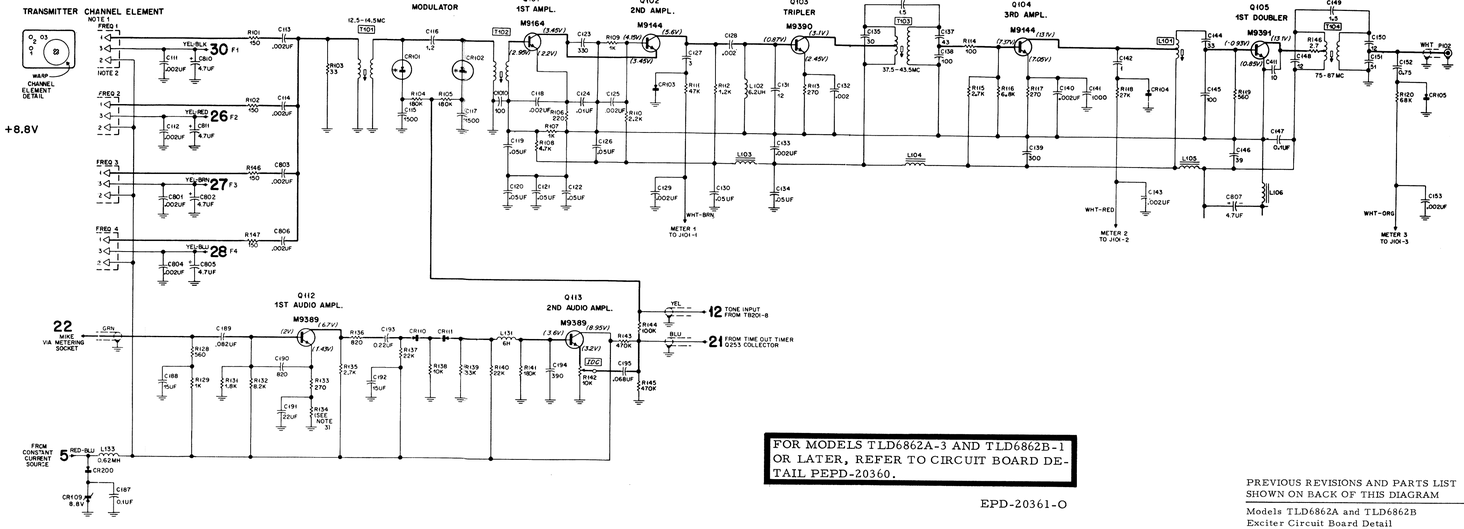
TLN8507A Audio and Squelch Board EPD-20832-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C322	8D83293B18	0.15 uf ±10%; 50 v
C323	8D82905G07	0.1 uf ±10%; 50 v
C324	23K865137	4.7 uf ±20%; 25 v
C325, 326, 331, 332, 334, 336	23K865136	15 uf ±20%; 25 v
C327	8D82905G08	.033 uf ±10%; 50 v
C328, 330, 335	8D83293B02	.022 uf ±10%; 50 v
C329	8D82905G01	.01 uf ±10%; 50 v
C333	8D82905G25	.0033 uf ±10%; 100 v
C338	23D82601A25	100 uf +150-10%; 20 v
C343, 344	8D82905G04	.068 uf ±10%; 50 v
		COIL, audio: choke
L307	25B82878A03	90 mh
L308	25B82738C01	70 mh
		TRANSISTOR: (SEE NOTE)
Q304, 311	48R869326	P-N-P; type M9326
Q305, 306	48R869570	N-P-N; type M9570
Q309, 310	48R869668	P-N-P; type M9668
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R311, 318	6S129804	2.2K ±5%
R312, 314	6S128688	2.7K
R313	6S129145	82K
R315	6S127804	4.7K
R319, 321, 328	6S129981	3.3K ±5%
R320	6S129237	6.8K ±5%
R322	6S129617	120
R323	6S129473	330K ±5%
R324	6S131641	22
R325	6S6291	560; 1/2 w
R326	17C82350A05	0.16; 1 w
R327	6S128903	39K
R329	6S128599	680
R330	6S129269	1.8K
R331, 342	6S129225	10K
R332	6S129232	3.9K
R333, 335	6S129433	5.6K
R336	6S129753	100
		THERMISTOR:
RT301	6C82769A01	10 @ 25°C
RT302	6B858402	1K @ 25°C
		VARISTOR:
RV301	6B858401	17.2K ±10%; 8.8 v
		TRANSFORMER, AF:
T301	25C82058H01	pri: pins 1 & 3 with center tap at pin 4 total res 670 ohms sec: pins 4 & 6 with center tap at pin 5; total res 13 ohms

NOTE:

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





FOR MODELS TLD6862A-3 AND TLD6862B-1 OR LATER, REFER TO CIRCUIT BOARD DETAIL PEPD-20360.

EPD-20361-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Models TLD6862A and TLD6862B
Exciter Circuit Board Detail
Motorola No. EPD-15544-H
6/6/69-CP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TLD6862A	R146	ADDED 6S124B55, 2.7 OHMS	PARTS LIST
B	TLD6862A-1	C120, 121, 122	WERE 21D82428B25, .002 uf	Q101 1ST AMPL. CIRCUIT
		C130, 134		Q103 TRIPLER INPUT CIRCUIT
		C141		Q104 EMITTER
		L103	WAS 24C82835G01, 2.6 uh	Q103 TRIPLER INPUT CIRCUIT
		L104	WAS 24C82835G02, 1.5 uh	BELOW T103
		L105	WAS 24C82835G01, 2.6 uh	BELOW L101
		L106	WAS 24C82835G13, 0.82 uh	Q105 EMITTER
		L131	WAS 25D82113H03	PARTS LIST
C	TLD6862A-2	C141	WAS 21C82372C04, .05 uf	Q104 EMITTER
		C411	ADDED 10 uuf	Q105 COLLECTOR
D	TLD6862B		ADDED	
E	TLD6862A-2 TLD6862B	C807	NEGATIVE END WAS CONNECTED TO Q105	Q105 FIRST DOUBLER
F	TLD6862A-2	CR109	CATHODE WAS GROUNDED	TOP RIGHT OF CIRCUIT BD.
G	TLD6862A-2 TLD6862B	C1010	ADDED	PARTS LIST
H	TLD6862A-3 TLD6862B-1		EXTENSIVE CIRCUIT & COMPONENT CHANGES.	REFER TO PEPD-20360-O

PARTS LIST

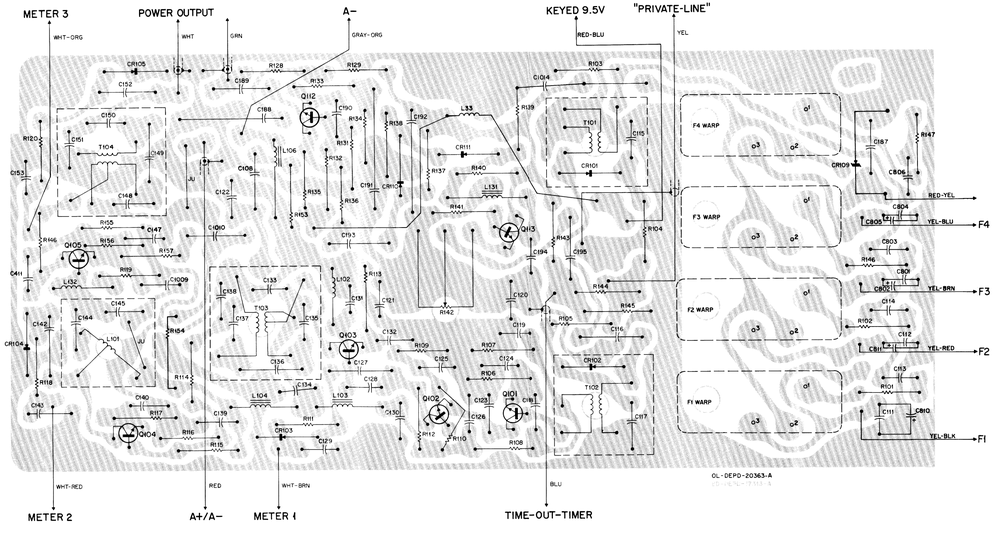
TLD6862A Exciter Board (150.8-174 MC)
TLD6862B Exciter Board (150.8-174 MC) EPD-15588-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf ±5%; 500 v; unl. stated
C111, 112, 113, 114, 118, 125, 128, 129, 132, 133, 140, 143, 153, 801, 803, 804, 806	21D82428B25	.002 uf ±20%
C115, 117	21D82187B18	1500 ±10%; 100 v
C116	21D82450B08	1.2
C119, 120, 121, 122, 126, 130, 134	21C82372C04	.05 uf +80-20%; 25 v
C123	21D82428B54	330; 200 v
C124	21D82428B59	.01 uf ±20%; 200 v
C127	21D82450B11	3
C131, 148	21D82133G02	12; NP0
C135	21K849335	30; N150
C136, 149	21D82450B13	1.5
C137	21D82610C02	43; N220
C138, 145	21D82610C44	100; N220
C139	21K859944	300
C141	21D82187B20	1000 ±10%; 100 v
C142	21K864518	1 ±10%
C144	21K855809	33; N150
C146	21D82610C17	39 ±2%; N220
C147	21C82372C01	0.1 uf +80-20%; 25 v
C150	21K864735	12; N220
C151	21D82610C07	51; N150
C152	21D82450B06	0.75 ±10%
C187	8D83293B01	0.1 uf ±10%; 50 v
C188, 192	23K865136	15 uf ±20%; 25 v
C189	8D82905G45	0.82 uf ±10%; 50 v
C190	21D82187B17	820 ±10%
C191	23D83214C07	22 uf ±20%; 15 v
C193	8D83293B02	0.22 uf ±10%; 50 v
C194	21K848158	390 ±10%; 300 v
C195	8D83293B13	.068 uf ±10%; 50 v
C411	21D82133G01	10; NP0
C802, 805, 807, 810, 811	23K865137	4.7 uf ±20%; 25 v
C1010	21D82204B06	100 uuf ±10%; 500 v; N1500
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102	48C82190H02	silicon; varactor
CR103, 104, 105	48C82139G01	germanium
CR109	48D82533D10	zener
CR110, 111	48C82392B03	silicon
		COIL, RF: choke, unl. stated
L101	24C80905A33	coded BLK-VIO; incl. 76B82611C02 CORE, tuning
L102	24D82723H06	6.2 uh
L103, 104, 105, 106	24C83961B01	choke; coded BRN
L131	25C82867C03	6 h
L133	24K847940	0.62 mh
		TRANSISTOR: (SEE NOTE)
Q101	48R869164	N-P-N; type M9164
Q102, 104	48R869144	N-P-N; type M9144
Q103	48R869390	N-P-N; type M9390
Q105	48R869391	N-P-N; type M9391
Q112, 113	48R869389	N-P-N; type M9389
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R101, 102	6S129862	150
R103	6S129754	33
R104, 105, 141	6S129229	180K
R106	6S127800	220
R107, 109, 129	6S127802	1K
R108	6S127804	4.7K
R110	6S128689	2.2K
R111	6S128902	47K
R112	6S129235	1.2K
R113, 117, 133	6S129752	270

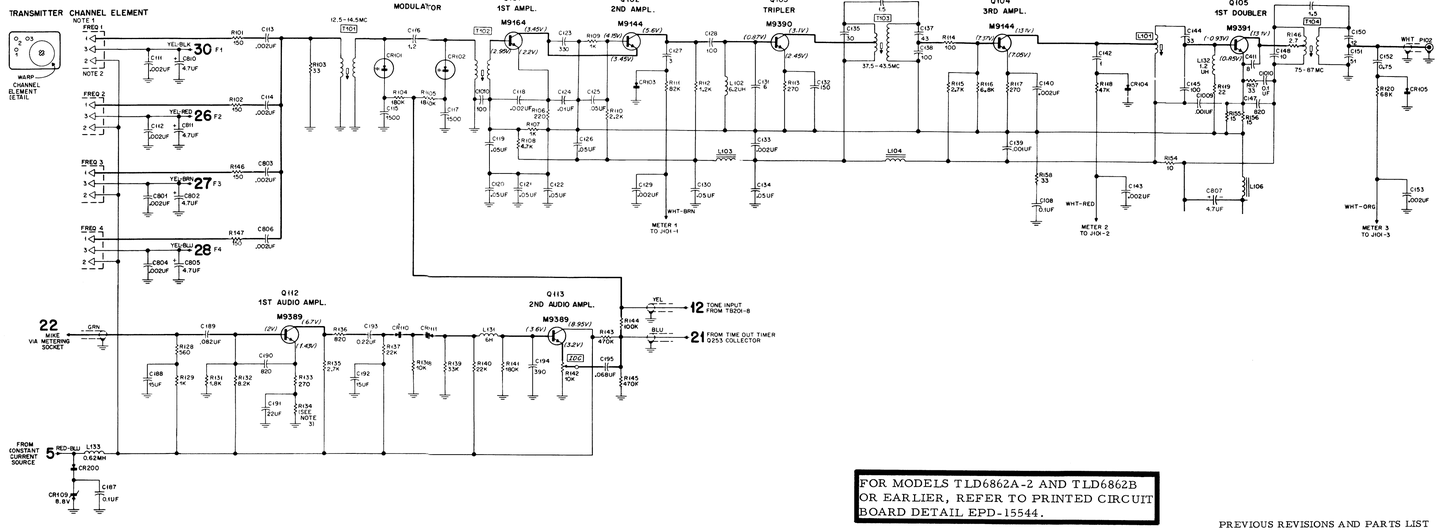
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R114	6S129753	100
R115, 135	6S128688	2.7K
R116	6S128687	6.8K
R118	6S127806	27K
R119, 128, 134	6S129620	560
R131	6S129269	1.8K
R132	6S128686	8.2K
R134	6S129863	390 (TLD6862A)
	or 6S129752	270 (TLD6862B)
R136	6S129432	820
R137, 140	6S129667	22K ±5%
R138	6S129668	10K
R139	6S129526	33K
R142	18D82238D15	var; 10K
R143, 145	6S129148	470K
R144	6K129226	100K
R146	6S124B55	2.7 ±5%
		TRANSFORMER:
T101	24V80903A20	coded BRN-BRN; incl. 76B82611C02 CORE, tuning
T102	24V80903A21	coded GRAY-ORG; incl. 76B82611C02 CORE, tuning
T103	24V80905A32	coded BRN-BLU; incl. 76K858875 CORE, tuning
T104	24V80905A34	coded BRN-YEL; incl. 76K858875 CORE, tuning

NOTE:

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



TRANSMITTER



FOR MODELS TLD6862A-2 AND TLD6862B OR EARLIER, REFER TO PRINTED CIRCUIT BOARD DETAIL EPD-15544.

EPD-20359-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Models TLD6862A-3 and TLD6862B-2
Exciter Circuit Board Detail
Motorola No. PEPD-20360-C
8/28/70-CP

REVISIONS

PEPD-20360-C

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLD6862B-2	Q105	WAS 48R869391, TYPE M9391	

PARTS LIST

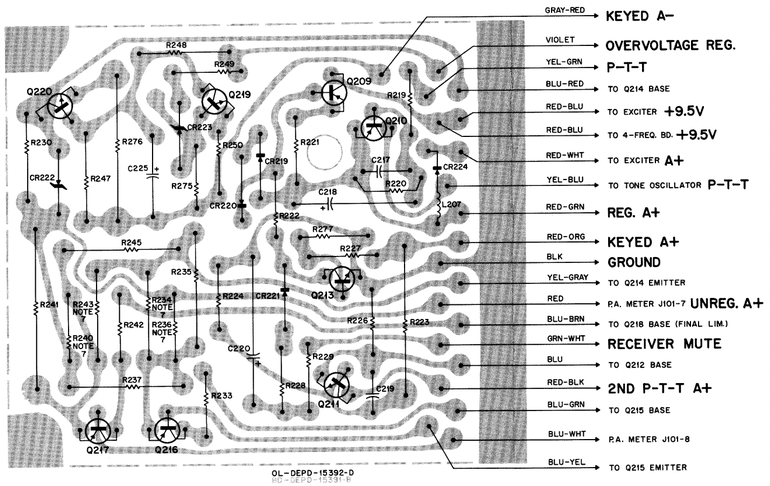
TLD6862A Exciter Board (150.8-174 MC)
TLD6862B Exciter Board (150.8-174 MC) EPD-20358-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf ±5%; 500 v; unl stated
C111,112,113, 114,118,129, 133,140,143, 153,801,803, 804,806	21D82428B25	.002 uf ±20%
C115,117	21D82187B18	1500 ±10%; 100 v
C116	21D82450B08	1.2
C119,120,121, 122,125,126, 130,134	21C82372C04	.05 uf +80-20%; 25 v
C123	21D82428B54	330; 200 v
C124	21D82428B59	.01 uf ±20%; 200 v
C127	21D82450B11	3
C128,138,145	21D82610C44	100; N220
C131	21D82404B03	6; NP0
C132	21K863147	150 ±10%
C135	21K849335	20; N150
C136,149	21D82450B13	1.5
C137	21D82610C02	43; N220
C139,1010	21D82187B20	1000 ±10%; 100 v
C142	21C82450B28	1 ±10%
C144	21K855809	33; N150
C147,1009	21C82372C01	0.1 uf +80-20%; 25 v
C148	21K828686	10; N150
C150	21K864735	12; N220
C151	21D82610C07	51; N150
C152	21D82450B22	0.75 ±10%
C187	8D83293B01	0.1 uf ±10%; 50 v
C188,192	23K865136	15 uf ±20%; 25 v
C189	8D82905G45	0.82 uf ±10%; 50 v
C190,1012	21D82187B17	820 ±10%
C191	23D83214C07	22 uf ±20%; 15 v
C193	8D83293B02	0.22 uf ±10%; 50 v
C194	21K848158	390 ±10%; 300 v
C195	8D83293B13	.068 uf ±10%; 50 v
C411	21D82133G22	8; NP0
C802,805,807, 810,811	23K865137	4.7 uf ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101,102	48C82190H02	silicon; varactor
CR103,104, 105	48C82139G01	germanium
CR109	48D82533D10	zener
CR110,111	48C82392B03	silicon
		COIL, RF: choke, unl stated
L101	24C80905A33	coded BLK-VIO; incl 76B82611C02 CORE, tuning
L102	24D82723H06	6.2 uh
L103,104,105, 106	24C83961B01	choke; coded BRN
L131	25C82498H02	6 h
L132	24D82723H01	1.2 uh
L133	24K847940	0.62 mh
		TRANSISTOR: (SEE NOTE)
Q101	48R869164	N-P-N; type M9164
Q102,104	48R869144	N-P-N; type M9144
Q103	48R869390	N-P-N; type M9390
Q105	48R869391	N-P-N; type M9391 (TLD6862A)
	or48R869613	N-P-N; type M9613 (TLD6862B)
Q112, 113	48R869389	N-P-N; type M9389
		RESISTOR, fixed: ±10%; 1/4 w unl stated
R101,102	6S129862	150
R103,152,155	6S129754	33
R104,105,141	6S129229	180K
R106	6S127800	220
R107,109,129	6S127802	1K
R108	6S127804	4.7K
R110	6S128689	2.2K
R111	6S129145	82K
R112	6S129235	1.2K
R113,117,133	6S129752	270
R114	6S129753	100
R115,135	6S128688	2.7K
R116	6S128687	6.8K
R118	6S127806	27K
R119	6S131641	22
R128,134	6S129620	560
R131	6S129269	1.8K
R132	6S128686	8.2K
R134	6S129863	390 (TLD6862A)
	or6S129752	270 (TLD6862B)
R136	6S129432	820
R137,140	6S129667	22K ±5%
R138	6S129668	10K
R139	6S129526	33K
R142	18D82238D15	var; 10K
R143,145	6S129148	470K
R144	6K129226	100K
R146	6S124B55	2.7 ±5%
R154,156	6S131377	15
R158	6K129755	10
		TRANSFORMER:
T101	24V80903A20	coded BRN-BRN; incl 76B82611C02 CORE, tuning
T102	24V80903A21	coded GRAY-ORG; incl 76B82611C02 CORE, tuning
T103	24V80905A32	coded BRN-BLU; incl 76K858875 CORE, tuning
T104	24V80905A34	coded BRN-YEL; incl 76K858875 CORE, tuning

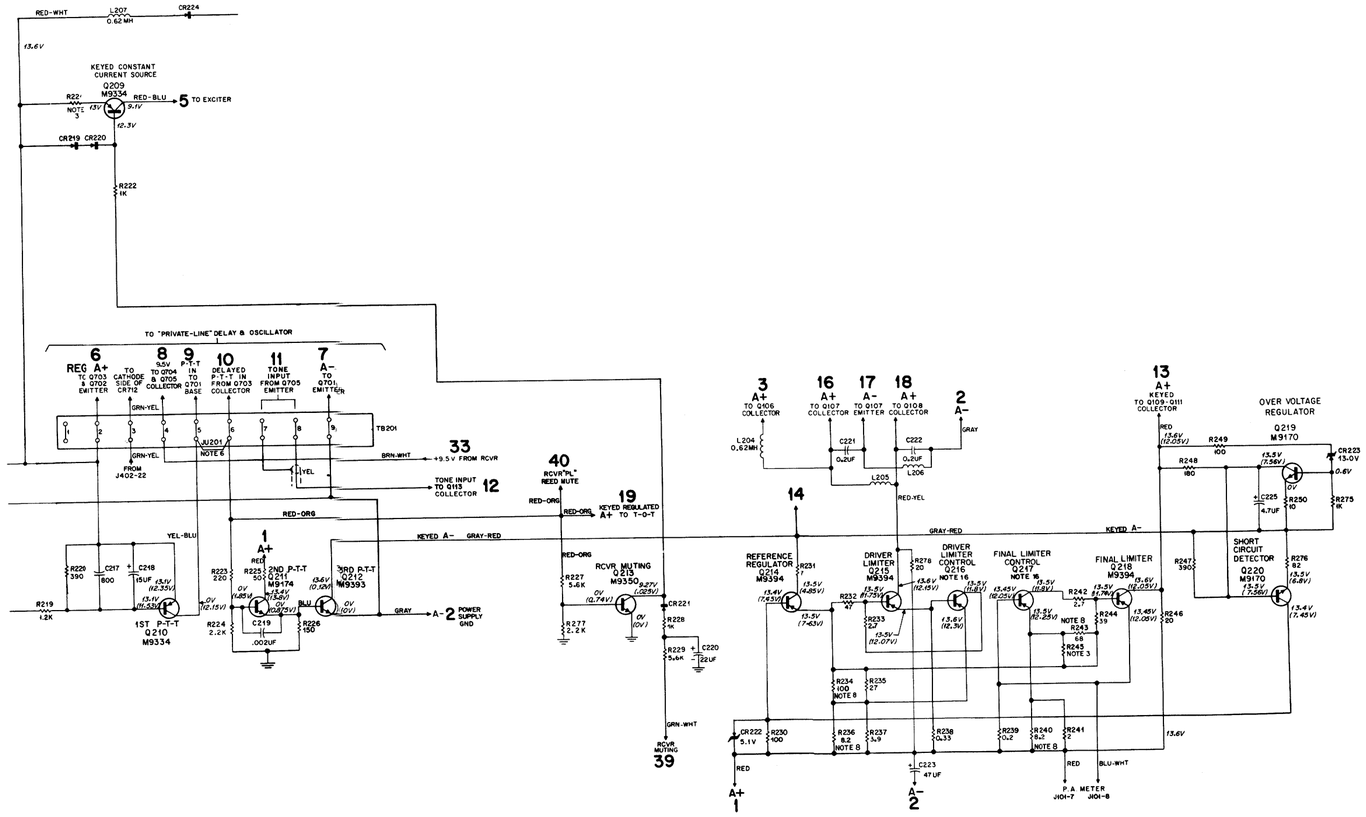
NOTE:

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

NOTES:
7. RESISTOR MAY BE OMITTED AT FACTORY.



