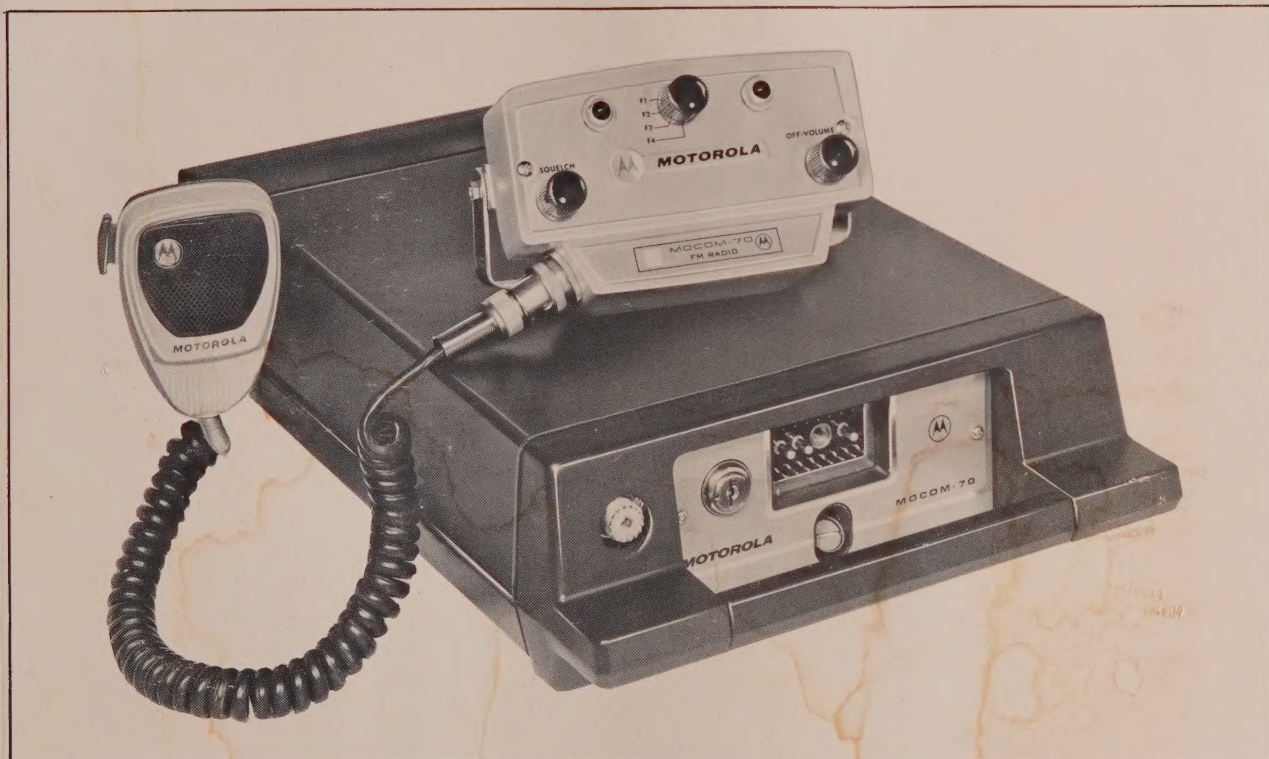




MOCOM® • 70 FM Two-Way Radio

136-174 MHz 30 & 45 Watts



Instruction Manual

68P81015E90-F



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AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Three reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us. (NOTE: One copy of each publication has already been distributed to Motorola Service Shops (MSS's) and field technical representatives (FTR's).

First
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First
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Check item desired:

- ☐ **Basic Logic Circuit Guide** 68P81105E88
Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.
- ☐ **"Digital Private-Line" Binary-Coded Squelch** 68P81106E83
Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.
- ☐ **Safe Handling of CMOS Integrated Circuit Devices** 68P81106E84
Describes special handling techniques needed to prevent irreparable damage from static charges encountered with normal handling of CMOS devices.

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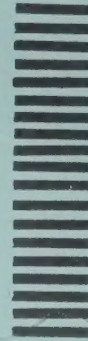
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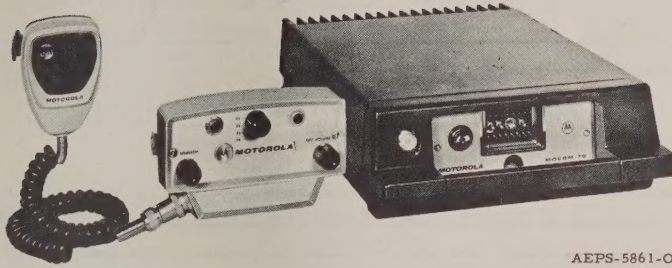
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"MOCOM • 70"

MOBILE FM TWO-WAY RADIO

136-174 MHz

30 & 45 W RF POWER



AEPS-5861-O

MOTOROLA INC.
Communications Division
SCHAUMBURG, ILLINOIS 60172

CANADIAN MOTOROLA*
ELECTRONICS LIMITED
WILLOWDALE, ONTARIO

"MOCOM - 70" RADIO IS MANUFACTURED AND SOLD IN BOTH LOCATIONS.

*(MANUFACTURED AND SOLD IN CANADA UNDER PATENT AND TRADEMARK
LICENSES FROM MOTOROLA, INC., SCHAUMBURG, ILLINOIS, U.S.A.)



MOTOROLA INC.
Communications Division

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service publications

1301 E. Algonquin Road, Schaumburg, IL 60196

68P81015E90-F

9/8/76-NPC

SPECIFICATIONS

GENERAL

MAXIMUM BATTERY DRAIN*		U33BBA Series	U43BBA Series
	RECEIVE (STANDBY)	13.8 V dc 450 mA	13.8 V dc 450 mA
	TRANSMIT	13.6 V dc 11 Amperes	13.6 V dc 14 Amperes
*Drain figures for negative ground only, add .080 amp for positive ground operation.			
FREQUENCY RANGE		136-174 MHz	
METERING		A single scale, 0-50 microampere meter with 20,000 ohms equivalent series resistance or Motorola portable test set can be used to measure all circuits essential to tuning and checking.	
DIMENSIONS		4" high x 10-3/4" wide x 16-1/2" long	
WEIGHT		Approximately 25 lbs (shipping weight including accessories: approximately 50 lbs).	

TRANSMITTER

RF POWER OUTPUT		30 Watts	45 Watts
OUTPUT IMPEDANCE		50 ohms	
SPURIOUS & HARMONIC EMISSIONS (PER EIA SPEC RS-152A, par. 4	136-150.8 MHz	85 dB	
	150.8-174 MHz	85 dB	
FREQUENCY STABILITY		A temperature compensated quartz crystal maintains oscillator frequency within $\pm .0005\%$ of reference frequency from -30°C to $+60^{\circ}\text{C}$ ambient ($+25^{\circ}\text{C}$ reference) and $\pm .0005\%$ with a 20% primary voltage deviation.	
MODULATION		16F3: ± 5 kHz for 100% at 1000 Hz @136-174 MHz	
AUDIO SENSITIVITY		.100 volt ± 3 dB for 3.0 kHz deviation at 1000 Hz	
FM NOISE		-80 dB below ± 3.0 kHz deviation at 1000 Hz	
AUDIO RESPONSE		+1, -3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz	
AUDIO DISTORTION		less than 3% at 1000 Hz for ± 3.0 kHz deviation	

RECEIVER

CHANNEL SPACING		30 kHz	
SELECTIVITY	-EIA SINAD	-90 dB at ± 30 kHz	
EIA SINAD INTER-MODULATION	TLD8430A SERIES RF DECK (STD)	-80 dB	
	TLD8370A SERIES RF DECK (OPTION)	-70 dB	
	TLD1770A SERIES RF DECK (OPTION)	-80 dB	
EIA MODULATION ACCEPTANCE		± 7.0 kHz minimum	
SENSITIVITY (50 ohms RF input impedance)	TLD8430A SERIES RF DECK (STD)	Less than 0.50 microvolt for 20 dB quieting. Less than 0.35 microvolt for EIA SINAD.	
	TLD1770A SERIES RF DECK (OPTION) (136 -174 MHz only)	Less than 0.50 microvolt for 20 dB quieting. Less than 0.35 microvolt for EIA SINAD.	
	TLD8370A SERIES RF DECK (OPTION)	Less than 0.35 microvolt for 20 dB quieting. Less than 0.25 microvolt for EIA SINAD.	

SPECIFICATIONS (Cont'd)

RECEIVER (CONT'D)

FREQUENCY STABILITY		A quartz crystal maintains oscillator frequency within $\pm .001\%$ or $\pm .0005\%$ (option) of reference frequency from -30°C to $+60^{\circ}\text{C}$ ambient ($+25^{\circ}\text{C}$ reference) and $\pm .001\%$ or $\pm .0005\%$ (option) with a 20% primary voltage deviation.
SPURIOUS AND IMAGE REJECTION	TLD8430A SERIES RF DECK (STD)	more than 90 dB
	TLD8370A SERIES RF DECK (OPTION)	more than 90 dB
	TLD1770A SERIES RF DECK (OPTION) (136 - 174 MHz only)	more than 100 dB
SQUELCH		Carrier squelch; noise compensated type, adjustable sensitivity, threshold sensitivity of 0.18 microvolt. "Private-Line" tone-coded squelch; also includes a tone-operated squelch circuit, adjustable sensitivity, threshold sensitivity of 0.18 microvolt.
AUDIO OUTPUT		5 watts to a 3.2 ohm load measured at the receiver output at less than 5% distortion.
AUDIO RESPONSE		+2, -8 dB/octave de-emphasis characteristic from 300 to 3000 Hz

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FCC LICENSE DESIGNATIONS

	Single Frequency	Multiple Frequency
30 Watt	CC3114	CC3114-4
45 Watt	CC3110	CC3110-4

D. O. C. LICENSE DESIGNATION: TYPE D BHA

Approval No. 109264227

FCC RECEIVER DESIGNATIONS

	Single Frequency	Multiple Frequency
TLD8430A Series RF Deck (STD)	RC0004	RC0006
TLD1770A Series RF Deck (Option)	RC0024	RC0026
TLD8370A Series RF Deck (Option)	RC0023	RC0025

SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to any two-way mobile radio equipment. Normal use of this radio will result in exposures far below the OSHA limit. There are no reported incidents of physical damage resulting from the use of this type radio. However, the following precautions are recommended:

DO NOT operate the transmitter when someone outside the vehicle is within two feet of the mobile antenna.

DO NOT operate the transmitter near unshielded electrical blasting caps or in an explosive atmosphere.

FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, revision suffix numerals are added to the affected kit model number. For example, a TLN4448A becomes a TLN4448A-1 with the first revision, TLN4448A-2 with the second revision, etc.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced when the suffix number changed. With this information, the technician can find the information for the current version, and any previous version, of the equipment covered by the manual.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 800 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district service representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Division
1301 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Division products.

Orders for all parts except crystals, channel elements, and "Vibrasender" and "Vibrasponder" resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

68P81025E81-F

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA, INC.
Communications Division Parts Dept.
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60172
Phone: 312-397-1000
Executive Offices: 1301 E. Algonquin Rd.,
Schaumburg, Illinois 60172

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
10 W. North Ave.,
Lombard, Ill. 60148
Phone: 312-620-3000
TWX: 910-693-1592

MID-ATLANTIC AREA PARTS
6701 Elkrigde Landing Road,
Linthicum, Maryland 21090
Phone: 301-796-8600

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
2333 Utah Avenue,
El Segundo, California 90245
Phone: 213-644-1101
TWX: 910-348-6278

SOUTHWESTERN AREA PARTS
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
5096 Panola
Industrial Blvd.
Decatur, Georgia 30032
Phone: 504-981-9800
TWX: 810-751-8300

5.3 CANADIAN ORDERS

*CANADIAN MOTOROLA ELECTRONICS
COMPANY*
Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 516-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

*MOTOROLA, INC. OR MOTOROLA
AMERICAS, INC.*
International Parts
1313 E. Algonquin Road
Schaumburg, Illinois 60172 U.S.A.
Phone: 312-397-1000
TWX: 910-693-1592 or 1599
Telex: 722443 or 722424
Cable: MOTOL

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

AIR MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

*REGULAR MAIL ORDERS
AND CORRESPONDENCE*
Motorola, Inc.
Component Products Sales & Service
2553 Edgington Street
Franklin Park, Illinois 60131

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MOTOROLA

MODEL CHART FOR 136-174 MHz "MOCOM-70" BASIC RADIO SET 30 W AND 45 W RF POWER (LATER VERSIONS)

CODES

- ☒ = ONE ITEM SUPPLIED
- ☒ = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY RANGE
- ☒ = NUMBER INDICATES QUANTITY SUPPLIED
- ☒ = ONE ITEM SUPPLIED FOR FIVE OR LESS RADIO SETS

ITEM	DESCRIPTION	MODEL NUMBER	DESCRIPTION	RF POWER
			CARRIER SQUELCH MODELS	
TUD1391BB	UNIFIED CHASSIS (136-150.8 MHz) 1-FREQ.	U33BBA-1000BA	1-FREQUENCY	30 W
TUD1392BB	UNIFIED CHASSIS (150.8-162 MHz) 1-FREQ.	U33BBA-1300BA	2-FREQUENCY	30 W
TUD1393BB	UNIFIED CHASSIS (162-174 MHz) 1-FREQ.	U33BBA-1600BA	4-FREQUENCY	30 W
TUD1401BK	UNIFIED CHASSIS (136-150.8 MHz) MULTI-FREQ.	U43BBA-1000BA	1-FREQUENCY	45 W
TUD1402BK	UNIFIED CHASSIS (150.8-162 MHz) MULTI-FREQ.	U43BBA-1300BA	2-FREQUENCY	45 W
TUD1403BK	UNIFIED CHASSIS (162-174 MHz) MULTI-FREQ.	U43BBA-1600BA	4-FREQUENCY	45 W
TUD1431BB	UNIFIED CHASSIS (136-150.8 MHz) 1-FREQ.	U33BBA-3000BA	"PRIVATE-LINE" TONE-CODED SQUELCH MODELS	
TUD1432BB	UNIFIED CHASSIS (150.8-162 MHz) 1-FREQ.	U33BBA-3300BA	1-FREQUENCY	30 W
TUD1433BB	UNIFIED CHASSIS (162-174 MHz) 1-FREQ.	U33BBA-3600BA	2-FREQUENCY	30 W
TUD1441BK	UNIFIED CHASSIS (136-150.8 MHz) MULTI-FREQ.	U43BBA-3000BA	1-FREQUENCY	45 W
TUD1442BK	UNIFIED CHASSIS (150.8-162 MHz) MULTI-FREQ.	U43BBA-3300BA	2-FREQUENCY	45 W
TUD1443BK	UNIFIED CHASSIS (162-174 MHz) MULTI-FREQ.	U43BBA-3600BA	4-FREQUENCY	45 W
K1017A	RESONATOR, TRANSMITTER	U33BBA-6000AA	"DIGIT-4-L" PRIVATE-LINE TONE-CODED SQUELCH MODELS	
K1057A	RESONATOR, RECEIVER	U33BBA-6300AA	1-FREQUENCY	30 W
THN6113A	FRONT PANEL & HOUSING	U33BBA-6600AA	2-FREQUENCY	30 W
TLN5817A	DIGITAL "PRIVATE-LINE" ENCODER-DECODER BOARD	U33BBA-6900AA	4-FREQUENCY	30 W
TRN6005A	CODE PLUG	U43BBA-6000AA	1-FREQUENCY	45 W
TLN4448A	"PRIVATE-LINE" ENCODER-DECODER BOARD	U43BBA-6300AA	2-FREQUENCY	45 W
KLN6210A	"VIBRASENDER" RESONANT REED (FORMERLY TLN6824A)	U43BBA-6600AA	4-FREQUENCY	45 W
TLN8381A	"VIBRASPINDER" RESONANT REED	U43BBA-6900AA		
TLN4345A	TUNING TOOL KIT			

EPS-17104-D

MOTOROLA

MODEL CHART FOR BASIC RADIO SET (EARLIER VERSIONS)

CODE:

- ☒ = ONE ITEM SUPPLIED.
☒ = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY.
☒ = ONE ITEM SUPPLIED FOR 5 OR LESS RADIO SETS.
☒ = NUMBER INDICATES QUANTITY SUPPLIED.

NOTE

UNITS MANUFACTURED BY CANADIAN MOTOROLA ELECTRONICS LIMITED ARE IDENTIFIED WITH AN "M" OR "C" PREFIX TO THE NOMENCLATURE.

MODEL CHART FOR BASIC RADIO SET (EARLIER VERSIONS)		TRANSMITTER RF POWER
DESCRIPTION		
MODEL	CARRIER SQUELCH	
U33BBA-1000A	RADIO SET, 1-FREQUENCY	30 W
U33BBA-1300A	RADIO SET, 2-FREQUENCY	30 W
U33BBA-1900A	RADIO SET, 4-FREQUENCY	30 W
U43BBA-1000A	RADIO SET, 1-FREQUENCY	45 W
U43BBA-1300A	RADIO SET, 2-FREQUENCY	45 W
U43BBA-1900A	RADIO SET, 4-FREQUENCY	45 W
"PRIVATE-LINE" TONE-CODED SQUELCH		
U33BBA-3000A	RADIO SET, 1-FREQUENCY	30 W
U33BBA-3300A	RADIO SET, 2-FREQUENCY	30 W
U33BBA-3900A	RADIO SET, 4-FREQUENCY	30 W
U43BBA-3100A	RADIO SET, 1-FREQUENCY	45 W
U43BBA-3300A	RADIO SET, 2-FREQUENCY	45 W
U43BBA-3900A	RADIO SET, 4-FREQUENCY	45 W

CODE:

☒ = ONE ITEM SUPPLIED.

☒ = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY.

☒ = ONE ITEM SUPPLIED FOR 5 OR LESS RADIO SETS.

☒ = NUMBER INDICATES QUANTITY SUPPLIED.

NOTE

UNITS MANUFACTURED BY CANADIAN MOTOROLA ELECTRONICS LIMITED ARE IDENTIFIED WITH AN "M" OR "C" PREFIX TO THE NOMENCLATURE.

ITEM	DESCRIPTION
TLN5058A	CHASSIS AND HARDWARE
THN6113A	HOUSING
TLD8431A	RECEIVER RF DECK, 136-150.8 MHz
TLD8432A	RECEIVER RF DECK, 150.8-174 MHz
TLD8721A	UNIFIED BOARD, 1-FREQUENCY, 136-150.8 MHz
TLD8792A	UNIFIED BOARD, 1-FREQUENCY, 150.8-162 MHz
TLD8793A	UNIFIED BOARD, 1-FREQUENCY, 162-174 MHz
TLD8801A	UNIFIED BOARD, MULTI-FREQUENCY, 136-150.8 MHz
TLD8802A	UNIFIED BOARD, MULTI-FREQUENCY, 150.8-162 MHz
TLD8803A	UNIFIED BOARD, MULTI-FREQUENCY, 162-174 MHz
TLD1741A	POWER AMPLIFIER, 30 WATT, 136-150.8 MHz
TLD1742A	POWER AMPLIFIER, 30 WATT, 150.8-162 MHz
TLD1743A	POWER AMPLIFIER, 30 WATT, 162-174 MHz
TLD1751A	POWER AMPLIFIER, 45 WATT, 136-150.8 MHz
TLD1752A	POWER AMPLIFIER, 45 WATT, 150.8-162 MHz
TLD1753A	POWER AMPLIFIER, 45 WATT, 162-174 MHz
TLN4647A	PROTECTION CIRCUIT
TLN4476A	ANTENNA SWITCH
TFD6121A	HARMONIC FILTER, 136-150.8 MHz
TFD6122A	HARMONIC FILTER, 150.8-174 MHz
TFN1000AS	RECEIVER FILTER
TLN4448A	"PRIVATE-LINE" TONE ENCODER & DECODER
KLN6210A	"VIBRASENDER" RESONANT REED (FORMERLY TLN6824A)
TLN8381A	"VIBRASPONDER" RESONANT REED
TKN6628A	1-FREQUENCY INTERCABLE KIT
TKN6627A	MULTI-FREQUENCY INTERCABLE KIT
TLN8427A	NEGATIVE GROUND KIT
TLN4345A	TUNING TOOLS
K1017A	RESONATOR, TRANSMITTER
K1057A	RESONATOR, RECEIVER

MODEL CHART
FOR
COMPLETE PACKAGE RADIO SET MODELS
WITH DASH OR TRUNK-MOUNT ACCESSORIES
(EARLIER VERSIONS)

CODE:
☒ = ONE ITEM SUPPLIED
☐ = ONE ITEM SUPPLIED DEPENDENT UPON FREQUENCY
 *SEE BASIC RADIO SET MODEL CHART FOR RADIO SET COMPLEMENT
 NOTES:

- EQUIVALENT MODEL TRUNK-MOUNT CONTROL HEADS WITHOUT DIMMER ARE AVAILABLE ON SPECIAL REQUEST.
- THE FOLLOWING OPTIONS ARE AVAILABLE ON SPECIAL REQUEST.
 - RADIO SET LESS TLN6246A "PRIVATE-LINE" HANG-UP KIT.
 - RADIO SET LESS TAB1000B OR TAB1010B SERIES ANTENNA.
 - RADIO SET LESS TMN6013A MICROPHONE.
 - RADIO SET WITH TLN1097A TIME-OUT TIMER AND TLN4323A MOUNTING KIT.
 - RADIO SET WITH TLN8482A GROUND REVERSING KIT. THE KIT CAN BE USED FOR EITHER POSITIVE OR NEGATIVE GROUND INSTALLATIONS (IN PLACE OF THE TLN8427A NEGATIVE GROUND KIT).
 - RADIO SET WITH TLN8845A NOISE REDUCTION KIT.
 - RADIO SET WITH -70 dB IM AND 0.35 uV SENSITIVITY RF DECK (MODEL TLD8371A FOR 136-150.8 MHz RANGE, MODEL TLD8372A FOR 150.8-174 MHz RANGE).
 - RADIO SET WITH 100 dB SPURIOUS AND IMAGE REJECTION AND -80 dB IM RF DECK. (MODEL TLD1772A FOR 150.8-162 MHz RANGE, MODEL TLD1773A FOR 162.0-174 MHz RANGE)
- UNITS MANUFACTURED BY CANADIAN MOTOROLA ELECTRONICS LIMITED ARE IDENTIFIED WITH AN "M" OR "C" PREFIX TO THE NOMENCLATURE.

MODEL	DESCRIPTION	ACCESSORY ITEMS
1CN6141HE	CONTROL HEADS, DASH-MOUNT WITH DIMMER	
1CN6141HF	1-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	2-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	4-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	CONTROL HEADS, TRUNK-MOUNT, WITH DIMMER (NOTE 1)	
1CN6141BI	1-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	2-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	4-FREQUENCY, DUAL-PURPOSE	
1CN6141BI	MISCELLANEOUS	
1CN6141BI	CABLE KIT, 1-FREQUENCY	
1CN6141BI	CABLE KIT, MULTI-FREQUENCY	
1CN6141BI	INSTALLATION KIT, TRUNK-MOUNT RADIO	
1CN6141BI	INSTALLATION KIT, DASH-MOUNT RADIO	
1CN6141BI	SPEAKER	
1CN6141BI	MICROPHONE	
1CN6141BI	ANTENNA, 136-144 MHz	
1CN6141BI	ANTENNA, 144-152 MHz	
1CN6141BI	ANTENNA, 152-162 MHz	
1CN6141BI	ANTENNA, 162-174 MHz	
1CN6141BI	HANG-UP SWITCH BOX	

PACKAGE MODEL	INCLUDES BASIC RADIO MODEL*	TRANSMITTER RF POWER
	CARRIER SQUELCH	
D33BBA-1000AK	U33BBA-1000A	30 W
D33BBA-1300AK	U33BBA-1300A	30 W
D33BBA-1900AK	U33BBA-1900A	30 W
D43BBA-1000AK	U43BBA-1000A	45 W
D43BBA-1300AK	U43BBA-1300A	45 W
D43BBA-1900AK	U43BBA-1900A	45 W
D33BBA-1000AK	U33BBA-1000A	30 W
T33BBA-1300AK	U33BBA-1300A	30 W
T33BBA-1900AK	U33BBA-1900A	30 W
T43BBA-1000AK	U43BBA-1000A	45 W
T43BBA-1300AK	U43BBA-1300A	45 W
T43BBA-1900AK	U43BBA-1900A	45 W
	"PRIVATE-LINE" TONE-CODED SQUELCH	
D33BBA-3000AK	U33BBA-3000A	30 W
D33BBA-3300AK	U33BBA-3300A	30 W
D33BBA-3900AK	U33BBA-3900A	30 W
D43BBA-3000AK	U43BBA-3000A	45 W
D43BBA-3300AK	U43BBA-3300A	45 W
D43BBA-3900AK	U43BBA-3900A	45 W
T33BBA-3300AK	U33BBA-3300A	30 W
T33BBA-3900AK	U33BBA-3900A	30 W
T43BBA-3000AK	U43BBA-3000A	45 W
T43BBA-3300AK	U43BBA-3300A	45 W
T43BBA-3900AK	U43BBA-3900A	45 W

DESCRIPTION

1. INTRODUCTION

The Motorola "Mocom-70" radios are completely transistorized mobile FM two-way units which fully utilize the advantages of solid-state circuits -- reliability, small size, ruggedness and low maintenance requirements. Current demands are low, since tube filaments are eliminated and unheated crystals are used for frequency control.

These radio sets can utilize existing "Motrac" accessories. The units may be installed so that the control head ON-OFF switch turns on the transmitter and receiver or the receiver alone. In the latter case, power for the transmitter is routed through the vehicle ignition switch, so that transmission is impossible unless the ignition switch is turned on.

A variety of models are available which provide carrier squelch or "Private-Line" tone-coded squelch operation. The model chart at the front of this manual lists the available models.

2. TRANSMITTERS

Complete transistorization of the FM transmitter and the use of unheated crystals allow instantaneous on-frequency transmission over an ambient temperature range of -30°C to $+60^{\circ}\text{C}$ as soon as power is applied. Modulation is effected by a direct frequency modulator. The frequency of the modulated signal is multiplied and then applied to the amplifier output stages. The output frequency is nine times the crystal frequency. A high level of spurious frequency attenuation is achieved in a four section harmonic filter in the transmitter output. The transmitter provides a minimum output of 30 or 45 watts depending on the model.

3. RECEIVERS

The receivers used in these radio sets are crystal-controlled, dual conversion models which provide five watts of audio power. Highly selective L-C tuned circuits in the receiver, rf deck, a crystal filter 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 resonators provide stable frequency control.

These models include a noise-actuated squelch circuit consisting of a noise limiter, a

noise detector and a dc control stage (switching circuit) to cut off the audio amplifier. This eliminates disturbing noise which would otherwise be heard at the speaker during intervals between received messages.

4. "DIGITAL PRIVATE-LINE" (DPL) AND TONE "PRIVATE-LINE" (TPL) SQUELCH MODELS

This type of radio set is an improvement in FM two-way radio equipment especially when operating under crowded channel conditions. Several networks, using either DPL or TPL, can use the same rf carrier frequency in the same area if each network uses a different code (in DPL) or a different tone (in TPL).

The transmitters are modulated by a continuous sub-audible code signal (digital or tone) in addition to the voice modulation. The receivers accept only signals which are modulated with the correct tone or digital code and reject all others.

Both DPL and TPL squelch models also include noise-actuated squelch circuitry as previously described for carrier squelch models. This enables the operator to monitor the channel before transmissions and prevent interference with other users of the frequency.

In DPL or TPL squelch models, the decoding circuits are operative at all times. The monitor-operate switch and the hook-switch on the hang-up switch box, when a dual-purpose control head is used, places the noise-actuated squelch circuit in or out of operation.

In "Private-Line" tone coded models, the SQUELCH control determines the composite dual-squelch sensitivity. In normal operation, the receiver audio is activated only when both of the following conditions occur:

- a. An on-frequency rf signal must be received to disable the noise (carrier squelch) circuit.
- b. The on-frequency rf signal must be FM modulated with the proper sub-audible tone frequency to activate the "Private-Line" decoder.

In "Digital Private-Line" binary-coded squelch models, squelch is only controlled by the "Digital Private-Line" decoder output.

5. NETTING FEATURES

The netting feature provides a quick method of checking the frequency of either the transmitter

or the receiver if both are assigned to the same frequency and if one is known to be "on-frequency". With the Motorola Portable Test Set, the test can be made in one simple operation.

Plug the test set into either meter socket and switch the test set meter to position #4. The meter will indicate the discriminator output. Remove one end of the wire netting jumper, located near L105 in the exciter, from its normal pin and connect it to the pin located near CR180 in the exciter IDC circuit. This energizes the low level stages of the transmitter exciter and causes a signal to be radiated to the receiver. The receiver or transmitter oscillator can then be "warped" on-frequency by adjusting for zero discriminator output.

6. HOUSING

The basic radio set consists of a transmitter and receiver housed together to form a drawer unit which slides into the #16 gauge housing. All external connections are made through receptacles on the front panel.

The radio set housing can be mounted either under the vehicle dashboard or in the trunk. The same drawer assembly, including transmitter and receiver, slides into the housing in either type of installation. In mobile radio fleets, where both dash- and trunk-mount installations are used, this design provides full flexibility in exchanging radio sets between vehicles. Trunk-mounted radio sets are remotely controlled by means of a dash-mounted control head.

A removable handle is attached to the front panel. It can be removed by loosening the two screws located on the bottom ends of the handle. A key lock is also mounted on the front panel to secure the radio from unauthorized persons.

For servicing purposes, the major chassis is easily accessible by removing the drawer unit from the housing. Refer to the SERVICE AIDS section of this manual for instructions on the removal of individual components.

7. ACCESSORY GROUPS

In addition to the basic radio set, an accessory group is required to complete the installation. Various combinations of accessories are available to meet specific require-

ments. The accessory groups are listed in the Package Radio Set Model Chart in the front part of this manual.

The control heads available as part of the accessory groups provide all the required control facilities for operation of the radio set. The dash-mount control heads plug directly into the front panel when the handle is removed. Control heads for trunk-mounted units have an adjustable angle-bracket for mounting to the vehicle dash and are connected to the radio set via a cable kit.

The microphone used with the radio set is a palm-type microphone with a transistorized pre-amplifier. The microphone has a 12 inch tinseil coiled-cord and a four-pin connector for plugging into the receptacle on the control head.

A special mounting kit is included with the dash-mount accessory groups to mount the radio set in the passenger compartment of the vehicle.

8. OPTIONAL ACCESSORIES

The following options are available to meet specific customer requirements.

● TLN1097A Time-Out Timer - This option prevents extended transmitter keying.

● TLN8482A Ground Reversing Kit - This kit is required for positive ground operation.

● Non-Dimmer Control Head - This option is available for all trunk-mounted radio set control heads.

● TLN8845A Noise Reduction Kit is available for use in unusually noisy environments.

● K-1056A Receiver Resonator for $\pm 0.005\%$ stability.

● TLD1770A Series RF Deck - This kit provides improved performance in areas where frequencies are highly congested. Refer to the model chart options for details.

● TLD8370A Series RF Deck - This kit provides improved performance in weak signal areas.

Additional options are available that allow the customer to delete antennas, speakers, microphones or "Private-Line" hang-up brackets from the package model equipment complements.

Many other accessories are available; some are given here. Contact your local Motorola Radio Communications Representative for complete details or for information on other accessories.