OL-DEPD-15392-D



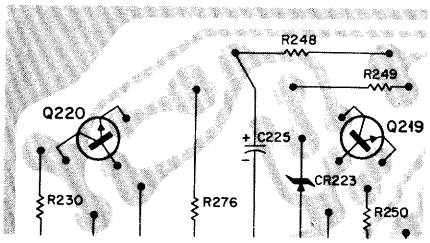
PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8481A and TLN8481B Transmitter
Switching Circuit Board Detail
Motorola No. EPD-15545-M
4/5/73-CP

REVISIONS

EPD-15545-M

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8481A-1	L207	ADDED 0.62 mh	BELOW Q210
TLN8481A-2	R235	WAS 6S5583, 47; 1 W	CENTER OF CKT BD
TLN8481A-3	C225	ADDED 4.7 uf	Q219 COLLECTOR
TLN8481B		ADDED	
TLN8481A-3 TLN8481B	CR223	WAS DIODE, 48D82533D08	PARTS LIST
	CR224	WAS DIODE, 48D82256C35	
TLN8481B-1	Q216, Q217	WERE 48R869401 TYPE M9401	DRIVER LIMITER CONTROL FINAL LIMITER CONTROL
TLN8481A-3	Q213	WAS Q206	RCVR MUTE AREA
TLN8481A-3	R221	WAS 6R131377, 15	Q209 EMITTER
TLN8481B-1	R245	WAS 6S48027, 18	Q217 EMITTER
TLN8481B-2	R245	WAS 17C82036G27, 18 ±5%; 2 w	Q217 EMITTER
		CIRCUIT WAS AS SHOWN BELOW	Q220



TLN8481B-2	CR223	WAS 48D82256C50	PARTS LIST

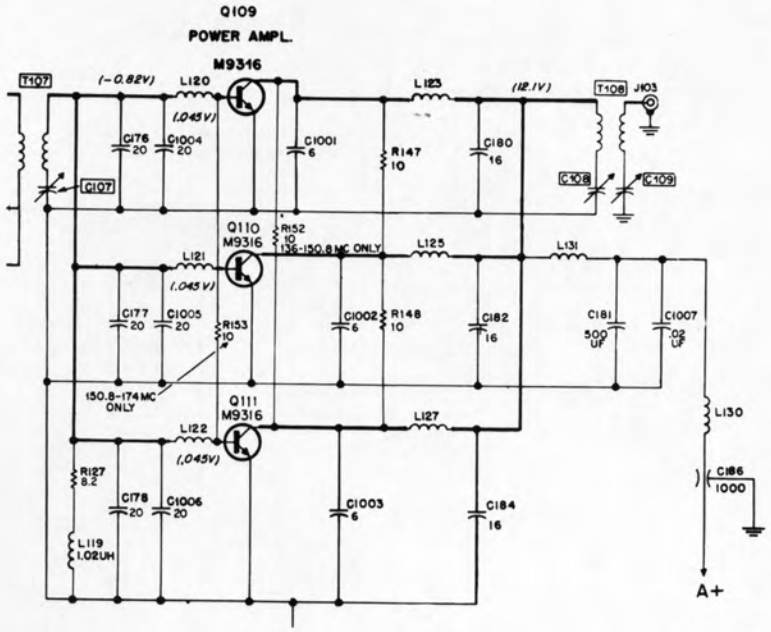
PARTS LIST

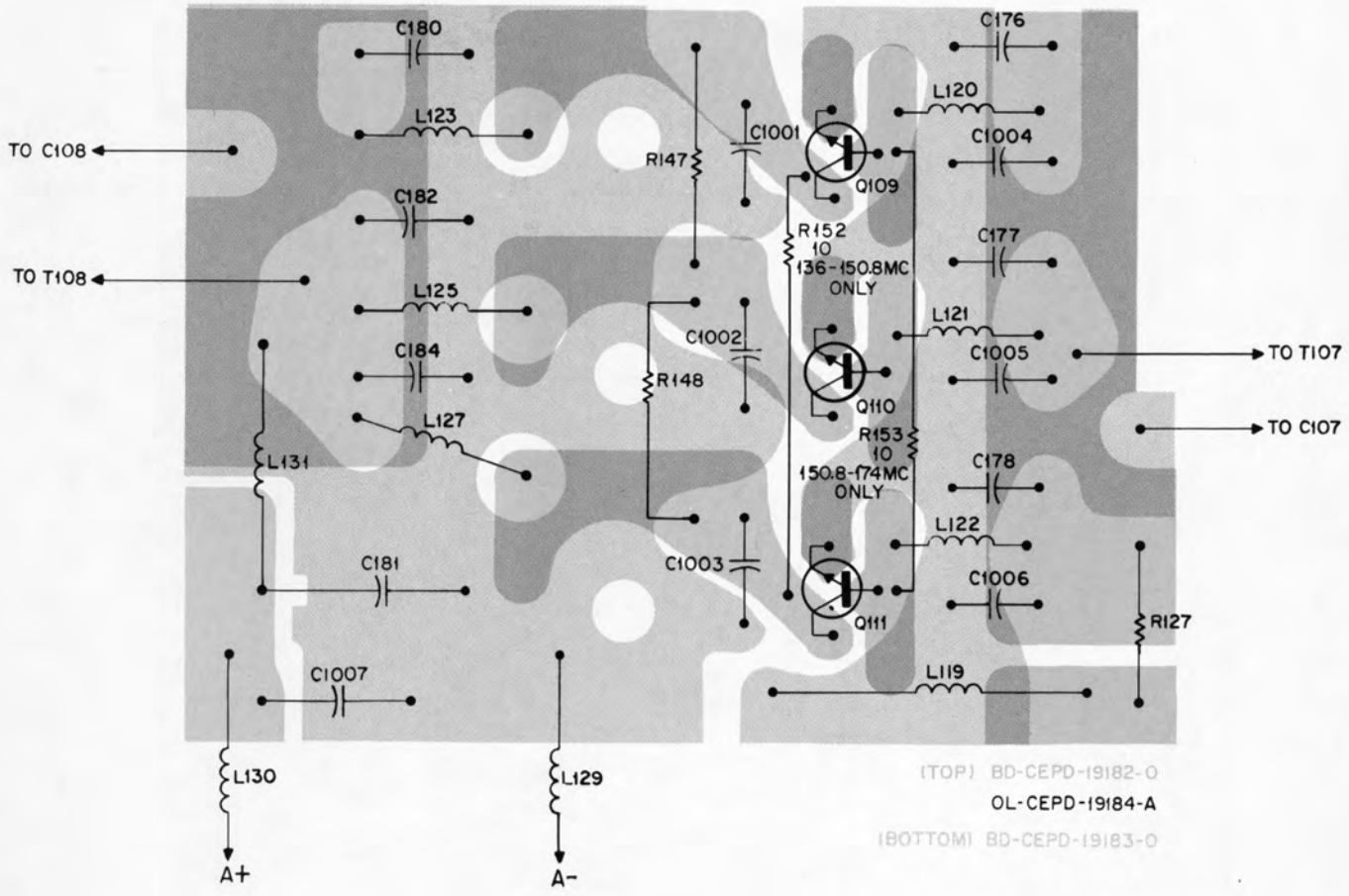
TLN8481A Transmitter Switching Board
TLN8481B Transmitter Switching Board EPD-15589-F

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C217	21K847070	800 uuf ±10%; 600 v
C218	23D83214C02	15 uf ±20%; 25 v
C219	21D82428B36	.002 uf ±10%; 200 v
C220	23D83214C07	22 uf ±20%; 15 v
C225	23K865137	4.7 uf ±20%; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR219, 220, 221	48C82392B03	silicon
CR222	48D82256C35	zener type; 5.1 v
CR223	48D83461E31	zener type; 13 v
CR224	48C82466H13	silicon
		COIL, RF:
L207	24V80900A61	0.62 mh; sleeved
		TRANSISTOR: (SEE NOTE)
Q209, 210	48R869334	P-N-P; type M9334
Q211	48R869174	N-P-N; type M9174
Q213	48R869350	N-P-N; type M9350
Q216, 217	48R869401	P-N-P; type M9401
	or48R869549	P-N-P; type M9549
Q219, 220	48R869170	N-P-N; type M9170
		RESISTOR, fixed: ±10%; 1/4 w unl. stated
R219	6S129235	1.2K
R220	6S129863	390
R221	6S131650	18 (TLN8481A)
	or6S131377	15 (TLN8481B)
R222, 228, 275	6S127802	1K
R223	6S488053	220; 2 w
R224, 277	6S128689	2.2K
R226	6S129862	150
R227,229	6S129433	5.6K
R230	6S129753	100
R233, 242	6S124B55	2.7 ±5%
R234, 249	6S6326	100; 1/2 w
R235	17C82036G04	27 ±5%; 2 w
R236, 240	6S124B67	8.2 ±5%
R237	17K837834	3.9 ±5%; 1/2 w
R241	17K847359	2 ±2%; 1 w
R243	6S2039	68; 1/2 w
R245	17C82036G27	18 ±5%; 2 w (TLN8481A)
	or17C82036G33	22 ±5%; 2 w (TLN8481B)
R247	6S5554	390; 1/2 w
R248	6S5660	180; 1/2 w
R250	6S129755	10
R276	6S488222	82; 2 w

NOTE:

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





(TOP) BD-CEPD-19182-O
OL-CEPD-19184-A
(BOTTOM) BD-CEPD-19183-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Power Amplifier Circuit Board Detail
Motorola No. PEPD-19185-B
8/28/70-CP

REVISIONS

PEPD-19185-B

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
	R152	REMOVED FROM BETWEEN COL LECTORS OF Q109 AND Q111 FOR 150.8-174 MC	Q109, Q111
	R153	ADDED BETWEEN BASE OF Q109 AND Q111 FOR 150.8-174 MC	

PARTS LIST

1V80773A06 Power Amplifier Circuit Board (p/o TLD6801A)
1V80772A74 Power Amplifier Circuit Board (p/o TLD6802A)

EPD-19410-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uuf; 500 v unl stated
C176, 177, 178, 1004, 1005, 1006	21K840849 or21D82610C72	20 ±5%; NP0 (150.8-174 mc) 18 ±5%; NP0 (136-150.8 mc)
C180, 182, 184	21K848525	16 ±5%; NP0
C181	21D82880E19	500 ±10%; 500 v
C1001, 1002, 1003	21K840848 or21K840846	6 ±0.5 uuf; NP0 (150.8-174 mc) 15 ±5%; NP0 (136-150.8 mc)
C1007	21C82372C05	0.2 uf +80-20%; 25 v
		COIL, RF:
L119	24V80900A86	choke; 1.02 uh; sleeved
L120, 121, 122	24B83656E01 or24B83656E03	final base; 1 turn; (150.8-174 mc) final base; 2 turns; (136-150.8 mc)
L123, 125, 127	24B83656E02	collector coils; 2 turns
L129, 130	24C82000E25	choke; coded BLU dot
L131	24C82000E26	choke; 6 turns; coded ORG dot
		TRANSISTOR, N-P-N; (NOTE)
Q109, 110, 111	48R869316	type M9316
		RESISTOR, fixed: ±10%; 1/2 w unl stated
R127	6S124B67	8.2 ±5%; 1/4 w
R147, 148	6S5621	10
NON-REFERENCED ITEM		
	14A83211B01	INSULATOR, transistor: used with Q109, Q110, Q111

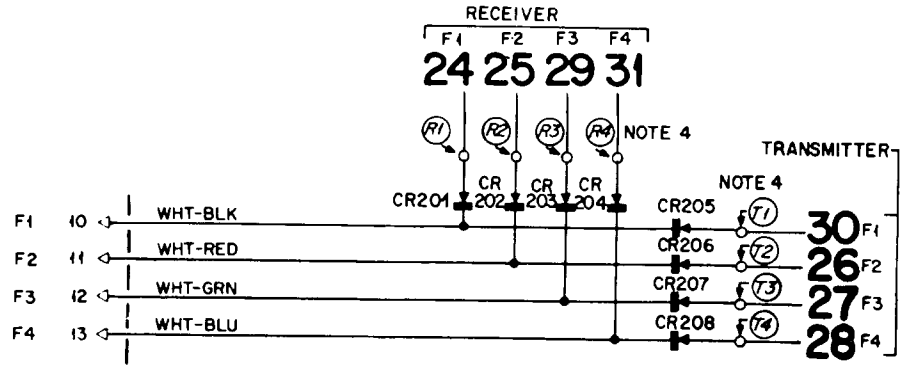
P/O TLD6801A Power Amplifier Chassis (136-150.8 MHz)
P/O TLD6802A Power Amplifier Chassis (150.8-174 MHz)

EPD-21127-A

		RESISTOR, fixed:
R152	6S5621	10 ±10%; 1/2 w (TLD6801A)
R153	6S5621	10 ±10%; 1/2 w (TLD6802A)

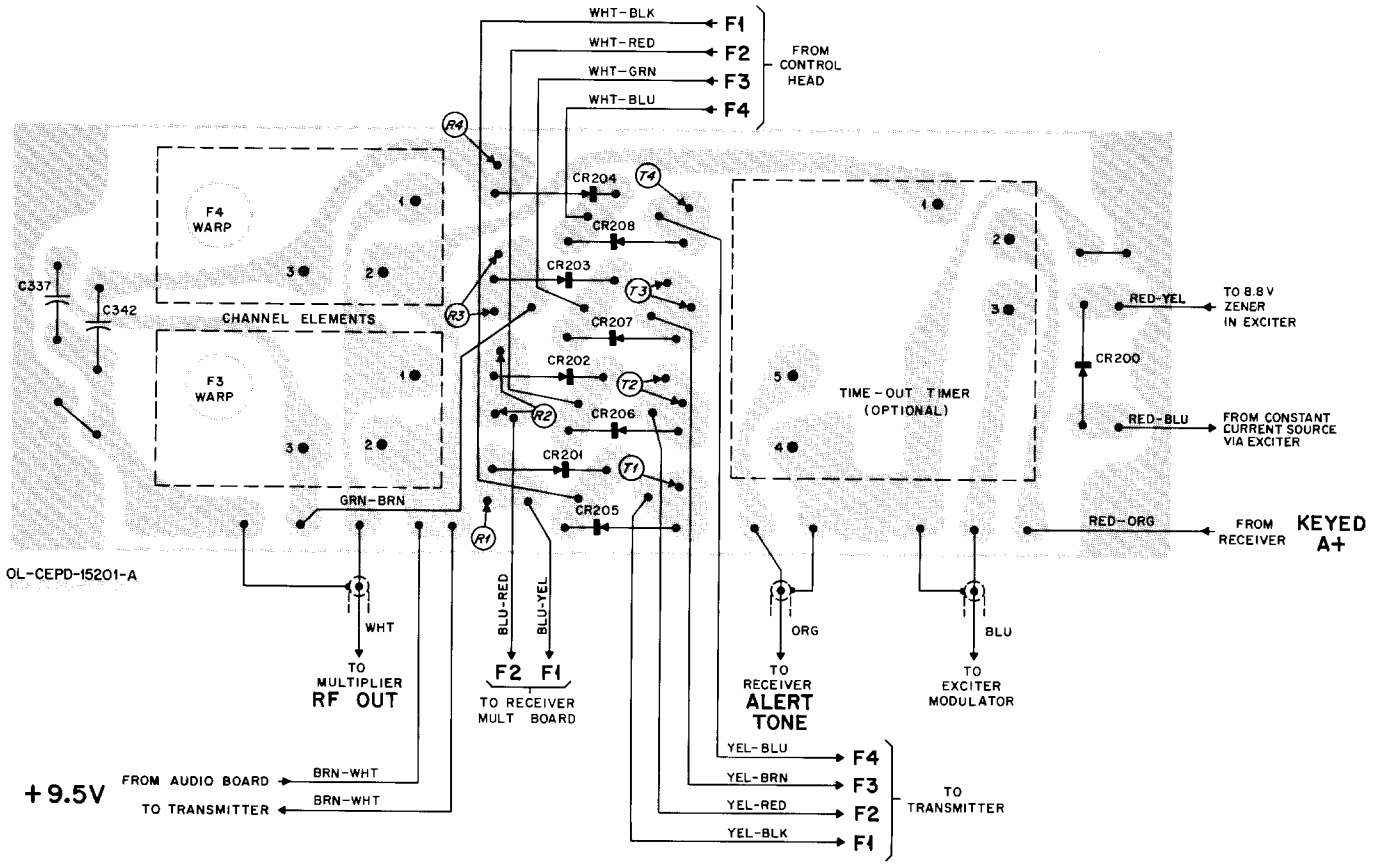
NOTE:

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



NOTES:

2. PIN NUMBERS ARE FOR REFERENCE ONLY. PINS ARE PART OF CIRCUIT BOARD.
4. NUMBERS IN ITALICS (R1, R2, ETC) INDICATE JUMPERING POINTS. REFER TO INSTRUCTION MANUAL TEXT FOR JUMPERING INFORMATION.



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Models TLN8466A and TLN8466B
Four-Frequency Circuit Board Detail
Motorola No. EPD-15203-B
8/28/70-CP

REVISIONS

EPD-15203-B

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8466B		ADDED	
	CR200 THRU 208	WERE 48C82392B03	PARTS LIST
TLN8466B-1			

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

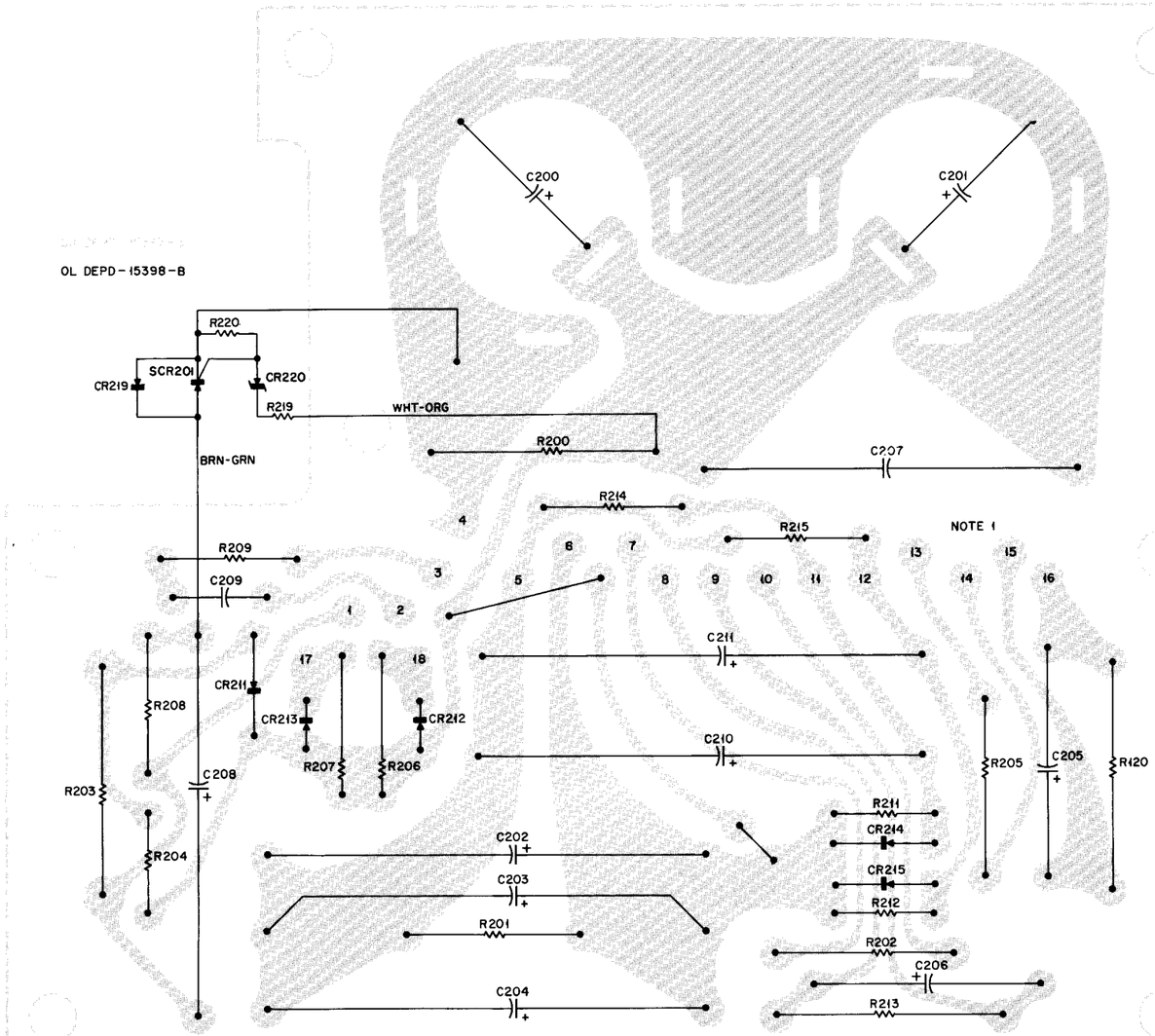
TLN8466A 4-Frequency Switching Kit
TLN8466B 4-Frequency Switching Kit