● Mobile Coaxial Antenna - where rooftop antenna is not practical or desirable.

● 3 dB Gain Antenna - for improved system performance.

● Dynamic Handset - where telephone type handset is either preferred or where speaker muting is desired for privacy.

● Electronic Siren - includes public address feature for police, fire, ambulance, or similar users.

● "Big Voice" Speaker - for public address operation and/or amplified radio signal without siren operation.

● "Quik-Call II" Mobile Paging Decoder - this unit provides selective tone-coded signaling to alert specific mobile units in a system.

● Mobile Voice Privacy Adapter - this audio frequency inversion unit scrambles audio messages to provide customer privacy and prevent casual eaves dropping.

● "Channel Scan" Monitor - this device permits automatic channel scanning on multiple frequency radios. All receive channels can be monitored in this manner.

INSTALLATION AND OPERATION

1. INSTALLING THE RADIO SET

Complete installation instructions are packed in the shipping carton with the radio set. Install the radio set according to the instructions supplied.

2. OPERATING INSTRUCTIONS

CAUTION

This radio set, when supplied with a Model TLN8427A Negative Ground Kit, must be used in negative ground installations only. For positive ground installations, a Model TLN8482A Ground Reversing Kit is available. This kit must be inserted in the socket with the POS GND mark opposite the arrow on the polarity plug plate when used in positive ground installations. This ground reversing kit may be used in negative ground installations also. In such cases, the kit must be inserted in the socket with the NEG GND mark opposite the arrow on the polarity plug plate.

TO RECEIVE

MULTI-FREQ. MODELS ONLY	Place the frequency selector switch in the desired position.
ALL MODELS	Place the ON-OFF switch in the ON position or turn the OFF-VOLUME control clockwise. The green lamp will go on to indicate the "stand-by" condition. The receiver is in full operation.

TO HEAR ALL ON-FREQUENCY SIGNALS

CODED SQUELCH MODELS ONLY	Place the monitor-operate switch on the hang-up switch box in the monitor position 
ALL MODELS	Turn the SQUELCH control to the full counterclockwise position. Tune the VOLUME control clockwise until noise is heard. Adjust the SQUELCH control by turning it slowly clockwise until the noise is just squelched (cuts out). Set the VOLUME control to the desired listening level with a received signal.

TO HEAR DPL OR TPL SIGNALS ONLY

CODED SQUELCH MODELS	Place the monitor-operate switch in the operate position (opposite the ). Place the microphone "on-hook" and set the VOLUME control to the desired listening level when receiving a signal.
----------------------	---

TO TRANSMIT

ALL MODELS	Proceed as previously described under "TO RECEIVE" and "TO HEAR ALL ON-FREQUENCY SIGNALS". Turn "on" the vehicle ignition switch. For short transmissions it is not necessary to start the engine; however, to conserve the battery, the engine should be running. <u>When the channel is clear</u>, remove the microphone from the hang-up bracket. Hold it about one inch from the lips and turned about 30° away from the face. Press the push-to-talk button. The red lamp will come on and the transmitter will go "on the air". Speak slowly and clearly across the microphone in a normal or slightly louder than normal voice. At the end of the message, release the push-to-talk button and replace the microphone in the hang-up bracket.
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CAUTION

To prevent accidental transmission or jamming of the channel by inadvertent keying of the transmitter, do not leave the microphone lying on the seat where the button may be accidentally operated.

TO TURN OFF

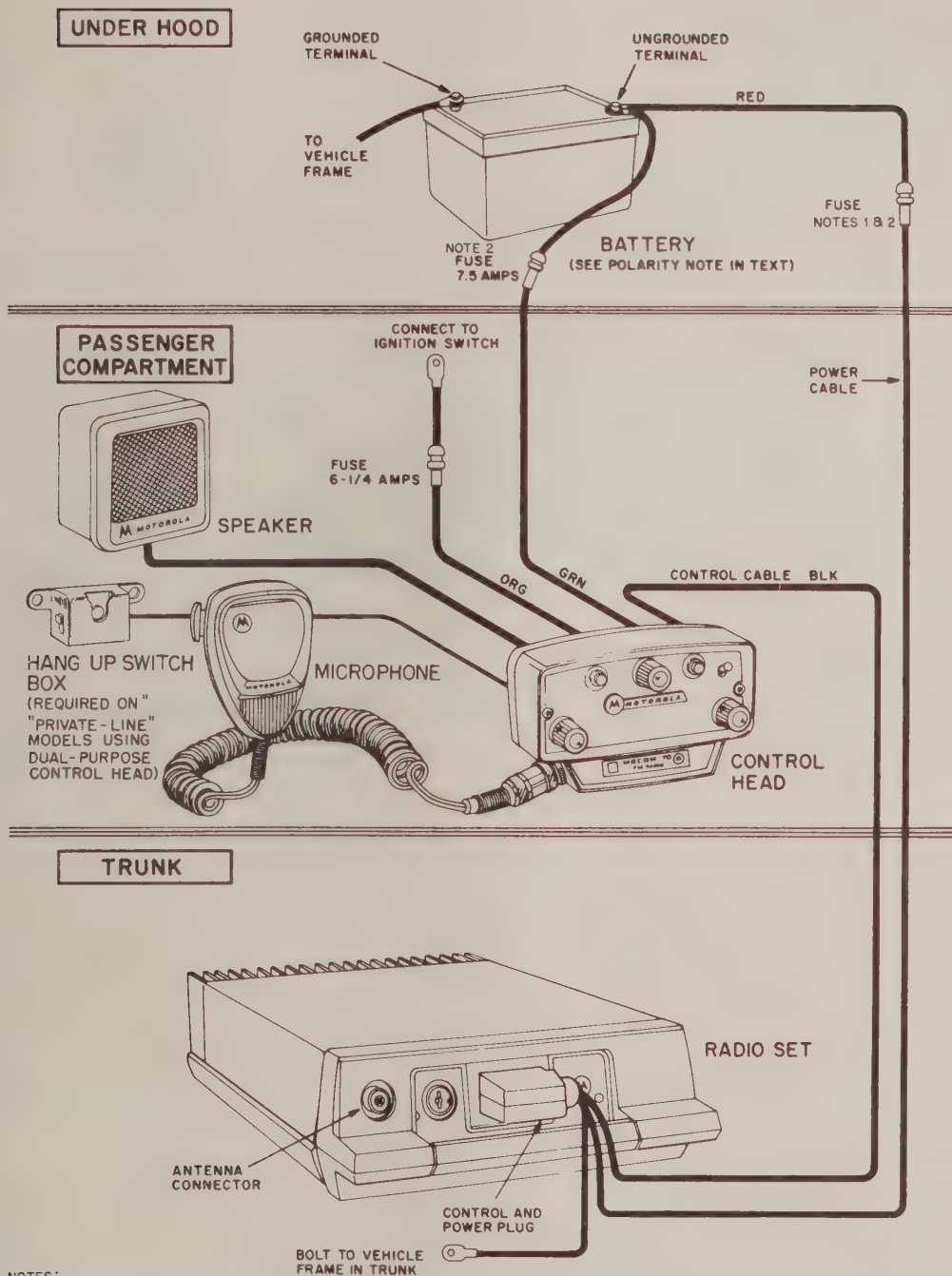
ALL MODELS	Place the ON-OFF switch in the OFF position -- or turn the OFF-VOLUME control counterclockwise until a click is heard.
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3. LOW CURRENT DRAIN MODIFICATION

(Non-Dimmer Control Heads Only)

If desired, an additional saving on battery current drain of about 200 mA (in the standby condition) may be obtained by a wiring modification in the control head. If this modification is incorporated, the green pilot lamp will not operate unless the ignition switch is in the ON position. Proceed as follows to complete the modification.

- Loosen the two mounting screws and remove the control head.
- Remove the end of the 33 ohm resistor attached to the green lamp from the terminal of the OFF-VOLUME control or the ON-OFF switch.
- Connect the end of the resistor which was removed in step b. to the terminal of the OFF-VOLUME control or the ON-OFF switch to which the red lamp is connected.



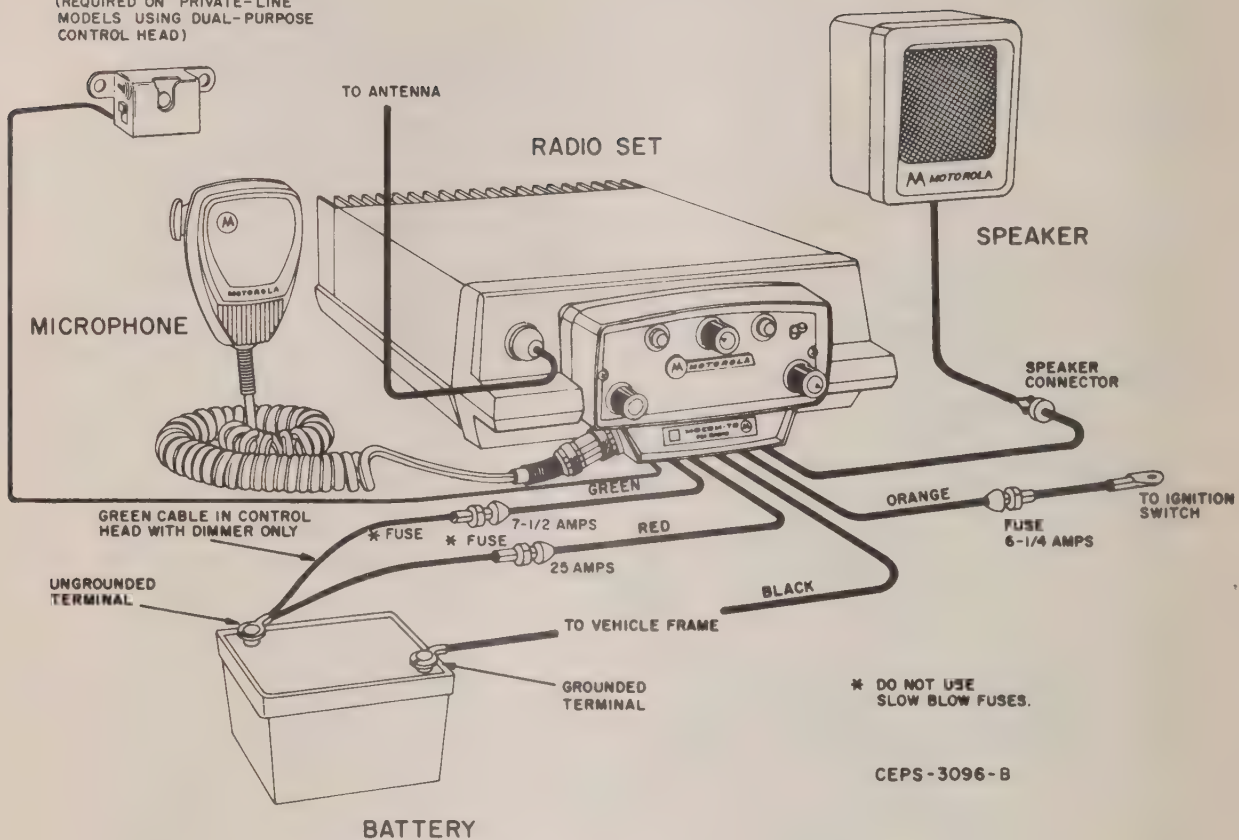
NOTES:

1. 25A FUSE USED FOR 30W AND 45W MODELS. FOR HIGHER POWER MODELS USE 40A FUSE.
2. DO NOT USE SLOW BLOW FUSE

CEPS-3097-D

Typical Trunk-Mounted Installation

HANG UP SWITCH BOX
(REQUIRED ON "PRIVATE-LINE"
MODELS USING DUAL-PURPOSE
CONTROL HEAD)





A

THEORY OF OPERATION

1. FUNCTIONAL OPERATION

The overall operation of the radio set is illustrated in the Functional Block Diagram in Figure 1. This diagram applies to both dash and trunk-mount installations.

The dc input to the radio is applied through three separate leads in the following manner:

- The primary power (12 volts from the ungrounded side of the battery) is applied to the transmitter via the polarity reversing socket and the relay.

- Power for the receiver and low level transmitter stages comes from the ungrounded terminal of the battery and passes through the OFF-ON switch (in the control head) and the polarity reversing socket.

- The transmitter keying voltage is connected to both the vehicle ignition switch and the OFF-ON switch in the control head. This gives vehicle ignition control to transmitter operation since the push-to-talk function will be inoperative with the ignition switch turned off.

The function of the polarity reversing socket is to provide voltages of the proper polarity to the radio circuitry in either positive or negative ground installations. With the exception of the audio push pull output stages, the receiver and some circuits within the transmitter require a voltage which is always positive with respect to chassis. In positive ground systems, this voltage is supplied by the TLN8482A Ground Reversing Kit. In negative ground systems, connections through the polarity reversing socket are supplied by the TLN8427A Negative Ground Kit or by the TLN8482A Ground Reversing Kit - (see the INSTALLATION AND OPERATION section of this manual).

When the control head ON-OFF switch is turned on, the receiver is immediately operative and the green lamp on the control head lights, indicating the radio set in ON.

In negative ground operation, battery voltage (A+) is applied to:

- The entire receiver.

- The transmitter audio amplifier.

- The PL encoder, decoder, and time delay circuits (in "Private-Line" radio sets only).

A regulated 9.1 volt supply (chassis referenced) is derived from the receiver A+ voltage. This regulated voltage is applied to:

- Both the transmitter and receiver oscillators.

- The receiver multiplier and rf deck

- The transmitter IDC circuit.

- The PL tone generator (in "Private-Line" radio sets only).

- The Time-Out Timer.

In positive ground operation, the chassis referenced A+ is supplied by the converter in the TLN8482A Ground Reversing Kit. Other connections in this kit provide for maintaining the required A+ to A- polarity for the remaining circuits.

When the power ON-OFF switch and the vehicle ignition switch are both turned on, the transmitter is immediately ready for operation. When the push-to-talk button on the microphone is pressed, the following functions are performed:

- The red lamp in the control head lights indicating a transmit condition.

- A chassis connection is made through the push-to-talk switch to activate the relay (in "Private-Line" radios, the push-to-talk switch activates the PL time delay circuit which in turn switches the relay).

The power relay performs the following switching functions:

- Filtered A+ is provided to operate the low level transmitter exciter stages.

- Regulated 9.1 V is removed from the receiver oscillator and multipliers to turn them off.

- Unfiltered A+ is provided to switch the antenna from the receiver input to the transmitter input and to operate the high level transmitter stages.

When the push-to-talk button is released, the following takes place:

a. Carrier Squelch Radios

- (1) The red transmit indicator lamp on the control head goes out.

(2) The power relay opens to remove A+ from all transmitter rf stages. The antenna and filtered A+ are switched to the receiver.

b. TPL or DPL Coded Squelch Radios

(1) The red transmit indicator lamp on the control head turns off.

(2) TPL systems only -- In this system the controlled A+ voltage to the tone generator is removed which causes a phase reversal of the tone output fed to the modulator. The path to the push-to-talk bridge is opened but a delay circuit keeps the transmitter on for approximately 150 milliseconds after release of the push-to-talk switch. During this time, the reverse burst is transmitted which damps the vibration of the "Vibrasponder" resonant reed in the listening receiver and returns it to the squelch condition. After the 150 millisecond delay, the power relay opens to remove all voltages and the radio reverts to receive operation.

(3) DPL systems only -- In this system the transmit code enable is removed from the DPL encoder; however, a delay circuit keeps the transmitter on for approximately 180 milliseconds after release of the push-to-talk switch. During this time, the DPL encoder generates a turn-off which is transmitted. The turn-off code is decoded in the listening receiver and returns it to the squelch condition. After the 180 millisecond delay, power is removed from the transmitter and the radio reverts to receive operation.

2. RECEIVER

The receiver is a completely transistorized double-conversion superheterodyne type. It receives FM signals on one (or up to four) fixed, crystal-controlled frequencies.

The multi-frequency receiver is the same as the one frequency model except for the addition of three oscillator circuits. Only one frequency can be received at a time. A switch on the control head selects the desired operating frequency on multi-frequency models. The frequency selector switch completes a path to ground for the corresponding transmitter and receiver oscillators thus allowing them to operate. (Unusual receive-transmit combinations, such as two frequency transmit and three frequency receive, require minor circuit modifications.) The modifications are covered in the Service Aids section of this manual.

a. RF Amplifier

The gain, low noise figure and selectivity of the rf amplifier provide excellent signal-to-noise ratio and rejection of intermodulation interference. Selectivity is obtained by the use of very low loss coils and by optimum coupling at both the input and output circuits.

b. Oscillator-Multiplier

The oscillator circuit(s) consist of either one of four (multi-frequency models) Colpitts Oscillators and use unheated temperature-compensated crystals to achieve the required frequency stability. The oscillator output is fed to a two-coil filter which is tuned to pass only the third oscillator harmonic. This output is applied to the base of the tripler.

c. Tripler

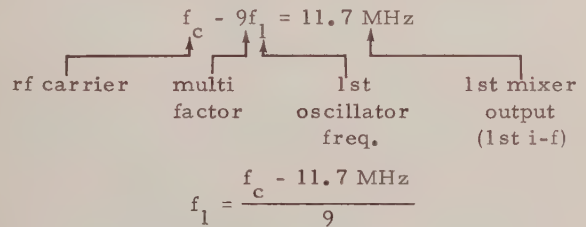
The tripler multiplies the input signal by three and feeds the output to a two-coil filter which is tuned to pass only the third harmonic of the tripler (ninth harmonic of the oscillator). This output is then applied to the source of the FET 1st mixer.

d. First Mixer

The first mixer is a field effect transistor which heterodynes the signal from the rf amplifier with the signal from the oscillator multiplier to produce the first intermediate frequency (1st i-f) of 11.7 MHz.

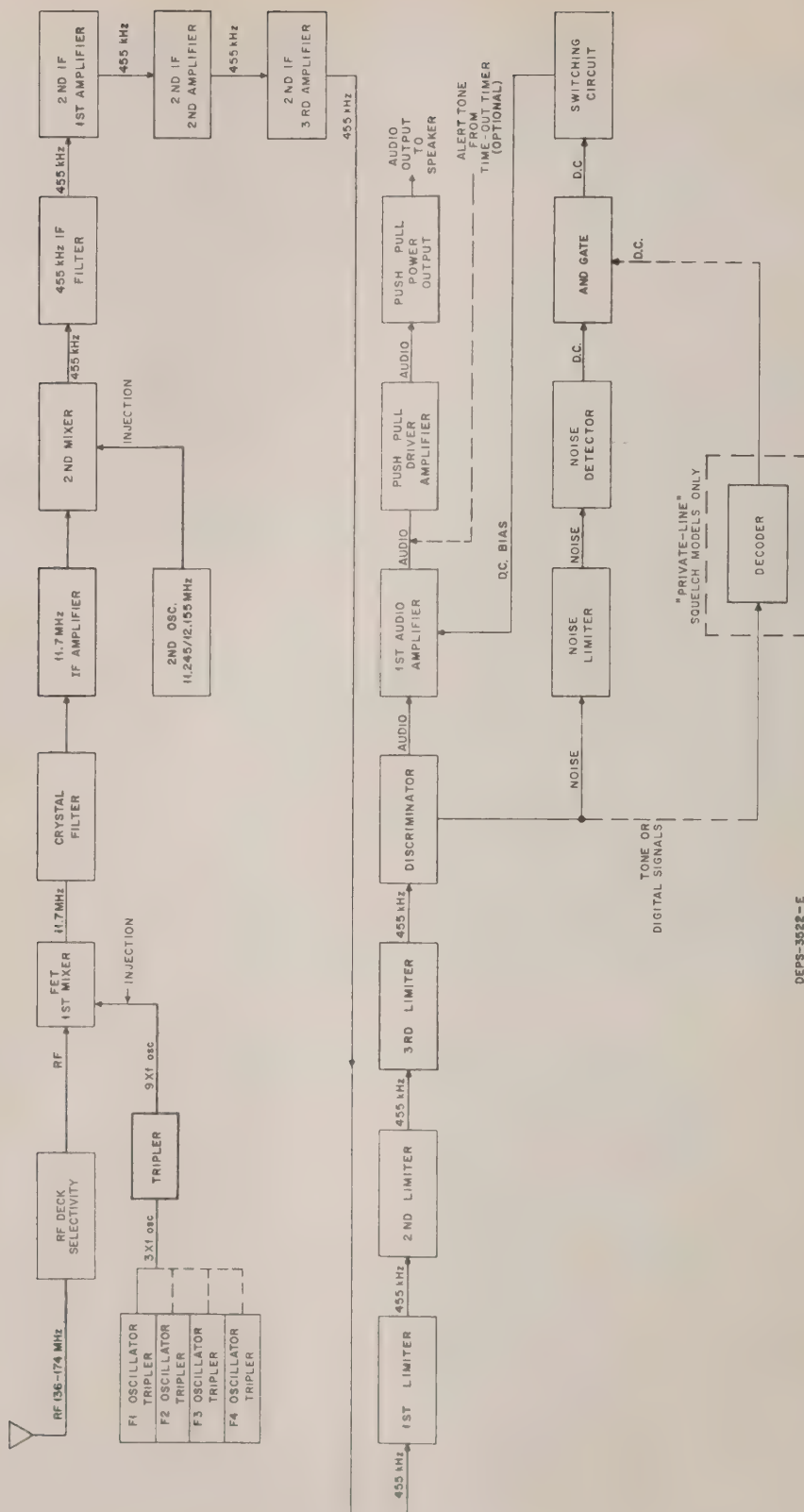
The first injection frequency is below (low side injection) the rf carrier frequency. The difference frequency is equal to the first i-f, 11.7 MHz.

The frequency relationship is as follows:



e. First IF and Second Mixer

The first i-f section consists of a monolithic crystal filter with two tuned matching circuits



DEPS-352E-E

Figure 2.
Receiver Block Diagram

plus the high-Q, low insertion loss coils. The output from the first mixer is loaded into a high impedance matching coil and to the crystal filter. The crystal filter provides close-in selectivity at adjacent and alternate channels; and the three-coil filter provides further-out selectivity.

The outputs of the 11.7 MHz i-f amplifier and the 2nd oscillator are applied to the input of the 2nd mixer circuit. The crystal-controlled 2nd oscillator operates below the 1st i-f at 11.245 MHz except in the case where the receiver is tuned near harmonics of this frequency. To avoid interference from these harmonics a crystal which oscillates above the 1st i-f at 12.155 MHz is used.

The 12.155 MHz crystal is 455 kHz above the 11.7 MHz 1st i-f and the 11.245 MHz crystal is 455 kHz below it. The output of the 2nd mixer is the difference between the 2nd local oscillator and the 11.7 MHz i-f. This resulting 2nd i-f frequency is 455 kHz.

f. Second IF

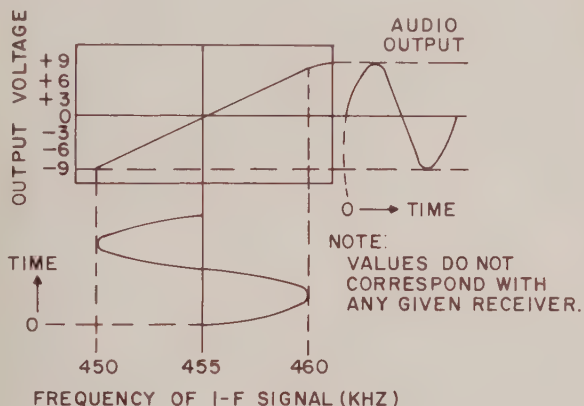
A "Permakay" 2nd IF Filter precedes the second i-f amplifier circuit. The filter sections are permanently sealed in polyesterstyrene and the filter is unconditionally guaranteed for the life of the receiver, provided the seal is not broken and the housing is not tampered with. This filter is the major 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 kHz filter to saturate the limiter.

g. Limiter Stage

The three limiter stages are 455 kHz amplifiers arranged so that an increase in input signal produces no change in the amplitude of the output signal. Because of more than adequate receiver gain, 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 when the signal is negative. This places a reverse bias at the emitter-base junction causing the collector current to drop to zero.

When the signal is positive, the base-emitter junction becomes forward biased thus increasing the collector current to its maximum value. Thus, the collector current is driven to both cut-off and maximum. 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 with its input signal of opposite polarity. The output of the limiters is a signal of constant amplitude.



AEPS-1795-0

Figure 3.
Typical Discriminator Response

h. 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 kHz i-f signal. A typical discriminator response curve is shown in Figure 3.

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.

An emitter follower (Q309) is used to prevent possible loading of the discriminator by the audio and squelch circuits.

i. 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 noise limiter (Q345), noise detector (Q346), and dc control stage or audio switch (Q347).

In the absence of a received rf 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 squelch (SQUELCH control fully clockwise); less current is drawn when the receiver is in the unsquelch 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 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.

j. Tone-Actuated Squelch Circuit in "Private-Line" Tone-Coded Squelch Models

As shipped from the factory, "Private-Line" receivers incorporate a tone actuated "Private-Line" squelch circuit that works in conjunction with the noise actuated carrier squelch circuit. In this mode the "Private-Line" squelch sensitivity is affected by the carrier squelch sensitivity. Thus the "Private-Line" squelch sensitivity is variable with the setting of squelch control. If desired, the radio can be wired so that the "Private-Line" squelch sensitivity is independent of the carrier squelch control. To accomplish this, insert jumper JU702 and remove jumper JU703. In normal operation, the receiver audio is activated only when both of the following conditions occur: (1) an on-frequency rf signal must be received to disable

the carrier squelch circuit and (2) the rf signal must be FM modulated with the proper sub-audible tone frequency to activate the "Private-Line" tone-coded squelch decoder circuit.

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

The output from the emitter follower is connected to the low-pass filter network, (L751, C752, C753, C754) which passes frequencies below 300 Hz. The low-frequency signals (PL tone) are amplified by Q751 and coupled to the input of the amplifier/clipper Q752. The output of the amplifier/clipper is applied to the "Vibrasponder" driver stage to drive the resonant reed.

The "Vibrasponder" resonant reed is a highly selective, contactless, electro-mechanical device which is permanently tuned and sealed at the factory. The reed is energized only when a tone of the precise frequency appears in the discriminator output. When this occurs, the vibrating reed produces a sinusoidal output which is amplified and detected. The detected output is applied to the output switching transistor (Q756) which provides a dc voltage for biasing the switching transistor (Q347). The noise (carrier squelch detector, (Q346) also provides dc voltage for biasing Q347. If both of the voltages exceed a certain level (approximately 10 V), the audio switching transistor (Q347) base-emitter junction will be back-biased and the first audio amplifier (Q340) will conduct.

The PL low-pass filter is paralleled by a high-pass circuit to prevent erratic operation of the "Vibrasponder" reed because of noise. The high-pass filter passes some higher frequency noise components which tend to drive the amplifier/clipper into limiting. The resulting saturation of Q751 effectively reduces the PL squelch sensitivity.

When the proper tone signal is received and the audio pre-driver stage is turned on, the high-pass path is shorted to ground through the noise switch (Q757). With the high frequency noise removed, the PL squelch sensitivity is at maximum to insure an unsquelched receive condition until the end of the transmission.

Since both a carrier and proper PL tone must be present in the receiver to activate the receiver audio, the carrier squelch control affects the PL sensitivity (with the jumper circuit configuration

on radio sets as shipped from the factory). For optimum sensitivity, use the procedure outlined in the INSTALLATION AND OPERATION section of this manual.

k. "Digital Private-Line" Binary-Coded Squelch Models

"Digital Private-Line" binary-coded squelch is a system that utilizes a binary code to unsquelch the radio set. The basic operation of this squelch is described in a separate Motorola instruction section, 68P81106E83. This instruction section together with the schematic diagram provides theory and maintenance information for this type of squelch.

1. 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 Hz (on "Private-Line" models, additional filtering is provided to more completely suppress the PL tone) and pass the desired audio range of 300-3000 Hz.

The first audio amplifier is reverse biased when the radio set is squelched. 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 signals are 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 per octave de-emphasis characteristic from 300 to 3000 Hz. As the frequency of the signal increases, the impedance across the capacitor decreases and the resultant signal amplitude decreases. The audio output from the drivers is transformer coupled to push-pull output amplifiers. The output stage provides a 5 watt output to a 3 ohm speaker with less than 5% distortion. Response is within +2, -8 dB of the 6 dB per octave de-emphasis characteristic between 300 to 3000 Hz.

3. TRANSMITTER

a. General

This solid-state transmitter is directly frequency-modulated for crystal-controlled frequency operation in the 136-174 MHz range. It consists of a modulator-oscillator-multiplier stage, buffer amplifier, tripler, oscillator-multiplier stage, buffer amplifier, tripler,

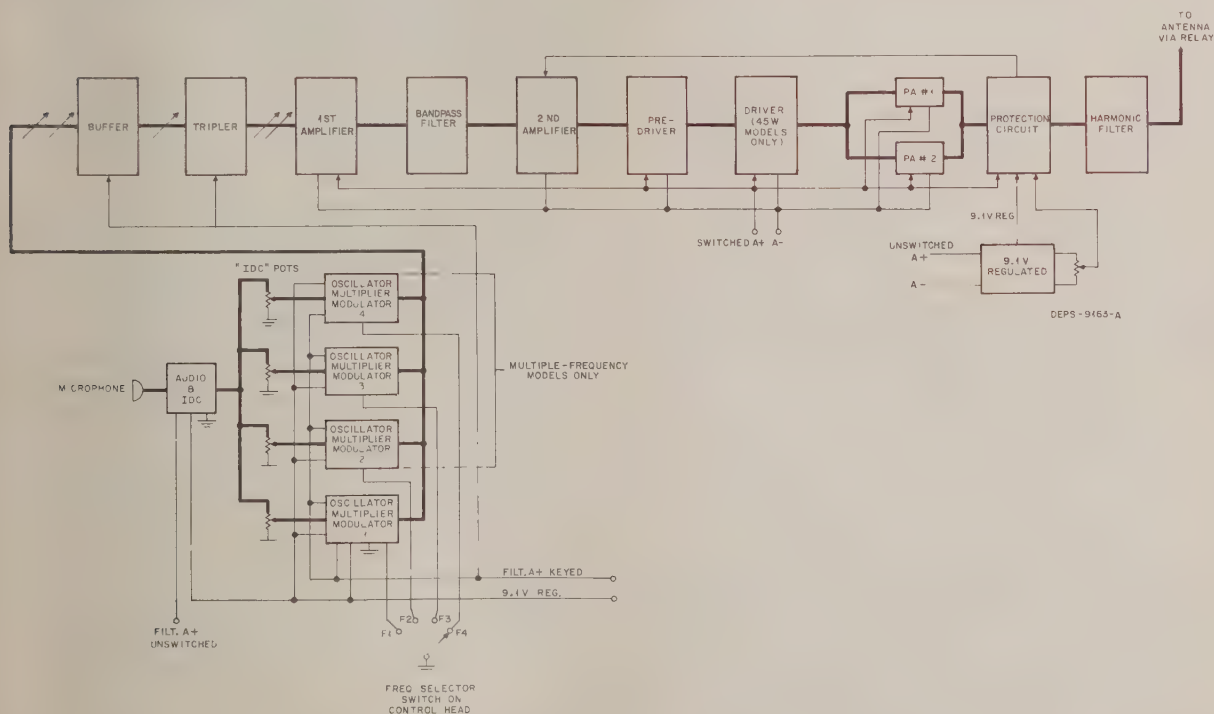


Figure 4.
Transmitter Block Diagram

four additional amplifier stages (three in 30 watt models) and a push-pull final amplifier pair. The fundamental crystal frequency is multiplied 9 times to provide the final output frequency.

b. Deviation Limiting Circuit

(1) A-Suffix Main Board Models

The output waveform from the microphone is connected to the deviation limiting circuit. The deviation limiting circuit consists of components for pre-emphasizing, amplifying and limiting the input waveform.

Bootstrap feedback from the emitter of Q101, through C182, R181, R182 and R183, is used to make the input impedance of the IDC ("Instantaneous Deviation Control") amplifier appear as a large low Q inductor. The pre-emphasis network (C191 and the IDC amplifier input impedance) yields a 6 dB per octave pre-emphasis response below 3 kHz and a flat response above 3 kHz. After pre-emphasis, the audio signal is amplified by Q101 and Q102. Negative feedback (R186 and R187) is used to maintain constant gain and low audio distortion. Amplitude peaks are clipped when Q102 is driven to saturation (fully on) or cut-off (fully off). The peak-to-peak amplitude is limited to the regulated supply voltage by CR180.

The pre-emphasized, amplified and clipped microphone audio passes through the splatter filter (L180, C188) to the base of the emitter follower (Q103). (The PL tone is injected at this point on PL models.) The emitter follower isolates the modulator load from the splatter filter thus insuring proper splatter filter response. An IDC adjustment potentiometer is provided for each oscillator (R101, R102, R103, R104). It is necessary to set the deviation for each channel in a direct FM system because the modulator sensitivity is related to the individual oscillator characteristics.

(2) B-Suffix Main Board Models

Refer to exciter schematic diagram EEPS-9136-A. Audio from the microphone is applied to the deviation limiting circuit. This provides pre-emphasis, amplification, and limiting to the microphone audio.

Coupling capacitor C182 and the input resistance of audio amplifier Q100 provide 6 dB per octave pre-emphasis.

Audio amplifier Q100 amplifies the microphone audio and applies it to the "IDC" limiter via C185 and C186. The "IDC" circuit consists of complementary-connected transistors Q101 and Q102, which have equal signal levels applied to their bases. Capacitor C185, with the base and emitter resistances of Q101, and C186, with the base and emitter resistances of Q102, form a high-pass filter with a

cutoff frequency of about 200 Hz. The single-ended output from the collectors of Q101 and Q102 is applied to emitter follower Q103. Emitter-to-base and collector-to-base feedback paths are provided to ensure a symmetrical audio signal input to the emitter follower.

The audio signal is applied through splatter filter L180 and C188 to the base of emitter follower Q103. The PL tone is also applied to the base of Q103 in PL models. The emitter follower isolates the modulator load from the splatter filter to ensure proper splatter filter response. An IDC adjustment potentiometer is provided for each oscillator. Because the exciter uses direct FM it is necessary to set the modulation deviation for each channel.

c. Modulator-Oscillator-Multiplier Stage

The combination modulator-oscillator-multiplier stage generates one third the carrier frequency by tripling the fundamental frequency of the transmitter crystal. The direct frequency modulator consists of the parallel combination of a varactor and warping coil connected in series with the crystal. A change in capacitance seen at the crystal terminals, will cause the crystal to vary its resonant frequency in proportion to the capacitance change. The audio voltage from the audio and IDC circuitry is applied to the varactor to cause a change in capacitance; this variation in turn causes the frequency to change at the same audio rate. The double-tuned circuit, L102 and L103 at the output of the oscillator transistor(s), tunes to the desired third harmonic of the crystal.

NOTE

Because the frequency adjustment coils (L101, L107, L108, L109) and the modulator circuitry are combined, THE TRANSMITTER FREQUENCY MUST BE PROPERLY ADJUSTED BEFORE SETTING THE TRANSMITTER DEVIATION WITH THE "IDC" CONTROL. Refer to the transmitter alignment procedure for details.

d. Buffer Amplifier

The buffer amplifier, Q105, is biased to operate as a Class A amplifier and provides reserve gain to isolate the oscillator from the succeeding stages.

e. Tripler

The tripler stage (Q106) is a Class C biased multiplier which triples the buffer output to the desired carrier frequency. The double-tuned circuit (L105 and L106) provides the required selectivity.

f. 1st Amplifier

The 1st amplifier (Q107) is a Class C stage which provides a 500 mW output at the carrier frequency to drive the power amplifier section. This stage and

the power amplifier operate on A+ voltage referenced to A-. A- is isolated from the chassis in positive ground operation while the preceding stages operate on filtered A+ voltage referenced to the chassis. C139, C101, L125 and C141 provide matching to the 50 ohm power amplifier input.

g. Power Amplifier

The power amplifier (Q108, Q109 and Q110) consists of three Class C amplifiers (Q110 is not used in 30 watt models) and two final amplifiers (Q111, Q112) arranged in a push-pull configuration. The stages are coupled by low Q broadband capacitive matching networks such that only two tuning elements (C102, C103) are required in the entire power amplifier circuit. The rf rated power output is either 45 or 30 watts depending on the model.

h. Protection Circuit

A series regulator (Q113) is the collector feed of the 2nd amplifier and it protects against harmful conditions which cause power amplifier over dissipation such as antenna mismatch, high battery voltage or excessively high temperatures. A directional coupler is used to sense forward and reflected power levels. By sensing the forward power, the output level can be stabilized within safe, controlled levels of transistor dissipation. By sensing the reflected power, antenna mismatching is determined and the transmission is maintained, even into a mismatch, only at lower power output levels.

The detected forward and reverse power levels, detected by CR670 and CR671, are applied to trigger amplifiers Q117 and Q118 respectively. The trigger level of Q117 is determined by potentiometer R105 and the trigger level of Q118 is determined by a resistive voltage divider (R674 and R675). Once Q117 or Q118 is triggered, dc amplifiers Q116 and Q115 are turned on. Normally Q113 and Q114 are saturated but collector current to Q115 causes Q114 and Q113 to drop out of saturation thus reducing the voltage supplied to the 2nd amplifier. Thermistor RT670 monitors the power amplifier temperature and is used to gradually reduce power amplifier transistor dissipation at high temperatures. This feature provides continuous duty capability.

R684, R681 and RT670 base bias Q115 at high temperatures thus causing a reduced A+ voltage to the 2nd amplifier. Short circuit protection for the 2nd amplifier supply line is achieved by current limiting Q114 with CR672, CR673 and R683.

i. "Private-Line" Tone Generator

This tone generator consists of a transistorized two-stage oscillator and "reverse burst" switching circuit. The frequency determining element of the oscillator is a Motorola "Vibrasender" resonant

reed (an electro-mechanical equivalent of a parallel-tuned high Q tank circuit). The oscillator operates continuously when the radio set is turned on. The oscillator output is amplified by Q706 and Q707 and is then injected into the transmitter audio-IDC circuit.

The oscillator circuit is made up of Q704, Q705, the "Vibrasender" resonant reed and the bias circuitry. The oscillator tone output is taken from the collector of Q705 or from resistor R724 in the emitter circuit of Q705. The selection of these two paths is determined by diodes CR710 and CR711. When the transmitter is keyed, the push-to-talk lead is connected to the grounded battery terminal. The diode bridge (comprised of CR701, CR702, CR703 and CR704) causes Q701 to turn on. When this happens, CR710 becomes reverse biased and CR709 is forward biased through R728, R730 and R731. The tone oscillator output is now taken from R724. When the push-to-talk button is released, Q701 is turned off and CR710 is now forward biased through R725, and R729. Diode CR709 becomes reverse biased and the tone output is now taken from the collector of Q705. The 180° phase shift between the two tone paths gives a "reverse burst" of tone just after the push-to-talk button is released. This tone prevents "squelch tail" from occurring in the receiver by quickly damping the "Vibrasponder" resonant reed. Even though the push-to-talk button is released, the transmitter remains "on" for approximately 150 milliseconds so that the "reverse burst" of tone may be transmitted. This delay is accomplished by Q702 and Q703 which comprise the "reverse burst" switching circuitry. When the transmitter is keyed, Q701 and Q703 are immediately turned on. Q703 supplies current to the transmit/receive relay. When the push-to-talk button is released, Q701 and Q702 are turned off but Q702 turns on again after capacitor C701 is discharged through R704. It should be noted that during the discharge time (approximately 150 milliseconds) Q702 is off and Q703 is on. Finally as Q702 is turned on, Q703 is turned off. This action removes the voltage from the relay which turns off the transmitter.

j. "Digital Private-Line" Encoder

The encoder is contained in an integrated circuit which generates a 23-bit code word during the transmit cycle and a turn-off code for approximately 180 milliseconds after PTT. These signals are applied to the transmitter audio-IDC circuit. For complete description refer to the schematic diagram and separate instruction section 68P81106E83.

4. GROUND REVERSING KIT

a. Description

These kits, available on special request adapt "Mocom-70" radio sets to vehicles with

either negative or positive ground electrical systems.

The unit consists of a converter circuit mounted in a compact housing with a plug for insertion into a mating receptacle located in the radio set. Rotating the unit 180° and reinserting it into the receptacle adapts the radio set for the opposite input polarity. The two input polarities are marked on the unit at opposite ends and an arrow on the polarity plug plate identifies the orientation of the unit.

b. General Circuit Operation
(Refer to Schematic Diagram)

When the unit is inserted in the power receptacle in the negative ground position, input polarity to the converter circuit is such that it does not operate. Wiring of the unit connects the dc input directly to the radio set with the proper polarity.

When the ground reversing kit is positioned for positive ground operation, a multivibrator switching circuit feeds the input current into the primary side of a toroid transformer. To produce 12 volts referenced to the chassis, A+ with respect to ground, the output from the transformer secondary (approximately 15 volts) is rectified, filtered and referenced to the battery positive terminal, which is the radio chassis. A limiter circuit in the output of the unit prevents damage to the switching transistors under a shorted output condition.

DC starting is provided by resistor R202, which feeds current from the positive input through the base-drive windings of the transformer to the base of the switching transistors. Reverse polarity protection is provided by series diode CR202, in the primary circuit negative-return lead.

c. Starting and Running

When voltage is applied to the converter, assume that Q201 conducts more than the other switching transistor because of a small imbalance in the circuit. The resulting increase in voltage across the primary of the transformer induces a voltage in the feedback winding of a polarity that will cause transistor Q201 to be driven into saturation and Q202 to be reverse biased and driven into cutoff. As the transformer saturates, causing no change in the flux density, the drive to the base of Q201 is reduced and the collector current begins to decrease. This causes a change in the flux in the opposite direction that drives Q201 into cutoff and forward biases Q202, turning it on. Q202 then operates as Q201 did in the initial half cycle.

d. Output Circuit

The output limiter circuit uses Q204 as a short-circuit detector to control the base drive of a saturated switching transistor (Q203) connected in series

with the positive output lead. If the output is short circuited, the output voltage falls and removes the drive voltage to the short-circuit detector (Q204). As Q204 turns off, the base drive to Q203 is removed forcing it into cutoff. This causes the 680-ohm resistor (R205), connected from the collector to the emitter of Q203 to appear as the load so that the converter operates correctly with a 680-ohm load instead of a short circuit load.

e. Conversion of Negative Ground Only Radio Sets to Positive or Negative Ground Operation

Remove existing plug P201 (TLN8427A Negative Ground Kit) from the radio and replace it with the TLN8482A Ground Reversing Kit. Insert this plug-in unit so that the arrow on the polarity plug plate points to the same ground polarity on the kit as that of the vehicle electrical system.

5. TIME-OUT TIMER

(Refer to Schematic Diagram)

The time-out timer circuitry (mounted on the polarity plug plate) is used to turn off the transmitter and activate the receiver audio to generate an alert tone if the radio set is keyed continuously for more than one minute.

Once the timer has timed out, it may be reset for another minute by simply unkeying and then keying the transmitter.

When the radio set is in the receive condition, keyed A+ with respect to ground 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 A+ with respect to ground 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 cutoff. 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 transistor Q250 to shut off. On radio sets equipped with a time-out timer, Q250 normally acts as an emitter follower and is the A+ voltage source for the transmitter oscillator-modulator. Thus, when Q250 is shut off, the transmitter is shut off.

When the transmit-receive relay opens, transmitter keyed A+ / GND drops to zero thereby permitting SCR251 to reset.

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). The following table 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 A+ with respect to ground is applied.

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

6. AUTOMATIC PILOT LIGHT DIMMER CIRCUIT

(Refer to applicable Schematic Diagram)

The pilot light dimmer circuit automatically controls the brilliance of the green (receive)

pilot light mounted on the control head. In bright daylight, the light glows brightest to insure visibility. The light becomes progressively dimmer to reduce excessive glare as daylight changes to darkness. External illumination is sampled through a window in the lower portion of the control head and acts upon a light detecting resistor which is mounted behind the window.

When the radio is turned on, transistor Q501 conducts. Its collector current flows through the green pilot light, DS501. The light detecting resistor (LDR) R513, which is part of the base biasing network for Q501, controls the base current flowing into the transistor. Consequently, the current passing through the green pilot light is inversely related to the resistance of R513 (LDR).

The resistance of the LDR is controlled by the amount of light striking it (the resistance decreases as the light intensity increases and vice versa). During daylight operation (LDR resistance low), the collector current of Q501 is high and the light glows brightly. During night time operation (LDR resistance high), the collector current of Q501 is low and the light glows dimly.

The diode bridge (comprised of CR501, CR502, CR503, and CR504) is a polarity switching network which permits dimmer circuit operation in both positive and negative ground systems.

SERVICE AIDS

TEST EQUIPMENT CHART

EQUIPMENT	APPLICATION
Motorola Model S1056B-9B Portable Test Set	Alignment and servicing the receiver and transmitter.
Motorola Model T1012A Power Supply with Motorola TEK-15A Ripple Filter or S1303 Regulated Power Supply	DC power requirements while servicing.
Motorola Model S1318A FM Signal Generator	Alignment of all rf and high i-f stages and receiver sensitivity measurements.
Motorola Model S1350A Wattmeter with appropriate elements and Motorola Model T1013A RF Load Resistor	Transmitter load and rf power indicator during tune-up and servicing.
Motorola Model S1344 Series Digital Frequency Meter with Deviation Monitor	Frequency and IDC Adjustments.
Oscilloscope	IDC Adjustment.
Motorola Model S1063A Solid-State DC Multimeter and Model SLN6055A RF Probe	All dc and rf measurements.
Motorola Model S1053C Solid-State AC Voltmeter	All audio voltage measurements.
Motorola Model TEK-1 Transistorized Tone Generator or Motorola S1067B Solid-State Tone Generator	IDC adjustment (the S1067B Tone Generator when used with an ac voltmeter can be used for measuring harmonic distortion, a function required when making EIA Sinad sensitivity measurements).
Motorola SLN6221A Tone Generator Motorola TLN4207A Alignment Tool Kit	Servicing receiver "Private-Line" decoder circuit. Adjusting the coils, variable capacitors, IDC and current limiter controls.
Motorola Model SLN6413A "Digital Private-Line" Test Set	"Digital Private-Line" encoder-decoder using TRN6005A Code Plugs or Thumb-Wheel Switches to determine the DPL code.

1. RECOMMENDED TEST EQUIPMENT

All the recommended test equipment for aligning and testing the radio set is listed in the above TEST EQUIPMENT CHART. The listed items or their equivalent may be used.

2. "DIGITAL PRIVATE-LINE" CIRCUIT SERVICING

a. General

All theory of operation, test voltages, waveforms, and other servicing information for the "Digital Private-Line" encoder-decoder is included on the schematic diagram. The "Digital Private-Line" encoder-decoder uses a CMOS integrated circuit. CMOS devices should be handled with care. The precautions described in this section should be read carefully before servicing the "Digital Private-Line" encoder-decoder.

b. Handling Precautions for CMOS Integrated Circuits

Many of the integrated circuit devices used in communications equipment are of the CMOS

(Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even in a system.

TO AVOID DAMAGE TO CIRCUITS, OBSERVE THE FOLLOWING HANDLING, SHIPPING, AND SERVICING PRECAUTIONS:

(1) Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

(2) Whenever possible avoid touching any electrically conductive parts of the circuit module with your hands.

(3) When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

(4) All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

(5) If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through a resistance of approximately 100k.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

(6) When soldering, be sure the soldering iron is grounded.

(7) Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

(8) When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

(9) All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

(10) Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER

USE NONCONDUCTIVE MATERIAL for packaging these modules.

c. Performance Tests

If the decoder is operating properly, a 0.25 microvolt rf carrier modulated ± 0.5 kHz with the appropriate "Digital PL" code should unsquelch the receiver. This can be checked as follows:

(1) Connect the rf signal generator output to the radio set antenna jack and set the generator output level to minimum.

(2) Modulate the signal generator ± 0.5 kHz with the appropriate "DPL" ("Digital Private-Line") code. The modulating signal can be obtained from a Motorola Model SLN6413A "Digital Private-Line" Test Set.

(3) Also modulate the signal generator with a 300 to 3000 Hz tone. Total deviation should be ± 4 kHz, including "DPL" code.

(4) Increase the signal generator output level until the receiver unsquelches. No more than 0.25 uV should be needed to unsquelch the receiver.

The encoder should modulate the transmitter rf carrier at least ± 0.5 kHz. The transmitted signal should unsquelch any properly-operating receiver that is equipped with the same "DPL" code and is operating in the "DPL" mode. After the microphone PTT button is released, the transmitter should remain keyed for about 180 milliseconds and the encoder should produce a turn-off code. No squelch tails should be heard in properly operating "DPL" receivers. Validity of the "DPL" code and turn-off code can be checked with a Motorola SLN6413A "Digital Private-Line" Test Set.

d. Troubleshooting

If the encoder-decoder performance is unsatisfactory, first thoroughly inspect the radio set and, particularly, the "DPL" encoder-decoder board. Check for visible defects in circuit boards, components and wiring. After any visible defects have been corrected, test the radio set and "DPL" board operation again. If performance is still unsatisfactory, use the following troubleshooting chart to help you isolate the defective circuit and component.

"DIGITAL PRIVATE-LINE" ENCODER-DECODER TROUBLESHOOTING CHART

Use this troubleshooting chart as a supplement to the maintenance information on the schematic diagram.

SYMPTOM	PROBABLE CAUSE	CIRCUIT CHECKS
Transmitter has no power output. Transmit relay doesn't operate.	No A+ from PTT delay circuit.	1. Check PTT switch circuit. 2. Check PTT delay circuit.
Transmitter causes squelch tails in "DPL"-equipped receivers.	Turn-off code not being sent, or is of insufficient duration or deviation.	1. Check turn-off code deviation: should be ± 500 to ± 1000 Hz. Turn-off code should begin as soon as PTT button is released. Transmitter should remain keyed for 160 to 250 msec after PTT button is released. 2. Check PTT delay circuit. 3. Check U801-9: should be 0 V during delayed PTT. 4. Check Q821: must be off for proper low-pass filter operation during transmit.
Transmitter cannot unsquelch "DPL"-equipped receivers.	Insufficient transmitter "DPL" deviation.	Check "DPL" deviation: should be ± 500 to ± 1000 Hz.
	Incorrect or faulty "DPL" code.	1. Check U801-15 through U801-23 for proper octal code. 2. Check U801-9: should be +6 V (high).
	Encoder filter is malfunctioning.	Check encoder filter (Q801-803 and Q821) for proper operation.
	50 kHz oscillator is malfunctioning.	Check U801-4 for 50 kHz square wave. Rise time should be 750 nsec or less.
Receiver will not unsquelch in "DPL" operation.	Switch interface circuits are malfunctioning.	Check switch interface circuits (Q805 and Q806). Q806 emitter should be 12.8 V when U801-7 is high.
	U801 is not decoding properly.	1. Check U801-7: should be 6 V when decoding a valid code. 2. Check U801-1: should be 0 V. 3. Check U801-12 with oscilloscope. You should see 6 V p-p pulses 1.84 msec apart.
	50 kHz oscillator malfunctioning.	Check U801-4 for 50 kHz square wave. Rise time should be 750 nsec or less.
	U801 is not properly programmed.	Check U801-15 through U801-23 for proper octal code.
	U801 is in encode mode.	Check U801-9: should be low.
	Decoder filter and data conditioner malfunctioning.	Compare waveforms and voltages with those on the schematic diagram.
	Decoder low-pass filter malfunctioning.	Check decoder filter response. At Q812 emitter the filter response should be -1 to -4 dB at 134 Hz and -12 to -15 dB at 250 Hz. Keep input signal below 400 mV p-p to keep CR803 and CR804 out of clip.
Excessive decoder falsing.	Encoder-decoder U801 malfunctioning.	Check U801-7: should be low when no code is decoded.
	U803C in current source is on.	Check U803-9: should be 10.0 V when U801-7 is low.
	Decoder filter malfunctioning.	Check decoder filter response. See checks for excessive decoder falsing.
Excessive blocking	Current source malfunctioning.	Check U803-9: should be 0.1 V when U801-7 is high.
	Decoder filter malfunctioning.	Check decoder filter response. See checks for excessive decoder falsing.
Squelch open at all times in "DPL".	Switch interface circuit malfunctioning.	Check switch interface circuits (Q805 & Q806).
	U801 malfunctioning.	Check U801-7: should be 6 V except when valid code is decoded.
	Power supply voltage is not 6.2 V $\pm$.5 V.	Check voltage at U801-24.
	50 kHz oscillator operating intermittently or at wrong frequency.	Check 50 kHz clock signal at U801-4: should be 50 kHz square wave. Rise time should be 750 nsec or less.

3. PRINTED CIRCUIT BOARD SERVICE AND REPAIR

a. Component Removal

Most components are located on printed circuit boards. Special care should be taken during troubleshooting to be as certain as possible that the suspected component is actually the one at fault. This special care will eliminate unnecessary unsoldering and removal of parts which may damage or weaken other components or the printed circuit board.

CAUTION

The components are soldered to the printed circuit plating which extends through the holes to the plating on the opposite side. Read this section for proper use of the soldering iron to prevent damage when removing components.

Transistors are dependable components and are not subject to replacement frequently, as vacuum tubes are. Therefore, the serviceman is cautioned not to replace transistors before a thorough check is made. The transistor terminal voltages should be checked first. If these voltages are not reasonably close to the value specified on the schematic diagram, the associated components should be checked. If all dc voltages are correct, the signal should be traced through the circuit to show any possibility of breaks in the signal path.

When removing resistors, capacitors and similar components, heat the connection to be loosened until the solder is molten. Then brush away, or shake off as much of the molten solder as possible. If the leads are bent over, use a soldering aid tool or a knife to straighten them. It may be necessary to apply the soldering iron while doing this. While applying the soldering iron, wiggle the component gently to free it, then lift it from the board. Be sure the component lead is free before trying to remove it or the printed circuit wiring might be damaged. Clean the circuit wiring around the holes with solvent. Install the new component and solder it in place. Never let the solder flux bridge the gap between the wiring pattern. This can reduce the resistance between circuits to only a few megohms which will cause leakage and disrupt certain electronic circuits. Use solvent to clean away flux after soldering.

Removal of the transmitter-receiver printed circuit board is not necessary. All components are accessible as mounted.

b. Repair

In the past, servicemen have been led to believe that printed circuits are extremely fragile and that an exceptionally low wattage soldering iron must be used to prevent the heat from lifting the plating. This is a misconception. Experience has shown that using a soldering iron with low heat output, in many cases, has actually caused the damage that the serviceman was trying to prevent. It is absolutely necessary to raise the temperature of the connection until the solder flows freely around the component lead. This usually takes a considerable length of time with a very low heat iron. During this time heat is conducted away from the connection by the printed wiring causing them, in some instances, to break away from the board. If a component is to be removed, its soldered connections must be raised to a temperature that permits free flow of solder. Otherwise the component's leads may not be freed from the plating in the hole which will be pulled out of the board as the component is removed. The soldering iron supplied with the Motorola Printed Circuit Repair Kit is recommended for most work on printed circuit boards. This hi-heat iron need be applied only a very short time to heat a connection to the point where solder flows freely. It is obvious that an iron this hot should not be held on a connection longer than necessary. Extended periods of high heat will cause the foil to peel loose from the board.

The tip of the iron has a tapered point to permit its exact application to the desired connection in the compact equipment. Always keep the iron tip well tinned and clean.

Breaks in the printed wiring can be repaired by bridging the gap with solder. Remove the resin coating covering the printed wiring with solvent before soldering. Large areas of the printed wiring that have peeled loose can be repaired with a piece of hook-up wire. The hook-up wire should follow along the path of the original printed wiring. This avoids any lead dressing problem in critical circuits.

c. Tools

Motorola has available several items which can be used to aid in parts replacement and repair of the printed circuit board. These tools are described and illustrated in the following paragraphs.

(1) Magnifying Glass

Miniaturization requires precision work both in manufacture and in field service. Adequate



ST-650 Magnifying Glass &
Built-In Light Source

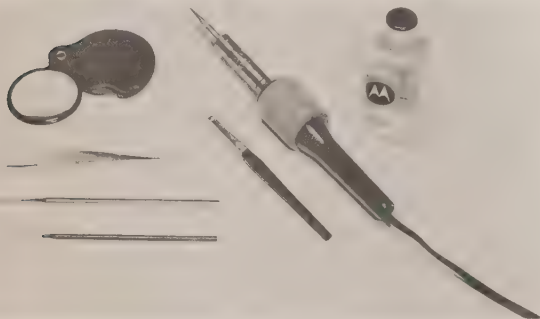
concentration of light and magnification are aids to service by enabling a visual examination of connections and miniature parts. The ST-650 or ST-652 Magnifying Glass & Built-In Light Source is a most satisfactory device for use in servicing miniature equipment in the shop. This large illuminated magnifying glass makes it easy to see any portion of the small components found on the printed circuit board. Refer to the accompanying illustration.

(2) Printed Circuit Repair Kit

The ST-639 Printed Circuit Repair Kit supplies most of the basic tools needed for work on printed circuitry and miniature components. Refer to the accompanying illustration.

NOTE

The needle point tiptlet for the soldering element may be filed to an even finer point to avoid damaging the compact printed circuitry.



ST-639 Printed Circuit Repair Kit

d. Front Panel and Key Lock Removal

The radio set is completely accessible for service without removing the front panel. Unusual circumstances, such as front panel damage, may necessitate front panel replacement.

To remove the front panel, the key lock must be dismantled, the escutcheon removed and the four front panel screws must be removed. A special tool, Motorola Part No. 66A84909B01, is required to free the lock barrel from the outside housing which in turn permits the locking bar to be removed.

The lock barrel is removed as follows:

- (1) Insert the key into the lock and turn the key horizontally to the unlocked position.
- (2) Insert tool (No. 66A84909B01), with the beveled edge of the tool facing upward, into the small slot in the front end of the lock.
- (3) Push the tool in until it stops and turn 180° clockwise.
- (4) Pull the key, this removes the key and the barrel from the lock housing.
- (5) If the lock has a metal locking bar, remove the locking bar spring. Plastic lock bars do not require springs.
- (6) Remove the lock bar.

Re-assembling the front panel and key lock is accomplished by reversing the order of the steps.

4. TRANSMITTER SERVICING

a. Alignment Procedure

Instructions for aligning the transmitter are provided in the Transmitter Alignment Procedure of this manual. Refer to these instructions for all information pertaining to transmitter tuning.

b. Metering the Transmitter

A 12-pin metering receptacle for connecting a Motorola Model S1056B-9B Portable Test Set is located in the exciter circuit on the main radio board. A Motorola Model SKN6012B Metering Cable must be used to connect the portable test

set to the metering socket. Typical meter readings are given in the Transmitter Alignment Procedure. If meter readings differ greatly from those in the table, check the transmitter for defective components or improper alignment.

c. Power Output

Connect a wattmeter at the antenna receptacle on the front panel of the radio set and take a power reading. If rated power output is not obtained (45 or 30 watts dependent on model) proceed with meter readings.

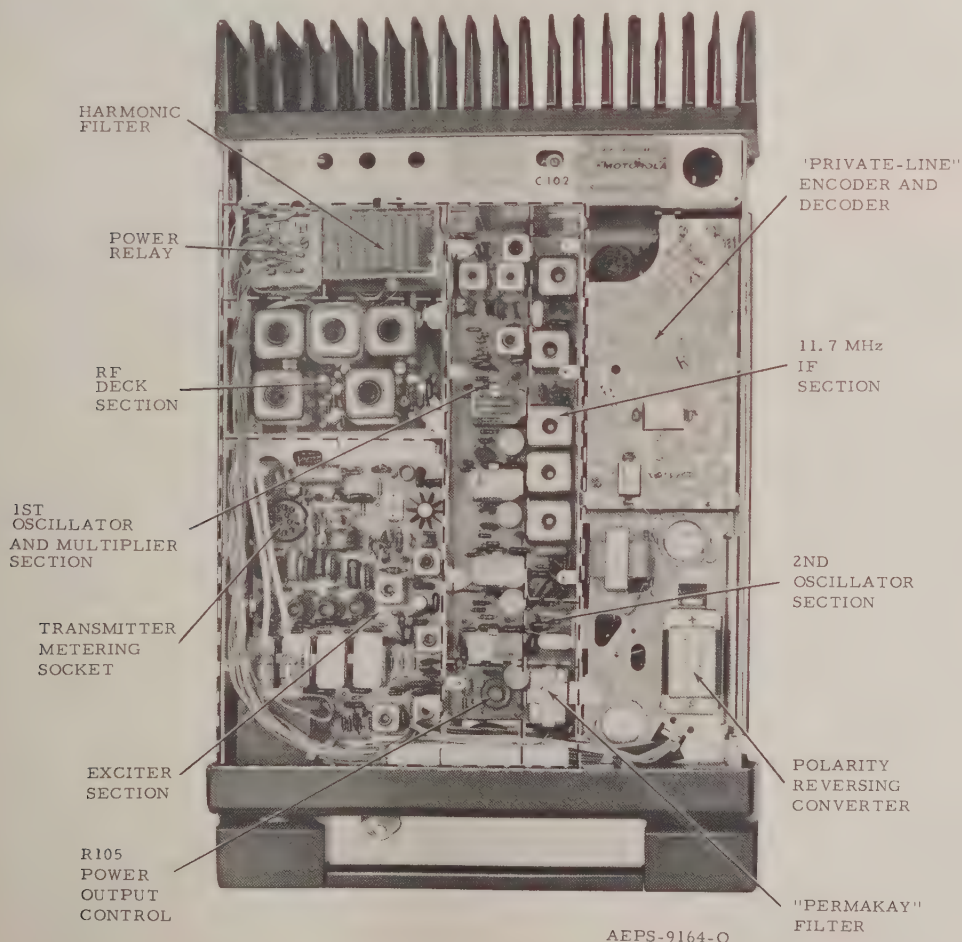
d. Meter Readings

Connect the portable test set to the transmitter metering socket and set the function selector switch of the test set to the XMTR position. Take readings and compare them with the values tabulated in the Transmitter Alignment Procedure, or preferably, compare them with the set of readings taken the last time the transmitter was serviced.

WARNING

To prevent possible damage to the radio, set, key the transmitter in short bursts only, long enough to take meter readings, until the transmitter is returned to normal.

If exciter meter readings are abnormal, the malfunction can be isolated by checking the appropriate stages for proper dc signal voltages. DC readings should be made with either a high impedance voltmeter or a VOM as noted on the schematic diagram, and compared to the readings on the schematic diagram or previous voltage data on the unit. It should be noted that the class C stages Q106, Q110, Q111 and Q112 will show reverse bias on the emitter-base junction. This is normal and due to the self-bias generated by the transmitter when drive is present. Consequently, this can be used as an indication of drive to a particular stage.