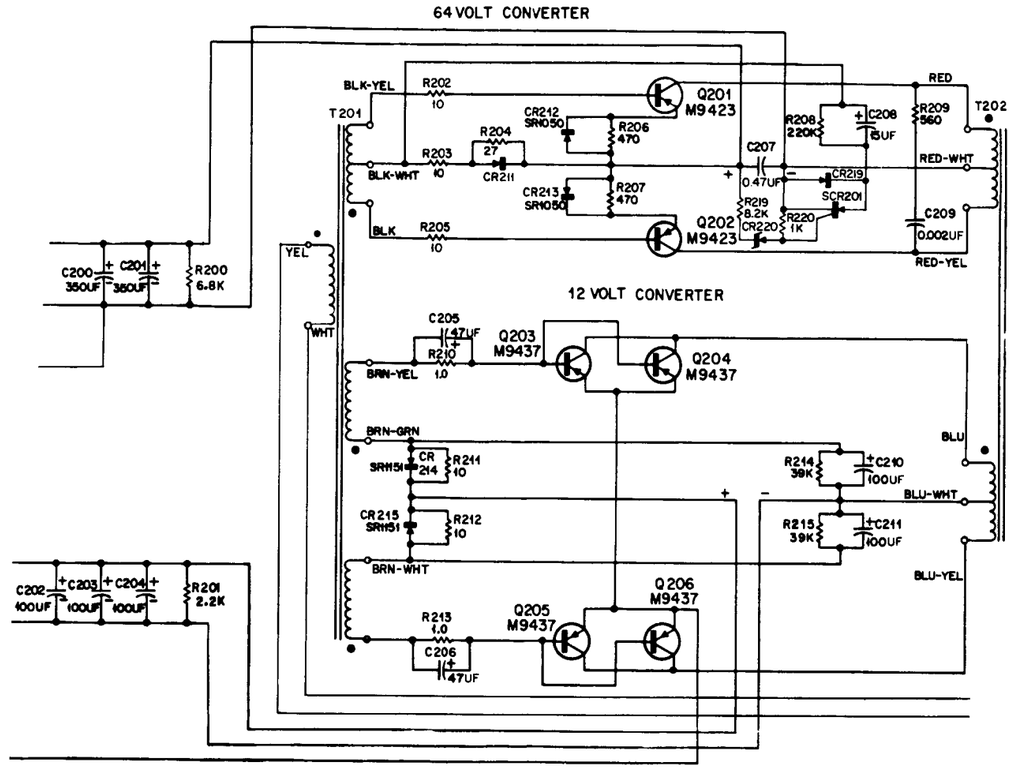
EPD-16159-B

C337, 342	21D82428B28	CAPACITOR, fixed: .002 uf ±10%; 200 v
CR200 thru 208	48D82466H12	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon (SR1151)

NOTE:

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





NOTE:

NUMBERS ON CIRCUIT BOARD DIAGRAM IDENTIFY CORRESPONDING NUMBERED WIRES IN TABLE OF EXTERNAL LEADS.

TABLE OF EXTERNAL LEADS

EYELET (SEE DIAGRAM)	COLOR CODE	DESTINATION
1	BLK-WHT	T201 (C.T.)
2	RED-YEL	T202 AND Q202 COLL.
3	RED	Q201 COLLECTOR
4	RED-WHT	FUSE BLOCK
5	BLU-WHT	CR210 ANODE
6	RED-GRN	CR210 CATHODE
7	BLK-YEL	T201
8	GRN-YEL	Q205, Q206 BASES
9	BRN	T201
10	BLU-RED	Q201 BASE
11	BRN-WHT	T201
12	BRN-GRN	T201
13	GRN-WHT	Q202 BASE
14	BLK	T201
15	GRN-BLK	Q203, Q204 BASES
16	BRN-YEL	T201
17	YEL	Q202 EMITTER
18	GRN	Q201 EMITTER

EPD-15399-A

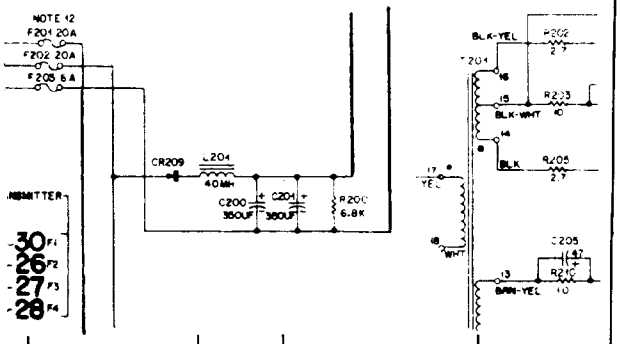
PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8467A Power Supply
Switching Circuit Board Detail
Motorola No. EPD-15547-E
8/28/70-CP

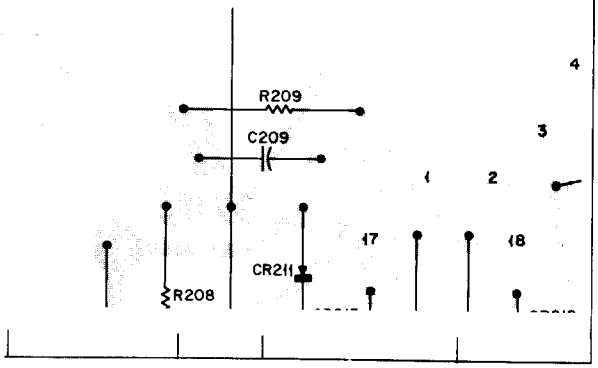
REVISIONS

EPD-15547-E

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8467A	CR209	REMOVED 48C82525G10 CIRCUIT WAS AS SHOWN BELOW	LOWER MIDDLE OF BOARD



TLN8467A	C205, 206	WERE 23D83214C14, 15 V	PARTS LIST
	C209	WAS .002	
TLN8467A-1	R202, 205	WERE 17C890468 2.7; 1 W	T210 SECONDARY, 64 V CONVERTER
	CR219, 221, R219, 220, SCR201	ADDED	
	C205, 206 CR219, 220, R219, 220, SCR201	ADDED ALTERNATE PART 23D82314C14 PARTS TRANSFERED TO MODEL TLN8504A	PARTS LIST
		CIRCUIT BOARD PLATING REMOVED CIRCUIT WAS AS SHOWN BELOW	



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8467A Switching Board — EPD-15592-C

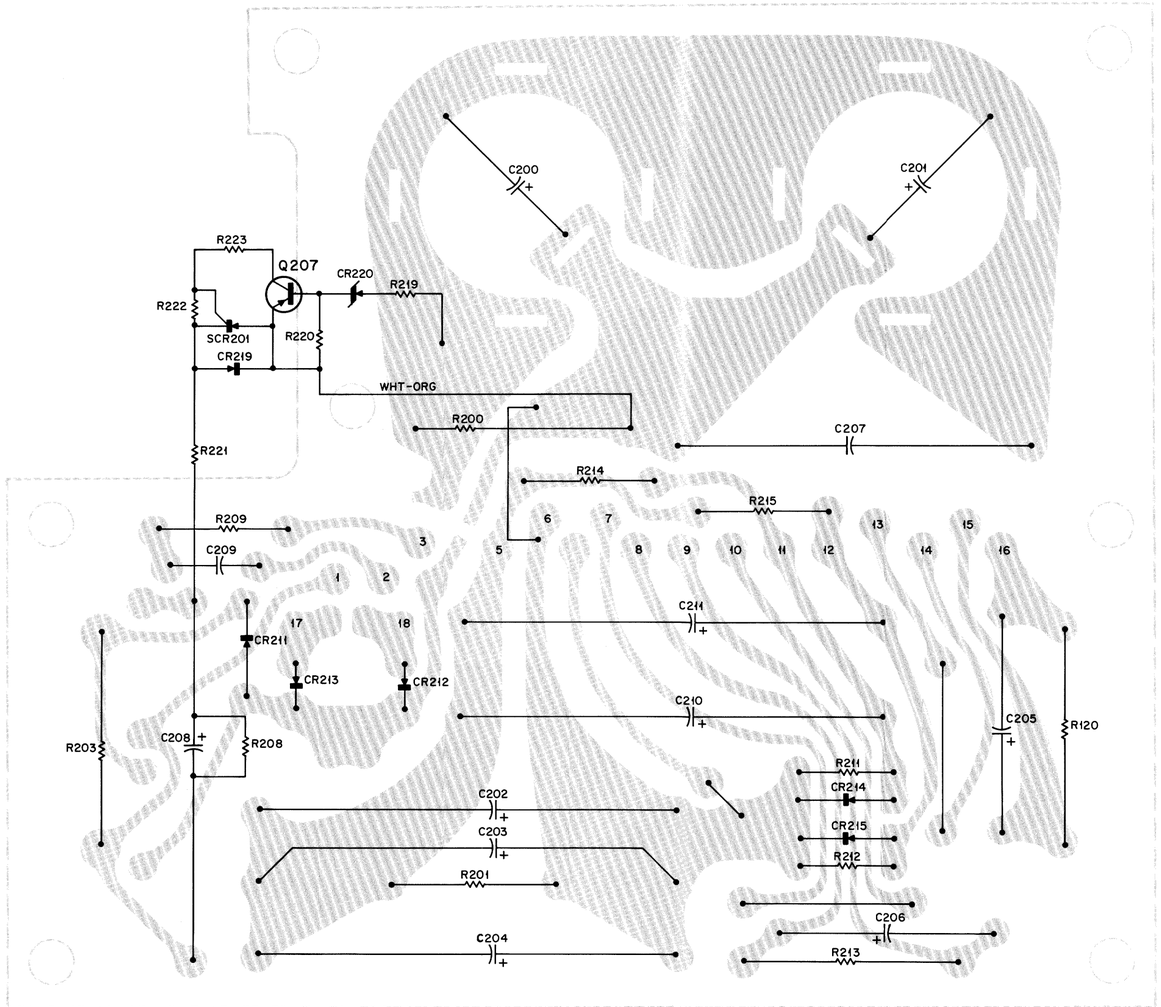
		CAPACITOR, fixed:
C200, 201	23D82304B21	350 +100-10%; 150 v
C202, 203, 204, 210, 211	23D83210A08	100 uf +150-10%; 25 v
C205, 206	23D83214C14	47 uf ±20%; 15 v
	or23D82783B31	47 uf ±20%; 20 v
C207	8K861614	0.47 uf ±10%; 100 v
C208	23D82601A17	15 uf +100-10%; 150 v
C209	21K868902	.001 uf ±20%; 3000 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR211	48C82466H13	silicon
CR212, 213	48C82525G02	silicon
CR214, 215	48C82466H12	silicon
		RESISTOR, fixed: ±10%; 1/2 w unl. stated
R200	6S5690	6.8K; 2 w
R201	6S6409	2.2K; 1 w
R202, 205	17C82036G08	10 ±5%; 2 w
R203	6S488033	10; 2 w
R204	6S131594	27; 1/4 w
R206, 207	6S6090	470
R208	6S6407	220K
R209	6S6291	560
R210, 213	17C82291B07	1 ±5%; 3 w
R211, 212	6S129755	10; 1/4 w
R214, 216	6S6487	39K

TLN8504A Power Supply Hardware Kit — EPD-21228-O

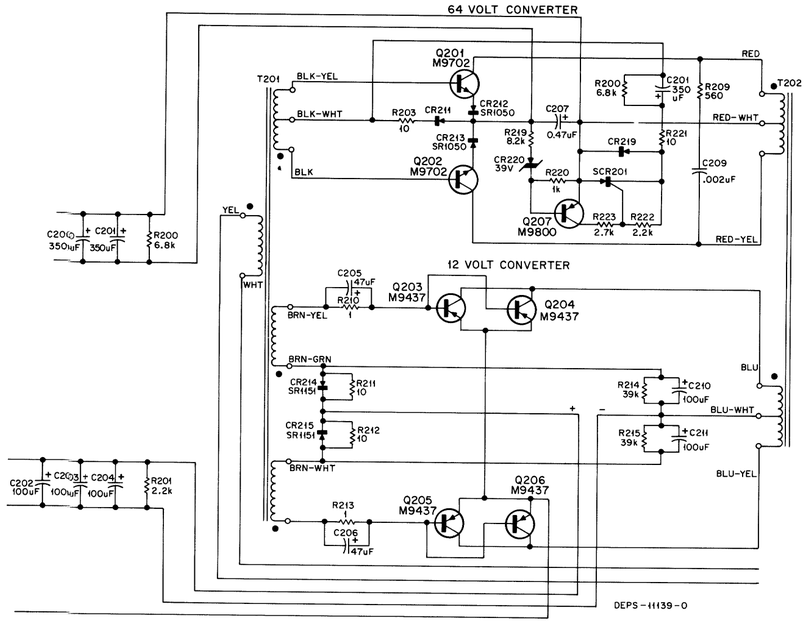
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR219	48C82466H03	silicon
CR220	48D83696E03	zener type; 39 v
		RESISTOR, fixed:
R219	6R2004	8.2K ±10%; 1/4 w
R220	6K127802	1K ±10%; 1/4 w
		RECTIFIER:
SCR201	48D83875D03	silicon controlled

NOTE:

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



OL - DEPS - 11861 - O



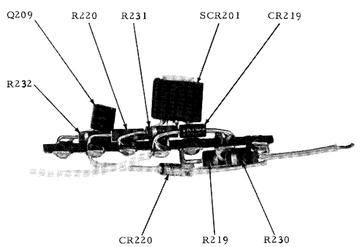
NOTE:

NUMBERS ON CIRCUIT BOARD DIAGRAM IDENTIFY CORRESPONDING NUMBERED WIRES IN TABLE OF EXTERNAL LEADS.

TABLE OF EXTERNAL LEADS

EYELET (SEE DIAGRAM)	COLOR CODE	DESTINATION
1	BLK-WHT	T201 (C. T.)
2	RED-RED	T202 AND Q202 COLL.
3	RED	Q201 COLLECTOR
4	RED-WHT	FUSE BLOCK
5	BLU-WHT	CR210 ANODE
6	RED-GRN	CR210 CATHODE
7	BLK-YEL	T201
8	GRN-YEL	Q205, Q206 BASES
9	BRN	T201
10	BLU-RED	Q201 BASE
11	BRN-WHT	T201
12	BRN-GRN	T201
13	GRN-WHT	Q202 BASE
14	BLK	T201
15	GRN-BLK	Q203, Q204 BASES
16	BRN-YEL	T201
17	YEL	Q202 EMITTER
18	GRN	Q201 EMITTER

EPS-11758-O



AEPS-11760-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN5393A Power Supply
Switching Circuit Board Detail
Motorola No. PEPS-11759-O
4/5/73-CP

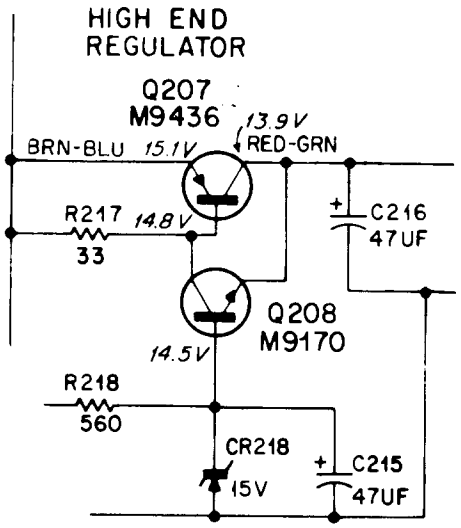
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

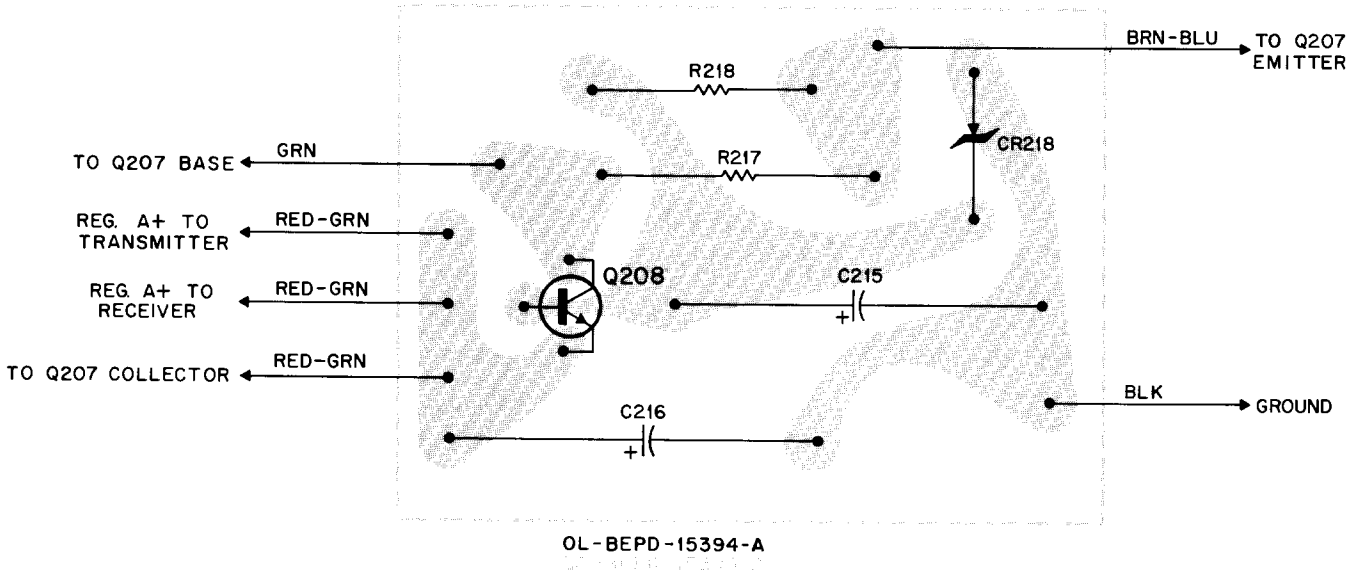
PARTS LIST

TLN5393A Switching Board PL-2387-O

		CAPACITOR, fixed:
C200, 201	23D82304B21	350 +100-10%, 150 V
C202, 203, 204, 210, 211	23D83210A08	100 uF +150-10%, 25 V
C205, 206	23D83214C14	47 uF ±20%; 15 V
	or23D82783B31	47 uF ±20%; 20 V
C207	8K861614	0.47 uF ±10%; 100 V
C208	23D82601A17	15 uF +100-10%; 150 V
C209	21K868902	.001 uF ±20%; 3000 V
		SEMICONDUCTOR DEVICE, diode (SEE NOTE)
CR211	48C82466H13	silicon
CR212, 213	48D82525G16	SR1050R type
CR214, 215	48C82466H12	silicon
CR219	48C82466H03	silicon
CR220	48D83696E03	Zener type; 39 V
		RESISTOR, fixed: ±10%; 1/2 W unless otherwise stated
R200	6S5690	6.8k; 2 W
R201	6S6409	2.2k; 1 W
R203	17C82177B01	3; 5 W; W.W.
R208	6R5656	12k; 1 W
R209	6S6291	560
R210, 213	17C82291B07	1 ±5%; 3 W
R211, 212	6S129755	10; 1/4 W
R214, 216	6S6487	39k
R219	6R2004	8.2k; 1/4 W
R220	6K127802	1k; 1/4 W
R230	6K129755	10; 1/4 W
R231	6R128688	2.7k; 1/4 W
R232	6R128689	2.2k; 1/4 W
		RECTIFIER:
SCR201	48D83875D03	silicon controlled

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





OL-BEPD-15394-A

PARTS LIST

TLN8480A Regulator Filter EPD-15593-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C215, 216	23D82783B31	CAPACITOR, fixed: 47 uf ±20%; 20 v
CR218	48D82256C14	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon; zener; 15 v
Q208	48R869170	TRANSISTOR: (SEE NOTE) N-P-N; type M9170
R217	6S476075	RESISTOR, fixed: 33 ±10%; 1 w
R218	6S6291	560 ±10%; 1/2 w

NOTE:

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

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TLN8480	C215, 216	WERE 23D83214C22	PARTS LIST
B	TLN8480		VOLTAGE READINGS ADDED	PARTIAL SCHEMATIC
C	TLN8480	Q208	WAS Q207	CIRCUIT BOARD DETAIL
D	TLN8480A	C216	WAS C210	PARTS LIST

Model TLN8480A High End Regulator
Circuit Board Detail
Motorola No. EPD-15548-D
8/28/70-CP