Radio Set Location Detail

The ac signal readings given in Figure 5 may be used as a guide to isolating a defective stage. Also, typical transmitter audio and rf waveforms are shown on the schematic. An rf probe and high impedance dc voltmeter, such as the Motorola S1063C can be used for the rf readings. The audio stages will require a sensitive ac voltmeter.

Voltage and resistance checks of the suspected stage in the exciter or power amplifier section should isolate the defective component.

e. Frequency and Audio Sensitivity

Check transmitter frequency and modulation sensitivity. A .14 volt 1000 Hz audio signal applied at the microphone receptacle should produce no less than 3.3 kHz deviation. If the transmitter cannot be "warped" to the proper frequency, check the regulator voltage (9.1 V dc). Replace the crystal or the varactor diode if necessary.

f. "Private-Line" Tone Generator

If transmitter deviation with PL tone applied is improper, check the tone oscillator and

tone amplifier circuits. The following typical ac signal levels were measured with a Motorola Transistorized AC Voltmeter. Signal levels may vary widely depending upon the frequency of the "Vibrasender" Resonant Reed. Refer to the chart in Figure 6 and the schematic diagram.

The phase of the signal at the tone generator output should reverse when the transmitter is keyed and revert to the original condition immediately when unkeyed. The "Vibrasender" Resonant Reed can be checked quickly by plugging it into a Motorola SLN6221A "Private-Line" Tone Generator. If a tone output is generated, the reed is good. Make dc voltage checks and resistance checks to isolate the defective part.

If "squelch tail" noise bursts are heard in listening receivers, check voltages in the "reverse burst" switch circuit of the transmitting station. DC voltages given on the schematic are for the transmitter keyed condition. Figure 7 shows the important transient waveforms which should be seen in the "reverse burst" circuitry when the transmitter is unkeyed.

FIGURE 5.
TRANSMITTER AUDIO AND RF VOLTAGE READINGS

METERING POINT	TYPICAL VOLTAGE READINGS (rms)		
	Emitter	Base	Collector
Audio Amplifier (Q101) Note 1	40 mV	40 mV	180 mV
Clipper (Q102) Note 1	--	7.6 mV	1.3 V
Emitter Follower (Q103) Note 1	1.1 V	--	--
Oscillator(s) (Q104, Q119, Q120, Q121)	--	--	1.7 V
Buffer (Q105)	--	0.8 V	4.0 V
Tripler (Q106)	--	3.0 V	5.3 V
1st Amplifier (Q107) Note 2	--	1.5 V	9.0 V
2nd Amplifier (Q108) Note 2	--	3.5 V	5.0 V
Pre-Driver (Q109) Note 2	--	2.5 V	9.0 V
Driver (Q110) Notes 2, 5	--	6.0 V	12.0 V
Final Amplifiers (Q111, Q112) Notes 2, 5	--	8.0 V	14.0 V
Final Amplifiers (Q111, Q112) Notes 2, 6	--	5.0 V	12.0 V

NOTES:

1. Audio readings are taken with 0.1 V rms of 1000 Hz tone applied at the microphone connector.
2. These voltages measured with respect to transmitter A- plating (not chassis ground).
3. All voltages measured with respect to chassis ground unless otherwise indicated.
4. Supply voltage = 13.6 V dc.
5. 45 watt power amplifier only.
6. 30 watt power amplifier only.

FIGURE 6.
"PRIVATE-LINE" TONE GENERATOR MEASUREMENTS

METERING POINT	TYPICAL AUDIO VOLTAGES
Tone Oscillator, Q704, Base	180 mV rms
Tone Oscillator, Q704, Collector	1.2 V rms
Across Reed Primary, B1 to B2	60 mV rms
Across Reed Secondary, A1 to A2	100 mV rms
Tone Oscillator, Q705, Base	0.85 V rms
Tone Oscillator, Q705, Collector	0.4 V rms
Tone Oscillator, Q705, Emitter	0.85 V rms
PL Amplifier, Q706, Base	.35 V rms
PL Amplifier, Q706, Emitter	.35 V rms
PL Amplifier, Q706, Collector	25 mV rms
PL Amplifier, Q707, Collector	3.2 V rms
PL Tone Output (BLK-GRN WIRE)	0.60 V rms

NOTES:

- Readings may be taken without keying transmitter.
- All readings taken with Motorola AC Voltmeter are referenced to chassis.

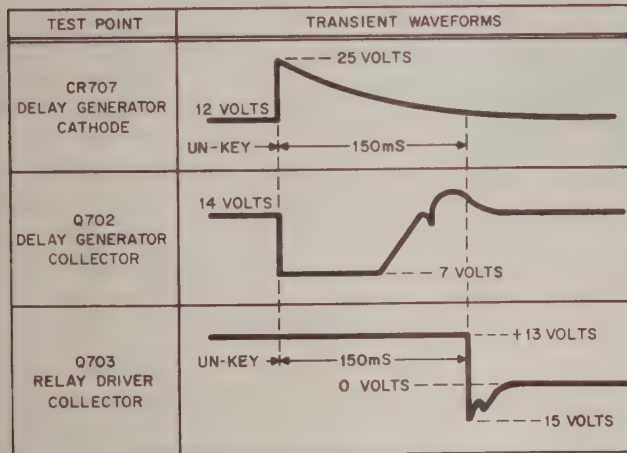


Figure 7.

AEPS-3137-0

Transients Appearing in "Private-Line" Delay Circuit After the Transmitter is Unkeyed

g. "Digital Private-Line" Code Generation

If transmitter deviation with "Digital Private-Line" binary signals applied is improper, refer to separate Motorola instruction section 68P81106E83 for information on setting deviation.

5. RECEIVER SERVICING

a. Alignment Procedure

Instructions for aligning the receiver are provided in the Receiver Alignment Procedure of this manual. Refer to these instructions for all information pertaining to receiver tuning.

b. Metering the Receiver

A 12-pin metering receptacle for connecting a Motorola Model S1056B-9B Portable Test Set is located near the discriminator transformer on the main radio board. A Motorola Model SKN6012B Metering Cable must be used to connect the portable test set to metering socket.

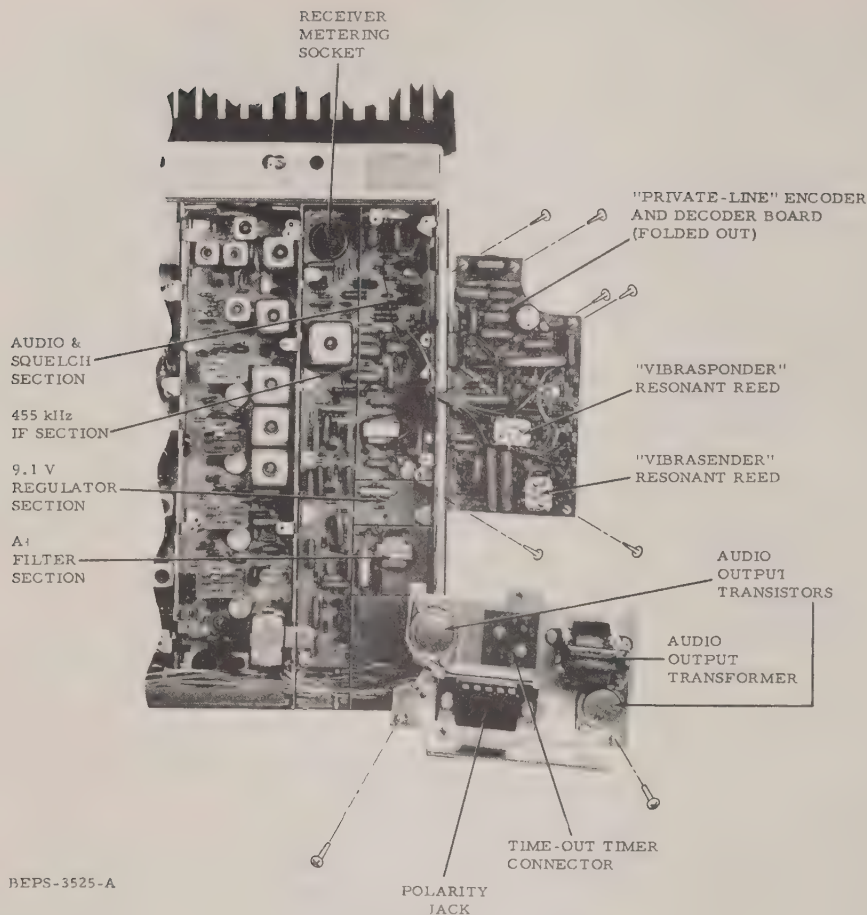
c. Receiver Sensitivity

The sensitivity measurement is a relatively simple means for making a very comprehensive check on receiver's overall gain distribution and general operating performance. The sensitivity check should be among the first measurements made when a receiver malfunction is suspected.

Receiver sensitivity can be determined by using either the EIA-SINAD method or the 20 dB quieting method. The SINAD method is certainly the better of the two since the use of a modulated carrier gives a check on receiver bandwidth and audio power output; two performance characteristics which the quieting method by and large ignores. Quieting sensitivity, however, is by far the simpler measurement and, consequently, is the measurement generally performed in the field. The procedures for both measurements are given here.

- (1) 20 dB Quieting Sensitivity: (Specification= 0.50 uV or less)

20 dB Quieting Sensitivity of a receiver is the minimum value of unmodulated rf generator



Radio Set Location Detail

voltage which will reduce the receiver noise output by 20 dB (1/10th of the initial noise voltage).

To conduct the test, an rf signal generator must be connected to the receiver antenna input and the receiver audio output terminated in its proper load (3 to 4 ohms) with means provided to measure the audio output level. (Either an audio vtm or a Motorola Model S1056B-9B Series Test Set may be used.)

With the signal generator initially turned off the carrier frequency, adjust the receiver audio volume control, located on the radio set control head, for 1.0 volt rms audio noise output. (Switch position 11 on the test set.) Note that the squelch control should be turned fully counterclockwise (receiver unsquelched) for this test. On "Private-Line" or "Digital Private-Line" squelch models, set the monitor-operate switch to .

With the signal generator initially adjusted for a substantial rf input to the receiver (1000 uV), set the generator frequency on the carrier frequency and carefully adjust for discriminator "0" (switch position 4 on the Motorola test set).

The signal generator output is then reduced until the audio output noise level increases to .1 V rms. This generator input level is the receiver 20 dB quieting sensitivity.

- (2) $\frac{12 \text{ dB Sinad Receiver Sensitivity:}}{\text{(Specification = 0.35 uV or less)}}$

The EIA definition for sensitivity of a receiver is the minimum value of the modulated rf generator voltage which will produce at least 50% of the receiver's rated audio power output with a (signal + noise + distortion) to (noise + distortion) ratio (SINAD ratio) of 12 dB or better.

To conduct the test, an rf signal generator frequency modulated with 1000 Hz at ± 3.3 kHz deviation, must be connected to the receiver antenna input and the receiver audio output terminated in its proper load (3 to 4 ohms) with means provided to measure audio output level and to "eliminate" the 1000 Hz signal.

The most convenient elimination device is a total harmonic audio distortion analyzer, which is also used as the output level indicator; however, any other filter device having an attenuation of at least 40 dB at 1000 Hz and effectively 0 dB attenuation below 900 Hz and above 1100 Hz (up to 3000 Hz or more) can be used in conjunction with a very high impedance audio voltmeter.

The Motorola Model S1067B Audio Oscillator can be used as a band elimination filter and, when used with an audio voltmeter, provides a convenient means for making this measurement.

With the signal generator initially adjusted for a substantial rf input to the receiver (1000 μ V), the generator frequency is carefully adjusted for discriminator "0" (switch position 4 on the Motorola Portable Test Set) and the receiver audio VOLUME control, located on the radio set control head, adjusted to provide an indication of the 5 watts rated audio power output (4 volts across 3 ohm load or 4.5 volts across 4 ohm load). Note that the SQUELCH control on the radio set control head should be turned fully counterclockwise (receiver unsquelched) for this test. On "Private-Line" or "Digital Private-Line" squelch models, set the monitor-operate switch to .

The signal generator output is then reduced to a low level (.25 μ V) and the audio output level noted, the 1000 Hz elimination filter is switched into the circuit and the level difference observed. If the difference is 12 dB (level reduced to one-quarter of the previous voltage) this generator input level is the receiver sensitivity. If the difference is either more or less than 12 dB, the generator attenuator must be adjusted slightly until 12 dB is reached and the new attenuator setting is the sensitivity figure. Should the receiver audio output fall to less than 2.5 watts, with the elimination filter switched out of the circuit, as a result of the test, the generator output must be increased until 2.5 watts is reached and this setting is the receiver sensitivity, even though the SINAD will be greater than 12 dB.

d. Meter Readings

Connect the portable test set to the receiver metering socket and set the function selector

switch to the RCVR position. Check the meter readings (with no carrier signal) and compare with the typical readings given in Figure 8.

FIGURE 8.
TYPICAL RECEIVER METER READINGS
WITH NO CARRIER SIGNAL

Selector Switch Position	Typical Meter Readings in μ A	Stage
1	0	Base of 3rd 455 kHz ampl.
4	0	Disc. Sec.
5	25	Disc. Primary
6	16	Base of multiplier-triplier

Set the signal generator on carrier frequency and set the level for a 10 microamp reading in meter position 1. No more than 8.0 microvolts should be required (typically 3.5 μ V).

A low meter position 5 reading indicates that the 455 kHz amplifier strip is not operating correctly. Refer to paragraph g.

A low meter position 6 reading indicates that the 1st mixer injection is probably low. Refer to paragraph e.

If more than 8.0 μ V of carrier signal is required for a 10 μ A reading on meter position 1, the receiver gain is low. Check for low mixer injection voltages (paragraph e) and improper receiver gain distribution (paragraph f).

e. Injection Voltages

With no signal into the receiver, measure the rf voltages on the bases of the first and second mixer transistors. The injection voltage to Q2 should be between 0.4-1.1 V and the injection voltage to Q6 should be between 55-95 mV.

If either injection voltage is low, check the corresponding oscillator for poor solder connections or defective components. Usually a check of dc voltages in the faulty circuit will pinpoint the source of trouble.

f. Receiver Gain Distribution + Low Level RF and IF Stages

The simplest method for checking the gain distribution of a receiver is to apply an on-channel rf voltage to the antenna connector while monitoring a selected point in the receiver with an rf

voltmeter. The amount of signal necessary to produce a specific reading on the voltmeter gives an indication of the total gain between the antenna connector and the point being monitored. The amount of signal required to produce this reading can then be compared with the values tabulated in Figure 9. Any significant deviation between measured and tabulated values indicates that some circuit between the antenna and the point being monitored is not operating correctly. The faulty circuit can usually be isolated after monitoring several points, where upon a visual inspection of soldered connectors or a dc voltage check will pinpoint the problem area.

g. High Level 455 kHz Stages

The last three 455 kHz stages should limit receiver noise when no carrier signal is present. Some typical RMS noise voltages on the three

limiter stages are tabulated in Figure 10. (All voltages were measured with a Motorola DC multimeter using the rf probe and are referenced to chassis ground.)

The recovered audio noise voltage (as measured at the collector of Q307 with an audio vtm) should be 1.5 V rms. The corresponding audio voltage at the emitter of Q309 (the emitter follower) should measure around 0.53 V rms.

These ac and rf voltage measurements coupled with the dc voltages listed on the schematic should make troubleshooting this section of the receiver relatively simple. It is possible for the voltage on the base of the 1st 455 kHz limiter (Q304) to be much lower than indicated and still

FIGURE 9.
TYPICAL RECEIVER GAIN DISTRIBUTION

METERING POINT	RF VOLTAGE AT ANTENNA CONNECTOR	NOMINAL RF VOLTAGE AT METERING POINT	
		TLD8430A or TLD1770A Series RF Deck	TLD8370A Series RF Deck
Junction of the 100 ohm resistor and L3 (Q1)	30 mV	-	0.25 V
1st Mixer Drain (Q2)	10 mV	0.13 V	1.1 V
11.7 MHz IF Collector (Q5)	1 mV	0.14 V	0.25 V
2nd Mixer Collector (Q6)	1 mV	0.15 V	0.5 V
1st 455 kHz IF Amp. Base (Q301)	1 mV	0.05 V	0.24 V
1st 455 kHz IF Amp. Coll. (Q301)	1 mV	2.3 V	2.5 V

NOTES:

1. All voltages referenced to chassis ground.
2. DC Supply Voltage = 13.8 V dc
3. All voltages measured with Motorola Model S1063A DC Multimeter using the SLN6055A RF Probe.

FIGURE 10.
LIMITER NOISE VOLTAGES WITH NO CARRIER SIGNAL

METERING POINT	NOMINAL VOLTAGES (RMS)
Base of 1st 455 kHz Limiter (Q304)	0.5 V
Base of 2nd 455 kHz Limiter (Q305)	0.62 V
Base of 3rd 455 kHz Limiter (Q306)	1.2 V
Collector of 3rd 455 kHz Limiter (Q306)	4.8 V

NOTES:

1. All voltages measured with Motorola Model S1063A DC Multimeter using the SLN6055A RF Probe.
2. All voltages referenced to chassis ground.

FIGURE 11.
TYPICAL AUDIO NOISE VOLTAGES

CIRCUIT METERED	TYPICAL READING
Discriminator Output (Collector of Q308)	1.5 V rms
Emitter Follower Output (Emitter of Q309)	.53 V rms
Base of 1st Audio Amplifier (Q340)	9 mV rms
Collector of 1st Audio Amplifier (Q340)	.25 V rms
Base of Audio Driver (Q341)	80 mV
Base of Audio Driver (Q342)	40 mV
Collectors of Audio Drivers (Q341, Q342)	2.7 V rms
Bases of Audio Finals (Q343, Q344)	.50 V rms
Collectors of Audio Finals (Q343, Q344)	6.6 V rms
Audio output into 3.2 Speaker	3.7 V rms

NOTES:

1. All readings referenced to chassis.
2. All voltages measured with Motorola Model S1053C AC Voltmeter.
3. VOLUME control at maximum fully clockwise; SQUELCH control fully counterclockwise; PL switch OFF.
4. DC Supply Voltage = 13.8 V dc.

maintain the correct voltage levels at the remaining points. This is an indication of loss of gain in the lower level stages (refer to paragraph f).

h. Receiver Audio Circuit

Checking the receiver audio section can be done by measuring noise voltages only (i.e., no carrier signal). Set the VOLUME control to maximum and the SQUELCH control fully counterclockwise (unsquelched). On "Private-Line" tone-coded squelch models, set the monitor-operate switch to .

Connect an ac voltmeter across the speaker and measure the noise output. At least 3.0 V rms of noise should be measured. (This should correlate to over 5 watts or 4.0 volts of audio output when the unit is receiving a carrier with the standard test modulation.) If the audio output is low, measure the noise voltages at the individual stages to isolate the problem. Typical values of audio noise voltage measured with the Motorola AC Voltmeter are given in Figure 11.

i. Carrier Squelch Circuit

Remove the carrier signal from the antenna input to the unit. If a "Private-Line" tone-coded squelch model is being checked, set the monitor-operate switch to  (checks for "Private-Line" tone-coded squelch models are given in the "Private-Line" section). On all sets, set the SQUELCH control fully clockwise to fully squelch the receiver. Typical meter readings are listed in Figure 12 and on the schematic diagram.

Check the dc voltages at the base and emitter of the 1st audio amplifier Q340. Whether this transistor is forward or reverse biased determines the squelch condition of the receiver. When sufficient noise is present, and the radio is fully squelched, as with no carrier, the voltage applied to the emitter of Q340 should be approximately 8.1 volts dc. The voltage should be increased to 10.0 volts dc to unsquelch the radio circuit.

A properly operating squelch circuit should meet the following sensitivity specifications.

(1) Squelch threshold sensitivity: 0.18 μ V or less. With no signal input, set the SQUELCH control so the noise just quiets (squelch threshold). On "Private-Line" tone-coded squelch models, set the monitor-operate switch to . Modulate the signal generator with 1000 Hz tone for 3.3 kHz deviation. Set the signal generator output to zero and increase until the tone is heard in the speaker. No more than 0.18 μ V should be required to cause the tone.

(2) Full squelch sensitivity: 0.5 μ V or less. Set the SQUELCH control fully clockwise and apply an input signal as in step (1), preceding. No more than 0.5 μ V should be required to produce the tone.

j. "Private-Line" Decoder

A general check of the "Private-Line" circuit performance may be conducted as follows:

FIGURE 12.
CARRIER SQUELCH NOISE VOLTAGE MEASUREMENTS

CIRCUIT METERED	TYPICAL READING
Squelch Limiter, Base (Q345)	.32 V rms
Squelch Limiter, Collector (Q345)	3.5 V rms
Squelch Detector, Base (Q346)	.40 V rms
Squelch Detector, Emitter (Q346)	.20 V rms
NOTES:	
1. All voltages measured with Motorola AC Voltmeter and are referenced to chassis.	
2. SQUELCH control at maximum, no signal input.	

FIGURE 13
"PRIVATE-LINE" DECODER MEASUREMENTS

METERING POINT	TYPICAL READING *
Decoder Board Input (GRAY-GRN lead)	60 mV rms
PL Amplifier, Base (Q751)	10 mV rms
PL Amplifier, Collector (Q751)	220 mV rms
Amplifier/Clipper, Base (Q752)	210 mV rms
Amplifier/Clipper, Collector (Q752)	2.8 V rms
"Vibrasponder" Driver, Base (Q753)	540 mV rms
"Vibrasponder" Driver, Emitter (Q753)	500 mV rms
Amplifier, Base (Q754)	100 mV rms
Amplifier, Collector (Q754)	2.0 V rms
Detector, Base (Q755)	1.8 V rms
Detector, Collector (Q755)	2.7 V dc
Output Switch, Base (Q756)	11.4 V dc
Output Switch, Collector (Q756)	11.9 V dc
Noise Switch, Base (Q757)	0.7 V dc
*Readings taken with 1000-mV input rf signal and 0.5-kHz PL tone deviation.	

(1) Receiver PL squelch sensitivity should be 0.18 μ V or less. Set the monitor-operate switch to operate (opposite ). Turn the SQUELCH control fully counterclockwise. Modulate the signal generator with the "Private-Line" tone frequency stamped on the "Vibrasponder" Resonant Reed of the radio set. (This may be done with the Motorola SLN6221A PL Tone Generator.) Adjust the modulating tone for 0.5 kHz deviation. Set the signal generator output to zero and increase until noise is heard in speaker. No more than 0.18 μ V should be required.

If "Private-Line" squelch sensitivity in the receiver is low or the circuit is inoperative, use the charts in Figures 13 and 14 and the schematic diagram to localize the trouble area.

(2) There should be no "squelch tail" (noise burst) at the end of a transmission from other stations in the communications system. A "squelch tail" is indicative of improper operation of the transmitter PL delay circuitry. Refer to the section on transmitter servicing.

k. "Digital Private-Line" Decoder

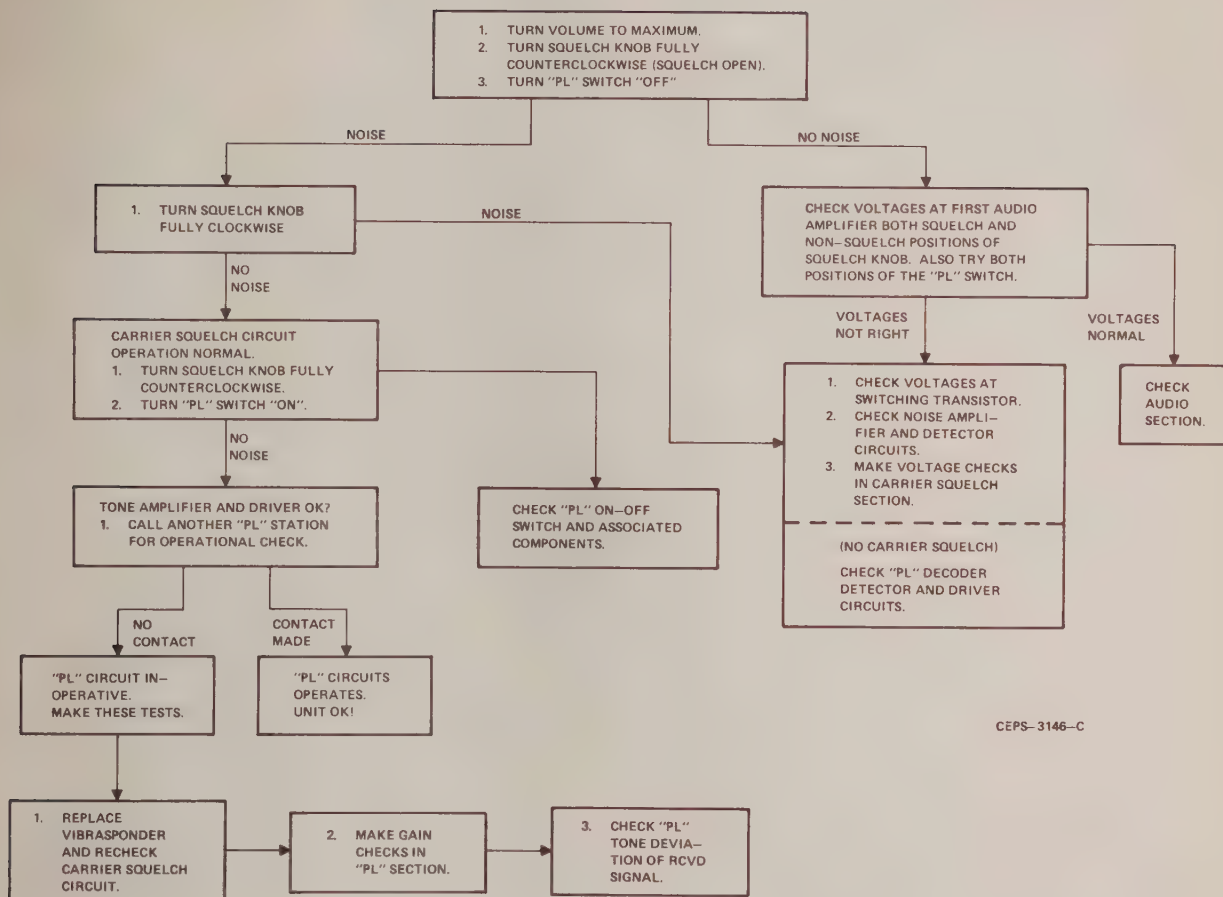
A complete check of the "Digital Private-Line" decoder circuit can be found in separate Motorola

instruction section 68P81106E83. The information in this instruction section together with the maintenance data on the schematic diagram should provide sufficient servicing information.

6. MULTIPLE FREQUENCY MODIFICATION CONNECTIONS

The MULTIPLE FREQUENCY RADIOS JUMPER AND COMPONENT CONNECTIONS TABLE lists the standard and optional transmit (C) and receive (R) combinations. Radio sets ordered with non-standard combinations are modified as necessary at the factory. New system requirements for different transmit-receive combinations are easily handled by field modification.

The table lists the frequency combination in the first column. The other columns on the same line indicate which resistors are removed to disable unused oscillators. Jumper columns indicate diodes to be jumpered to ground (for single-frequency operation) or diodes to be jumpered together. Jumpered diodes provide a ground path for the unused oscillator's control leads to activate a desired oscillator. Refer to the Transmitter and Receiver Circuit Board Details for component locations.



CEPS-3146-C

Figure 14.
Receiver "Private-Line" Tone-Coded Squelch Troubleshooting
Chart

**MULTIPLE FREQUENCY RADIO SETS
JUMPER AND COMPONENT CONNECTIONS TABLE**

DESIRED FREQUENCY COMBINATION	2-FREQ. CONTROL HEAD (NOTE 2)	4-FREQ. CONTROL HEAD (NOTE 2)	NO MODIFICATION REQUIRED	TRANSMITTER OSCILLATOR MODIFICATIONS				RECEIVER OSCILLATOR MODIFICATIONS				TRANSMIT & RECEIVE OSCILLATORS ACTIVATED WHEN CONTROL HEAD FREQUENCY SWITCH IS IN THE POSITION INDICATED			
				REMOVE THE INDICATED RESISTORS	REMOVE THE INDICATED RESISTORS	JUMPER THE INDICATED DIODE ANODES TOGETHER	REMOVE THE INDICATED RESISTORS	REMOVE THE INDICATED RESISTORS	JUMPER THE INDICATED DIODE ANODES TOGETHER	REMOVE THE INDICATED RESISTORS	REMOVE THE INDICATED RESISTORS	POSITION 1	POSITION 2	POSITION 3	POSITION 4
C1-R1				R466	R473	R480	R432	R435	R438	R432	R435	T1/R1	T2/R2	T3/R3	T4/R4
1-1	X		X	X				X	X ¹			T1/R1	T2/R2		
1-2				X	X	X						T1/R1	T2/R2		
1-3				X	X	X						T1/R1	T2/R2		
1-4				X	X	X						T1/R1	T2/R2		
2-1				X	X	X						T1/R1	T2/R2		
2-2				X	X	X						T1/R1	T2/R2		
2-3				X	X	X						T1/R1	T2/R2		
2-4				X	X	X						T1/R1	T2/R2		
3-1				X	X	X						T1/R1	T2/R2		
3-2				X	X	X						T1/R1	T2/R2		
3-3				X	X	X						T1/R1	T2/R2		
3-4				X	X	X						T1/R1	T2/R2		
4-1				X	X	X						T1/R1	T2/R2		
4-2				X	X	X						T1/R1	T2/R2		
4-3				X	X	X						T1/R1	T2/R2		
4-4				X	X	X						T1/R1	T2/R2		
5-1				X	X	X						T1/R1	T2/R2		
5-2				X	X	X						T1/R1	T2/R2		
5-3				X	X	X						T1/R1	T2/R2		
5-4				X	X	X						T1/R1	T2/R2		
6-1				X	X	X						T1/R1	T2/R2		
6-2				X	X	X						T1/R1	T2/R2		
6-3				X	X	X						T1/R1	T2/R2		
6-4				X	X	X						T1/R1	T2/R2		
7-1				X	X	X						T1/R1	T2/R2		
7-2				X	X	X						T1/R1	T2/R2		
7-3				X	X	X						T1/R1	T2/R2		
7-4				X	X	X						T1/R1	T2/R2		
8-1				X	X	X						T1/R1	T2/R2		
8-2				X	X	X						T1/R1	T2/R2		
8-3				X	X	X						T1/R1	T2/R2		
8-4				X	X	X						T1/R1	T2/R2		

NOTES:

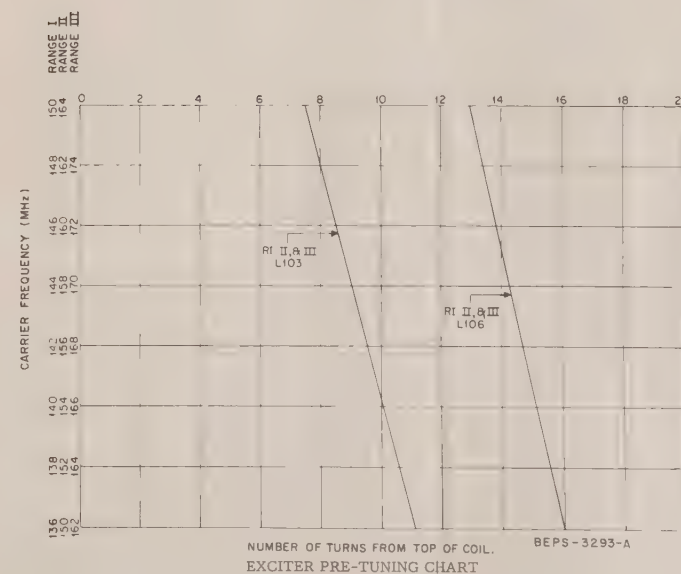
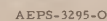
- INSTALL A JUMPER FROM THE ANODES OF THE INDICATED DIODE TO GROUND.
- MODIFICATION REQUIRED DIFFER DEPENDING ON WHETHER A TWO-FREQUENCY OR FOUR-FREQUENCY CONTROL HEAD IS BEING USED.
- TO MODIFY A MULTI-FREQUENCY RADIO FOR C1-R1 OPERATION WITH A SINGLE FREQUENCY CONTROL HEAD, PLACE JUMPER WIRES FROM THE ANODES OF CR101 AND CR40 TO GROUND. PLACE THE CRYSTALS IN OSCILLATORS T1 AND R1.