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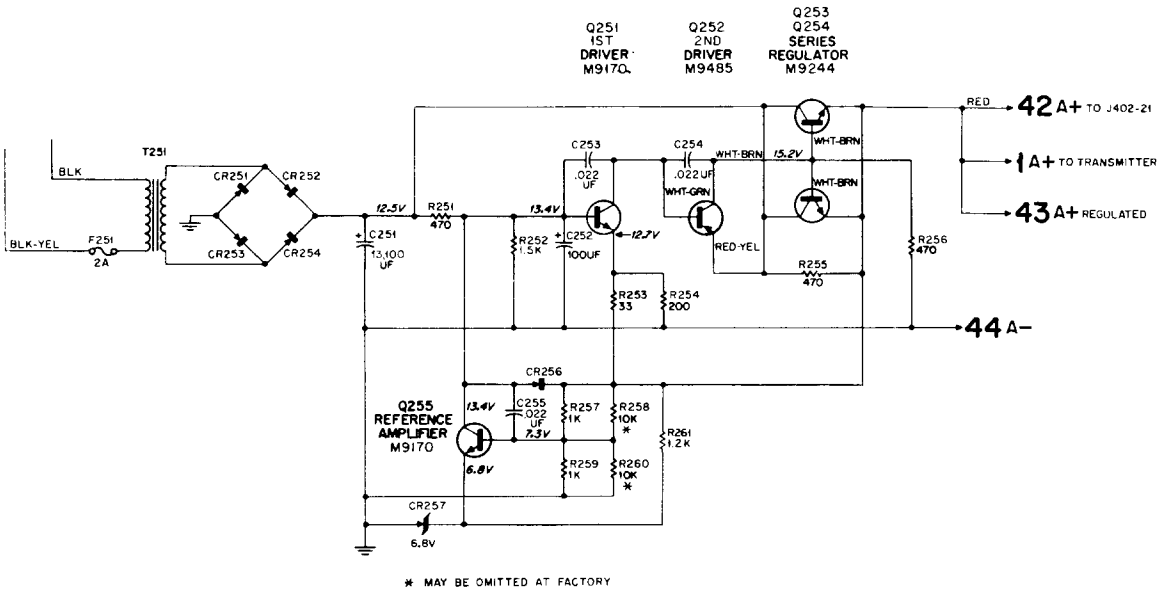
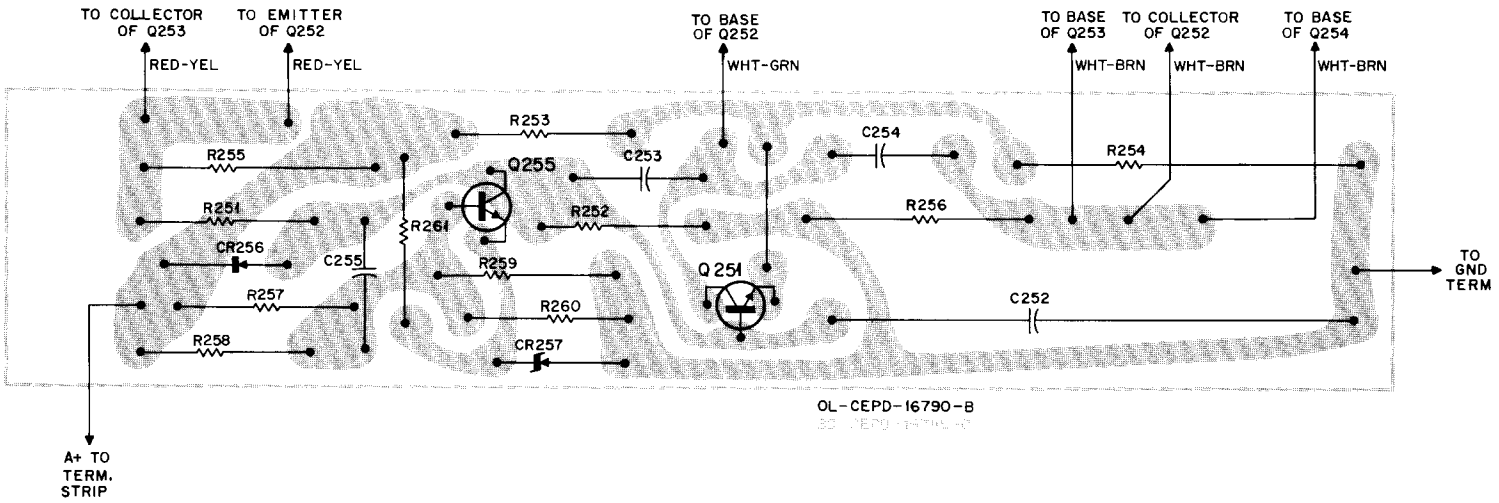




PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON BACK OF THIS DIAGRAM

TPN1056A Power Supply
Circuit Board Detail
Motorola No. EPD-17053-C
8/28/70-CP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A	TPN1056A	R252	WAS 6S2028, 2.2K	PARTS LIST
		CR255	REMOVED AND REPLACED BY STRAIGHT WIRE	BETWEEN Q251 EMITTER AND R253
B	TPN1056A-1	C251	WAS 23D82464C05, 21,000 uf +75-10%; 40 v	BASE CIRCUIT Q251
C	TPN1056A-1	CR257	ADDED VOLTAGE RATING	PARTS LIST

PARTS LIST

TLN8596A Regulator Board Kit — EPD-16983-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf
C252	23D83210A08	100 -10+150%; 25 v
C253, 254, 255	8D82905G02	.022 ±10%; 50 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR256	48C82392B03	silicon
CR257	48D83696E01	silicon, zener (1N754A) 6.8 v
		TRANSISTOR: (NOTE)
Q251, 255	48R869170	N-P-N; type M9170
		RESISTOR, fixed: ±5%; 1/2 w unl stated
R251	6S400812	470
R252	6S400459	1.5K ±5%; 1/2 w
R253	6S400422	33
R254	17D82177B40	200; 5 w
R255, 256	6S5593	470 ±10%; 1 w
R257, 259	6S6411	1K
R258, 260	6S6320	10K ±10%
R261	6S6393	1.2K ±10%

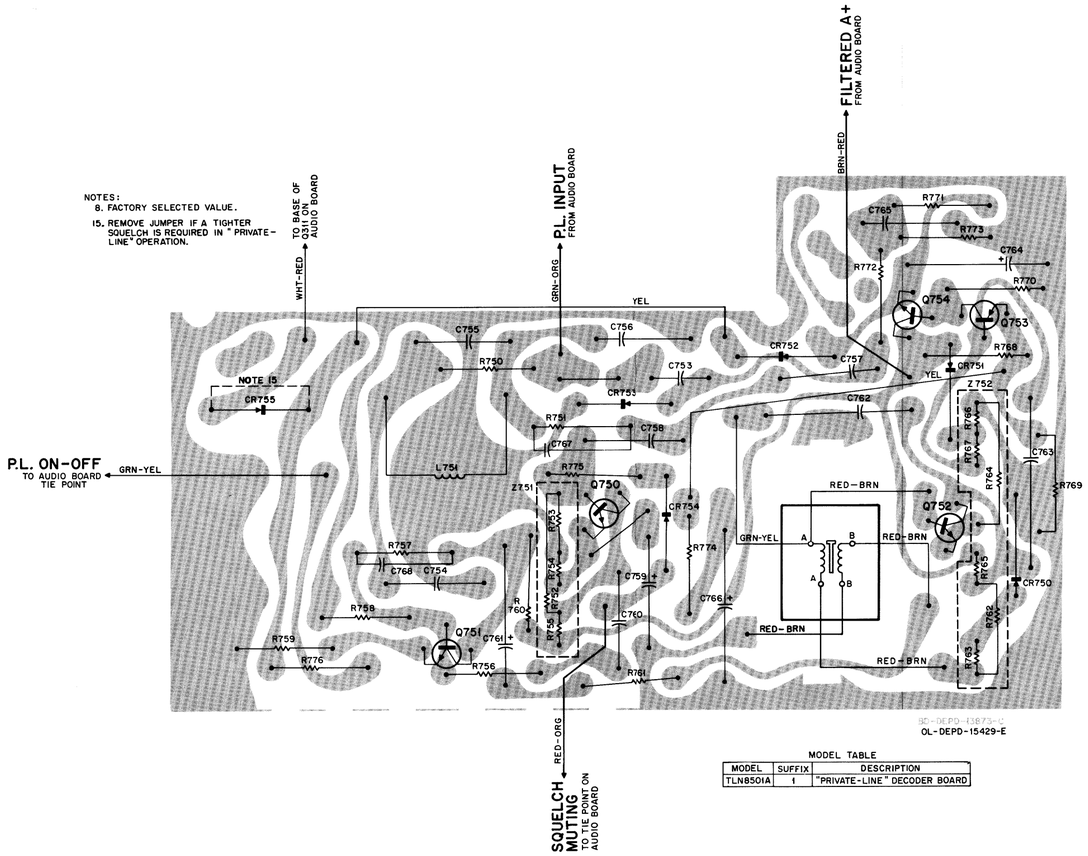
TLN8595A Chassis Kit — EPD-16999-A

		CAPACITOR, fixed:
C251	23D82464C06	13,100 uf +75-10%; 40 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR251, 253	48C82732C10	silicon
CR252, 254	48C82732C07	silicon
		FUSE, slow-blow:
F251	65S42092	2 amp
		TRANSISTOR: (NOTE)
Q252	48R869485	P-N-P; type M9485
Q253, 254	48R869244	N-P-N; type M9244
		TRANSFORMER:
T251	25D83594E01	power; resistance: pri. 2.75 ohm; sec. 0.11 ohm
		FUSEHOLDER:
XF251	9C82083C01	extractor; post type; incl. cap

NOTE:

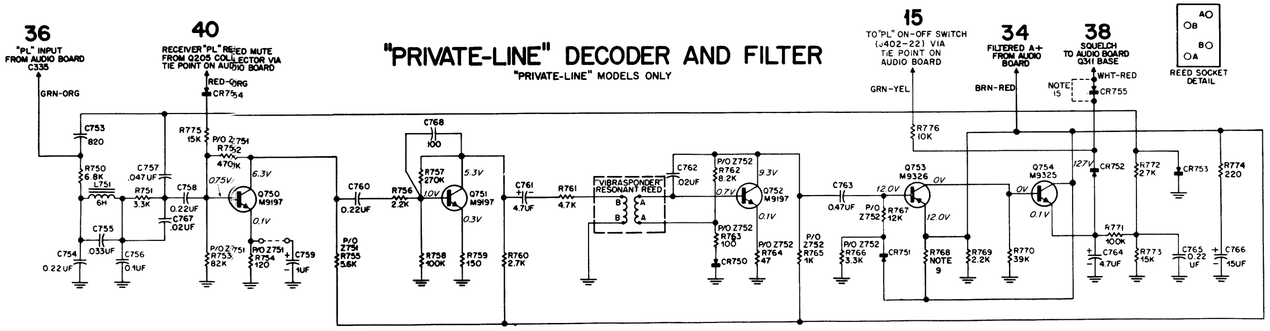
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

NOTES:
8. FACTORY SELECTED VALUE.
15. REMOVE JUMPER IF A TIGHTER SQUELCH IS REQUIRED IN "PRIVATE-LINE" OPERATION.



MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
TLN8501A	1	"PRIVATE-LINE" DECODER BOARD



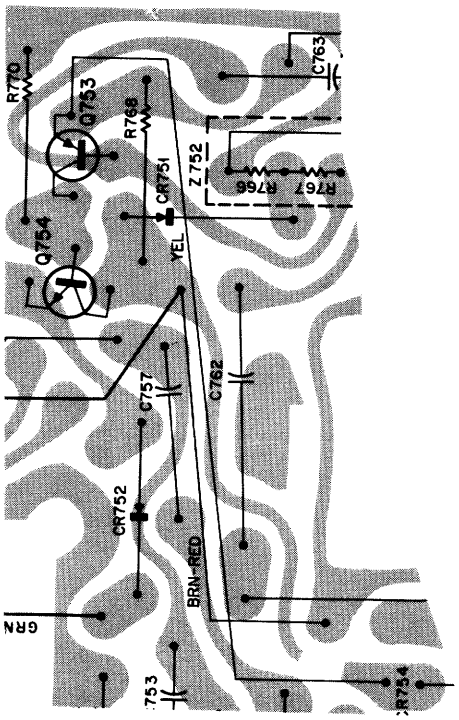
PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TLN8501A "Private-Line"
Decoder Circuit Board Detail
Motorola No. EPD-15549-G
8/28/70-CP

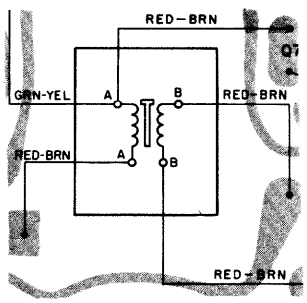
REVISIONS

EPD-15549-G

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8501A-1	C767	ADDED .02 uf	ABOVE Q750
	C768	ADDED 100 uuf	Q751 BASE
TLN8501A-1		CIRCUIT BOARD REVISED, CIRCUIT WAS AS SHOWN BELOW	BELOW Q754



TLN8501A-1	CR755	ADDED 48C82392B03	TOP LEFT OF CKT BD.
	R776	ADDED 10K	BOTTOM LEFT OF CKT BD.
TLN8501A-1		VOLTAGE READINGS ADDED	PARTIAL SCHEMATIC
TLN8501A-1		"VIBRASPONDER" WIRING WAS AS SHOWN BELOW	LOWER RIGHT CORNER CKT. BOARD
TLN8501A-1	C750	REMOVED 8D82905G03, .047 uf	PARTS LIST



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

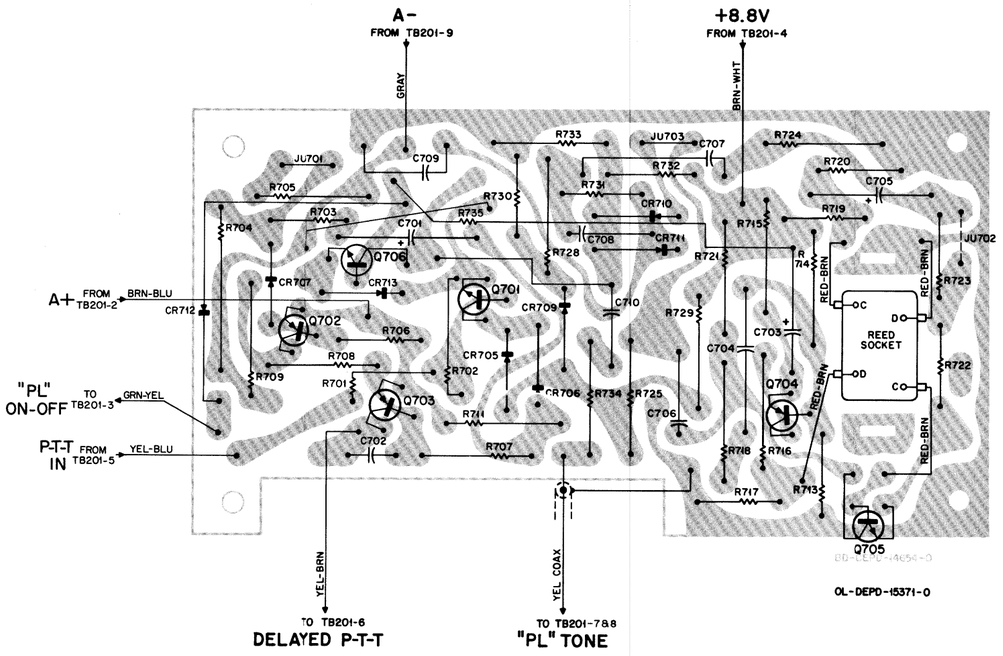
PARTS LIST

TLN8501A "Private-Line" Decoder and Filter EPD-15584-C

		CAPACITOR, fixed: uf ±10%
C753	21D82187B21	820; 200 v
C754, 758, 760, 765	8D82905G11	0.22; 50 v
C755	8D82905G08	.033; 50 v
C756	8D82905G07	0.1; 50 v
C757	8D82905G03	.047: 50 v
C759	23D82783B08	1.0; 35 v
C761, 764	23K865137	4.7; 25 v
C762	8K863628	.02; 100 v
C763	8D82905G06	0.47; 50 v
C766	23K865136	15; 25 v
C767	8D82905G23	.02; 100 v
C768	21D82133G03	100 uuf ±5%; 500 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR750, 751, 753, 754, 755	48C82392B03	silicon
CR752	48C82178A11	germanium
		COIL, audio:
L751	25D847527	choke; 6 h
		TRANSISTOR: (SEE NOTE)
Q750, 751, 752	48R869197	N-P-N; type M9197
Q753	48R869326	N-P-N; type M9326
Q754	48R869325	N-P-N; type M9325
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R750	6S128687	6.8K
R751	6S129231	3.3K
R752		470K; p/o Z751
R753		82K; p/o Z751
R754		120; p/o Z751
R755		5.6K; p/o Z751
R756	6S128689	2.2K
R757	6S129227	270K
R758, 771	6S129226	100K
R759	6S129862	150
R760, 772	6S128688	2.7K
R761	6S127804	4.7K
R762		8.2K; p/o Z752
R763		100; p/o Z752
R764		47; p/o Z752
R765		1K; p/o Z752
R766		3.3K; p/o Z752
R767		12K; p/o Z752
R768		factory selected
R769	6S129804	2.2K ±5%
R770	6S128903	39K
R773, 775	6S127805	15K
R774	6S129775	330
R776	6S129225	10K
		NETWORK
Z751	51C83481C01	incl. ref parts R752, R753, R754, R755
Z752	51C83481C02	incl. ref parts R762, R763, R764, R765, R766, R767
NON-REFERENCED ITEMS		
	1V80757A15	SOCKET & BRACKET ASSY; "Vibrasender"
	1V80757A14	CIRCUIT BOARD ASSY; (less components)

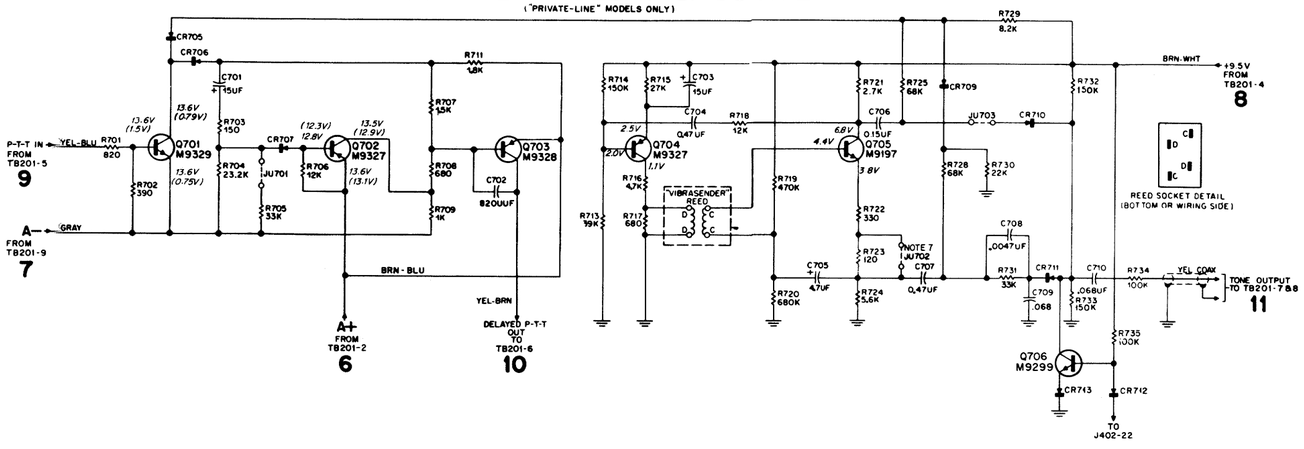
NOTE:

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



"PRIVATE-LINE" DELAY & OSCILLATOR

("PRIVATE-LINE" MODELS ONLY)



FOR MODEL TLN8560A SUFFIX-1, REFER TO CIRCUIT BOARD DETAIL PEPD-20740.

EPD-20825-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

"Private-Line" Delay & Oscillator
Model TLN8560A Circuit Board Detail
Motorola No. PEPD-15546-B
8/28/70-CP

REVISIONS

DIAG. ISSUE	BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A & B	TLN8560A		EXTENSIVE CIRCUIT AND COMPONENT CHANGES. REFER TO PEPD-20740-O FOR SUFFIX-1 VERSION.	