A. EXCERPTS FROM FCC REGULATIONS

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

1. Motorola SI056B-9B Series Portable Test Set with a Motorola Model SKN6012B Metering Cable. A 0-50 microampere meter with 20,000 ohms equivalent series resistance may be used if a test set is not available.
2. Motorola Part No. 66B83256C01 Alignment Tool (Part of Motorola TLN4345A Alignment Tool Kit supplied with the radio).
3. Motorola Model TI013A RF Load Resistor (or equivalent) and Model SI350A Wattmeter with appropriate element.
4. Motorola Model TI012A Power Supply (or equivalent) with TEK-15A Ripple Filter.
5. Motorola Model TEK-1 Transistorized Tone Generator (or equivalent).
6. Motorola Model SI344 Series Frequency Meter (or equivalent).

1. Set function selector switch to XMTR position.
2. Place the oscillator and meter reversing switch in the OFF position.
3. Connect the 20-pin meter cable plug to the test set; connect the other end of the 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.



1. Connect the rf wattmeter to the front panel antenna receptacle.
2. Key the transmitter with XMTR-ON switch on the test set or with a microphone plugged into the test set or radio set control head.

Do not key the transmitter for more than a few seconds at a time until it is properly tuned. Turn on the transmitter for brief periods while reading the meter and making the adjustments.

136-174

$$f_o = \frac{f_c}{q}$$

Where f_0 = crystal frequency, f_c = carrier frequency.

S1056B-9B SERIES TEST SET	3	5	7
CIRCUIT METERED	Base of Buffer Amplifier	Output of 1st Amplifier	Final Amplifier Current

ALIGNMENT CONTINUED ON REVERSE SIDE

Transmitter Alignment Procedure
Motorola No. PEPS-9167-E
9/8/76-NPC

"IDC" ADJUSTMENT PROCEDURE

NOTE

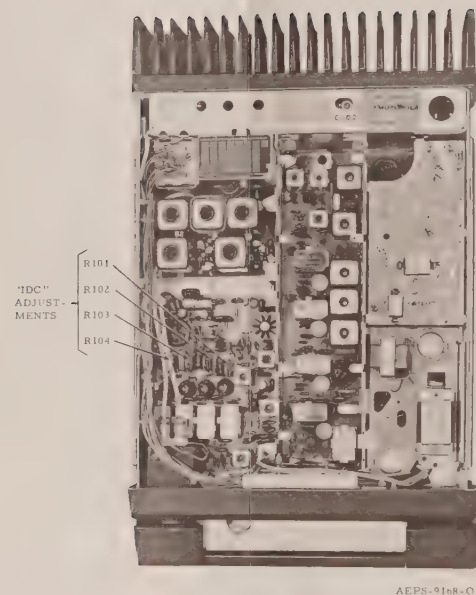
The oscillator frequency adjustment must be made prior to this adjustment.

1. TEST EQUIPMENT REQUIRED

- a. Motorola S1344 Series Digital Frequency Meter/Deviation Monitor, or Motorola S1058B or S1059B Portable Test Set with Deviation Meter, or equivalent. A modified Motorola S1327B Service Monitor or equivalent must be used for "Digital Private-Line" deviation measurements.
- b. Motorola Model TEK-1 Transistorized Tone Oscillator or equivalent.
- c. Motorola Solid-State AC Voltmeter or equivalent.
- d. Motorola Model S1318A FM Signal Generator.

2. PROCEDURE

- a. Insert the "Vibrasender" resonant reed or code plug in "Private-Line" squelch models.
- b. Connect the output leads of the tone oscillator through a .33 uF capacitor to the transmitter audio input (microphone receptacle).
- c. Connect the ac voltmeter across the same terminals and adjust the tone generator output to 1 volt at 1000 Hz.
- d. Place the control head frequency selector switch in the F1 position (in multiple frequency models) and key the transmitter using the portable test set. Adjust the F1 IDC control, R101, for 5 kHz deviation as read on the deviation measuring instrument used. For multiple frequency models adjust the F2, F3, and F4 IDC controls (R102, R103, and R104 respectively) with the frequency selector switch in the corresponding position.
- e. Reduce the tone oscillator output to 200 millivolts. Essentially full deviation should still be indicated. Less than full deviation may indicate a weak audio stage or other lack of audio gain.
- f. Remove the 1000 Hz modulation. "Private-Line" tone deviation should be between 0.5 and 1 kHz. "Digital Private-Line" deviation should be between 0.5 and 1 kHz; see 1a. above.



AEPS-9168-C

RECEIVER ALIGNMENT PROCEDURE
(STANDARD TLD8430A SERIES AND OPTIONAL TLD8370A SERIES RF DECKS)

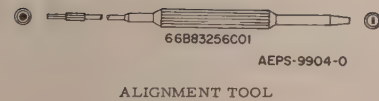
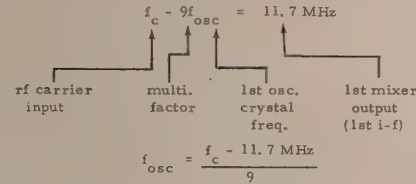
A. TEST EQUIPMENT REQUIRED

1. Motorola Model S1056B-9B Series Portable Test Set with Motorola Model SKN6012A Metering Cable.
2. Motorola T1012A DC Power Supply with a Motorola TEK-1A Ripple Filter.
3. Motorola Model S1318A FM Signal Generator or equivalent.
4. Motorola TLN4345A Alignment Tool Kit (supplied with radio).
5. Motorola S1063A DC Multimeter (or equivalent) with Motorola SLN6055A RF Probe.

B. TEST SET SELECTOR SWITCH POSITIONS

S1056B-9B SERIES TEST SETS	1	4	5	6	11
CIRCUIT METERED	Base of 3rd 455 kHz IF Amplifier	Discr. Output	3rd 455 kHz Limiter Output	Base of the Multiplier Tripler	Audio

FREQUENCY CALCULATIONS
For all ranges
(K1056A or K1057A Resonators)



455 kHz DISCRIMINATOR ALIGNMENT
C. HOW TO SET UP THE S1056B-9B SERIES TEST SET FOR 455 kHz ALIGNMENT

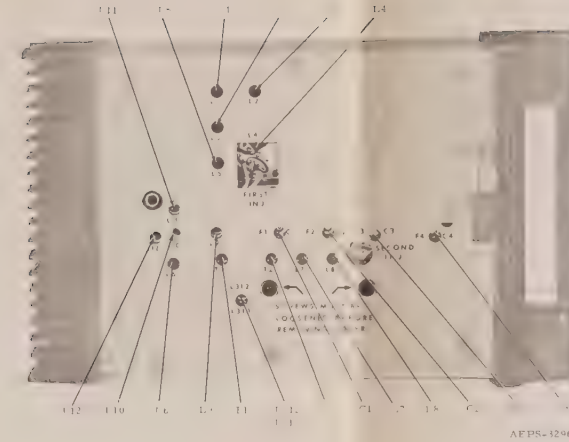
1. Set the function selector switch to the RCVR position.
2. Connect the 20-pin plug end of the metering cable into the receptacle on the test set. Connect the other end of the metering cable to the RECEIVER metering socket. The 20-pin metering cable plug acts as the internal battery ON-OFF switch. Pins 19 and 20 on the plug are jumpered. Connecting the plug to the test set socket completes the battery circuit. To conserve battery life when not using the test set either (1) disconnect meter cable from test set, or (2) set the Oscillator and Meter Reversing Switch to OFF and put Position Selector Switch to any position except 11 or 13.
3. Connect one end of the test set rf extension cable to the rf connector on the test set. Connect the other end of the extension cable to the rf probe cable.
4. Place the oscillator and meter reversing switch to the 455 kHz position.

STEP	TEST SET SWITCH POSITION	ADJUSTMENT	METER READING	PROCEDURE
1		L312 Disc. Primary		Position slug flush with top of coil form.
2		L313 Disc. Secondary		Position slug to bottom of form (next to circuit board).
3	5	Discriminator Primary (Top Slug) L312	PEAK	Inject a strong 455 kHz crystal-controlled signal (25 uA minimum in position 1) to the input of the 455 kHz filter (collector of 2nd mixer-Q6). Tune L312 for a peak indication in meter position 5.
4	4	Discriminator Secondary (Bottom Slug - nearest to circuit board) L313	ZERO	Tune exactly to zero. DO NOT readjust primary.

FIRST OSCILLATOR MULTIPLIER ALIGNMENT

Coils are tuned to 3rd harmonic of oscillator frequency.

5		L9, L10, L11, L12		If necessary preposition the oscillator-multiplier coil slugs according to pretuning chart. If the RF deck and 1st i-f coils, L1, L2, L3, L4, L5, L6, T1, T2, L7, and L8, are not tuned, pretune according to the pretuning chart. (This step is required only if these coils have been drastically misaligned, or if the receive frequency is being changed.)
6	6	L9, L10	PEAK	Tune L9 and L10 for peak indication on meter position 6.
7	1	L11, L12	PEAK	Connect an rf signal generator to the radio antenna connector. Set the generator level to approximately 200 mV and slowly vary the generator frequency until the receiver quiets and a zero uA reading is obtained in meter position 4. Tune L11 and L12 for peak indication in meter position 1. Note: Reduce the signal generator output as necessary to maintain a meter 1 reading of below 35 uA.



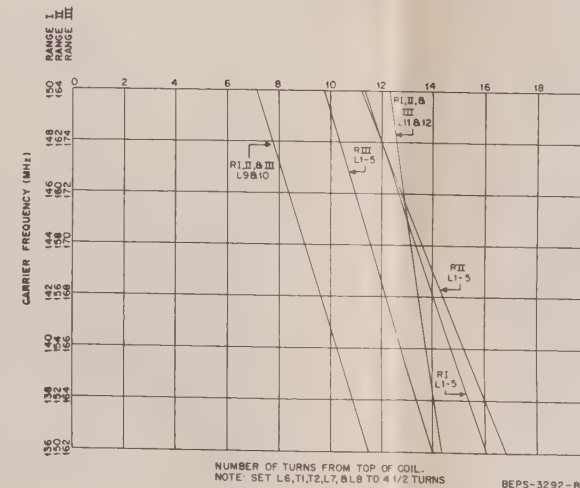
1ST IF AND RF DECK ALIGNMENT

STEP	TEST SET SWITCH POSITION	ADJUSTMENT	METER READING	PROCEDURE
8		L1, L2, L3, L4, L5, L6, T1, T2, L7, L8		If necessary, preposition the 1st i-f and RF deck coils, L1, L2, L3, L4, L5, L6, T1, T2, L7, and L8, according to the pre-tuning chart. (This step is required only if these coils have been drastically misaligned or if the receive frequency is being changed.)
9	1	L6, T1, T2, L7, L8	PEAK	Tune L6, T1, T2, L7, and L8 for peak indication in meter position 1. Observe note in step 7.
10	1	L1, L2, L3, L4, L5	PEAK	Tune L1, L2, L3, L4, and L5 for peak indication in meter position 1.
11	1 & 6	L1, L2, L3, L4, L5, L6, T1, T2, L7, L8, L9, L10, L11 and L12	PEAK	Repeat steps 6, 7, 9, and 10.

RECEIVER FREQUENCY ADJUSTMENT

12	4	C1 (Freq #1) C2 (Freq #2) C3 (Freq #3) C4 (Freq #4)	0 uA	With a carrier of known frequency on the air, set the corresponding oscillator warp capacitor to obtain a 0 uA reading in meter position 4. If the radio's receiver and transmitter are on the same frequency and if the transmitter is warped on frequency, then the receiver may be netted to the transmitter by using the built in netting function. Remove one end of the wire netting jumper, located near L105 in the exciter, from its pin and connect it to the pin located near CR180 in the exciter IDC circuit. Refer to exciter circuit board detail for location of jumper. This activates the low level exciter stages, which quiets the receiver. Set the corresponding receiver oscillator warp capacitor to obtain a 0 uA reading in meter position 4.
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NOTE
FOR OTHER RECEIVER RF DECKS,
REFER TO REVERSE SIDE OF THIS
PANEL.



RECEIVER PRE-TUNING CHART

RECEIVER ALIGNMENT PROCEDURE
(USING OPTIONAL TLD1770A SERIES RF DECK)

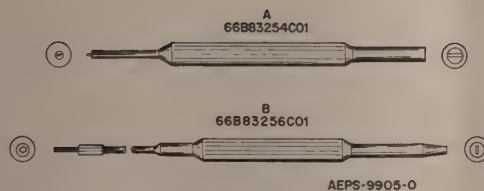
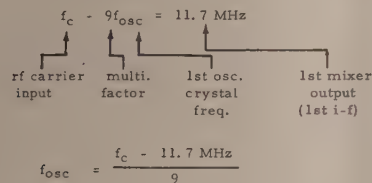
A. TEST EQUIPMENT REQUIRED

1. Motorola Model S1056B-9B Series Portable Test Set with Motorola Model SKN6012A Metering Cable.
2. Motorola T1012A DC Power Supply with a Motorola TEK-15A Ripple Filter.
3. Motorola Model S1318A FM Signal Generator or equivalent.
4. Motorola TLN4345A Alignment Tool Kit (supplied with radio).
5. Motorola S1063A DC Multimeter (or equivalent) with Motorola SLN6055A RF Probe.

B. TEST SET SELECTOR SWITCH POSITIONS

S1056B-9B SERIES TEST SETS	1	4	5	6	11
CIRCUIT METERED	Base of 3rd 455 kHz IF	Discr. Output	3rd 455 kHz Limiter Output	Base of the Multiplier Tripler	Audio

FREQUENCY CALCULATIONS
For all ranges
(K1056A or K1057A Resonators)



AEPS-9905-O

ALIGNMENT TOOL

Alignment Procedure
For Receivers Using
Optional TLD1770A Series RF Deck
Motorola No. PEPS-9171-E
9/8/76-NPC

455 kHz DISCRIMINATOR ALIGNMENT

C. HOW TO SET UP THE S1056B-9B SERIESTEST SET
FOR 455 kHz ALIGNMENT

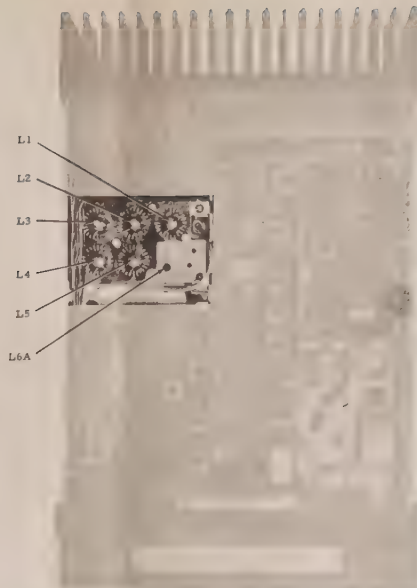
1. Set the function selector switch to the RCVR position.
2. Connect the 20-pin plug end of the metering cable into the receptacle on the test set. Connect the other end of the metering cable to the RECEIVER metering socket. The 20-pin metering cable plug acts as the internal battery ON-OFF switch. Pins 19 and 20 on the plug are jumpered. Connecting the plug to the test set socket completes the battery circuit. To conserve battery life when not using the test set either (1) disconnect meter cable from test set, or (2) set the Oscillator and Meter Reversing Switch to OFF and put Position Selector Switch to any position except 11 or 13.
3. Connect one end of the test set rf extension cable to the rf connector on the test set. Connect the other end of the extension cable to the rf probe cable.
4. Place the oscillator and meter reversing switch to the 455 kHz position.

STEP	TEST SET SWITCH POSITION	ADJUSTMENT	METER READING	PROCEDURE
1		L312 Disc. Primary		Position slug flush with top of coil form.
2		L313 Disc. Secondary		Position slug to bottom of form (next to circuit board).
3	5	Discriminator Primary (Top Slug) L312	PEAK	Inject a strong 455 kHz crystal-controlled signal (25 uA minimum in position 1) to the input of the 455 kHz filter (collector of 2nd mixer - Q6). Tune L312 for a peak indication in meter position 5.
4	4	Discriminator Secondary (Bottom Slug-nearest to circuit board) L313	ZERO	Tune exactly to zero. DO NOT readjust primary.

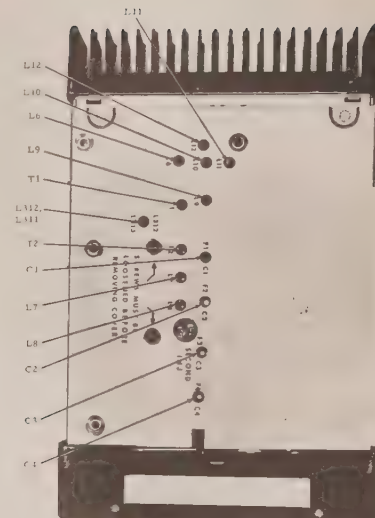
FIRST OSCILLATOR MULTIPLIER ALIGNMENT

Coils are tuned to 3rd harmonic of oscillator frequency.

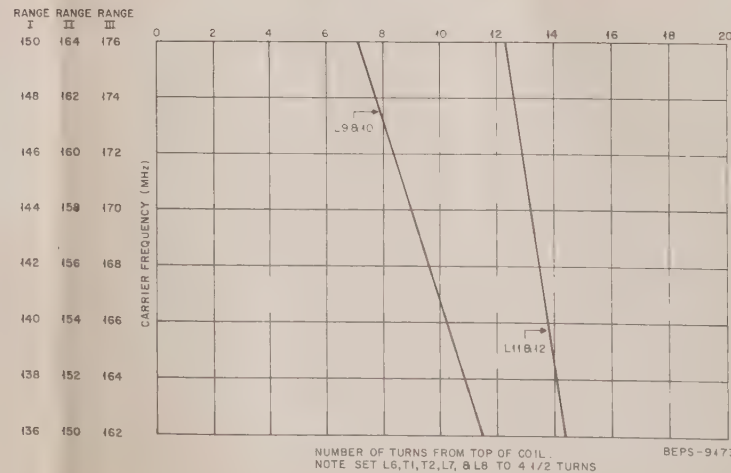
5		L9, L10, L11, L12, L6, T1, T2, L7, L8		If necessary, use tuning tool B to pre-position the slugs of oscillator-multiplier coils L9, L10, L11, L12, and the 1st i-f coils L6(B), T1, T2, L7, and L8, according to the pretuning chart. (This step is required only if these coils have been drastically misaligned, or if the receive frequency is being changed.)
6	6	L9, L10	PEAK	Tune L9 and L10 for peak indication on meter position 6.
7		L1 thru L6(A)	1	Use screwdriver end of tuning tool A. Detune L1 thru L6(A) by turning slugs counterclockwise to the end of the tuning range.
8	1	L11, L12	PEAK	Connect an rf signal generator to the radio antenna connector. Set the generator level to approximately 200 mV and slowly vary the generator frequency around the desired carrier frequency until the receiver quiets and a zero uA reading is obtained in meter position 4. Tune L11 and L12 for peak indication in meter position 1. Note: Reduce the signal generator output as necessary to maintain a meter 1 reading of below 35 uA.



AEPS-5860-O



AEPS-5862-O



BEPS-9473-A

Receiver Pre-Tuning Chart

1ST IF AND RF DECK ALIGNMENT

STEP	TEST SET SWITCH POSITION	ADJUSTMENT	METER READING	PROCEDURE
9	1	L1, L2, L3, L4, L5, L6(A)	PEAK	Tune L1 thru L6(A) (in that order) for maximum indication on meter 1. Observe note in step 8.
10	1	L6, T1, T2, L7, L8	PEAK	Tune L6, T1, T2, L7, and L8 for peak indication in meter position 1. Observe note in step 8.
11	1	L1 thru L6(A)	1	Repeat L1 through L6(A) (in that order) for maximum indication on meter position 1. Repeat. Retune L12 for peak indication on meter position 1. Reduce signal generator output as necessary to maintain a meter 1 reading of below 35 uA.
12	1 & 6	L1, L2, L3, L4, L5, L6(A), L6, T1, T2, L7, L8, L9, L10, L11 and L12	PEAK	Repeat steps 6, 8.

RECEIVER FREQUENCY ADJUSTMENT

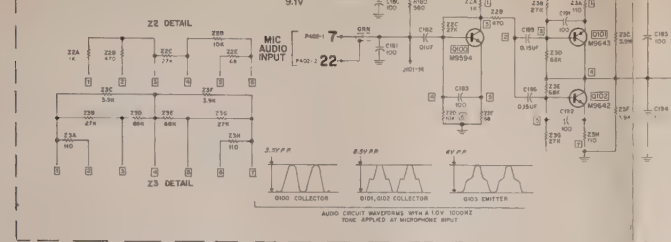
STEP	TEST SET SWITCH POSITION	ADJUSTMENT	METER READING	PROCEDURE
13	4	C1(Freq#1) C2(Freq#2) C3(Freq#3) C4(Freq#4)	0 uA	With a carrier signal generator on the air, set the corresponding oscillator capacitor to obtain a 0 uA reading in meter position 4. If the radio's receiver and transmitter are on the same frequency and if the transmitter is warped on frequency, then the receiver may be netted to the transmitter by using the built in netting function. Remove one end of the wire netting jumper, located near L105 in the exciter, from its pin and connect it to the pin located near CR180 in the exciter IDC circuit. This activates the low level exciter stages, which quiets the receiver. Set the corresponding receiver oscillator warpcapacitor to obtain a 0 uA reading in meter position 4.

4. THIS CONNECTION TO R193 AND RT480 IS MADE WITH A WIRE AND IS NOT PART OF THE PRINTED CIRCUIT.

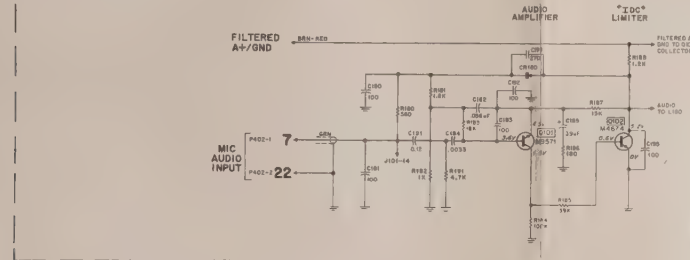
SHOWN FROM SOLDER SIDE

Exciter Circuit Board Detail
Motorola No. PEPS-9151-F
(Sheet 1 of 2)
9/8/76-NPC

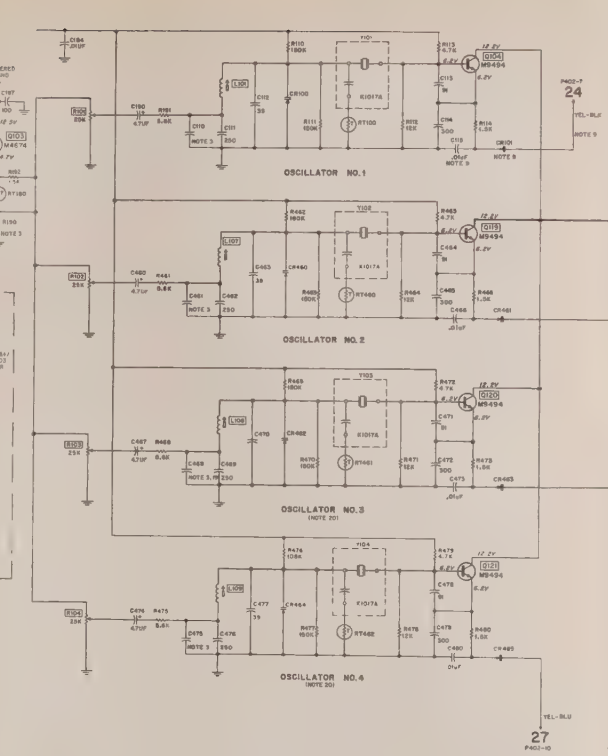
AUDIO & "DC" USED IN B-SUFFIX MAIN BOARD MODELS



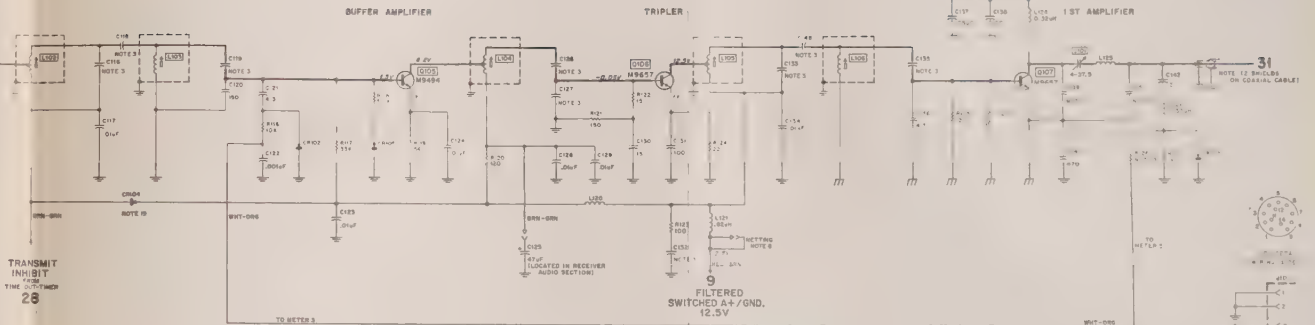
AUDIO & "DC" USED IN A-SUFFIX MAIN BOARD MODELS



OSCILLATOR-MODULATOR-TRIPLER



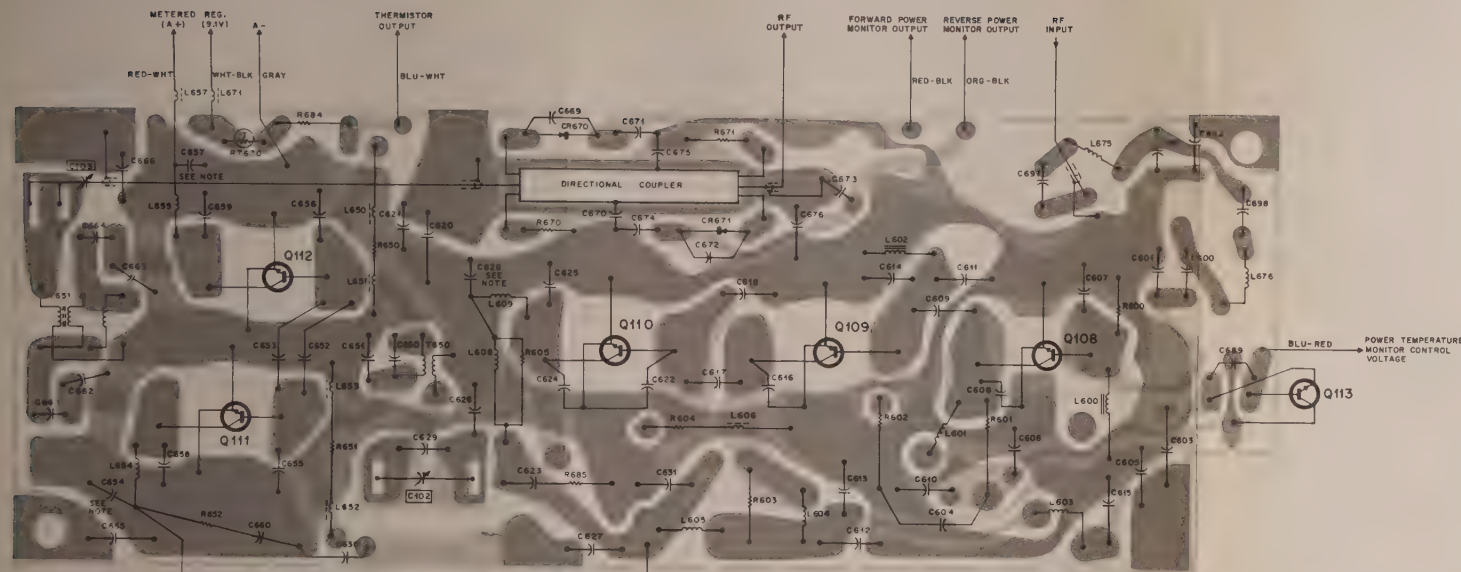
EXCITER



(THESE ARE THE ONLY NOTES THAT APPLY TO THIS DIAGRAM)

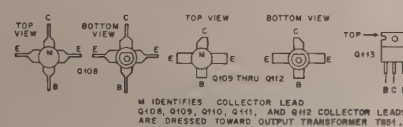
- REFER TO THE TRANSMITTER AND RECEIVER ALIGNMENT PROCEDURES FOR THEIR CORRESPONDING TRANSMITTER AND RECEIVER CRYSTAL FREQUENCY CALCULATIONS.
- SEE PARTS LIST FOR COMPONENT VALUE.
- UNLESS OTHERWISE STATED: CAPACITOR VALUES ARE IN PICOFARADS, RESISTOR VALUES ARE IN OHMS, ALL RESISTORS ARE 1/4 W.
- ALL DC VOLTAGES ARE MEASURED WITH A 20K OHM PER VOLT MULTIMETER, EXCEPT WHERE OTHERWISE NOTED. SUPPLY VOLTAGE DURING TRANSMIT 13.6 V.
- WHEN MEASURING TRANSMITTER VOLTAGES, USE A 33 OHM CHOKER IN SERIES WITH THE MULTIMETER PROBE TO BLOCK RF VOLTAGES.
- ALL EXCITER VOLTAGES FOR STAGES UP TO THE FIRST AMPLIFIER ARE REFERENCED TO CHASSIS.
- ALL VOLTAGES IN THE FIRST AMPLIFIER, ALL POWER AMPLIFIER STAGES AND THE PROTECTION CIRCUIT 9.1 VOLTS ARE REFERENCED TO A-.
- "FL" VOLTAGES MARKED BY ASTERISKS ARE MEASURED IN THE TRANSMIT CONDITION.
- ⏏ DENOTES A- (NOT CHASSIS GROUND).
- ⏏ DENOTES METAL CHASSIS GROUND.
- VOLTAGES MEASURED WITH A MOTOROLA DC MULTIMETER (11 MEGOHM INPUT IMPEDANCE), OR EQUIVALENT.
- TWO MALE PINS ARE PROVIDED IN THE EXCITER CIRCUIT FOR NETTING THE RECEIVER TO THE TRANSMITTER FREQUENCY. TO NET THE RECEIVER, REMOVE THE FEMALE CONNECTOR LEAD FROM THE NORMAL POSITION NEAR L105 AND CONNECT IT TO THE MALE PIN NEAR THE TRANSMITTER METERING SOCKET. THIS ACTUATES THE LOW LEVEL EXCITER STAGES AND THE RECEIVER OSCILLATOR CAN BE SET FOR A "0" DISCRIMINATOR READING.
- IN A SINGLE-FREQUENCY RADIO, TRANSMITTER AND RECEIVER OSCILLATORS #2, #3 AND #4 AND THE FREQUENCY SWITCHING WIRES ARE OMITTED. IN RECEIVER OSCILLATOR #1, CR40 AND C43 ARE DELETED AND A JUMPER IS SUBSTITUTED FOR C43. IN TRANSMITTER OSCILLATOR #1, CR101 AND C115 ARE DELETED. A JUMPER IS SUBSTITUTED FOR C115.
- OMIT WHEN TIME-OUT TIMER IS USED.
- TWO-FREQUENCY RADIOS CONTAIN ALL FOUR OSCILLATORS WITH THE MODIFICATIONS DESCRIBED IN THE "MULTIPLE FREQUENCY RADIOS JUMPER AND COMPONENT CONNECTION TABLE" IN THE SERVICE AIDS SECTION.
- BOLD NUMBERS INDICATE CORRESPONDING TIE POINTS.
- TRANSMITTER EXCITER RF WAVEFORMS MEASURED WITH A TEKTRONIX "TYPE 454" OSCILLOSCOPE (DC TO 150 MHZ BANDWIDTH) OR EQUIVALENT.

45 WATT POWER AMPLIFIER



SHOWN FROM COMPONENT SIDE

TRANSISTOR DETAILS

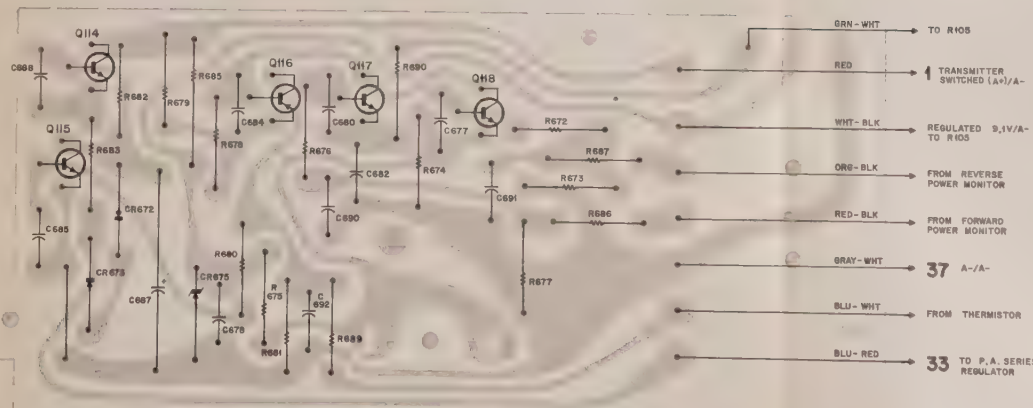


CAUTION
WHEN MOUNTING TRANSISTORS, DO NOT
OVERTIGHTEN (BEYOND 5-7 INCH-POUNDS);
OTHERWISE DAMAGE MAY RESULT TO
THE TRANSISTORS.

NOTE:
C628, C654 AND C657 ARE
STAND-OFF CAPACITORS.

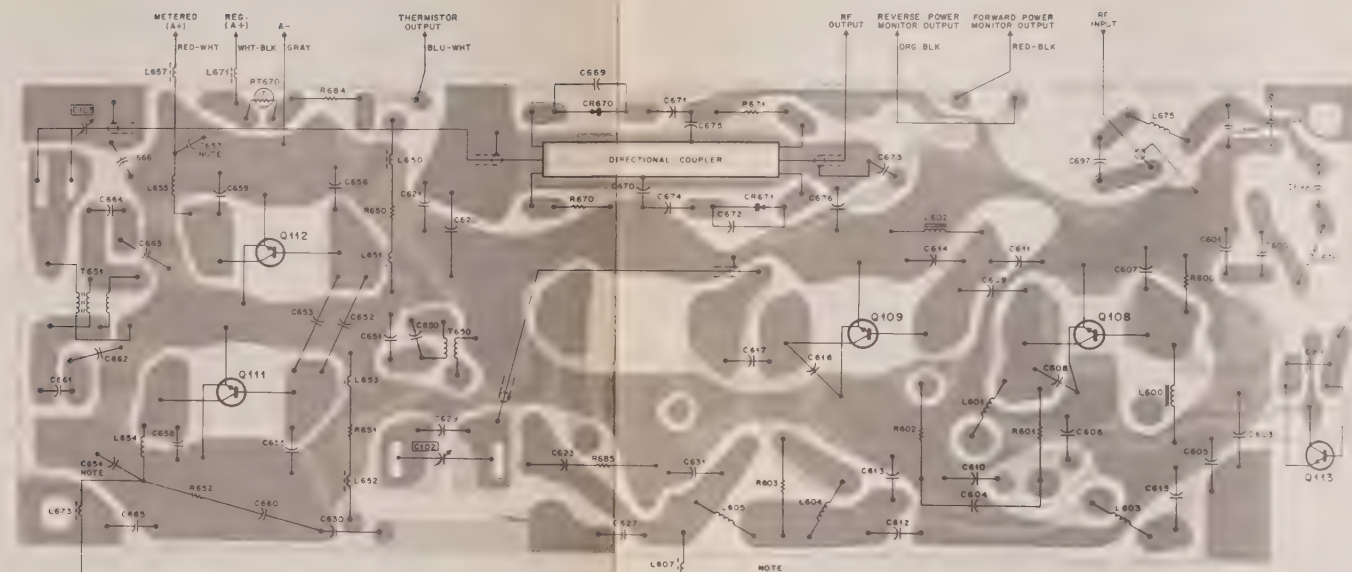
SOLDER SIDE
COMPONENT SIDE
OL-DEPS-9142-B
OL-DEPS-9144-C

PROTECTION CIRCUIT



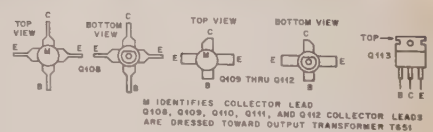
SHOWN FROM SOLDER SIDE

30 WATT POWER AMPLIFIER



SHOWN FROM COMPONENT SIDE

TRANSISTOR DETAILS



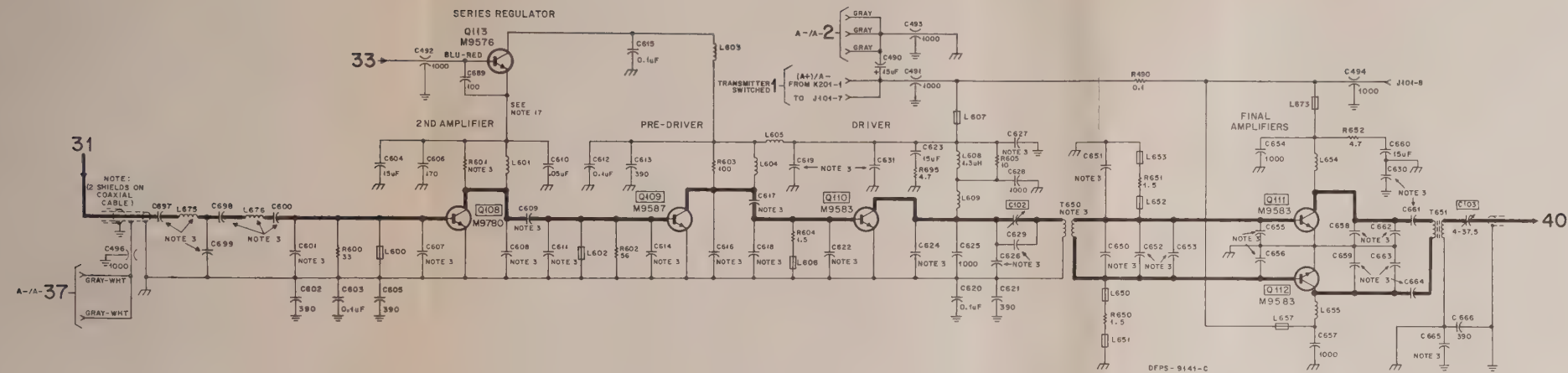
NOTE:
C654 AND C657
ARE STAND-OFF CAPACITORS.

OL-DEPS-9142-B
OL-DEPS-9144-A

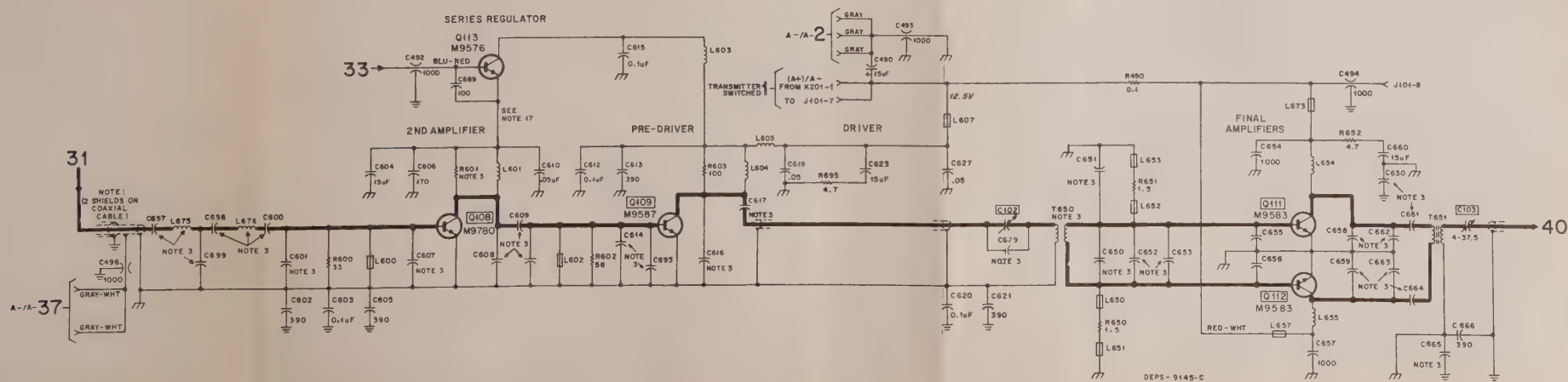
NOTE
PROTECTION CIRCUIT BOARD IS ACCESSIBLE
FROM BOTTOM OF RADIO SET.

EPS-9940-O

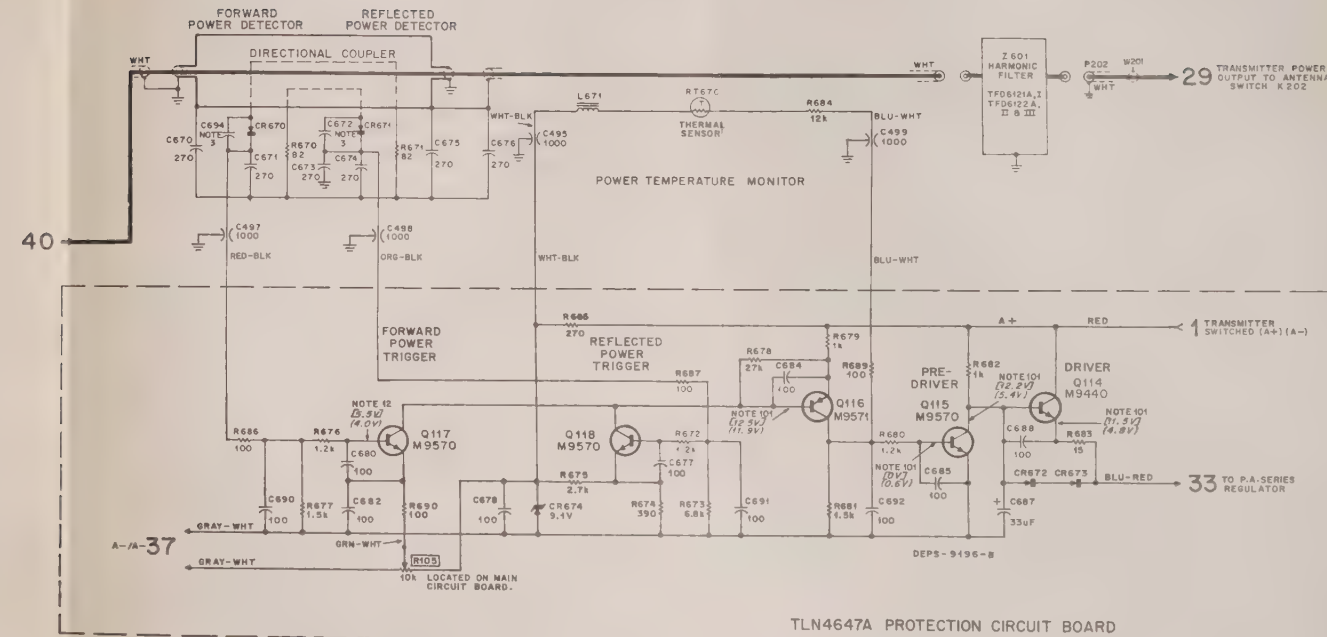
45-WATT POWER AMPLIFIER



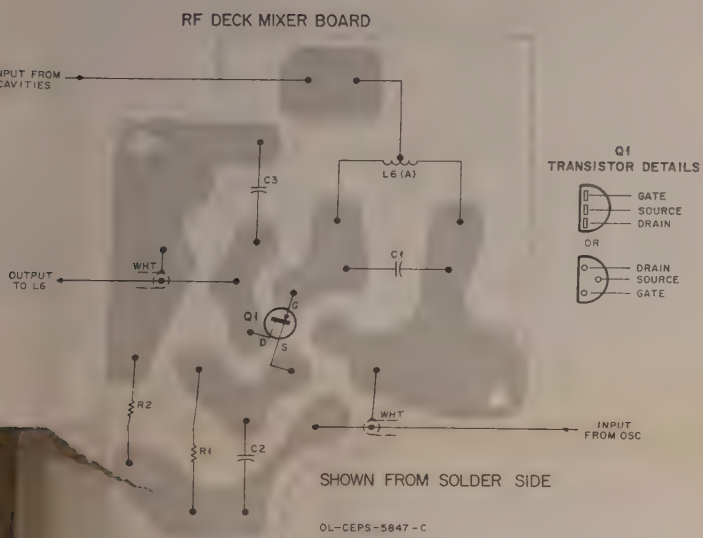
30-WATT POWER AMPLIFIER



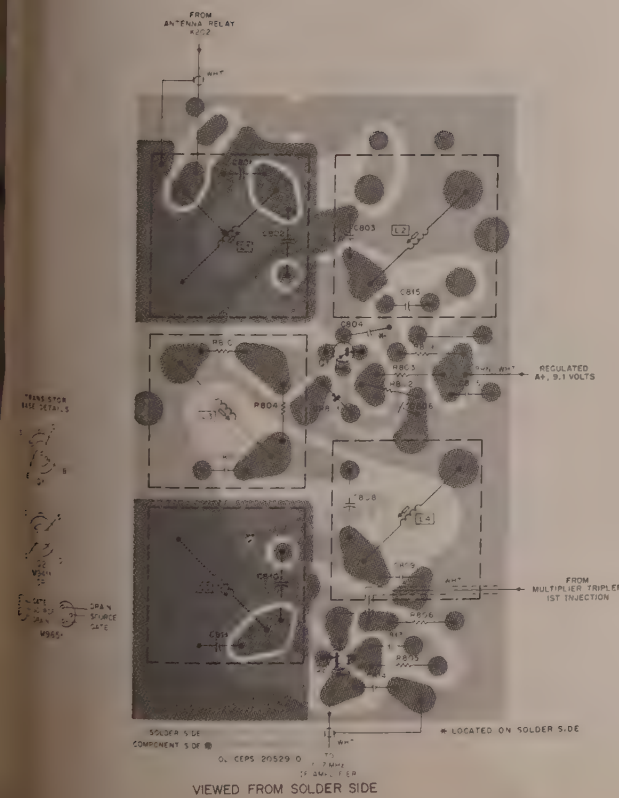
TLN4647A PROTECTION CIRCUIT BOARD



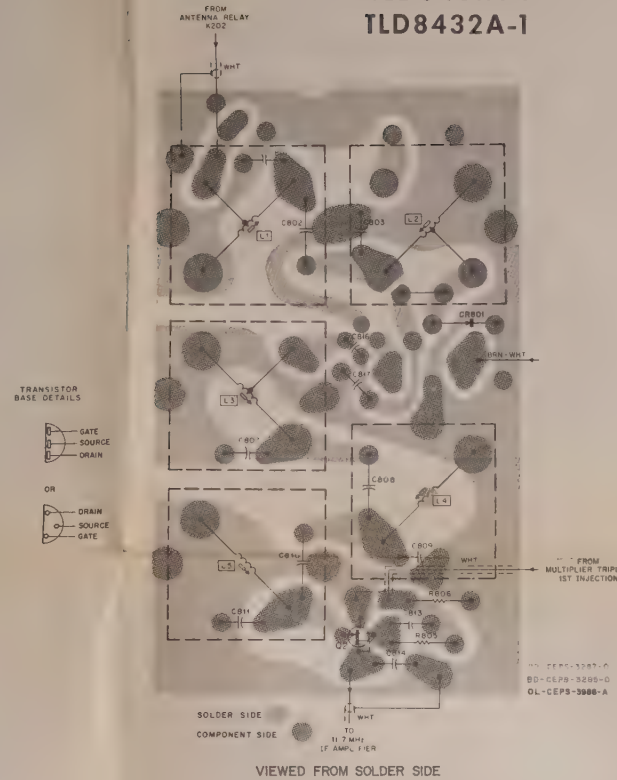
TLD1770A SERIES OPTIONAL RF DECK



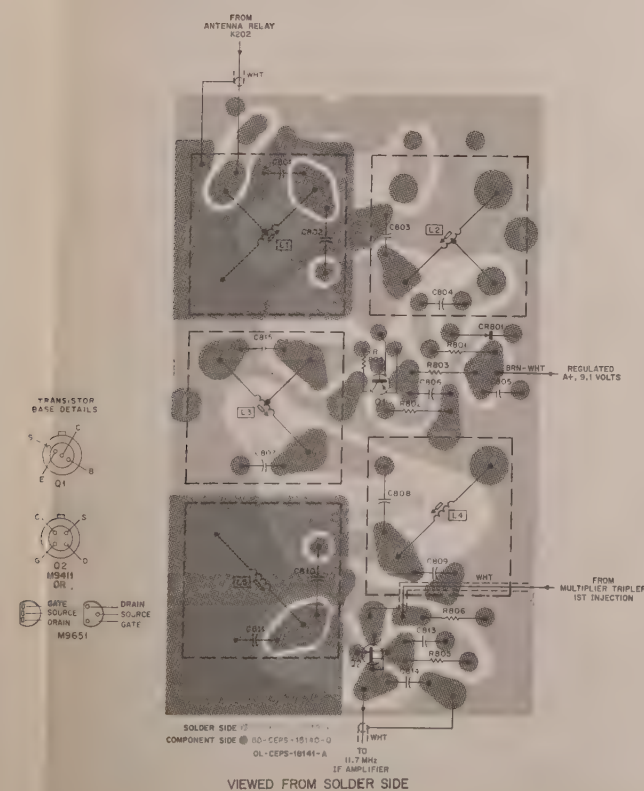
OPTIONAL RF DECK
TLD8371A-4
TLD8372A-3



TLD8431A-1
TLD8432A-1

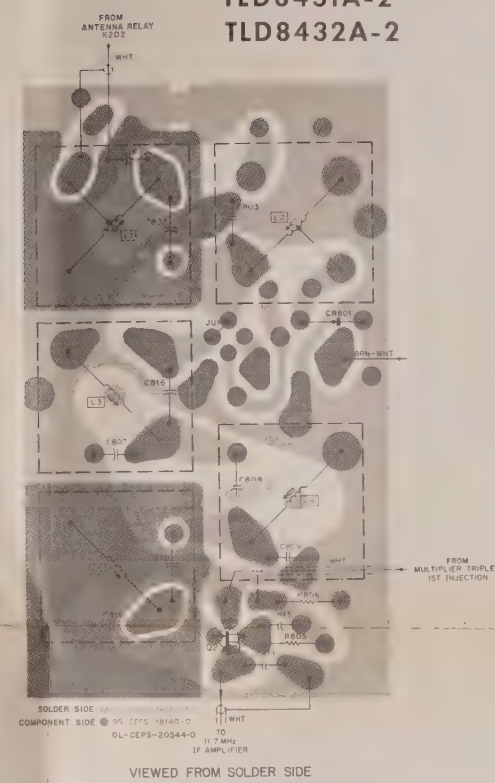
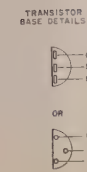


OPTIONAL RF DECK
TLD8371A-3
TLD8372A-2



STANDARD RF DECK

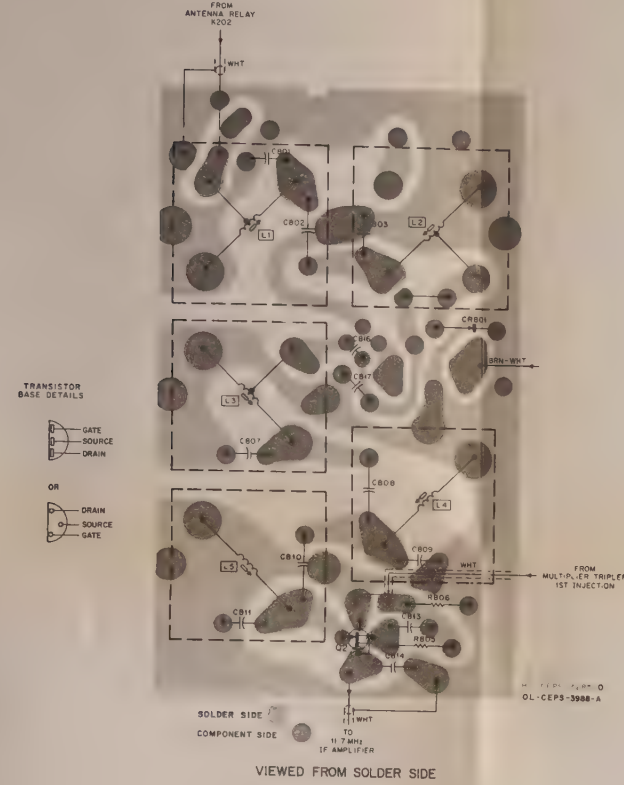
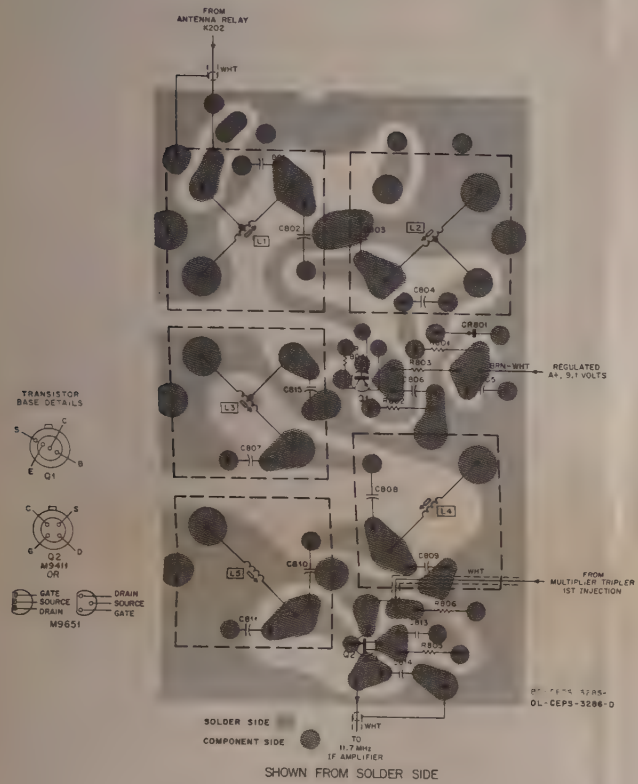
TLD8431A-2
TLD8432A-2

RCVR SECTION
OF MAIN BOARD

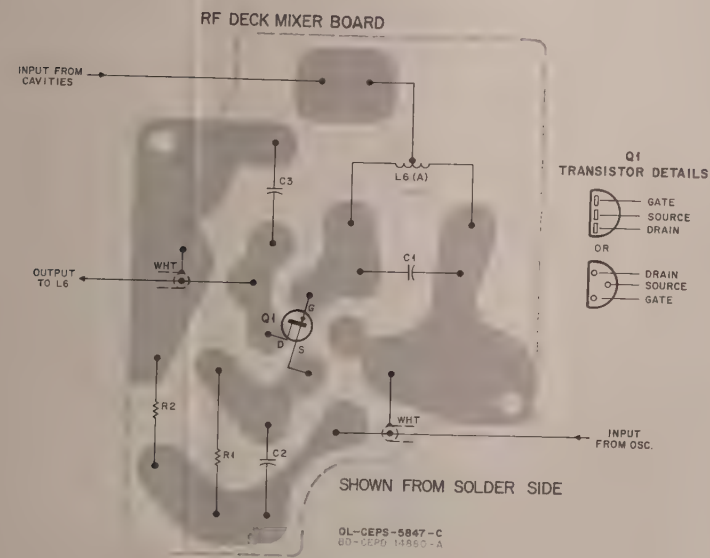
TLD8370A SERIES OPTIONAL RF DECK

TLD8430A SERIES STANDARD RF DECK

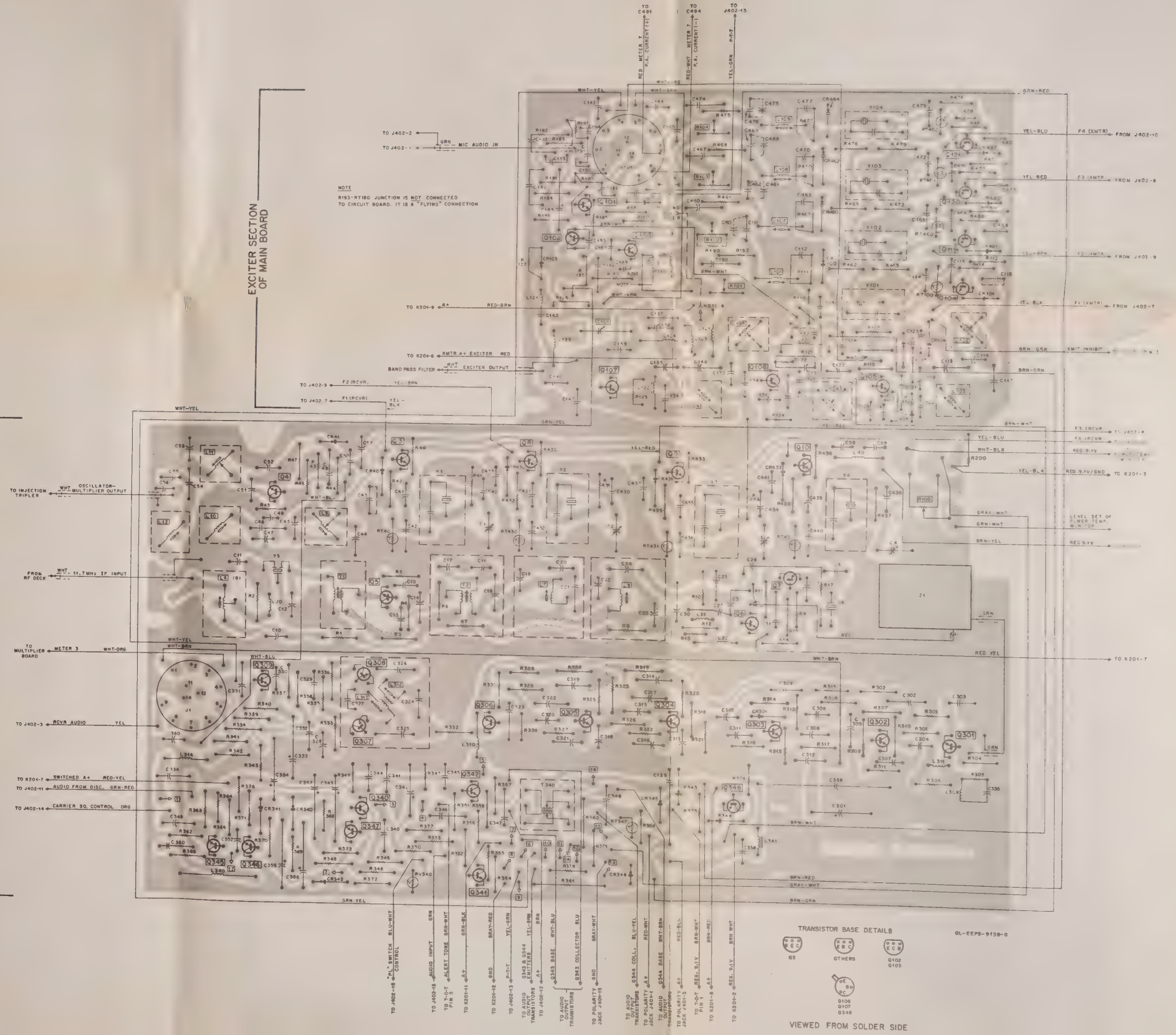
TRANSMITTER-RECEIVER MAIN BOARD



TLD1770A SERIES OPTIONAL RF DECK



RCVR SECTION OF MAIN BOARD



IMPORTANT
USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING
REPLACEMENT PARTS

TL08371A RF Deck (136-150.8 MHz)
TL08372A RF Deck (150.8-174 MHz) PL-1110-D

CR801	48C83654H01	SEMICONDUCTOR DEVICE, <u>diode</u> ; (SEE NOTE) silicon
L1	24D84971A02	<u>COIL, RF</u> : 2-1/2 turns, tapped, coded RED, incl. 76C83156H09 CORE, tuning, coded ORG
L2 thru 5	24D84971A01	2-1/2 turns, coded BRN, incl. 76C83156H09 CORE, tuning, coded ORG

NON-REFERENCED ITEMS	
26BA4957B01 1V80713B02	SHIELD, coil, 4 req'd. COIL SHIELD ASSY.