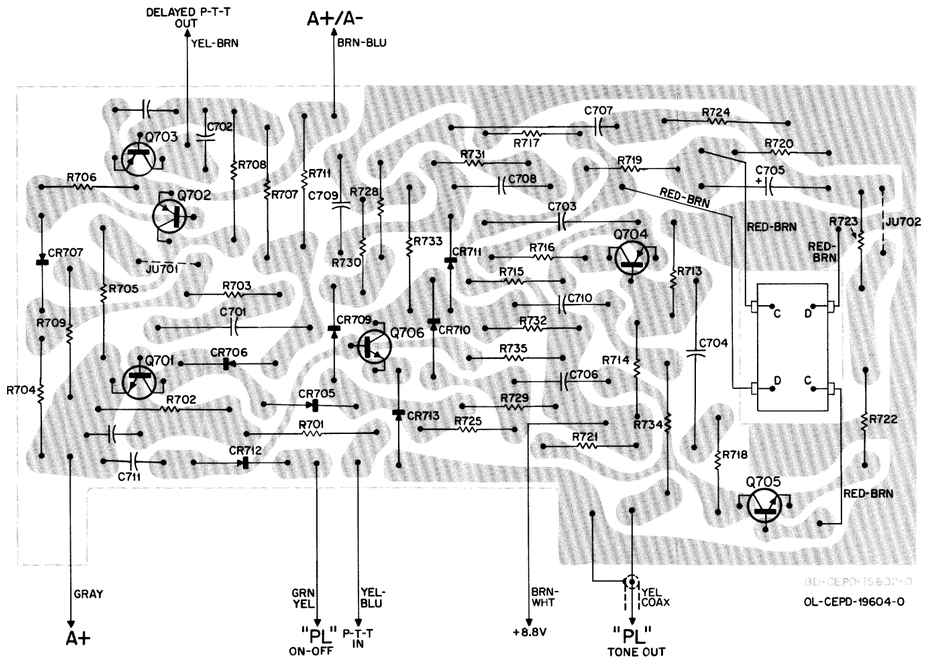
PARTS LIST

TLN8560A "Private-Line" Tone Generator EPD-20748-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; 50 v; unl stated
C701	23D82783B24	15; 25 v
C702	21D82187B21	820 uuf; 200 v
C703	23K865136	15 ±20%; 25 v
C704, 707	8D82905G33	0.47 ±20%
C705	23K865137	4.7; 25 v
C706	8D82905G24	0.15 ±5%; 25 v
C708	8D82905G26	.0047; 100 v
C709, 710	8D82905G04	.068; 25 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR705, 706, 707, 709, 710, 711, 712, 713	48C82392B03	silicon
		TRANSISTOR: (SEE NOTE)
Q701	48R869329	N-P-N; type M9329
Q702, 704	48R869327	P-N-P; type M9327
Q703	48R869328	P-N-P; type M9328
Q705	48R869197	N-P-N; type M9197
Q706	48R869299	N-P-N; type M9299
		RESISTOR, fixed: ±5%; 1/4 w; unl stated
R701	6S129818	820
R702	6S400804	390; 1/2 w
R703	6S129862	150 ±10%
R704	6D83175C32	23.2K ±1%
R705	6S2068	33K; 1/2 w
R706	6S129887	12K
R707	6S400459	1.5K; 1/2 w
R708	6S5651	680; 1/2 w
R709	6S6411	1K; 1/2 w
R711	6S2089	1.8K ±10%; 1/2 w
R713	6S129777	39K
R714	6S5559	150K; 1/2 w
R715	6R5786	27K; 1/2 w
R716	6S3924	4.7K; 1/2 w
R717	6S129984	680
R718	6R6394	12K ±10%; 1/2 w
R719	6S129149	470K
R720	6S131857	680K
R721	6S5557	2.7K ±10%; 1/2 w
R722	6S129806	330
R723	6S129617	120 ±10%
R724	6S3940	5.6K; 1/2 w
R725, 728	6R6074	68K ±10%; 1/2 w
R729	6S2004	8.2K ±10%; 1/2 w
R730	6S129667	22K
R731	6S129526	33K
R732	6S129146	150K ±10%
R733	6S6398	150K ±10%; 1/2 w
R734	6S5553	100K; 1/2 w
R735	6S129226	100K ±10%
NON-REFERENCED ITEM		
	1V80762A75	SOCKET ASSY; "Vibrasponder" female; 4 contact

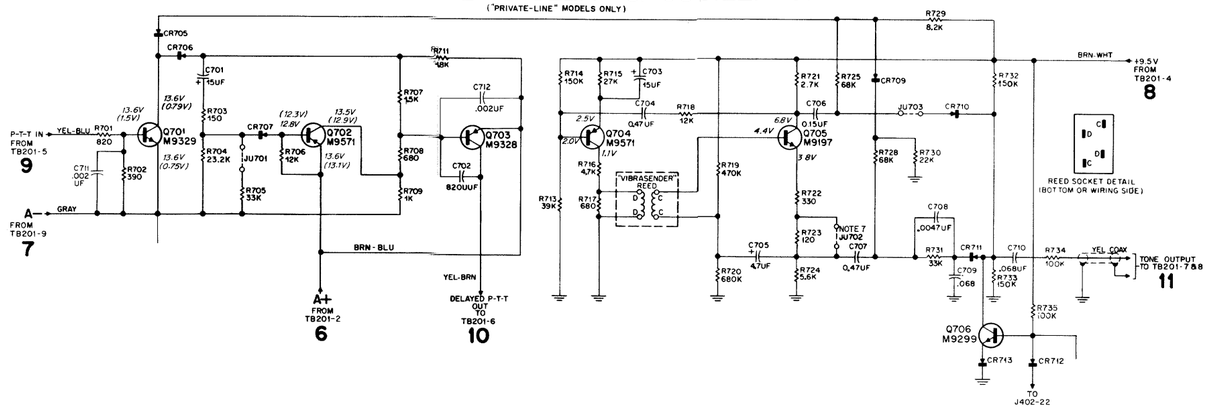
NOTE:

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



"PRIVATE-LINE" DELAY & OSCILLATOR

("PRIVATE-LINE" MODELS ONLY)



FOR MODEL TLN8560A WITH NO SUFFIX, REFER TO CIRCUIT BOARD DETAIL PEPD-15546.

EPD-20824-O

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

"Private-Line" Delay & Oscillator
Model TLN8560A-1 Circuit Board Detail
Motorola No. PEPD-20740-A
8/28/70-CP

REVISIONS

PEPD-20740-A

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8560A-1	Q702, 704	WERE 48R869327, M9327	SCHEM. & PARTS LIST

PARTS LIST

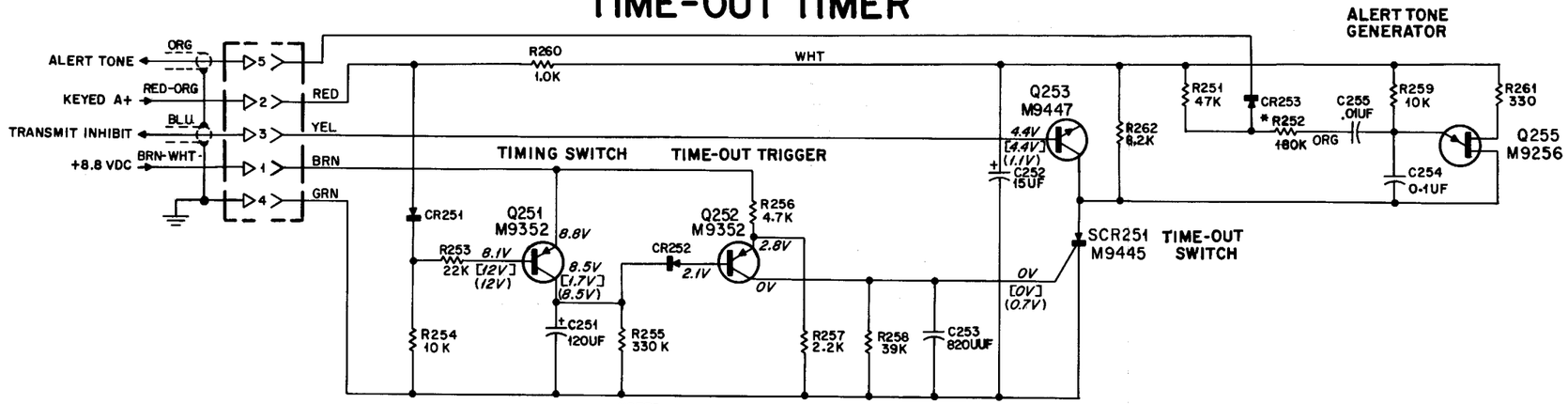
TLN8560A "Private-Line" Tone Generator EPD-16791-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; 50 v; unl stated
C701	23D82783B24	15; 25 v
C702	21D82187B21	820 uuf; 200 v
C703	23K865136	15 ±20%; 25 v
C704, 707	8D82905G33	0.47 ±20%
C705	23K865137	4.7; 25 v
C706	8D82905G34	0.15; 25 v
C708	8D82905G26	.0047; 100 v
C709, 710	8D82905G04	.068; 25 v
CR711, 712	21D82428B25	0.002 ±20%; 500 v
CR713	21D82187B29	0.001 ±20%; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR705, 705, 707, 709, 710, 711, 712, 713	48C82392B03	silicon
		TRANSISTOR: (SEE NOTE)
Q701	48R869329	N-P-N; type M9329
Q702, 704	48R869571	P-N-P; type M9571
Q703	48R869328	P-N-P; type M9328
Q705	48R869197	N-P-N; type M9197
Q706	48R869299	N-P-N; type M9299
		RESISTOR, fixed: ±5%; 1/4 w; unl stated
R701	6S129818	820
R702	6S400804	390; 1/2 w
R703	6S129862	150 ±10%
R704	6D83175C32	23.2K ±1%
R705	6S2068	33K; 1/2 w
R706	6S129887	12K
R707	6S400459	1.5K; 1/2 w
R708	6S5651	680; 1/2 w
R709	6S6411	1K; 1/2 w
R711	6S2089	1.8K ±10%; 1/2 w
R713	6S129777	39K
R714	6S128683	150K
R715	6S129886	27K
R716	6S129669	4.7K
R717	6S129984	680
R718	6S129230	12K ±10%;
R719	6S129149	470K
R720	6S131857	680K
R721	6S128688	2.7K ±10%
R722	6S129806	330
R723	6S129617	120 ±10%
R724	6S3940	5.6K; 1/2 w
R725, 728	6S129144	68K ±10%
R729	6S128686	8.2K ±10%
R730	6S129667	22K
R731	6S129526	33K
R732	6S129146	150K ±10%
R733	6S6398	150K ±10%; 1/2 w
R734	6S5553	100K; 1/2 w
R735	6S129226	100K ±10%
NON-REFERENCED ITEMS		
	1V80762A75	SOCKET ASSY; "Vibrasponder" female; 4 contact

NOTE:

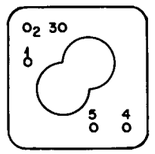
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

TIME-OUT TIMER

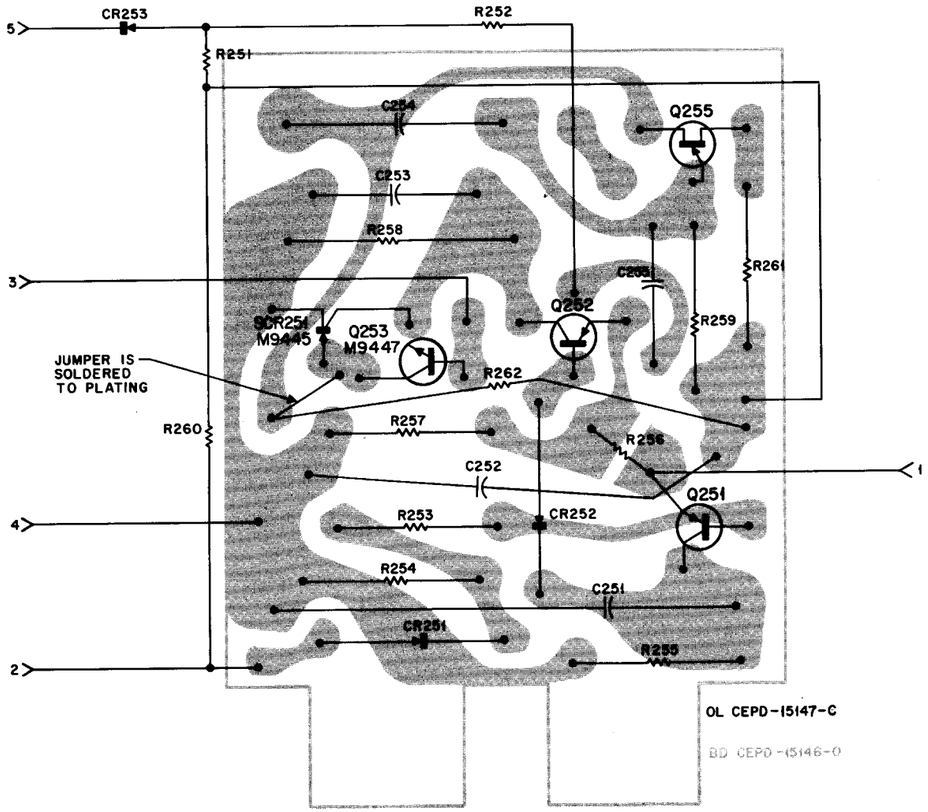


NOTES:
1. * = DECREASE VALUE TO INCREASE VOLUME LEVEL. SEE MANUAL.
2. VOLTAGE READING CONDITIONS,
   [ ] = KEYED READING
   ( ) = TIME-OUT READING

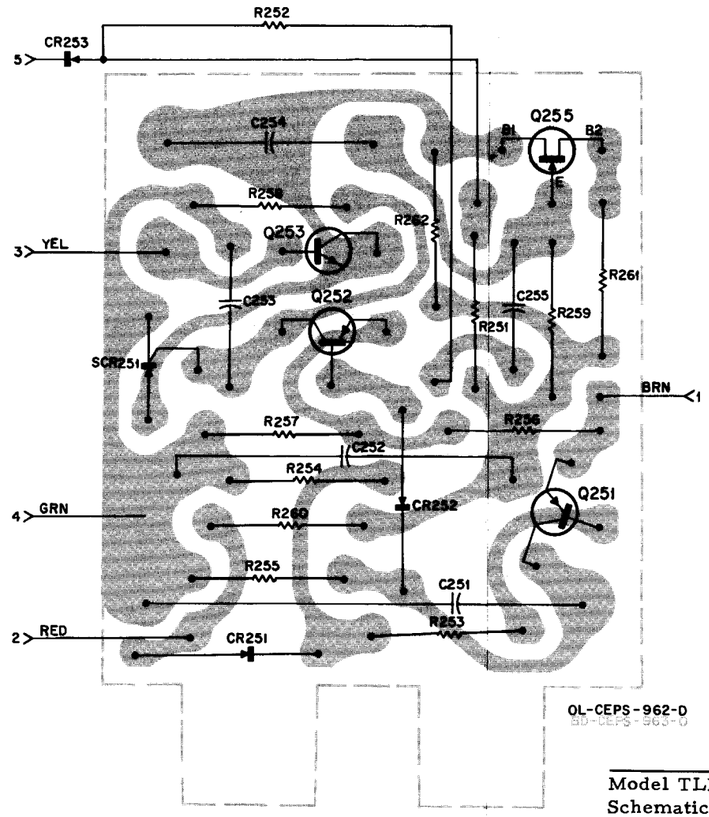
63D81057A37-C



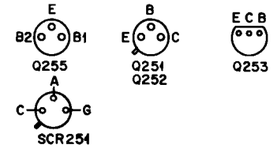
BOTTOM VIEW
TIME-OUT TIMER CAN



Version 1



TRANSISTOR DETAILS



Version 2

Model TLN1097A Time-Out Timer
Schematic Diagram and Circuit Board Detail
Motorola No. PEPD-14969-J
8/11/71-CP

REVISIONS

EPD-14969-J

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN1097A	Q255	WAS REF Q254	PARTS LIST
		REVISED CIRCUIT BOARD CONFIGURATION.	VERSION 2

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA PART NUMBERS WHEN ORDERING REPLACEMENT PARTS

TLN8403A Time-Out Timer Board EPD-15076-E

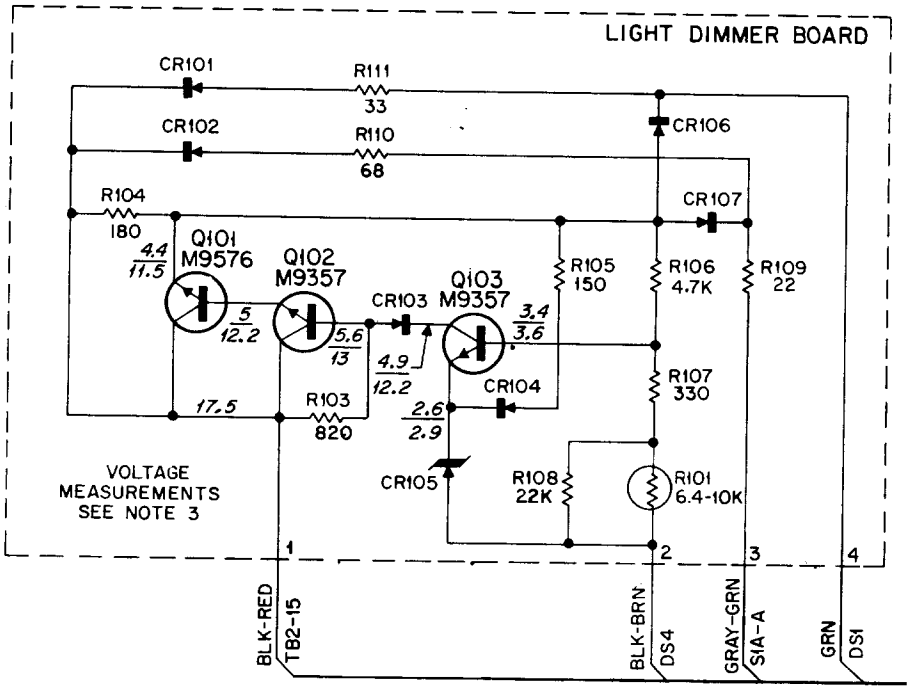
		CAPACITOR, fixed: uF ±10% unl stated
C251	23D83185D01	120; 15 V
C252	23D83214C02	15 ±20%; 25 V
C253	21C82187B17	820 pF 500 V ±10%
C254	8D83293B01	0.1; 50 V
C255	21D82428B59	.01 ±20%; 200 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR251	48C82392B03	silicon
CR252	48C82392B09	silicon
		RECTIFIER, control:
SCR251	48R869445	type M9445
		TRANSISTOR: (SEE NOTE)
Q251, 252	48R869352	P-N-P; type M9352
Q253	48R869447	N-P-N; type M9447
Q255	48R869256	unijunction; type M9256
		RESISTOR, fixed: ±10%; 1/4 W unl stated
R251	6S128902	47K
R253	6S128685	22K
R254, 259	6S129225	10K
R255	6S129473	330K ±5%
R256	6S129669	4.7K ±5%
R257	6K129804	2.2K ±5%
R258	6K128903	39K
R260	6S127802	1K
R261	6S129775	330
R262	6S128686	8.2K

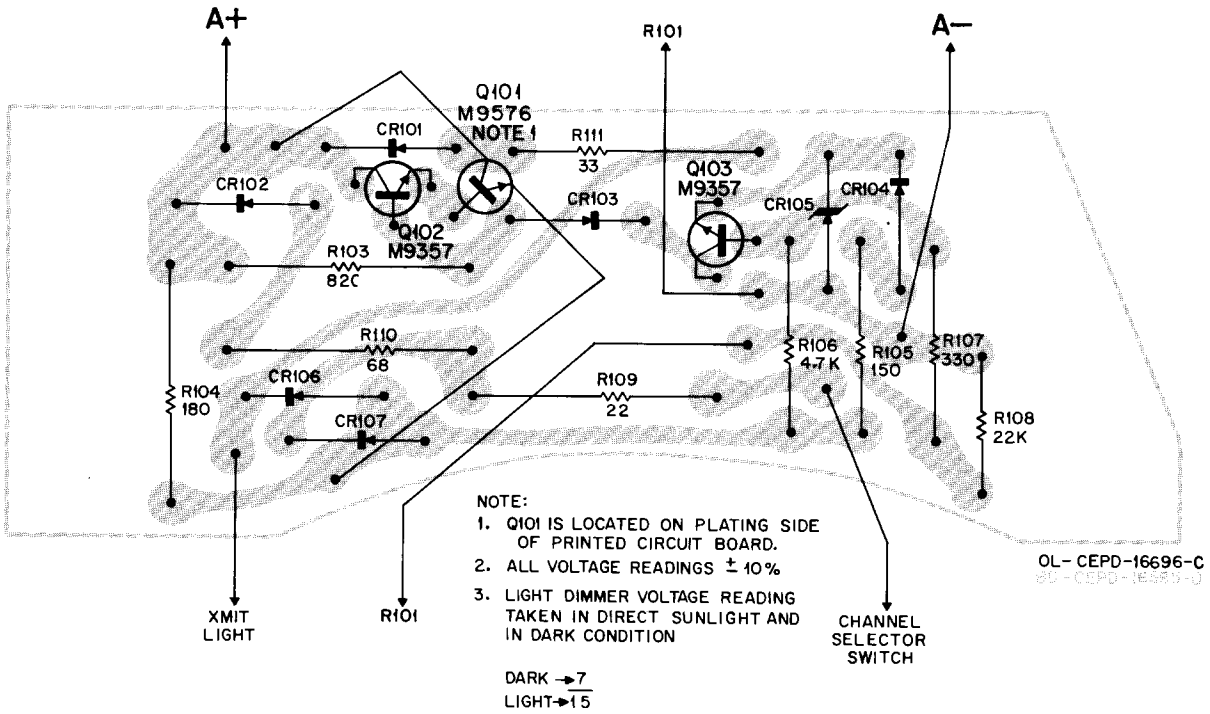
TLN8404A Components Kit EPD-15077-B

		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR253	48C82392B03	silicon
		RESISTOR, fixed:
R252	6S129229	180K ±10%; 1/4 W
NON-REFERENCED ITEM		
	1V80763A66	SOCKET ASSY. timer board

NOTE:

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





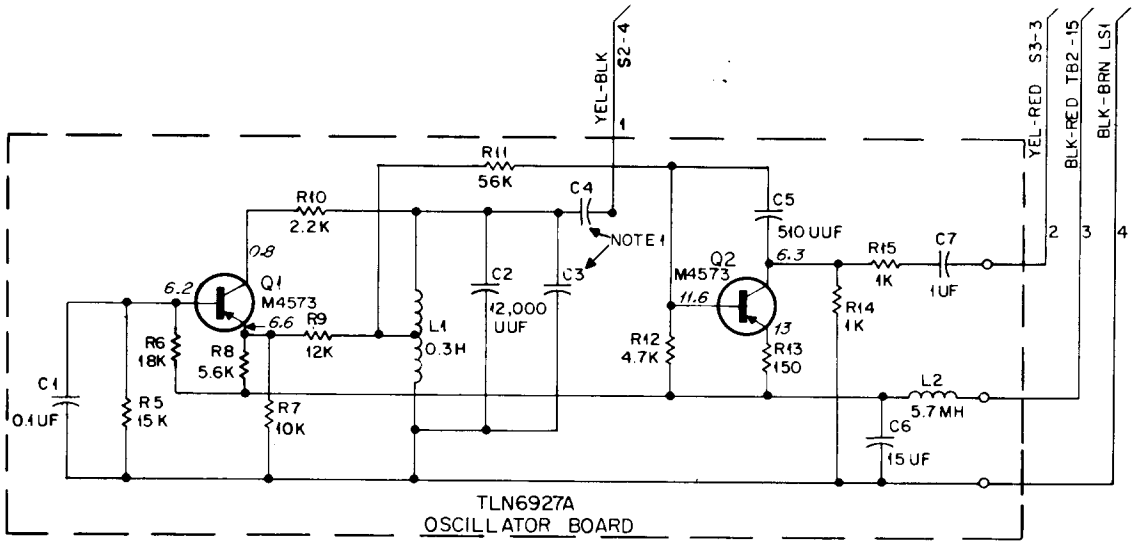
REVISIONS

PEPD-16697-C

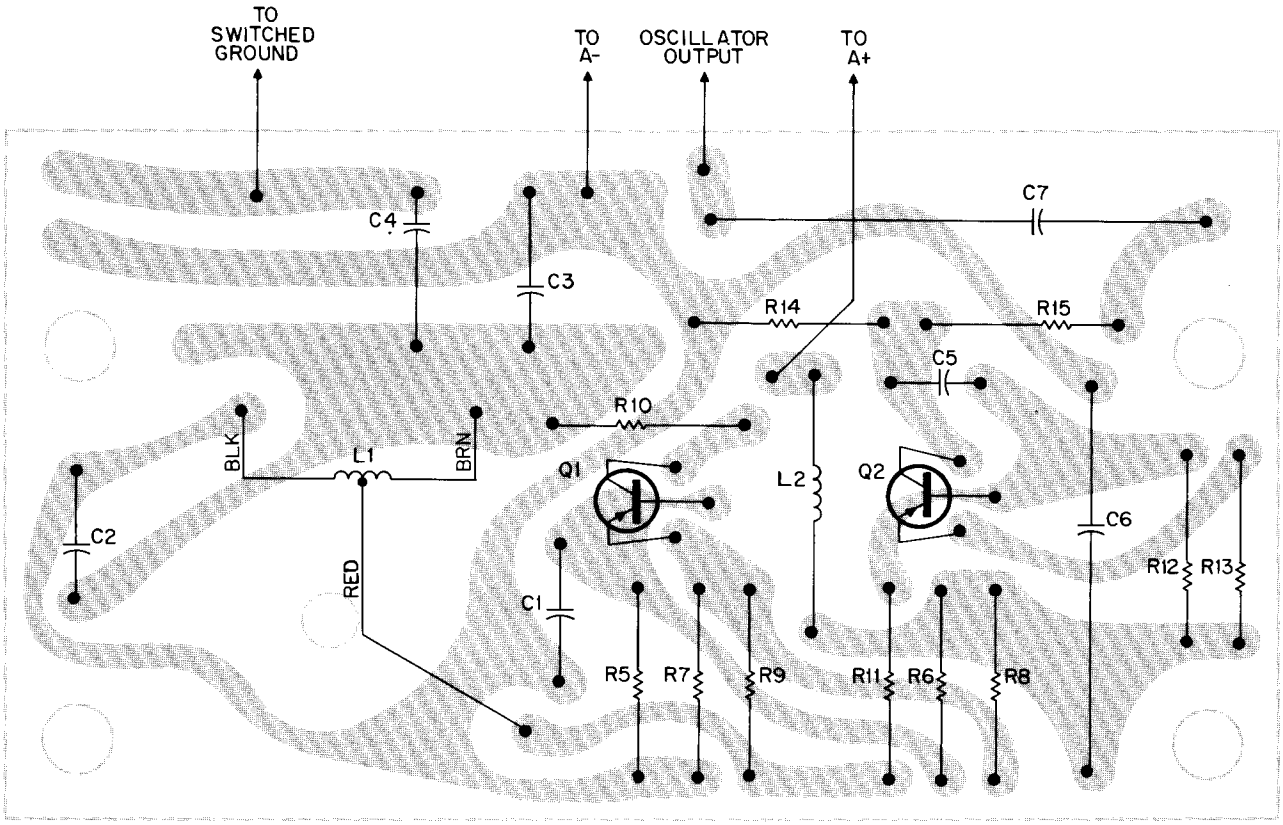
BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN6110AJ TCN6108AJ TCN6108AK TCN6109AJ TCN6109AK	R106	WAS 1K	Q103 BASE
	R109	WAS 15	BOTTOM CENTER OF BD.
	R101	WAS REF LDR101	
	Q101	WAS 48R869488, M9488	

REFER TO SCHEMATIC DIAGRAM
63D81113A74 (Page 115) FOR PARTS LIST

Automatic Light Dimmer
Printed Circuit Board Detail
Motorola No. PEPD-16697-C
8/28/70-CP



NOTES:
1. SEE PARTS LIST FOR VALUE.
2. ALL VOTAGES ARE ± 10%



CEPD-10237-A

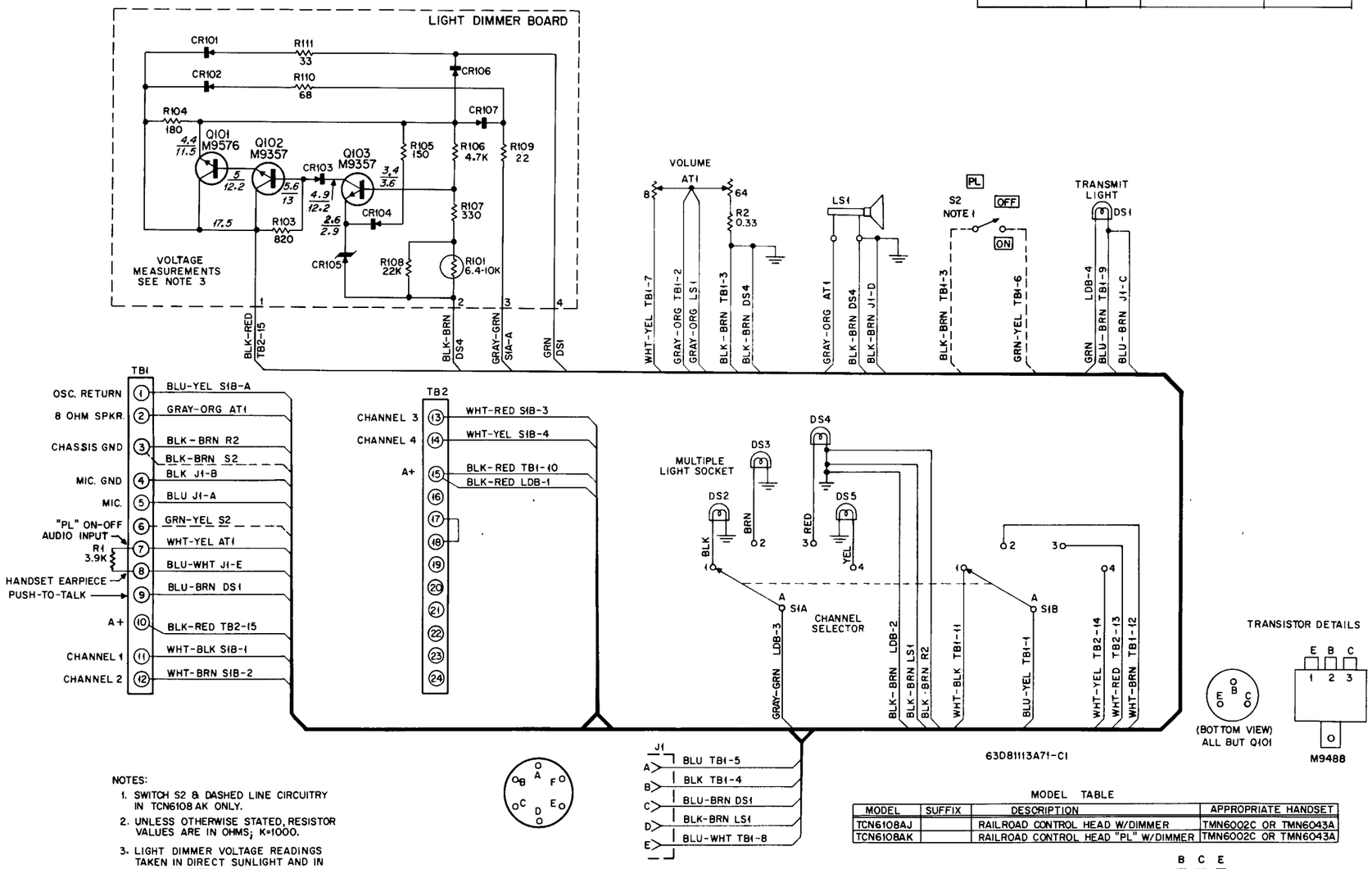
REFER TO SCHEMATIC DIAGRAM
63D81113A74 (Page 115) FOR PARTS LIST

Model TLN6927A Tone Oscillator
Printed Circuit Board and Wiring Diagram
Motorola No. PEPD-10238-A
8/28/70-CP

REVISIONS

63D81113A71-C1

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN6108AJ TCN6108AK	S2	WAS 40K80247	PARTS LIST
	R106	WAS 6S6229, 1K ±10%; 1/2 W	Q103 BASE CIRCUIT
	R109	WAS 6S118227, 15 OHMS	
	R101	WAS LDR101	LIGHT DIMMER BOARD
	Q101	WAS 48R869488	



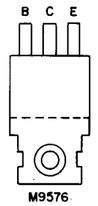
NOTES:

1. SWITCH S2 & DASHED LINE CIRCUITRY IN TCN6108AK ONLY.
2. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS; K=1000.
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION;
   VOLTAGE READINGS ± 10%
   DARK → 7
   LIGHT → 15

TRANSISTOR DETAILS

MODEL TABLE

MODEL	SUFFIX	DESCRIPTION	APPROPRIATE HANDSET
TCN6108AJ		RAILROAD CONTROL HEAD W/DIMMER	TMN6002C OR TMN6043A
TCN6108AK		RAILROAD CONTROL HEAD "PL" W/DIMMER	TMN6002C OR TMN6043A



PARTS LIST

TCN6108AJ Control Head & Speaker, 4-freq., non-reverting, carrier squelch, w/dimmer
TCN6108AK Control Head & Speaker, 4-freq., non-reverting, tone-coded squelch, w/dimmer EPD-17238-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad; 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		LOUSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round: 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR, fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @2 F.C. @ 25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2	40B858304	toggle dpst (Model TCN6108AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 section
NON-REFERENCED ITEMS		
	36C82632H02	KNOB, control; 2 req'd
	28A82771G01	PLUG, threaded

NOTE:

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

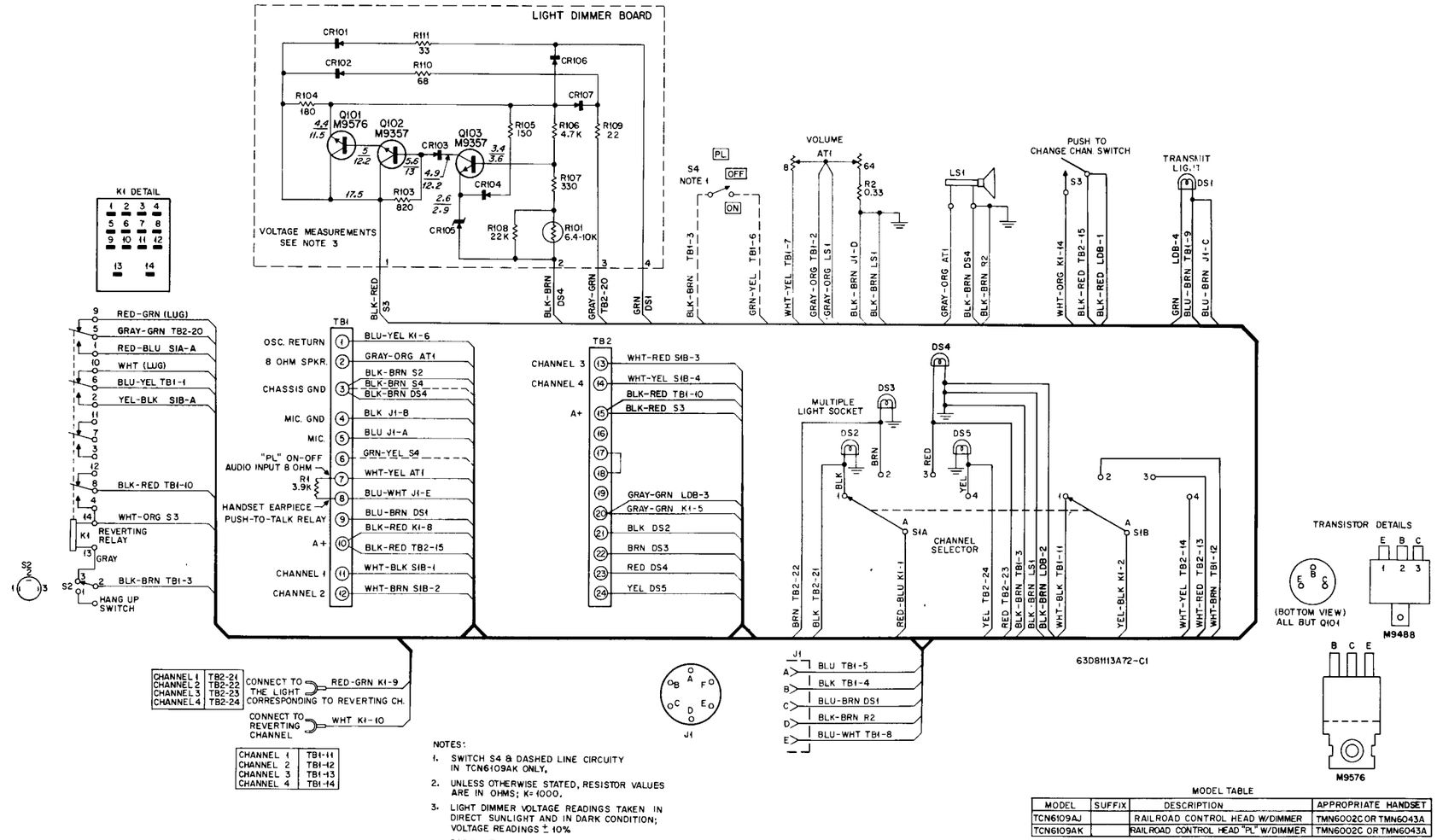
PARTS LIST

TCN6109AJ Control Head & Speaker, 4-freq., reverting, carrier squelch, w/dimmer
TCN6109AK Control Head & Speaker, 4-freq., reverting, tone-coded squelch, w/dimmer EPD-17239-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, AF: "L" pad: 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10%; (front)
AT1B		64 ohms ±10%; (rear)
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay; type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		RELAY, armature:
K1	80D83576E01	4 form "C"; coil resistance: 80 ohms ±10%; @25°C
		LOUDSPEAKER, permanent, magnet:
LS1	50D82731G01	5" round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	49R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR, fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH
S1	40C82772G01	rotary; 2 pole; 4 position; non-shorting
S2	40B82737G02	push; spdt
S3	40A881084	push; spst-normally open
S4	40B858304	toggle: dpst (Model TCN6109AK only)
		TERMINAL BOARD:
TB1, 2	31B880805	15 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay 4 section
NON-REFERENCED ITEM		
	36C82632H02	KNOB, control; 2 req'd

NOTE:

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



TRANSISTOR DETAILS

(BOTTOM VIEW) ALL BUT Q101

M9488

M9576

CHANNEL	TB2-24	CONNECT TO THE LIGHT CORRESPONDING TO REVERTING CH.
1	TB2-21	RED-GRN K1-9
2	TB2-22	
3	TB2-23	
4	TB2-24	WHT K1-10

CONNECT TO REVERTING CHANNEL

CHANNEL 1	TB1-11
CHANNEL 2	TB1-12
CHANNEL 3	TB1-13
CHANNEL 4	TB1-14

NOTES:

1. SWITCH S4 & DASHED LINE CIRCUITRY IN TCN6109AK ONLY.
2. UNLESS OTHERWISE STATED, RESISTOR VALUES ARE IN OHMS; K= 1000.
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION; VOLTAGE READINGS ± 10%

DARK → 7
LIGHT → 15

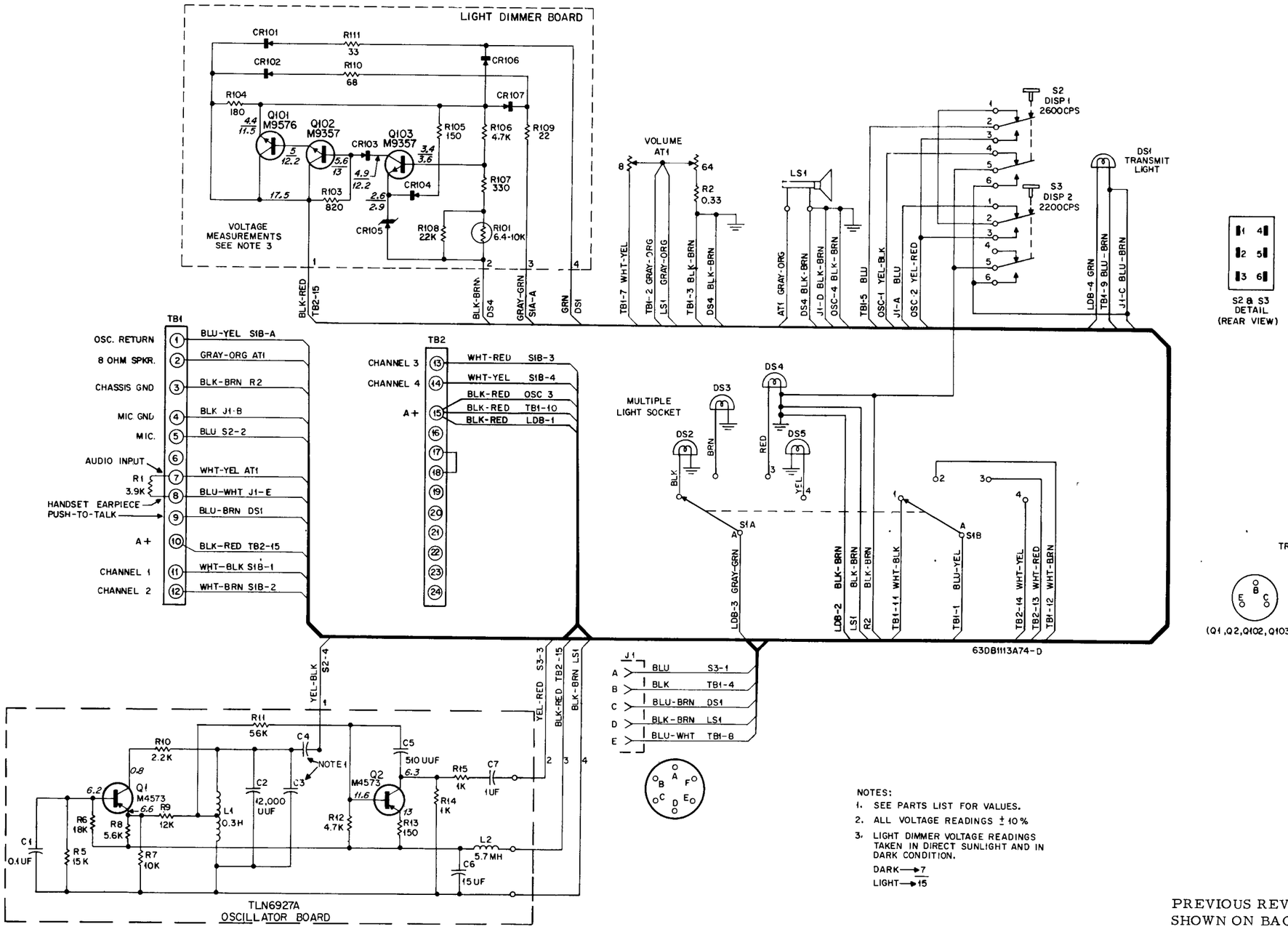
MODEL TABLE

MODEL	SUFFIX	DESCRIPTION	APPROPRIATE HANDSET
TCN6109AJ		RAILROAD CONTROL HEAD W/DIMMER	TMN6002C OR TMN6043A
TCN6109AK		RAILROAD CONTROL HEAD "PL" W/DIMMER	TMN6002C OR TMN6043A

REVISIONS 63D81113A72-C1

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN6109AJ TCN6109AK	S4	WAS 40K80247	PARTS LIST
	R106	WAS 6S6229, 1K ±10%; 1/2 W	Q103 BASE CIRCUIT
	R109	WAS 6S118227, 15 OHMS	
	DS1	ADDED	PARTS LIST
	Q101	WAS 48R869488, M9488	LIGHT DIMMER BOARD

Models TCN6109AJ and TCN6109AK
Control Head Schematic Diagram
Motorola No. 63D81113A72-C1
8/28/70-CP



NOTES:

1. SEE PARTS LIST FOR VALUES.
2. ALL VOLTAGE READINGS ± 10%
3. LIGHT DIMMER VOLTAGE READINGS TAKEN IN DIRECT SUNLIGHT AND IN DARK CONDITION.
   DARK → 7
   LIGHT → 15

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Model TCN1057AJ Control Head
Schematic Diagram
Motorola No. 63D81113A74-D
8/11/71-CP

REVISIONS

63D81113A74-D

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TCN6110AJ	R106	WAS 6S6229, 1K ±10%; 1/2 W	Q103 BASE CIRCUIT	DIMMER BD PEPD-16697-A
	R109	WAS 6S118227 15 OHMS		
TCN6110AJ	Q101	WAS 48R869488, M9488		DIMMER BD PEPD-16697-B
	R6	WAS 6S5591, 18K ±10%		PARTS LIST
	R7	WAS 6S6320, 10K ±10%		
	R8	WAS 6S1117, 5.6K ±10%		

PARTS LIST

TCN6110AJ Control Head, with Dimmer — EPD-17236-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR: AF: "L" pad; 12 watt:
AT1	18C82744G01	c/o:
AT1A		8 ohms ±10% (front)
AT1B		64 ohms ±10% (rear)
		SEMICONDUCTOR DEVICE diode (SEE NOTE)
CR101, 102, 106, 107	48C82466H01	silicon
CR103, 104	48C82392B03	silicon
CR105	48D82256C33	silicon; zener; 2.7 v
		LAMP, incandescent:
DS1, 2, 3, 4, 5	65R4151	6-8 v; 0.2 a; min. bay. type 51
		CONNECTOR, receptacle:
J1	9C848764	female; 6 contact
		LOUDSPEAKER, permanent magnet:
LS1	50D82731G01	5"; round; 8 ohm imp. 15 w; weather-resistant
		TRANSISTOR: (SEE NOTE)
Q101	48R869576	N-P-N; type M9576
Q102, 103	48R869357	N-P-N; type M9357
		RESISTOR: fixed: ±10%
R1	6R5618	3.9K; 1 w
R2	17K848766	0.33; 1 w
R101	6C83828D01	light-dependent type; 6.4-10K @ 2 F.C. @25°C
R103	6S5701	820; 1 w
R104	17C82036G10	180; 2 w
R105	6S6373	150; 1/2 w
R106	6R3924	4.7K ±5%; 1/2 w
R107	6S6022	330; 1/2 w
R108	6S128685	22K; 1/4 w
R109	6R488026	22; 1 w
R110	17C82036G01	68; 2 w
R111	17C82036G11	33; 2 w
		SWITCH,
S1	40C82772G01	rotary; 2 pole; 4 position non-shorting
S2, 3	40C83098A01	push; dpdt
		TERMINAL BOARD:
TB1, 2	31B880805	12 screw terminals
		LIGHT, indicator:
XDS1	60B82197H01	min. bay; incl BLU lens
		LAMPHOLDER ASSEMBLY:
XDS2, 3, 4, 5	9B82685G01	min. bay; 4 section
	NON-REFERENCED ITEMS	
	36C82632H02	KNOB, control; 2 req'd
	28A82771G01	PLUG, threaded
	3A82227A03	SCREW, special (4-40-5/16") 4 req'd