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

IMPORTANT
USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING

H=162-174 MHz

		CAPACITOR, fixed: pF: $\pm 5\%$
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C28	21-82450B08	1.2 (high-side injection)
	or 21-82133C35	3 $\pm$ 0.5 pF, NP0 (low-side injection)
C29	21-840047	150
C30	8-82905G07	0.1 μ F $\pm$ 10%, 50 V
C31	8-82905G02	0.22 μ F $\pm$ 10%, 50 V
C32	8-82905G07	0.1 μ F $\pm$ 10%, 50 V
C33	21-82610C22	20, 200 V, NP0
C41	21-84494B09	175
C42	21-84494B18	390
C43	21-82428B59	0.01 μ F $\pm$ 80%, 200 V
C44	21-821817B0	0.01 μ F $\pm$ 10%, 100 V

C48	21-82610C27	120, 200 V, N470
C49	21-84247	2.2 $\pm 10\%$
C50	21-82428B59	.01 $\mu\text{F} +80-20\%$, 200 V
C51	21-82187B18	.0015 $\mu\text{F} \pm 10\%$, 100 V
C52	21-82187B18	.0015 $\mu\text{F} \pm 10\%$, 100 V

C56M	21-82810C47	57; 100 V; N220
C56H	21-82610C57	47; 200 V; N220
C57	21-82187B20	.01 uF +80-20%; 200 V
C58	21-82187B20	.001 uF $\pm$ 10%; 100 V
C59	21-82187B20	.001 uF $\pm$ 10%; 100 V
C301	23-83214C02	15 uF $\pm$ 20%; 25 V

320	21-82428B59	.01 uF +80-20%; 200 V
321	8-82025C07	0.1 uF +10%; 50 V

345	8-8329B02	0.22 uF ±10%; 50 V
346	8-8290SG1	.01 uF ±10%; 50 V
347	8-8209GJ18	.1 uF ±10%; 100 V
348	8-8209GJ18	.1 uF ±10%; 100 V
349	8-8329B02	0.22 uF ±10%; 50 V
350	8-8209SG03	.047 uF ±10%; 50 V
352	21-873269	820 ±2%
353	23-83214C15	4.7 uF ±20%; 25 V
355	23-83214C02	15 uF ±20%; 25 V
356	23-83214C02	15 uF ±20%; 25 V
357	21-83214C02	15 uF ±20%; 25 V
358	21-82428B59	.01 uF ±40-20%; 200 V
359		200 V

40	48-82392B03	SEMICONDUCTOR DEVICE, <u>diode;</u> silicon
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R430	48-83654H01	silicon
R431	48-83654H01	silicon
R432	48-83654H01	silicon
R1033	48-82178A15	germanium
		<u>CONNECTOR, receptacle:</u>

20	24-82835G22	choke; 5.6 mH
21	24-82835G04	choke; 1.5 μ H

0	48 860494	N-P-N; type M9494
1	48 860494	N-P-N; type M9494
001	48 860494	N-P-N; type M9494
002	48 860571	P-N-P; type M9571
003	48 860570	N-P-N; type M9570
004	48 860570	N-P-N; type M9570
005	48 860570	N-P-N; type M9570
006	48 860571	P-N-P; type M9571
007	48 860570	N-P-N; type M9570
008	48 860570	N-P-N; type M9570
009	48 860570	N-P-N; type M9570
040	48 860571	P-N-P; type M9571

6-127803	1.5k
6-127802	1k
6-129233	47
6-129233	47
6-127802	22

6-128687	6.8K $\pm 5\%$
6-129669	4.7k $\pm 5\%$
6-129779	560 $\pm 5\%$
6-129775	330
6-129232	3.9k
6-128685	22k

14	6-12800	1. 92
15	6-129232	3. 92

96	0-129866	27k ±5%
97	0-128703	39k
98	0-131858	270k ±5%
99	0-129433	5, ok
100	6-129144	68k
101	6-128902	47k
102	6-127802	1k
103	6-129775	330
104	6-129804	2, 2k ±5%
105	6-128688	2, 7k

3	6-131446	120k $\pm 5\%$
4	6-129887	12k $\pm 5\%$
5	6-129984	680 $\pm 5\%$
6	6-129982	8.2k $\pm 5\%$
7	6-128902	47k

6	6-129753	100
7	6-129225	10k
9	6-129667	22k $\pm 5\%$
0	6-128687	6.8k $\pm 5\%$
1	6-129669	4.7k $\pm 5\%$

TRANSFORMER, RF:

thru 4	K1056A or K1057A	± .0005% ± .001%
	Type FYC	<u>CRYSTAL UNIT, quartz</u> receiver bandpass filter; 11.7 MHz center frequency rcvr. 2nd osc.: 11.245 MHz (low-side injection) rcvr. 2nd osc.: 12.155 MHz (high-side injection)
	G22 or G21	
	TFN1000AS	<u>FILTER, IF:</u> 455 kHz

LEGEND

L=136-150.8 MHz
M=150.8-162 MHz
H=162-174 MHz

08431A RF Deck (136-150.8 MHz)
08432A RF Deck (150.8-174 MHz)

809M	21-847743	8: NP0
809H	21-82133G33	6.8: NP0

6-124C41	470
NON-REFERENCED ITEM	
26-84956B01	SHIELD, coil (used with L1, L2, L3, L4, L5)

RF DECK (Basic)

L31	24-82890D01	coded CB5
L3M	24-82890D03	coded CB5

		(used for locking tuning screws for L1 thru L5)
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M=150.8-162 MHz
H=162-174 MHz

FIRST MIXER ASSEMBLY

TLD8861A (136-150.8 MHz)
TLD8862A (150.8-162 MHz)

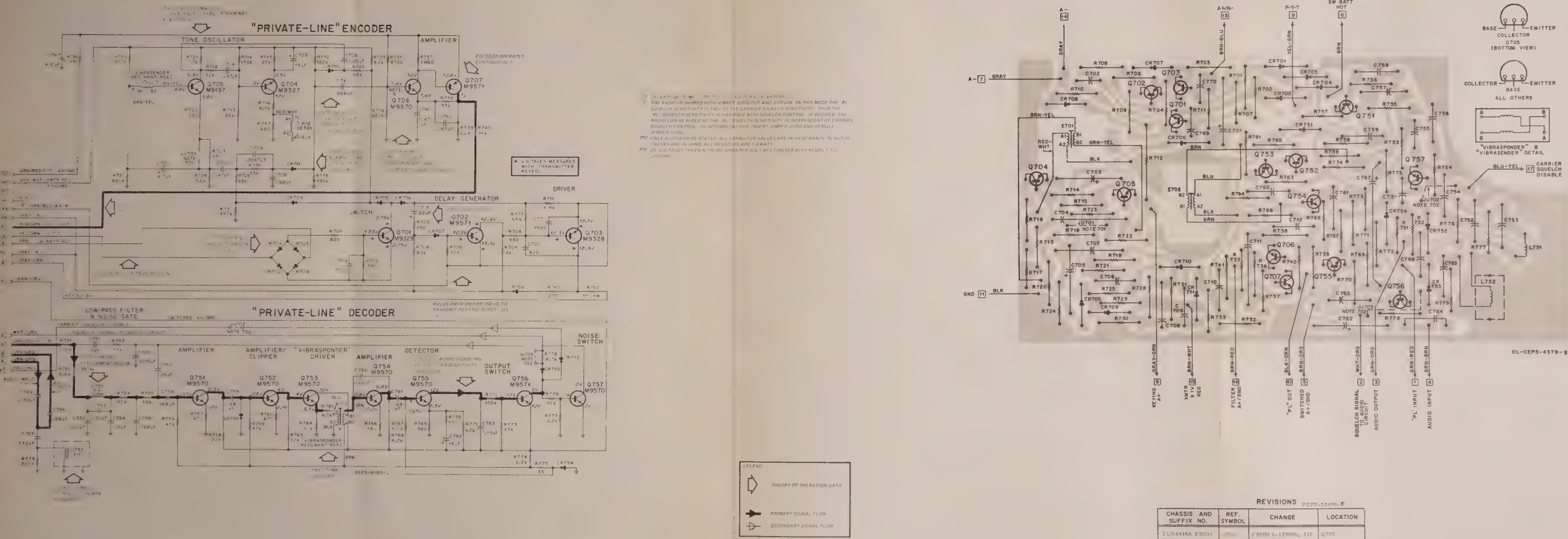
RESISTOR, fixed $\pm 10\%$, 1/4

T 143	25-H3492G02	
XQ343, 344	9-82673A01	
NON-REFERENCED ITEM		
3-138303	SCREW, tapping; 8-32 x 9/2 req'd.	
3-130491	SCREW, tapping; 8-18 x 1 1/2 req'd.	

26-84541B03	(transistor mounting) SHIELD (receiver injection tripler circuit)
7-82075H01	BRACKET, connector mount
4-801846	WASHER, insulating, 4 req

"PL" ENCODER-DECODER

SHOWN FROM SOLDER SIDE



REVISIONS

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4448A FROM SUFFIX -2 TO -4		FROM 6-129806, 330 TO 6-124A13, 300	Q705
		FROM 6-124A13, 120 TO 6-124A29, 150	Q705
		FROM 6-124A13, 300 TO 6-124A13, 330	Q705
		FROM 6-124A29, 150 TO 6-124A31, 180	Q705

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

IMPORTANT
USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING
REPLACEMENT PARTS

TLN4448A "Private-Line" Encoder & Decoder PL-1227-E

		CAPACITOR, fixed: $\mu F \pm 10\%$, 50 V; unil. stated
C701	23D84762H16	22 μF ; 20 V
C702	21-82187B21	820, $\pm 5\%$; 200 V
C703	23-83214C02	15 $\pm 20\%$; 25 V
C704	8-82905G06	0.47 μF
C705	23-83214C15	0.47 $\mu F \pm 20\%$; 25 V
C706	8-83293B18	0.15 μF
C707	8-82905G06	0.47 μF
C708	8-82905G26	.0047 μF , $\pm 5\%$; 100 V
C709, 710	8-82905G04	.068 μF
C711	8-82905G06	0.47 μF
C712	8-82905G03	.047 μF
C713	21-865922	300; 500 V
C714	8-82905G11	0.22 μF
C715	8-82905G08	.033 μF
C716	8-82905G07	0.1 μF
C717	21-82187B18	.0015 μF , $\pm 5\%$; 100 V
C718	8-82905G04	.068 μF
C719	8-82905G01	.01 μF
C758, 759	8-82905G04	.068 μF
C760	8-82905G02	.022 μF
C761	8-82905G04	.068 μF
C762	23-83214C02	15 $\mu F \pm 20\%$; 25 V
C763	8-82905G05	0.15 μF
C764	8-82905G08	.033 μF
C765	8-82905G09	0.12 μF
C766	8-82905G04	.068 μF
C767	23-82601A25	100 $\mu F \pm 10\%$; 20 V
C769, 770	21-844163	1500; 250 V
		SEMICONDUCTOR DEVICE, diode
CR701 thru 706	48-82466H01	silicon
CR705 thru 711 751 thru 754	48-83654H01	silicon
		"VIBRASPENDER" RESONANT REED
E711	TLN6824A	"plug-in" unit
		"VIBRASPENDER" RESONANT REED
E702	TLN8381A	"plug-in" unit
		COIL, RF
L751	24-84003A01	AF choke; 6 H
L752	24-84004A01	AF choke; 4 H; shielded
		TRANSISTOR
Q701	48-869329	N-P-N, type M9329
Q702	48-869571	P-N-P, type M9571
Q703	48-869328	N-P-N, type M9328
Q704	48-869327	N-P-N, type M9327
Q705	48-869197	N-P-N, type M9570
Q706	48-869570	P-N-P, type M9571
Q707	48-869571	N-P-N, type M9570
Q708	48-869570	N-P-N, type M9570
Q709	48-869570	N-P-N, type M9570
Q710	48-869570	N-P-N, type M9570
Q711	48-869570	N-P-N, type M9570
Q712	48-869570	N-P-N, type M9570
Q713	48-869570	N-P-N, type M9570
Q714	48-869570	N-P-N, type M9570
Q715	48-869570	N-P-N, type M9570
Q716	48-869570	N-P-N, type M9570
Q717	48-869570	N-P-N, type M9570
Q718	48-869570	N-P-N, type M9570
Q719	48-869570	N-P-N, type M9570
Q720	48-869570	N-P-N, type M9570
Q721	48-869570	N-P-N, type M9570
Q722	48-869570	N-P-N, type M9570
Q723	48-869570	N-P-N, type M9570
Q724	48-869570	N-P-N, type M9570
Q725	48-869570	N-P-N, type M9570
Q726	48-869570	N-P-N, type M9570
Q727	48-869570	N-P-N, type M9570
Q728	48-869570	N-P-N, type M9570
Q729	48-869570	N-P-N, type M9570
Q730	48-869570	N-P-N, type M9570
Q731	48-869570	N-P-N, type M9570
Q732	48-869570	N-P-N, type M9570
Q733	48-869570	N-P-N, type M9570
Q734	48-869570	N-P-N, type M9570
Q735	48-869570	N-P-N, type M9570
Q736	48-869570	N-P-N, type M9570
Q737	48-869570	N-P-N, type M9570
Q738	48-869570	N-P-N, type M9570
Q739	48-869570	N-P-N, type M9570
Q740	48-869570	N-P-N, type M9570
Q741	48-869570	N-P-N, type M9570
Q742	48-869570	N-P-N, type M9570
Q743	48-869570	N-P-N, type M9570
Q744	48-869570	N-P-N, type M9570
Q745	48-869570	N-P-N, type M9570
Q746	48-869570	N-P-N, type M9570
Q747	48-869570	N-P-N, type M9570
Q748	48-869570	N-P-N, type M9570
Q749	48-869570	N-P-N, type M9570
Q750	48-869570	N-P-N, type M9570
Q751	48-869570	N-P-N, type M9570
Q752	48-869570	N-P-N, type M9570
Q753	48-869570	N-P-N, type M9570
Q754	48-869570	N-P-N, type M9570
Q755	48-869570	N-P-N, type M9570
Q756	48-869570	N-P-N, type M9570
Q757	48-869570	N-P-N, type M9570
Q758	48-869570	N-P-N, type M9570
Q759	48-869570	N-P-N, type M9570
Q760	48-869570	N-P-N, type M9570
Q761	48-869570	N-P-N, type M9570
Q762	48-869570	N-P-N, type M9570
Q763	48-869570	N-P-N, type M9570
Q764	48-869570	N-P-N, type M9570
Q765	48-869570	N-P-N, type M9570
Q766	48-869570	N-P-N, type M9570
Q767	48-869570	N-P-N, type M9570
Q768	48-869570	N-P-N, type M9570
Q769	48-869570	N-P-N, type M9570
Q770	48-869570	N-P-N, type M9570

MODEL TLN5817A & TLN5817AV

If the decoder is operating properly, a 0.18 microvolt rf carrier modulated ± 0.5 to 1 kHz with the appropriate code should unscramble the receiver. This can be checked as follows:

(1) Connect the rf signal generator output to the radio set antenna jack and set the generator output level to minimum.

(2) Modulate the signal generator ± 0.5 kHz with the appropriate "Digital Private-Line" code. The modulating signal can be obtained from a Motorola Model SLN613A "Digital Private-Line" Test Set. The signal generator must have an external modulation frequency response of less than 1 Hz. The Motorola Model S1314A Signal Generator or S1327B Service Monitor have the required low frequency response.

(3) Also modulate the signal generator with a 300 to 3000 Hz tone. Total deviation should be ± 4 kHz, including code modulation.

(4) Increase the signal generator output level until the receiver unsquelches. No more than 0.18 uV should be needed to unsquelch the receiver.

The encoder should modulate the transmitter rf carrier ± 0.5 to 1 kHz. The transmitted signal should unquench any properly operating receiver that is equipped with the same coded squelch code and is operating in the coded squelch mode. After the microphone PTT button is released, the transmitter should remain keyed for about 180 milliseconds and the encoder should produce a turn-off code. No squelch tails should be heard in properly operating coded squelch receivers. Validity of the coded squelch code and turn-off code can be checked with a Motorola SLN613A "Digital Private-Line" Test Set.

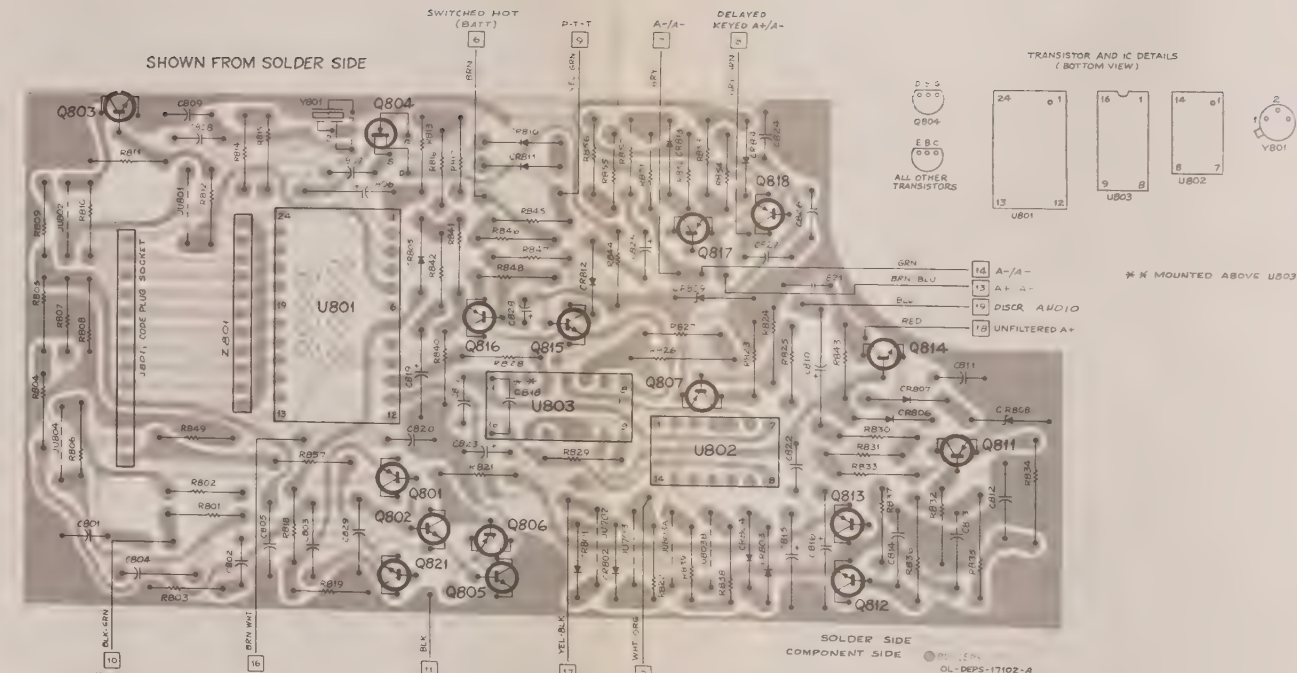
SYMPTOM	PROBABLE CAUSE	CIRCUIT CHECKS
Transmitter has no power output. Transmitter relay doesn't operate.	No A+ from PTT delay circuit.	1. Check PTT switch circuit. 2. Check PTT delay circuit.
Transmitter causes squelch tails in "Digital Private-Line" receivers.	Turn-off code not being sent, or is of insufficient duration or deviation.	1. Check turn-off code deviation: should be ± 500 to ± 1000 Hz. Turn-off code should begin as soon as PTT button is released. Transmitter should remain keyed for 160 to 250 msec after PTT button is released. 2. Check PTT delay circuit. 3. Check U801-9: should be 0 V during delayed PTT. 4. Check Q821: must be off for proper low-pass filter operation during transmit.
Transmitter cannot un-squelch "Digital Private-Line" receivers.	Insufficient transmitter code deviation. Incorrect or faulty code.	Check code deviation: should be ± 500 to ± 1000 Hz. 1. Check U801-15 through U801-23 for proper octal code. 2. Check U801-9: should be +6 V (high).
	Encoder filter is malfunctioning. 50 kHz oscillator is malfunctioning.	Check encoder filter (Q801-803 and Q821) for proper operation. Check U801-4 for 50 kHz square wave. Rise time should be 750 nsec or less.
Receiver will not unsquelch in "Digital Private-Line" operation.	Switch interface circuits are malfunctioning.	Check switch interface circuits (Q805 and Q806). Q806 emitter should be 12.8 V when U801-7 is high.
	U801 is not decoding properly.	1. Check U801-7: should be 6 V when decoding a valid code. 2. Check U801-1: should be 0 V. 3. Check U801-12 with oscilloscope. You should see 6 V p-p pulses 1.84 msec apart.
	50 kHz oscillator malfunctioning.	Check U801-4 for 50 kHz square wave. Rise time should be 750 nsec or less.
	U801 is not properly programmed.	Check U801-15 through U801-23 for proper octal code.
	U801 is in encode mode.	Check U801-9: should be low.
	Decoder filter and data conditioner malfunctioning.	Compare waveforms and voltages with those on the schematic diagram.
Excessive decoder falsing.	Decoder low-pass filter malfunctioning.	Check decoder filter response. At Q812 emitter the filter response should be -1 to -4 dB at 134 Hz and -12 to -15 dB at 250 Hz. Keep input signal below 400 mV p-p to keep CR803 and CR804 out of clip.
	Encoder-decoder U801 malfunctioning.	Check U801-7: should be low when no code is decoded.
	U803C in current source is on.	Check U803-9: should be 10.0 V when U801-7 is low.
Excessive blocking.	Decoder filter malfunctioning. Current source malfunctioning.	Check decoder filter response. See checks for excessive decoder falsing. Check U803-9: should be 0.1 V when U801-7 is high.
Squelch open at all times in "Digital Private-Line" mode.	Switch interface circuit malfunctioning. U801 malfunctioning.	Check switch interface circuits (Q805 & Q806). Check U801-7: should be 6 V except when valid code is decoded.
	Power supply voltage is not $6.2 \text{ V} \pm 5 \text{ V}$.	Check voltage at U801-24.
	50 kHz oscillator operating intermittently or at wrong frequency.	Check 50 kHz clock signal at U801-4: should be 50 kHz square wave. Rise time should be 750 nsec or less.

TLN5817A & TLN5817AV Encoder-Decoder Board Pl.-3385-C

CR801, 820, 821, 822, 824, 826, 827	21-82428B959	CAPACITOR, fixed: uF ±5%; 50 V unless otherwise stated; .01 to .005; 200 V
CR802, 811, 817	21-82187B20	.001 ±10%; 100 V
CR803	8-83813H26	.0056
CR804	8-83813H24	.0056
CR805	8-83213H14	.043
CR806, 819	23-84762H07	4.7 ±20%; 10 V
CR807	21-82428B09	.0047 ±10%; 100 V
CR808	21-840849	20 pF; NP0
CR809	21-83798B01	100 pF; 200 V
CR810	23-82763B16	39 ±10%; 10 V
CR812	8-82905G39	.023
CR813	8-83813H23	.068
CR814	8-83813H19	.0039
CR815	23-8672H03	10 ±10%; 20 V
CR816	23-82763B48	0.68; 35 V
CR818	21-82187B14	.001 ±10%; 100 V
CR823, 825	23-84538G04	15 ±20%; 10 V
CR828	23-84538G01	1 ±20%; 35 V
CR829	8-83813H27	.0033
CR801, 802, 805, 806, 807, 812, 813	48-83654H01	DIODE: (SEE NOTE) silicon
CR803, 804	48-84616A01	hot carrier
CR808	48-82256C11	Zener type: 10 V
CR809	48-83696E07	Zener type: 6.2 V
CR810, 811, 814	48-82460H13	silicon
J801	9-82071K01	SOCKET; female; 12 contact
Q801, 806, 807, 811, 813, 816, 817	48-869643	TRANSISTOR: (SEE NOTE) PNP; type M9643
Q802, 805, 812, 815, 821	48-869642	PNP; type M9642
Q803	48-869648	PNP; type M9642 (TLN5817AV only)
Q804	48-869648	field-effect
Q814	48-869648	PNP; type M9648
Q818	48-869649	PNP; type M9649
R801	6-124A74	11k
R802, 844	6-124A37	330
R803, 853	6-124A49	1k
R804, 805, 808, 813	6-124A97	100k
R806, 854	6-124A45	80
R807, 831	6-124B02	50k
R809	6-124A91	150k
R810	6-124A73	100k (TLN5817AV only)
R811, 812	6-124A89	47k (TLN5817AV only)
R815, 827	6-124B04	470k
R816	6-124A77	15k
R817	6-124B08	270k
R818, 841	6-124C99	120k ±10%
R819, 840, 842	6-124C95	82k ±10%
R820, 821	6-124C89	47k ±10%
R822	6-124C59	2.7k ±10%
R823, 830, 848	6-124A83	27k
R824, 829, 836, 839, 845, 846	6-124A73	10k
R825	6-124A59	2.7k
R826	6-10621D80	56.2k ±1%; 1/8 W
R829, 833, 847	6-124A89	47k
R832	6-124A93	68k
R834, 835, 836	6-13755D04	56.2k ±1%
R837	6-124A55	1.8k
R843	6-124A33	220
R849, 852, 859	6-124C75	12k ±10%
R850, 855	6-124A53	1.5k
R851	6-124A79	18k
R856	6-124C57	2.2k ±10%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U801	51-8420A782	INTEGRATED CIRCUIT: (SEE NOTE) type M5752 type LM565CN type CA3096AE
U'802	51-84320A55	
U803	51-84320A79	
Z801	51-82142K02 or 1-80772B36	NETWORK: resistive resistive network assembly CRYSTAL: resonator 50.00000- 50.00000KH
YR01	48-82003K01	
NON-REFERENCED ITEMS		
	39-10184A24	CONTACT, chain form
	37-82603D02	SLEEVING, coded #2
	37-82603D06	SLEEVING, coded #6
	37-82603D07	SLEEVING, coded #7
	37-82603D08	SLEEVING, coded #8
	37-82603D09	SLEEVING, coded #9
	37-82603D10	SLEEVING, coded #10
	37-82603D11	SLEEVING, coded #11
	37-82603D13	SLEEVING, coded #13
	37-82603D14	SLEEVING, coded #14
	37-82603D16	SLEEVING, coded #16
	37-82603D17	SLEEVING, coded #17
	37-82603D18	SLEEVING, coded #18
	37-82603D19	SLEEVING, coded #19

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



"DIGITAL PRIVATE-LINE"
ENCODER-DECODER

MODELS TLN5817A & TLN5817AV

FUNCTION

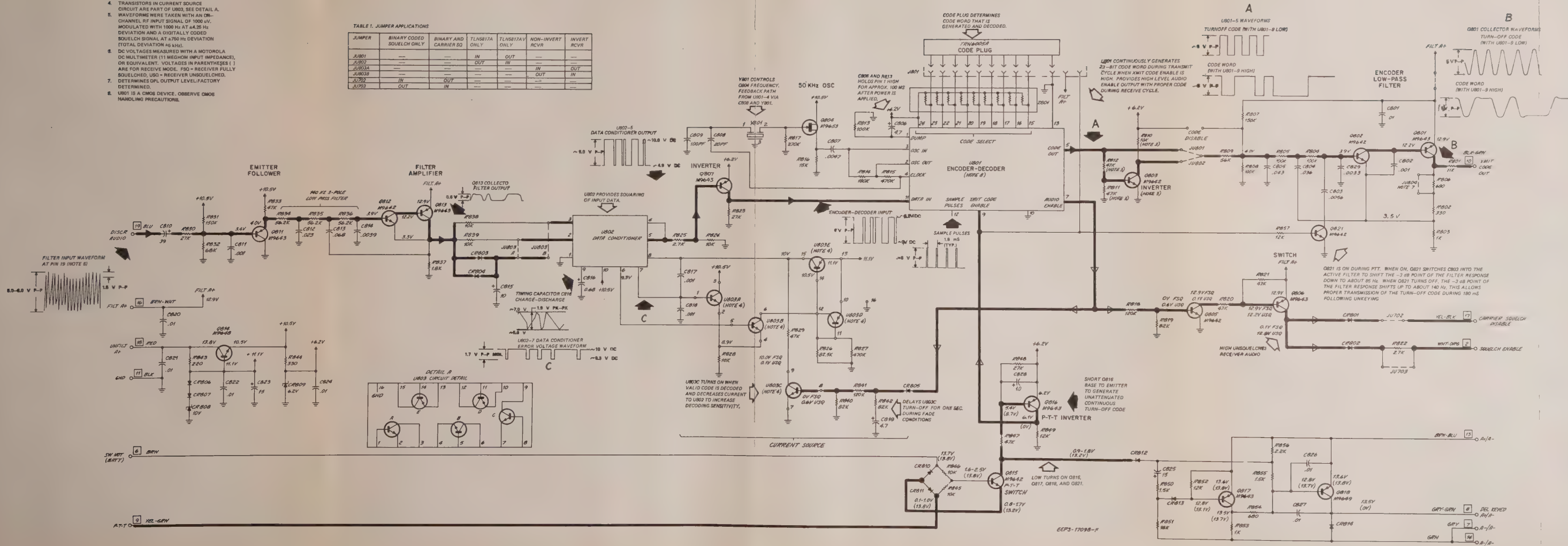
Used as a code generator and decoder in "CONSOLETE" Base Stations and "MOCOM +70" Mobiles. Generates and decodes 23-bit binary code word in "Digital Private-Line" squelch system.

NOTES

1. UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS.
2. SEE TABLE 1 FOR JUMPER APPLICATIONS.
3. RB10, RB11, RB12, AND Q803 USED ON TLN5817AV ONLY.
4. TRANSISTORS IN CURRENT SOURCE CIRCUIT ARE PART OF U803; SEE DETAIL A.
5. WAVEFORMS WERE TAKEN WITH AN 80-CHANNEL RF INPUT SIGNAL OF 1000 uV, MODULATED WITH 1000 Hz AT 44.25 Hz DEVIATION AND A DIGITALLY CODED SQUELCH SIGNAL AT 4750 Hz DEVIATION (TOTAL DEVIATION 46 kHz).
6. DC VOLTAGES MEASURED WITH A MOTOROLA DC MULTIMETER (11 MEGOHM INPUT IMPEDANCE), OR EQUIVALENT. VOLTAGES IN PARENTHESES () ARE FOR RECEIVER MODE. P80 = RECEIVER FULLY SQUELCHED, U80 = RECEIVER UNSQUELCHED.
7. DETERMINES OPL OUTPUT LEVEL FACTORY DETERMINED.
8. U801 IS A CMOS DEVICE. OBSERVE CMOS HANDLING PRECAUTIONS.

TABLE 1. JUMPER APPLICATIONS

JUMPER	BINARY CODED SQUELCH ONLY	BINARY AND CARRIER SQ	TLN5817A ONLY	TLN5817AV ONLY	NON-INVERT RCVR	INVERT RCVR
JU801	---	---	IN	OUT	---	---
JU802	---	---	OUT	IN	---	---
JU803A	---	---	---	---	IN	OUT
JU803B	---	---	---	---	OUT	IN
JU702	IN	OUT	---	---	---	---
JU703	---	---	IN	---	---	---

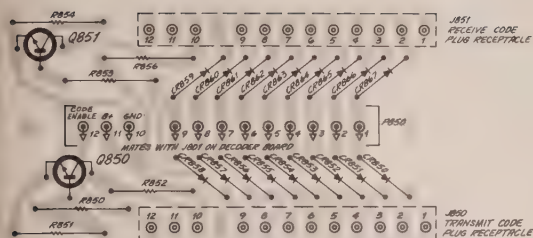


"DIGITAL PRIVATE-LINE" TWO-CODE ADAPTER

MODEL TLN5730A

APPLICATION —

Plugs into code plug receptacle on "Digital Private-Line" Decoder or Encoder-Decoder to allow separate "Digital Private-Line" codes for transmit and receive. Code plugs for the two codes then plug into the receptacles on the two-code adapter board.