TLN6927A Oscillator Board — EPD-17237-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; unless stated
C1	8D82905G22	.10; 100 v
C2	21K865815	12000 uuf ±1%; 500 v
C3, 4		(factory-selected; see following list)
	21D84494B24	39 uuf ±5%; 500 v
	or21D84494B31	75 uuf ±5%; 500 v
	or21D84494B07	150 uuf ±5%; 500 v
	or21D84494B14	270 uuf ±5%; 500 v
	or21K848158	390 uuf; 300 v
	or21K845214	510 uuf ±5%; 300 v
	or21K848236	650 uuf ±5%; 300 v
	or21K863298	5000 uuf ±1%; 500 v
C5	21K845214	510 uuf ±5%; 300 v
C6	23C82013C01	15-10+100%; 25 v
C7	8K863306	1; 200 v
		COIL, RF:
L1	24C813452	toroid filter; .3 uh
L2	24K864763	choke; 5.7 uh
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R134573	P-N-P; type M4573
		RESISTOR, fixed: ±10%; 1/2 w unless stated
R5	6S6477	15K
R6	6S488095	18K ±5%
R7	6S5556	10K ±5%
R8	6S3940	5.6K ±5%
R9	6S6394	12K
R10	6S6069	2.2K
R11	6S6378	56K
R12	6S6080	4.7K
R13	6S6373	150
R14, 15	6S6229	1K

NOTE:

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

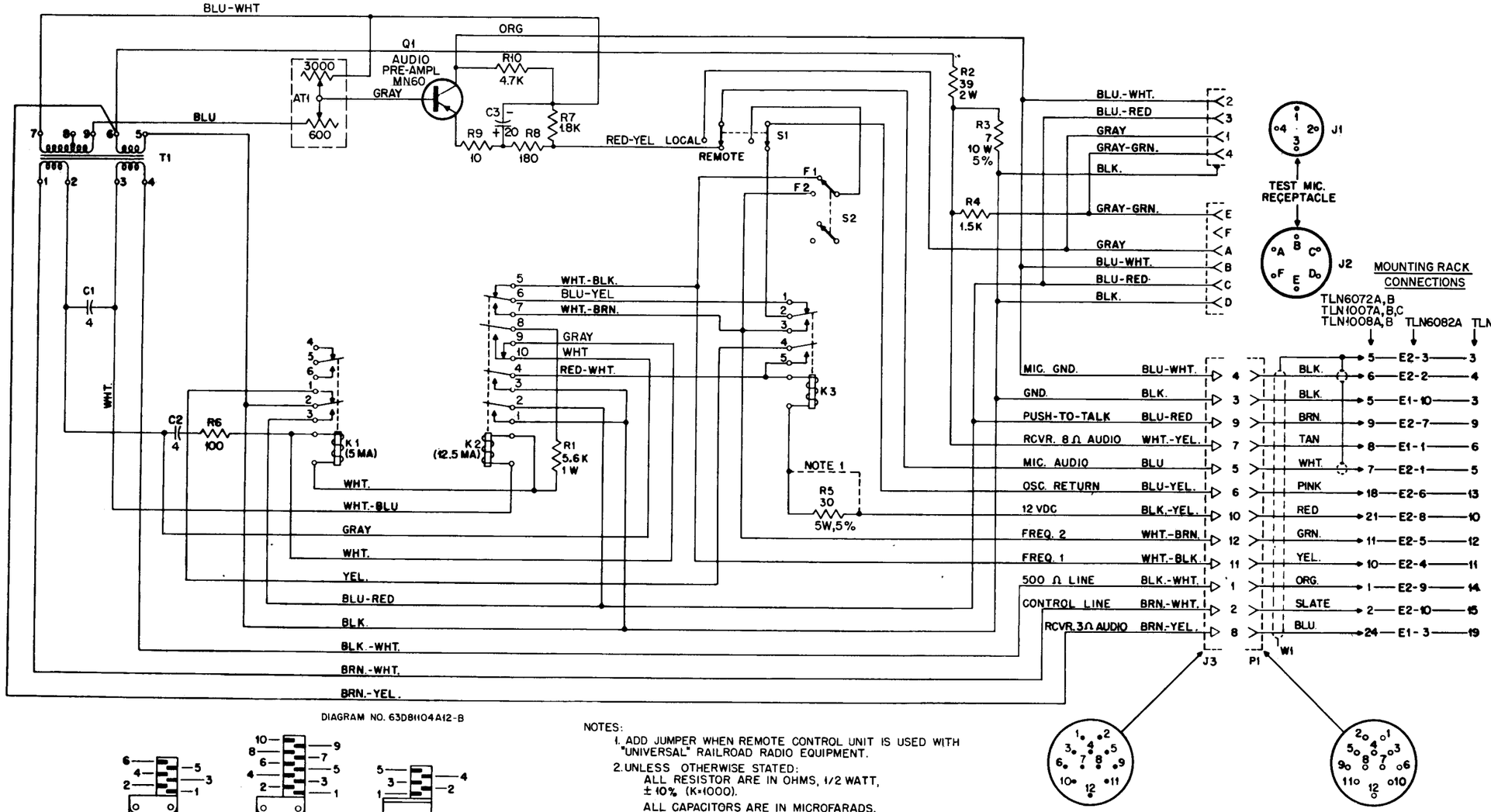


DIAGRAM NO. 63D81104A12-B

RELAY TERMINAL IDENTIFICATION

NOTES:

1. ADD JUMPER WHEN REMOTE CONTROL UNIT IS USED WITH "UNIVERSAL" RAILROAD RADIO EQUIPMENT.
2. UNLESS OTHERWISE STATED:
   ALL RESISTOR ARE IN OHMS, 1/2 WATT, ± 10% (K=1000).
   ALL CAPACITORS ARE IN MICROFARADS.

MODEL TABLE

MODEL	SUFFIX	DESCRIPTION
TLN6075C		REMOTE CONTROL UNIT

PREVIOUS REVISIONS LISTED ON BACK OF THIS DIAGRAM

Model TLN6075C Remote Control Unit
Schematic Diagram
Motorola No. 63D81104A12-B
8/28/70-CP

REVISIONS

DIAG. ISSUE	CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
A			MOUNTING RACK MODEL TLN1007C ADDED	
B	TLN6075C	Q1	WAS TYPE M4317	PARTS LIST

PARTS LIST for Schematic Diagram 63D81104A12-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		ATTENUATOR, variable:
AT1	18A82053D01	"L" pad; 600-3000 ohm; 4 w nominal
		CAPACITOR, fixed:
C1, 2	8B810340	4 uf ±20%; 150 v
C3	23C82601A03	20 uf +100-0%; 25 v
		CONNECTOR, receptacle:
J1	9B16345	female; 4 contact
J2	9C848764	female; 6 contact
J3	28B850545	male; 12 contact
		RELAY, armature:
K1	80K82984	contact arrangement, 2 form "C"
K2	80D82564D01	contact arrangement, 1 form "C"; 1 form "D" and 2 form "A"
K3	59B880926	4.5 volt; contact arrangement, 1 form "C" and 1 form "A"
		CONNECTOR, plug: female;
P1	9C850546	12 contact
		TRANSISTOR: (SEE NOTE)
Q1	48A124317	P-N-P; MN60
		RESISTOR, fixed: unl. stated
R1	6R5654	5.6K ±10%; 1 w
R2	6R488043	39 ±10%; 2 w
R3	17K832491	7 ±5%; 10 w
R4	6R6038	1.5K ±10%; 1/2 w
R5	17K893053	30 ±5%; 5 w
R6	6R6326	100 ±10%; 1/2 w
R7	6R2089	1.8K ±10%; 1/2 w
R8	6R5660	180 ±10%; 1/2 w
R9	6R5621	10 ±10%; 1/2 w
R10	6R6080	4.7K ±10%; 1/2 w
		SWITCH, toggle:
S1	40A800452	dpdt; momentary contact; sprint loaded
S2	40A80248	spdt
		TRANSFORMER, AF: line:
T1	25B811697	pri #1; term. #1 and #2; 125 ohm pri #2; term. #3 and #4; 125 ohm sec #1; term. #7 and #9; 600 ohm and tapped at term. #8; 50 ohm sec #2; term. #5 and #6; 3 ohm
		CABLE ASSEMBLY:
W1	1V851435	special purpose; incl. 30C850298 CABLE, 12 cond; shielded; 35" req'd ref P1

NOTE:

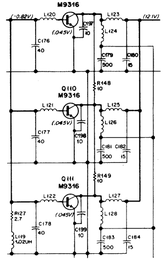
Replacement transistors must be ordered by Motorola part number only for optimum performance.

REVISIONS

63E8104 1A16-AU (1 of 2)

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TTD1550BJ-3 TTD1550BK-3	R127	WAS 6S124B55 2.7 ±5%	Q111 BASE	POWER AMPL PEPD-19185-O
	R147, 148	WERE 6S129755, 10	PARTS LIST	
	C180, 182, 184	WERE 21D828F0E15, 15 uuf	Q109 CIR-CUITRY	
	C181	WAS 21D82785H07, 500 uuf; 400 V	PARTS LIST	
	C176	WAS 21D82880E13, 40 uuf	Q109 BASE	
	C177		Q110 BASE	
	C178		Q111 BASE	
	C1004	ADDED 20 uuf	Q901 CIR-CUITRY	
	C1005		Q110 CIR-CUITRY	
	C1006		Q111 CIR-CUITRY	
	C1007	ADDED 0.2 uf	Q110 CIR-CUITRY	
	L113	WAS 24D83188D08	PARTS LIST	NONE
	L114	WAS 24D83188D07		
	L117	WAS 24D83188D09		
	L118	WAS 24D83188D10		
	L120, 121, 122	WERE 24B83209D01		POWER AMPL BD PEPD-19185-O
	L123, 125, 127	WERE 24B83211D01 (CODED BLU DOT)		
	L125, 130	ADDED RF CHOKE		
	T107	WAS 24B83475D01 CODED ORG DOT		NONE
	T108	WAS 24B83476D01 CODED YEL DOT		
	L115	WAS 24V80900A86		
	L119	WAS 24V80900A86		POWER AMPL BD PEPD-19185-O
	L131	ADDED CHOKE CODED ORG DOT		
	R152	ADDED 6S5621, 10		
	C1008	ADDED 21D822O4B03, 6 uuf	PARTS LIST	NONE
	L202, 203	WERE 24B82606B03, 40 MH		
	C179, 183	REMOVED 21D82785H07 500 uuf; CIRCUIT WAS AS SHOWN BELOW:	Q109 & Q111 CIRCUITRY	

Q109
POWER AMPL.

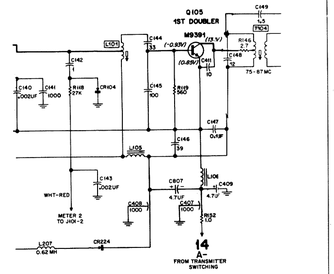


TTD1550BJ-3 TTD1550BK-3	CR402	WAS 48C83225D02	PARTS LIST	NONE
TTD1550BJ-4 TTD1550BK-4	R153 R152	ADDED 6S5621, 10 REMOVED 6S5621, 10	Q109 BASE PARTS LIST	NONE
				"PRIVATE-LINE" DELAY AND OSC. BD. PEPD-15546-A
				EXCITER BD. EPD-15544-G
				TRANS. SW. BOARD EPD-15545-G

REVISIONS

63E8104 1A16-AU (2 of 2)

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLD6862A-3 TLD6862B-1		CIRCUIT WAS AS SHOWN BELOW:		REFER TO EXCITER BD PEPD-20360-O



TPN1056A-2		POWER SUPPLY CHASSIS MODIFIED TO PROVIDE A LARGER HOLE FOR MOUNTING THE POWER TRANS-FORMER.	117 V AC PWR SUP.	NONE
TTD1550BJ-5 TTD1550BK-5	C810	ADDED 15 uf	Q106CIR-CUITRY	NONE
	C223, 808	WAS 23D82783B37, 47 uf; 20 V	PAR'S LIST	
TLN8505A-3				MULTI BD EPD-15769-F
TLN8474B-1	CR306 R345, 346	ADDED ADDED	Q310 EMITTER	AUDIO & SQ BD EPD-15543-F
TLN8507A-5				AUDIO & SQ BD EPD-15543-G
TLN8481B-2				XMTR SW BD EPD-15545-J
TCN6067AJ-1 TCN6067AK-1 TCN6068AJ-1 TCN6068AK-1	R506, 507	ADDED	SCHMATIC DIAGAM	NONE
TLN8560A	Q702, 704	WERE M9327		"PL" OSC. & DELAY BD, PEPD-20740-A
TLN8464A	F201	REMOVED. WAS 65K4637, 20 AMP, 32 V, REPLACED WITH DIRECT CONNECTION		J402-1 (-13.6 V LINE)
	F204	ADDED 6 AMP CIRCUIT WAS AS SHOWN BELOW		J402-3 & F203 (-72 V) LINE

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST
TRANSMITTER

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

TLN8503A Transmitter Chassis Kit EPD-15585-C

C154	21K859939	CAPACITOR, fixed: 110 uuf ±5%; 500 v
C156, 161, 164, 168, 169, 171, 174, 175, 185, 186	21K861219	1000 uuf GMV; 500; coded RED
C221, 222	21C82372C05	0.2 +80-20%; 25 v
C207	23R865137	4.7 uf ±20%; 25 v
CR107	48C82139G01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) germanium
J205, 206	9B82323G01	CONNECTOR, receptacle: female; single cont.
L204	24K847940	COIL, RF: choke; 0.62 mh
L205	24D83188D01	2 turns
L206	24D83188D02	2 turns
R126	6S129229	RESISTOR, fixed: 180K ±10%; 1/4 w

TLN8547A Current Limiter
TLN8547B Current Limiter EPD-15586-D

C223	23D82783B37	CAPACITOR, fixed: 47 uf ±20%; 25 v
J101	9C857358	CONNECTOR, receptacle: female; 12 cont.
Q212	48R869393	TRANSISTOR: (SEE NOTE) N-P-N; type M9393
Q214, 215, 218	48R869394	P-N-P; type M9394
R225	17C82177B05	RESISTOR, fixed: ±5%; 5 w uni stated 50 ±10%
R231	17K865603	7 ±10%
R232	6S5583	47 ±10%; 1 w
R238	17C82586H04	0.33
R239	17C82586H01	0.2
R244	6S400436	39; 1 w
R246	17C82177B07	20
R278	17K868695	20; 10%

TLN8486A Hardware Kit EPD-15587-D

C407, 408	21C83191A01	CAPACITOR, fixed: 1000 uuf +100-0%; 500 v
C409	23K865136	15 uf ±20%; 25 v
C414	21C82372C07	.05 uf +80-20%; 25 v
C808	23D82783B37	47 uf ±20%; 25 v
C810	23D83214C02	15 uf ±20%; 25 v
J403	9K867432	CONNECTOR, receptacle: female; single contact
P401, 402	28B82331G01	CONNECTOR, plug: male single cont. 0.125" dia.
P403, 404, 405	28A474006	single cont. 5/8" long
TB201	1V80761A54	BOARD, terminal: assy: 16 cont.
NON-REFERENCED ITEMS		
	26D83630D01	HEAT SINK
	1V80760A43	HEAT SINK, transistor

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLD6962A Antenna Switch Kit (160.2-161.6 MC)
TLD6811A Antenna Switch Kit (136-150.8 MC)
TLD6812A Antenna Switch Kit (150.8-174 MC) EPD-15189-G

C401	20C82984E02	CAPACITOR, fixed: uuf; NP0; 500 v; uni. stated
C402	21S410063	var; 5-25; 350 v
C403, 404	21K851846	10 ±0.5 uuf
	or21K865357	8 ±0.25 uuf (150.8-174 mc)
C405	21S410063	8.2 ±5% (136-150.8 mc)
	or21D82355B26	10 ±0.5 uuf (150.8-174 mc)
C406	21K840850	10 ±0.25 uuf (136-150.8 mc)
CR401, 402	48C83650G01	4 ±0.5 uuf
CR403	48D82617C02	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon silicon
J401, 404	9B82323G01	CONNECTOR, receptacle: female; single cont
L401	24C83383D03	COIL: 1-3/4 turn (150.8-174 mc)
	or24C83383D05	1-3/4 turn (136-150.8 mc)
L402	24C83383D01	2 turn; 0.8" (150.8-174 mc)
	or24C83383D04	2 turn; (136-150.8 mc)
L403	24C83383D02	2 turn; 1.1"
R401	6R5621	RESISTOR, fixed: 10 ±10%; 1/2 w

Harmonic Filter EPD-15193-O

	TFD6000A	ass'y (150.8-174 mc)
	TLD6710A	ass'y (136-150.8 mc)

Channel Element EPD-14785-A

	TLN1083A	Transmitter Control: ±0.0005% frequency stability
	orTLN1087A	Transmitter Control: ±0.0002% frequency stability

TLD6962A Antenna Switch Kit EPD-17376-D

C402	21S410063	CAPACITOR, fixed: uuf; NP0; 500 v; uni stated 10 ±0.5 uuf
C403, 404	21K851846	8 ±0.25 uuf
CR402	48C83650G01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) silicon
CR403	48D82617C02	silicon
J401, 402	9B82323G01	CONNECTOR, receptacle: female; single cont.
L402	24C83383D01	COIL: 2 turn; 0.8" 1.
L403	24C83383D02	2 turn; 1.1" 1.
P101	1V80760A59	CONNECTOR, plug; male single cont.
R401	6R5621	RESISTOR, fixed: 10 ±10%; 1/2 w

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TRANSMITTER

TLD6802A PA Chassis (150.8-174 MC) EPD-21864-A

C101	19C83191D02	CAPACITOR, fixed: uuf; 500 v; uni stated var; 2.3-34; 650 v
C102, 103	19C83191D01	var; 2.3-34; 650 v
C104, 150, 106, 107, 108	19C83221D01	var; 2.3-15; 850 v
C109	19C83221D02	var.; 2.3-15; 850 v
C110, 167	21S127024	6.8 ±0.5 uuf; NP0
C155	21D82355B15	24 ±5%; N750
C157	21K865941	90 ±2%
C158, 165, 172	21D82785H07	500 ±10%; 400 v
C159, 166, 173	23K865137	4.7 uf ±20%; 25 v
C160	21K859773	2500 ±5%
C162	21C82450B30	1.8 ±5%
C163	21K847743	8 ±0.5 uuf; NP0
C170	21C82450B06	0.75 ±10%
C196	21R122235	18 ±0.5 uuf; NP0
C197	21K859220	33 ±5%; N75
C1008	21D82204B03	6 ±5%; NP0
C1009	21S127024	6.8 ±0.5 uuf; NP0 (136-150.8 mc)
C1010, 1011 1012	21K848525	18 ±5%; NP0 (136-150.8 mc)
CR106	48C82139G01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) germanium
L107	24C83194D01	COIL, RF: doubler input; 4-1/2 turn
L108	24D83188D05	2 turns; 0.37" x 0.82"
L109	24D83188D06	2 turns; 0.38" x 0.91"
L110	24K800484	0.31 uh
L111	24C83961B01	choke; coded BRN
L112	24C82542E06	choke; 5 turns; incl R124
L113	24D83188D08	2 turn; 0.58" x 1.3"
L114	24D83188D07	2 turn; 0.5" x 0.92"
L115, 119	24V80900A86	choke; 1.02 mh; sleeved
L116	24C83193D01	d-c feed; 2-1/2 turn
L117	24D83188D09	2 turn; 0.58" x 1.3"
L118	24D83188D10	2 turn; 0.5" x 1.2"
L120, 121, 122	24B83209D01	final base; 1 turn
L123, 125, 127	24B83211D01	coupling; 2 turn; 0.6" x 0.37"
L124, 126, 128	24B83210D01	d-c feed; 2-1/4 turn
Q106	48R869395	TRANSISTOR: (SEE NOTE) N-P-N; type M9395
Q107	48R869247	N-P-N; type M9247
Q108	48R869316	N-P-N; type M9316
R121	6S129233	RESISTOR, fixed: ±10%; 1/4 w uni stated 47
R122	6S129229	180K
R123	6S127800	220
R124	6S6291	560; 1/2 w; p/o L112
R151	6S6291	560; 1/2 w
T105	24B83473D01	TRANSFORMER: power doubler; coded BRN-BLK dot
T106	24B83474D01	pre-driver; coded RED-BRN dot
T107	24B83340E01	driver output; coded GRN dot
T108	24B83901E01	final output; coded BLU dot

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TLD6932A PA Chassis EPD-15190-D

C101	19C83191D02	CAPACITOR, fixed: uuf; 500 v; uni stated var.; 2.2-34; 650 v
C102, 103	19C83191D01	var.; 2-27; 650 v
C104, 105, 106, 107, 108	19C83221D01	var.; 2.3-15; 850 v
C109	19C83221D02	var.; 2.3-15; 850 v
C110, 167	21S127024	6.8 ±0.5 uuf; NP0
C155	21D82355B15	24 ±5%; N750
C158, 165, 172, 179, 181, 183	21D82785H07	500 ±10%; 400 v
C159, 166, 173	23K865137	4.7 uf ±20%; 25 v
C160	21C82450B30	1.8 ±5%
C162	21C82450B06	0.75 ±10%
C163	21K847743	8 ±0.5 uuf; NP0
C176, 177, 178	21D82880E13	40 ±10%; 850 v
C180, 182, 184	21D82880E15	15 ±10%; 850 v
C196	21S122235	18 ±0.5 uuf; NP0
C197	21K859220	33 ±5%; N75
C1001, 1002, 1003	21K840848	6 ±0.5 uuf; NP0
C410	21K865941	90 ±2%; 300 v
C411	21D82133G01	10 ±5%; NP0
CR106	48C82139G01	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) germanium
L107	24C83194D01	COIL, RF: doubler input; 4-1/2 turn
L108	24D83188D05	2 turns; 0.37" x 0.82"
L109	24D83188D06	2 turns; 0.38" x 0.91"
L110	24K800484	0.31 uh
L111	24C83961B01	choke; coded BRN
L112	24C82542E06	choke; 5 turns; incl R124
L113, 114, 117, 118	24C82000E25	choke; coded BLU dot
L115	24V80900A86	choke; 1.02 uh; sleeved
L116	24C83193D01	dc feed; 2-1/2 turns
Q106	48R869395	TRANSISTOR: (SEE NOTE) N-P-N; type M9395
Q107	48R869247	N-P-N; type M9247
Q108, 109, 110, 111	48R869316	N-P-N; type M9316
R121	6S129233	RESISTOR, fixed: ±10%; 1/4 w; uni stated 47
R122	6S129229	180K
R123	6S127800	220
R124, 151	6S6291	560; 1/2 w; p/o L112
R125, 147, 148	6S129755	10
R127	6S124B55	2.7 ±5%
R152	17C82291B07	1 ±5%; 3 w
T105	24B83473D01	TRANSFORMER: power doubler; coded BRN-BLK dot
T106	24B83474D01	pre-driver; coded RED-BRN dot
T107	24B83475D01	driver output; coded ORG dot
T108	24B83476D01	final output; coded YEL dot
NON-REFERENCED ITEM		
	14A83211B01	INSULATOR, transistor (used with Q109, Q110, Q111)

NOTES:

1. FREQUENCY CALCULATIONS:

RECEIVER:

$$f_1 = \frac{f_c - 8 \text{ mc}}{12}$$

f_1 = 1ST OSCILLATOR FREQUENCY

f_c = CARRIER FREQUENCY

TRANSMITTER:

$$f_c = 12 f_o$$

f_c = CARRIER FREQUENCY

f_o = OSCILLATOR FREQUENCY

2. PIN NUMBERS ARE FOR REFERENCE ONLY. PINS ARE PART OF CIRCUIT BOARD.
3. SEE PARTS LIST FOR COMPONENT VALUES.
4. SYMBOL INDICATES FOUR-LAYER DIODE.
5. NUMBERS IN ITALICS (R1, R2, ETC.) REPRESENT JUMPERING POINTS ON CIRCUIT BOARD. SEE INSTRUCTION MANUAL FOR JUMPERING INSTRUCTIONS.
6. JUMPER JU201 CONNECTED FROM TB201-5 TO TB201-6 ONLY ON NON-"PRIVATE-LINE" TONE-CODED SQUELCH MODELS.
7. REMOVE JUMPER JU702 TO DECREASE "PRIVATE-LINE" TONE DEVIATION.
8. RESISTOR MAY BE OMITTED AT FACTORY.
9. FACTORY SELECTED VALUE.
10. CONTROL HEAD MAY BE CONNECTED TO REVERT TO FREQUENCY F1, F2, F3, OR F4 WHEN HANDSET IS HUNG UP AS FOLLOWS:

REVERTING FREQUENCY	GRAY-RED LEAD	GRAY-GRN LEAD
F1	TB501-1	TB501-9
F2	TB501-2	TB501-10
F3	TB501-3	TB501-11
F4	TB501-4	TB501-12

11. S503 AND CONNECTING LEADS ONLY IN "PRIVATE-LINE" TONE-CODED SQUELCH MODELS.
12. Q307 AND Q308 LOCATED BEHIND FRONT PANEL.
13. DO NOT USE SLOW BLOW TYPE FUSE.
14. UNLESS OTHERWISE STATED CAPACITOR VALUES ARE IN MICROMICROFARADS.
15. REMOVE JUMPER IF A TIGHTER SQUELCH IS REQUIRED IN "PRIVATE-LINE" OPERATION.
16. REFER TO PARTS LIST.

EPD-15313-D

RECEIVERS

SERIES	MODEL	SUFFIX	FREQ. RANGE	TYPE OF SQUELCH
TRD1510AD	TRD1512AD	1	150.8-162 MC	CARRIER
	TRD1513AD	1	162-174 MC	
TRD1510AH	TRD1512AH	1	150.8-162 MC	"PRIVATE-LINE" DUAL
	TRD1513AH	1	162-174 MC	
TRD1510BD	TRD1512BD		150.8-162 MC	CARRIER
	TRD1513BD		162-174 MC	
TRD1510BH	TRD1512BH		150.8-162 MC	"PRIVATE-LINE" DUAL
	TRD1513BH		162-174 MC	

TRANSMITTERS

MODEL	SUFFIX	FREQ. RANGE	TYPE
TTD1550AJ	6	150.8-174 MC	CARRIER
TTD1550AK	6	150.8-174 MC	"PRIVATE-LINE"
TTD1550BJ	5	150.8-174 MC	CARRIER
TTD1550BK	5	150.8-174 MC	"PRIVATE-LINE"

POWER SUPPLY

MODEL	SUFFIX	DESCRIPTION
TPN1053A	1	12/64 V DC
TPN1056A	2	117 V AC

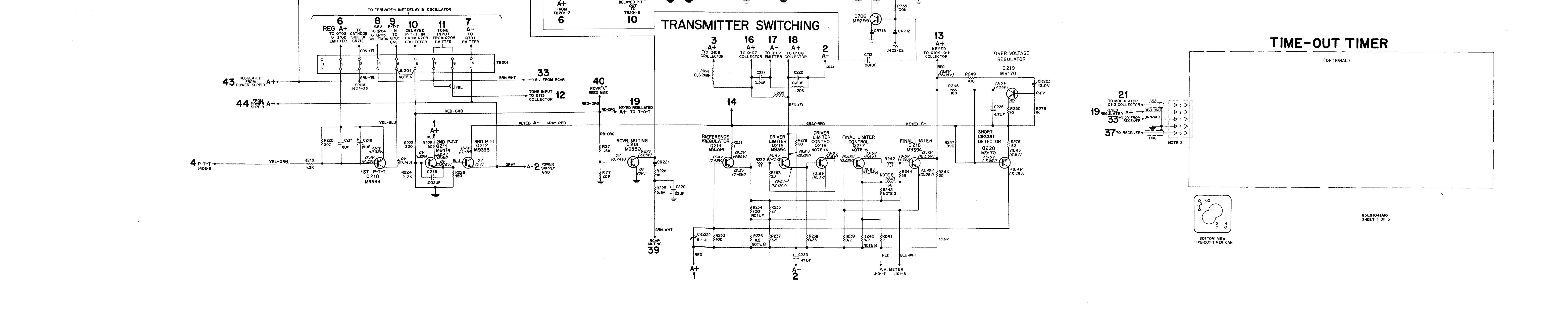
CHANNEL ELEMENTS

MODEL	SUFFIX	APPLICATION
TLN1081A		RECEIVER
TLN1083A		TRANSMITTER
TLN1086A		RECEIVER
TLN1087A		TRANSMITTER

SPEAKER AND CONTROL HEAD

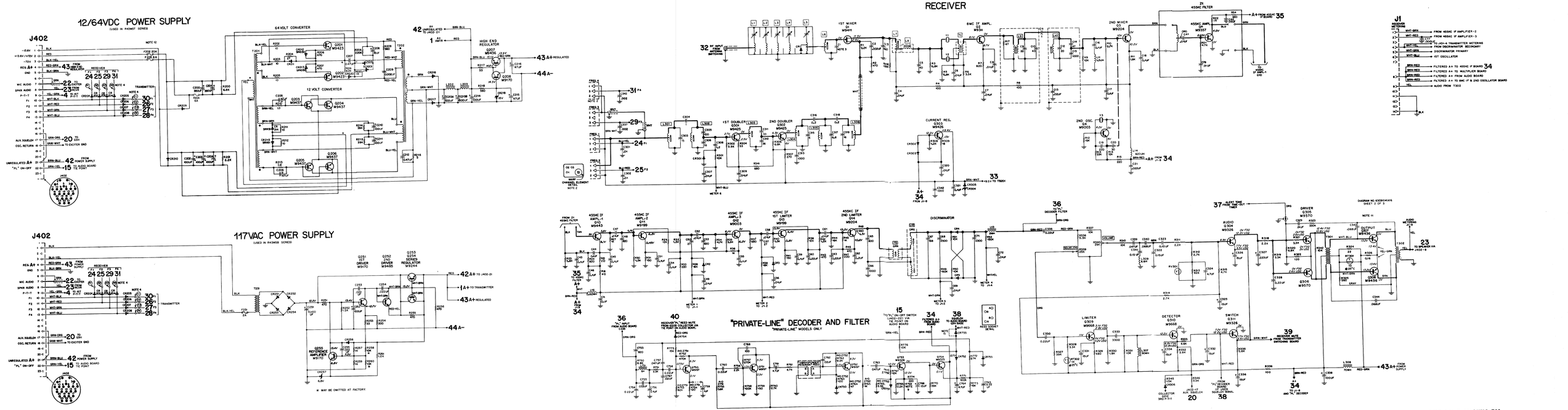
MODEL	SUFFIX	TYPE	APPLICATION
TCN6067AJ		CARRIER	"UNIVERSAL" NON-REVERTING
TCN6068AJ		CARRIER	"UNIVERSAL" REVERTING
TCN6067AK		"PRIVATE-LINE"	"UNIVERSAL" NON-REVERTING
TCN6068AK		"PRIVATE-LINE"	"UNIVERSAL" REVERTING

EPD-15314-G



PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON FRONT OF THIS DIAGRAM

Schematic & Intercabling Diagram
Motorola No. 63E81041A16-AU
(Sheet 1 of 3)
8/28/70-CP



PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Schematic & Intercabling Diagram
Motorola No. 63E81041A16-AV
(Sheet 2 of 3)
4/5/73-CP

PARTS LIST

TLN8474A Receiver Chassis Kit
TLN8474B Receiver Chassis Kit — EPD-15475-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf ±10%; 50 v, unl stated
C339	8D82905G03	.047
C340	8D82905G04	.068
C341	8D82905G05	0.15
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR306	48C82392B03	silicon
		COIL, audio:
L309	25C82024D01	choke; 6.6 h
		TRANSISTOR: (SEE NOTE)
Q307, 308	48R869436	P-N-P; type M9436
		RESISTOR, fixed: unl stated
R310, 337	6S129225	10K ±10%; 1/4 w
R338, 346	6S129231	3.3K ±10%; 1/4 w
R339, 340	18K867272	var; 25K
R345	6K127803	1.5K ±10%; 1/4 w
		TRANSFORMER: AF,
T302	25C83593D01	pri: TERM. 1 and TERM. 3 w/center tap @ TERM. 2; coil res 0.5 ohms sec: TERM. 4 and TERM. 5 coil res 0.35 ohms
		SOCKET, transistor:
XQ307, 308	9B851303	female; 2 cont.
NON-REFERENCED ITEM		
	14B82399B01	INSULATOR, transistor (used with Q307, Q308)

TLN8490A Chassis Hardware Kit — EPD-15476-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J402	28B848777	CONNECTOR, receptacle: male; 23 cont.

IF Filter — EPD-15477-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Z1	TFN6017CS	FILTER, IF: bandpass; split channel

TLN8506A Metering Socket and Cable — EPD-15473-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C77	21K800801	CAPACITOR: .0015 uf GMV +100%; 500 v
J1	9C857358	CONNECTOR: female; 12 cont.

Channel Element — EPD-14419-A

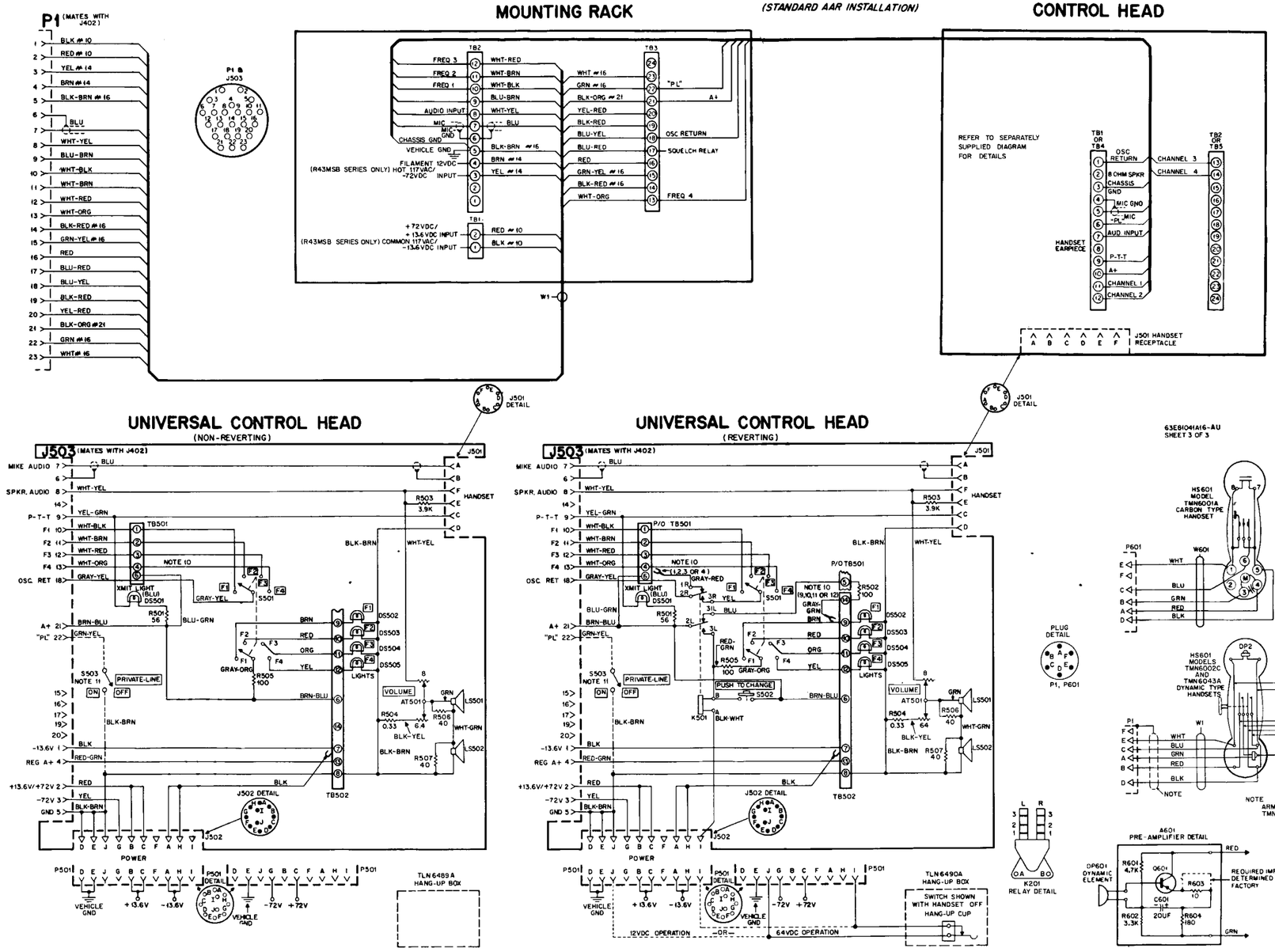
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	TLN1081A or TLN1086A	Receiver Control: ±0.0005% frequency stability Receiver Control: ±0.0002% frequency stability

POWER SUPPLY

TLN8464A, TLN5392A Power Supply Chassis — EPD-15591-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C212	8D82905G33	0.47 uF ±20%; 50 V
C213	23K868706	consists of 3 sect:
C213A		○ 1500 uF +100-10%; 25 V
C213B		□ 500 uF +250-10%; 25 V
C213C		△ 50 uF +50-10%; 25 V
C214	23D83210A08	100 uF +150-10%; 25 V
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR210, 216, 217	48C82732C07	germanium
CR224	48C82525G02	silicon
		FUSE, cartridge
F202	65K4637	20 amp; 32 V
F203, 204	65K15270	6 amp; 250 V
		COIL, AF:
L202, 203	24B82606B03	choke; 40 mH
		TRANSISTOR: (NOTE 1)
Q201, 202	48R869423	P-N-P; type M9423
Q201, 202	48R869702	N-P-N; type M9702 (NOTE 2)
Q203, 204, 205 206	48R869437	P-N-P; type M9437
Q207	48R869436	P-N-P; type M9436
		RESISTOR, fixed:
	17C82381A03	5 ±10%; 15 W
		TRANSFORMER:
T201	25D83553D01	consists of 2 sect:
T201A		pri. No. 1: BRN, BRN-WHT; coil res .05 ohms pri. No. 2: BRN-GRN, BRN-YEL coil res .05 ohms pri: No. 3: BLK, BLK-YEL w/ center tap @ BLK-WHT total coil res 0.2 ohms sec: YEL, WHT; coil res 0.48 ohms
T201B		pri No. 1: RED, RED-YEL w/center tap @ RED-WHT total coil res 1.15 ohms pri: No. 2: BLU, BLU-YEL w/center tap @ BLU-WHT; total coil res .06 ohms sec: GRN, GRN-YEL w/center tap @ GRN-WHT; total coil res 0.5 ohms

NOTE:
1. Used in Model TLN8464A Only
2. Used in Model TLN5392A Only



PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Schematic & Intercabling Diagram
Motorola No. 63E81041A16-AV
(Sheet 3 of 3)
4/5/73-CP

REVISIONS

63E81041A16-AV

MODEL AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TMN6002C TMN6043A	DP1 DP2 HS1	ADDED ADDITIONAL PART NO., 59D82933C02 PART NO. WAS 50D82994G01	PARTS LIST

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

CONTROL HEADS

TCN6067AJ Control Head and Speaker (Non-Reverting)
TCN6067AK Control Head and Speaker (Non-Reverting "Private-Line")
TCN6068AJ Control Head and Speaker (w/Reverting Switch)
TCN6068AK Control Head and Speaker (w/Reverting Switch - "Private-Line") EPD-15590-B

		ATTENUATOR:
AT501	18K848773	"L"-pad; 8 ohm & 64 ohms
		LAMP, incandescent:
DS501 thru 505	65R4151	6.8 v; type #51
		CONNECTOR, receptacle:
J501	9C848764	female; 6 cont.
J502	28B82739D01	male; 10 cont.
J503	9C82164C01	female; 23 cont.
		RELAY, armature:
K501	80B848943	2 form "C" (TCN6068AJ, TCN6068AK only)
		LOUDSPEAKER:
LS501, 502	50D82929A01	coil impedance 4 ohms; 3" dia.
		RESISTOR, fixed: ±10%; 1 w; unl stated
R501	6R488090	56; 2 w
R503	6S5618	3.9K
R504	17K848766	0.33
R505	6S3963	100; 2 w
R506, 507	17D82177B36	40; 5 w
		SWITCH:
S501	40C82772G02	rotary; 2 pole; 4 pos.
S502	40A881084	pushbutton (spst) TCN6068AJ, TCN6068AK only
S503	40K80247	toggle; (dpst)
		BOARD, terminal:
TB501	31B82272B01	6 solder lug
TB502	31B82272B02	8 solder lug
		LAMPHOLDER:
XDS501, 502, 503	9B83667D01	3 cont.
XDS504, 505	9B863168	single cont. bayonet base
NON-REFERENCED ITEMS		
	61B82132C02	LENS, WHT (used with DS502, DS503, DS504, DS505)
	61B82132C01	LENS, BLU (used with DS501)

FRONT PANEL KITS

TGN6050A Front Panel EPD-15594-O

NON-REFERENCED ITEMS		
	1V80763A20	ASSY, HANDLE AND PANEL; incl: 64D83603D01 PANEL, front; 55B852658 HANDLE
	41A864597	SPRING, handle (2 req'd.)
	55A852656	LOCK

HOUSING KITS

THN6069A Housing & Base Plate EPD-15595-O

NON-REFERENCED ITEMS		
	15D83578D01	COVER, top
	1V80763A21	ASSY; COVER, bottom
	64D82747D01	PLATE, base

THN6070A Housing Kit EPD-16163-O

NON-REFERENCED ITEMS		
	15D83578D01	COVER, top
	1V80763A60	ASSY: COVER, bottom

MICROPHONES

TMN6001A Microphone EPD-15596-O

		HANDSET:
HS1	59K834032	carbon; incl. 59K51049 CARTRIDGE, transmitter; 59K51050 CARTRIDGE, receiver 15K840998 CAP, handset receiver; 15K840999 CAP, handset transmitter; 40K854349 SWITCH, push; 8K842123 CAPACITOR, fixed: tubular; .01 uf; 200 v
		CONNECTOR, plug:
P1	28C848760	male; 6 cont; polarized; round molded phenolic ins. cable mtg.
		CORD, handset:
W1	1V848806	assy: incl. 30K84270 CORD, handset; coiled 5 cond. 29A800038 LUG, terminal; for .120" dia. stud and 3/32" dia. wire; 5 req'd. 42A85648 CLAMP ground 42B848761 CLAMP cable ref. part P1

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

TMN6002C Dynamic Handset
TMN6043A Dynamic Handset with Armored Cord EPD-15597-B

		CARTRIDGE, microcphone:
DP1	59D82933C01	transistor amplifier
DP2	or 59D82933C02	P/O HS1
		HANDSET, dynamic:
HS1	50D83307F01	incl. the following items: 59-83308F01 CARTRIDGE; receiver: imp. .125; 55-83308F02 HANDLE, handset; 15K868297 CAP, transmitter; 15-83308F03 CAP, receiver
		CONNECTOR, plug:
P1	28C848760	male, 6 cont.
		CORD, coiled:
W1	30K854038	5 cond.; stranded; (TMN6002C only)
	or 30B864145	5 cond.; 42" length req'd (used on TMN6043A only)
NON-REFERENCED ITEMS		
	37A842245	STRAIN RELIEF
	42A82782A01	CLAMP, ground (used on TMN6002C only)
	42B83848E01	CLAMP, armor cable (used on TMN6043A only)
	32-84622A01	GASKET, transmitter cap

END OF DOCUMENT