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE

DL-CEPS-1764B-0

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
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PARTS LIST

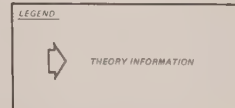
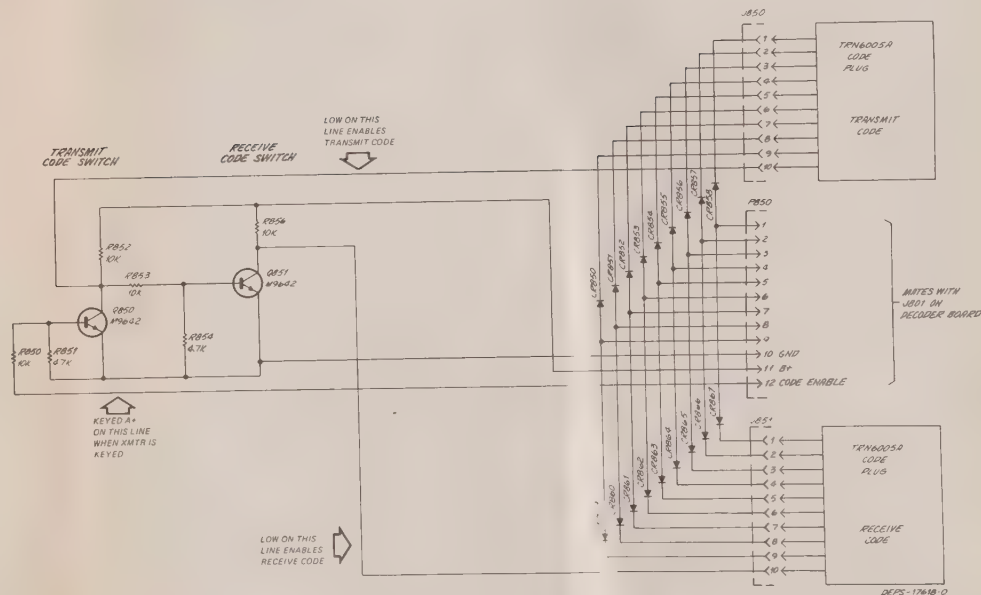
TLN5730A 2-Code Adapter Board PL-3414-0

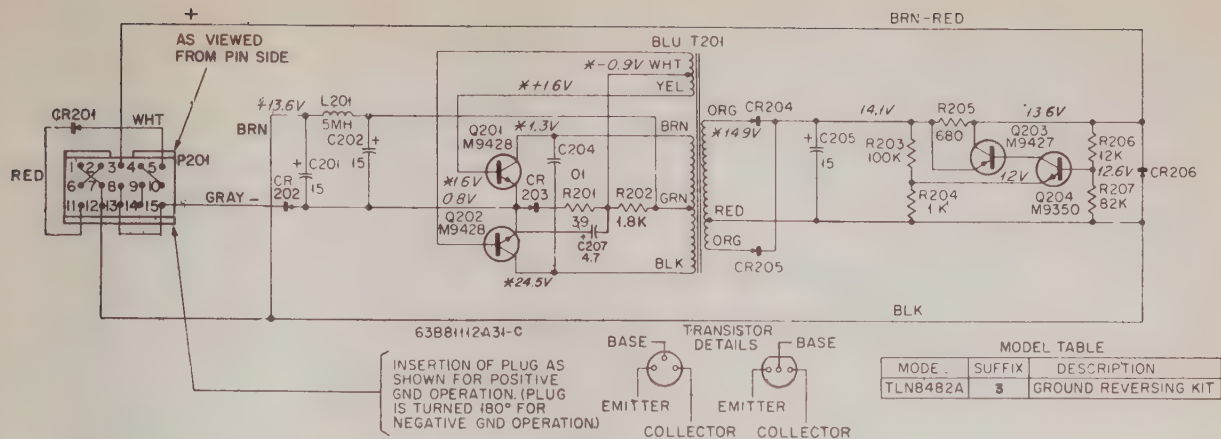
CR850 thru 867	48-83654H01	DIODE: (SEE NOTE) silicon
J850, 851	9-82071K01	CONNECTOR, receptacle: female; 12-contact
P850		CONNECTOR, plug: consists of: 28-82070K01 CONTACT, male; 13 req'd.
Q850, 851	48-869642	TRANSISTOR: (SEE NOTE) NPN; type M9642
R850, 852, 853, 856	6-124A73	RESISTOR, fixed: 10k $\pm 5\%$; 1/4 W
R851, 854	6-124A65	4.7k $\pm 5\%$; 1/4 W

NON-REFERENCED ITEMS

	1V80769B88	CIRCUIT BOARD ASSY., incl. referenced item P850
	3-138804	SCREW, machine: 4-40 x 5/16"; 2 req'd.

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

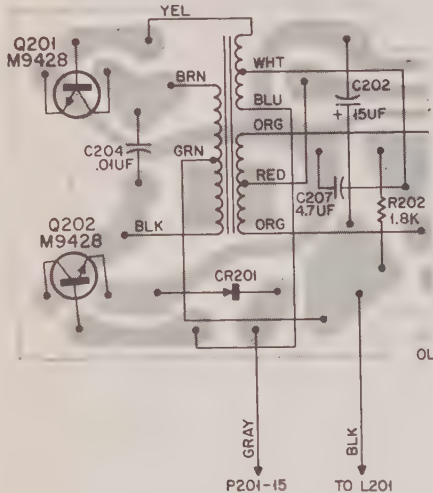




REVISIONS

PEPD-14830-5

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN8482A	CR202	WAS 48C82466H21	PARTS LIST
	R202	WAS 6S128688, 2.7K	T201PRIMARY
	C203	REMOVED 21C82372C02 0.2 uf WAS CONNECTED IN PARALLEL WITH C202	Q201 EMIT-TER
	C206	REMOVED 21C82372C02 0.2 uf WAS CONNECTED IN PARALLEL WITH C205	T201 SEC-ONDARY
TLN8482A-1	C207	ADDED 4.7 uf	Q202 EMITTER
TLN8482A-2	R204	WAS 6S129235, 1.2K	Q204 EMITTER
TLN8482A-3		RELOCATED C207 AND REVISED CIRCUIT BOARD PLATING. CIRCUIT WAS AS SHOWN BELOW.	



PARTS LIST

TLN8482A Ground Reversing Kit

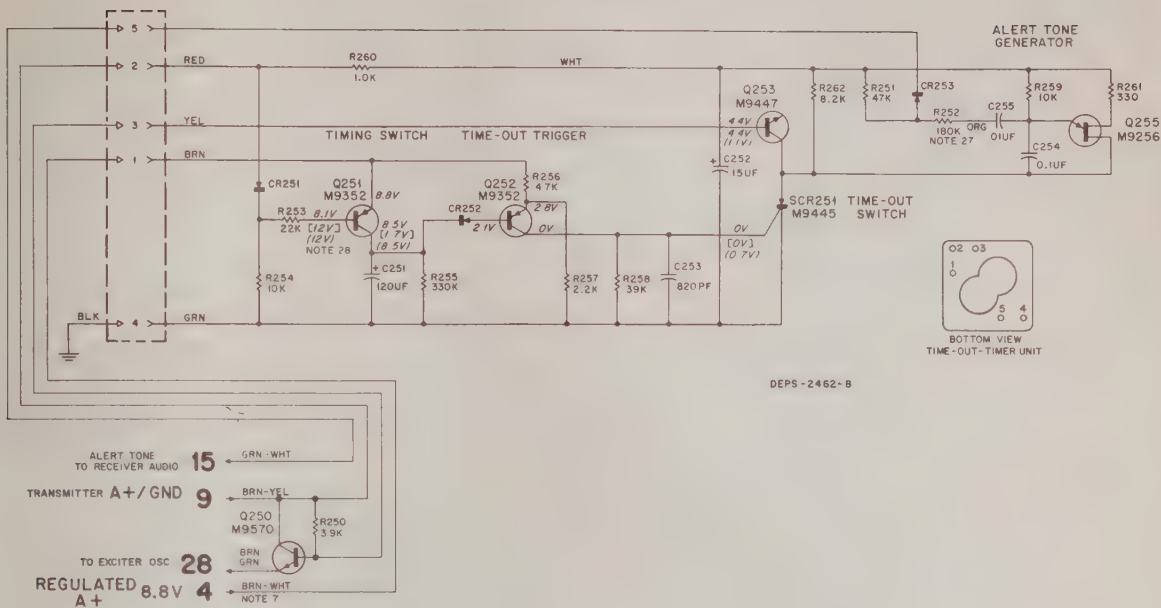
EPD-14846-D

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C201, 202, 205 C204 C207	23K865136 21D82428B40 23K865137	CAPACITOR, fixed: uF 15 ±20%; 25 V .01 +60-40%; 250 V 4.7 ±20%; 25 V
CR201 CR202 CR204, 205 CR203, 206	48C82525G07 48C82466H01 48C82466H12 48C82392B03	SEMICONDUCTOR DEVICE, diode; (SEE NOTE) silicon silicon silicon silicon
L201	25B82142H01	COIL, audio; choke 5 mH
P201	1V80735A23	CONNECTOR, plug; ass'y; male; 15 contact; includes 14C82141H01 INSULATOR, 29C82335A01 TERMINAL
Q201, 202 Q203 Q204	48R869428 48R869427 48R869350	TRANSISTOR; (SEE NOTE) N-P-N; type M9428 P-N-P; type M9427 N-P-N; type M9350
R201 R202 R203 R204 R205 R206 R207	6S131652 6S129269 6S129226 6K127802 6S6040 6S129230 6S129145	RESISTOR, fixed; ±10%; 1/4 W; unl. stated 39 1.8k 100k 1k 680; 1/2 W 12k 82k
T201	25D83633D01	TRANSFORMER: pri. No. 1: BLU, YEL w/center tap @WHT; total coil res. .087 ohms pri. No. 2: BRN, BLK w/center tap @GRN; total coil res. 0.16 ohms sec: ORG, ORG w/center tap @ RED; total coil res. 0.339

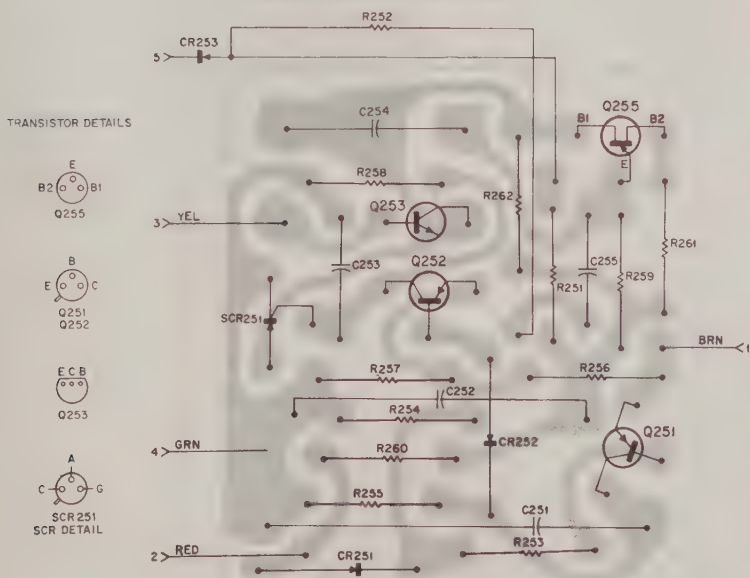
NOTE:

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

TIME-OUT TIMER



SHOWN FROM SOLDER SIDE



OL-CEPS - 962-F

Model TLN1097A Time-Out Timer (Optional)
Schematic Diagram & Circuit Board Detail
Motorola No. PEPS-9210-B
2/24/76-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING
REPLACEMENT PARTS

TLN8403A Time-Out Timer Board

EPD-15076-E

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

TLN8404A Components Kit

EPD-15077-B

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

TLN4323A Installation Kit

PL-1021-O

Q250	48R869570	TRANSISTOR: (SEE NOTE) N-P-N; type M9570
R250	6S129232	RESISTOR, fixed: 3.9k $\pm 10\%$; 1/4 W
NON-REFERENCED ITEMS		
	1V80708B80	CIRCUIT BOARD ASSY.
	41A82114E01	SPRING, crystal hold-down
	3S134184	SCREW, tapping: No. 4-40 x 5/16"

NOTE:

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

DUAL PURPOSE
2-FREQUENCY
DASH MOUNT CONTROL HEAD



Dash Mount Dual-Purpose
Control Heads
Schematic Diagram
Motorola No. PEPS-5652-C
8/26/75- NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

CONTROL HEADS

WITH DIMMER
DASH-MOUNT
1-FREQ. & 4-FREQ.

TCN6141BE (Dual Purpose, 1-Freq.)
TCN6141BJ (Dual Purpose, 4-Freq.)

PL-1321-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR505	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) dual Zener type: 25 V
DS501, 502	654151	LAMP, incandescent: min. bay: 6-8 V; 0.2 A; type No. 51
F501	65K86099	FUSE, cartridge: 1-1/4" x 1/4": 32 V; 7.5 A
F502	65B61682	25 A
F503	65B475247	6-1/4 A
J501	9K830418	CONNECTOR, receptacle: female: 4 contact; does not include 487699 LOCKWASHER; 13/16" internal 2A482070 NUT, machine; ring type (knurled)
J502	9C801050	female: 19-contact
P501	9B855112	CONNECTOR, plug: female: 2-contact; does not include 15B85111 SHELL, connector
R501	18K857840	RESISTOR, fixed: $\pm 10\%$; 1/2 W; unl. stated
R504	655581	variable: 25k $\pm 30\%$; 0.33 W
R505	656320	3.3k
R506	18K868896	10k
R507	656336	variable: 25k $\pm 30\%$; 0.33 W; includes switch S501
R512	17D82177B05	270; 1 W
S501		50; 5 W
S502	40C83624D01	SWITCH: dpst; p/o: R506 rotary; 1-pole: 4-position non-shorting (TCN6141BJ)
TB502	31C84922A01	BOARD, terminal: 7 terminal
W501	1V80764A18	CABLE ASSEMBLY, power: includes F501, XF501 and the following items: 10S345 CABLE, power: No. 18 ga., str.; GRN; 107" length req'd; 29K865065 LUG, ring-tongue
W502	1V80705A13	includes F502, XF502 and the following items: 30K813233 CABLE, power: No. 10 ga., str.; RED; 9-1/2 ft. length req'd
W503	1V80705A06	includes F503, XF503 and the following items: 10M343 CABLE, power: No. 18 ga., str.; ORG; 66" length req'd
W504	30K831572	CABLE, power, No. 10 ga., str.; BLK; 10 ft. length req'd.
W505	30C83155H02	2-conductor; each conductor No. 18 ga., str.; 36" length req'd
XDS501, 502	9B863168	LAMPHOLDER: miniature bayonet type

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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XF501, 502, 503		FUSEHOLDER: "in-line" type; consists of: 14A82882A01 BODY 14A82883A02 CAP 42A82884A01 CLIP, contact: 2 req'd; 41A82885A01 SPRING, compression
NON-REFERENCED ITEMS		
61B83678D01	LENS, indicator light: RED	
61B83678D02	LENS, indicator light: GRN	
3A82670A07	SCREW, machine: special type; 2 req'd (control head mounting)	
36B82629H02	KNOB, control: (2 req'd for TCN6141BE; 3 req'd for TCN6141B)	
26B83806D01	SHELL, light: (for light-dependent resistor located on "dimmer" board)	
3A82227A02	SCREW, machine: special type; 4 req'd	
1V80708B72	COVER, housing: (back)	
15D8376D07	HOUSING, control head	
13D857971	ESCUTCHEON (TCN6141BE)	
13D82286C23	ESCUTCHEON (TCN6141B)	
3B82126B07	SCREW, nylon: 4-40 x 1/4"	

MICROPHONE

TMN6013A Microphone

TMN6018A Microphone Weatherproof

PL-924-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
DP551	59-82933C01	CARTRIDGE, microphone: translator amplifier
	or 59-82933C02	
P551	28-16370	CONNECTOR, plug: male; 4 contact
S551	40-82263C02	SWITCH, push: dpst not replaceable; in (TMN6013A)
	or 40-82263G01	(TMN6018A)
W551	1-80707A58	CORD, microphone: assembly; includes P551 and the following items: 41-852707 SPRING, strain relief
	or 1-80724A28	29-847034 LUG, insulation-piercing; required
	(TMN6018A)	CORD, PLUG & SWITCH ASSY. includes P551, S551
NON-REFERENCED ITEMS		
1-80720A94	CASE, microphone; includes hang-up stud	
11-2506	TUBING; No. 9 BLK, 5" length req'd	
3-124693	LOCKSCREW; 6-32 x 1/4" Phillips round head; 2 required	
42-852710	STRAP, strain relief	
38-852699	PUSHBUTTON	
15-82701B01	COVER, microphone case (front)	
32-82703B01	GASKET: neoprene	
4-114201	WASHER: 1/4" x 0.156" x .015 3 required	
3-127924	LOCKSCREW; 6-32 x 5/16" Phillips round head	
3-132436	SCREW, machine: 6-32 x 13/16" Phillips round head	
42-82702B01	3 required	
1-865398	RETAINER, mic. cartridge	
	MOUNTING KIT, microphone includes 64-85596 PLATE mic, hang-up; 3-122830 SCREW, tapping; No. 8 x 1/2" slotted binder head; 2 required	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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CONTROL HEADS

DASH MOUNT WITH DIMMER, 2-FREQUENCY

TCN141BF (Dual Purpose)

PL-1322-A

CR505	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) dual Zener type: 25 V
DS501, 502	654151	LAMP, incandescent: min. bay: 6-8 V; 0.2 A; type No. 51
F501	65K86099	FUSE, cartridge: 1-1/4" x 1/4": 32 V; 7.5 A
F502	65B61682	25 A
F503	65B475247	6-1/4 A
J501	9K830418	CONNECTOR, receptacle: female: 4 contact; does not include 487699 LOCKWASHER; 13/16" internal, 2A482070 NUT, machine; ring type (knurled)
J502	9C801050	female: 19-contact
P501		CONNECTOR, plug: incl; 9B851112 CONNECTOR, plug and 15B85111 COVER, connector
R501	18K857840	RESISTOR, fixed: $\pm 10\%$; 1/2 W; unl. stated
R504	655581	var: 25k $\pm 30\%$; 0.33 W
R505	656320	3.3k
R506	18K857698	10k
R507	656336	var: 25k $\pm 30\%$; 0.33 W
R512	17D82177B05	270; 1 W
S501	40K80247	50; 5 W
S502	40A80246	SWITCH: toggle; dpst; toggle; dpdt
TB502	31C84922A01	BOARD, terminal: 7 terminal
W501	1V80764A18	CABLE ASSEMBLY, power: incl F501, XF501 and the following items: 10S345 CABLE, power: No. 18 ga., str.; GRN; 107" length req'd; 29K865065 LUG, ring tongue
W502	1V80705A13	incl F502, XF502 and the following items: 30K813233 CABLE, power: No. 10 ga, str; RED; 9-1/2 ft length req'd
W503	1V80705A06	incl F503, XF503 and the following items: 10M343 CABLE, power: No. 18 ga, str; ORG; 66" length req'd
W504	30K831572	CABLE, power: No. 10 ga, str; BLK; 10 ft. length req'd
W505	30C82155H02	2-cond; each cond, No. 18 ga, str; 36" length req'd
XDS501, 502	9B863168	LAMPHOLDER: miniature bayonet type
XF501, 502, 503		FUSEHOLDER: "in-line" type: c/o: 14A82882A01 BODY 14A82883A02 CAP 42A82884A01 CLIP, cont: 2 req'd; 41A82885A01 SPRING, compression

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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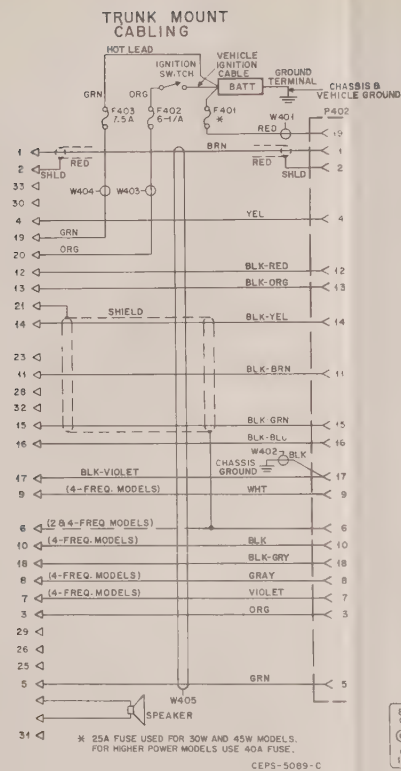
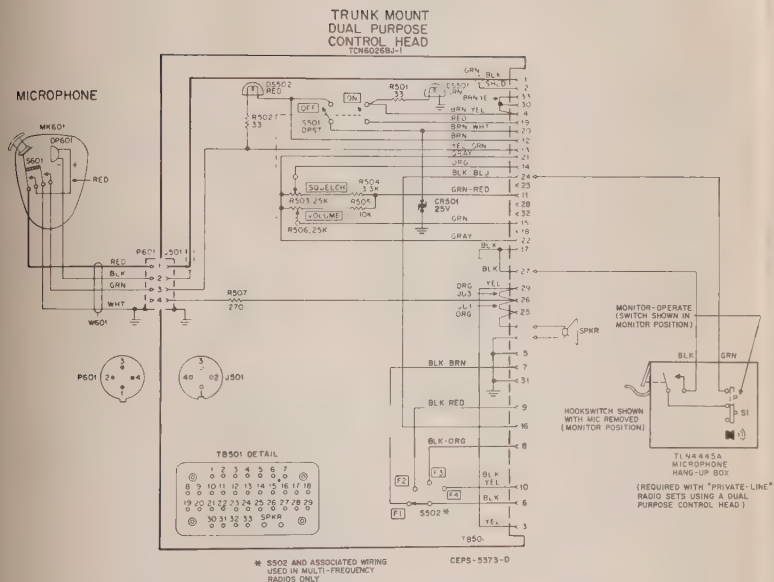
NON-REFERENCED ITEMS

61B83678D01	LENS, indicator light: RED
61B83678D02	LENS, indicator light: GRN
3A82670A07	SCREW, machine: special type; 2 req'd (control head mtg)
36B82629H02	KNOB, control: (3 req'd for TCN6141BE; 4 req'd for TCN6141B)
26B83806D01	SHELL, light: (for light-dependent resistor located on "dimmer" board)
3A82227A02	SCREW, machine: special type; 4 req'd
1V80708B72	COVER, housing: (back)
15D8376D07	HOUSING, control head
13K857972	ESCUTCHEON
3B82126B07	SCREW, nylon: 4-40 x 1/4"

REVISIONS

PEPS-11-2-D

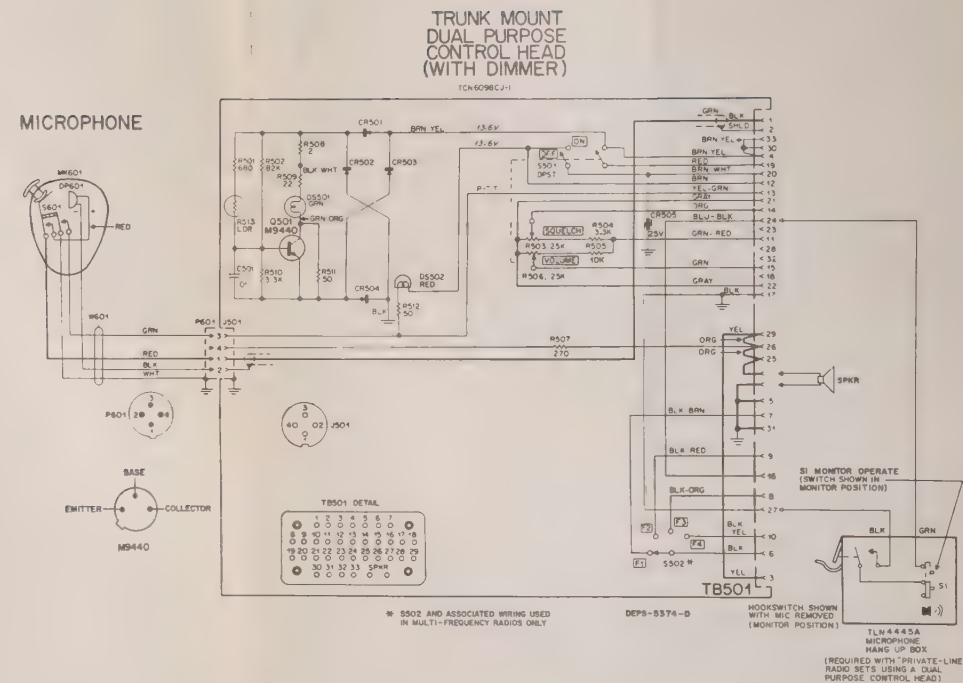
CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TCN6141BE-1 TCN6141BF-1 TCN6141BJ-1	CR505	Added 48-83461E45	TB501-12



NOTES:

1. NO ELECTRICAL CONNECTION.
2. NO ELECTRICAL CONNECTION ON CARRIER SQUELCH MODELS.
3. NO ELECTRICAL CONNECTION ON 1-FREQUENCY MODELS.
4. S502 USED IN MULTI-FREQUENCY RADIOS ONLY.

EPS-5372-O



PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Trunk Mount Dual-Purpose Control Heads and Cabling Schematic Diagram
Motorola No. PEPS-5653-C
8/26/75-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

IMPORTANT
USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING

REPLACEMENT PARTS
TCN6098CE Control Head, Trunk Mount 1-Freq.
Dual Purpose with Dimmer
TCN6098CF Control Head, Trunk Mount 2-Freq.
Dual Purpose with Dimmer PL-1274-A

CR505	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) dual Zener type; 25 V
DS501, 502	65S4151	LAMP, incandescent; min. bay. 6-8 V; 0.2 A; type No. 51
J501	9K830418	CONNECTOR, receptacle; female; 4 contact; does not incl. 4S7699 LOCKWASHER; 13/16" internal 2A482070 NUT, machine ring (knurled)
R501	17-82350A04	RESISTOR, fixed ±10%; 1/4 W; unl. stated
R502	17-82350A04	33 ±10%, 2 W
R503	18-857840	var; 25k ±30%, 0.33 W
R504	6R5581	3.3k; 1/2 W
R505	6-6320	10k; 1/2 W
R506	18-868896	var; 25k ±30%; 0.33 W; incl. SWITCH, toggle; dpst (1-freq.)
R507	or18C857698	variable; 25k ±30%; 0.33 W (2-freq.)
R512	656336 17D82117B05	270; 1 W 50; 5 W
S501	or40K80247	SWITCH, p/o R506; (1-freq.) toggle; dpst (2-freq.)
S502	40A80246	toggle; dpst
TB501	31C83826D01	TERMINAL BOARD 35 female contact
XDS501, 502	9B863168	LAMPHOLDER min. bay.
NON-REFERENCED ITEMS		
26B83806D01	SHIELD, light (for R513)	
61B83678D01	LENS, indicator; light; RED	
61B83678D02	LENS, indicator; light; GRN	
3A82670A01	SCREW, control head mounting 2 req'd	
36K858652	KNOB, control; 2 req'd	
15D83576D03	HOUSING, control head	
13D857971	ESCUTCHEON, cont. hd. (1-freq.)	
13D857972	ESCUTCHEON, cont. hd. (2-freq.)	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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1 & 2 FREQUENCY MODELS CONTROL HEAD

TCN6026BE (Trunk-Mount, 1-Freq.) Dual Purpose
TCN6026BF (Trunk-Mount, 2-Freq.) Dual Purpose PL-1231-C

CR501	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) dual Zener type; 25 V
DS501	65-4151	LAMP, incandescent; 6-8 V; 0.2 A; 1 cond; type No. 51
DS502	65-4151	6-8 V; 0.2 A; 1 cond; type No. 51
J501	9-830418	CONNECTOR, receptacle; female; 4 contact
R501	17-82350A04	RESISTOR, fixed; unl. stated
R502	17-82350A04	33 ±10%, 2 W
R503	18-857840	var; 25k ±30%, 0.33 W
R504	6-5581	3.3k ±10%; 1/2 W
R505	6-6320	10k ±10%; 1/2 W
R506	18-868896	var; 25k ±30%; 0.33 W; incl. dpst switch; 1-freq.
R507	or18-857698 6-6336	var; 25k ±30%; 0.33 W; 2 freq. 270 ±10%, 1 W
S501	or40-80247 40-80246	SWITCH, toggle; p/o R506; 1-freq. dpst ("on-off"), 2 freq. dpst ("F1-F2"), 2 freq.
S502		
TB501	31-83826D02	BOARD, term; 35 female; cont term.
XDS501,	9-863168	LAMPHOLDER
XDS502	9-863168	min; bayonet type min; bayonet type
NON-REFERENCED ITEMS		
61-866158	LENS, indicator light; RED	
61-865159	LENS, indicator light; GRN	
3-82670A01	SCREW, control head	
36-858652	KNOB, control; 2 req'd	
2-482070	NUT, ring; knurled	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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4 FREQUENCY MODELS CONTROL HEAD

TCN6026BJ Control Head, Trunk Mount
(Dual Purpose) PL-1232-C

CR501	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE I) dual Zener type; 25 V
DS501	65-4151	LAMP, incandescent; 0.2 A; type No. 51
DS502	65-4151	0.2 A; type No. 51
J501	9-830418	CONNECTOR, receptacle; female; 4 contact
R501	17-82350A04	RESISTOR, fixed ±10%; unl. stated
R502	17-82350A04	33; 2 W
R503	18-857840	var. 25k ±30%
R504	6-5581	3.3k; 1/2 W
R505	6-6320	10k; 1/2 W
R506	18-868896	var.; 25k ±30%; 0.33 W; incl. S501
R507	6-6336	270; 1 W
S501	40-83624D01	SWITCH, rotary; unl. stated dpst; p/o R506
S502		1 pole; 4 position
TB501	31-83826D02	BOARD, terminal 35 female contacts
XDS501	9-863168	LAMPHOLDER
XDS502	9-863168	single contact; bayonet base single contact; bayonet base
NON-REFERENCED ITEMS		
61-865158	LENS, indicator light; GRN	
61-865159	LENS, indicator light; RED	
2-482070	NUT, knurled; 13/64"-27 x 1/8"	
3-82670A01	SCREW, machine; 6-32 x 1.44" (2 req'd)	
36-858652	KNOB, vol. control (2 req'd)	
36-82869D01	KNOB, freq. selector	

NOTE:

- Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.
- When ordering crystal units, specify carrier frequency, crystal frequency and crystal type number.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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MICROPHONE

TMN601-A Microphone
TMN601-A Microphone Weatherproof PL-1224-B

DS501	65-82933C01	CARTRIDGE, microphone transistor amplifier
DS502	or65-82933C02	25 ±10%, 2 W
J501	9-830418	CONNECTOR, receptacle; female; 4 contact
R501	17-82350A04	RESISTOR, fixed ±10%; unl. stated
R502	17-82350A04	33; 2 W
R503	18-857840	var. 25k ±30%
R504	6-5581	3.3k; 1/2 W
R505	6-6320	10k; 1/2 W
R506	18-868896	var.; 25k ±30%; 0.33 W; incl. S501
R507	6-6336	270; 1 W
S501	40-83624D01	SWITCH, rotary; unl. stated dpst; p/o R506
S502		1 pole; 4 position
TB501	31-83826D02	BOARD, terminal 35 female contacts
XDS501	9-863168	LAMPHOLDER
XDS502	9-863168	single contact; bayonet base single contact; bayonet base
NON-REFERENCED ITEMS		
61-865158	LENS, indicator light; GRN	
61-865159	LENS, indicator light; RED	
2-482070	NUT, knurled; 13/64"-27 x 1/8"	
3-82670A01	SCREW, machine; 6-32 x 1.44" (2 req'd)	
36-858652	KNOB, vol. control (2 req'd)	
36-82869D01	KNOB, freq. selector	

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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CABLE KIT

TKN6055A Cable Kit (1-Freq., 12 V)
TKN6056A Cable Kit (2- & Multi-Freq., 12 V) EPD-9982-L

F401	65-61682	FUSE, cartridge; 25 amp; 250 V
F402	65-475247	6-1/4" x 1/2" x 1/2"
F403	65-86099	7.5 amp; 250 V
J402	1-80715A24	CONNECTOR, plug; incl: 9-801050 CONNECTOR, plug 19-cont, female 15-12075D01 HOUSING L.H. 15-82075D01 HOUSING R.H. 3-131758 SCREW, 4-40 x 1-1/8" 2 req'd 2-129964 NUT, hex; 4-40 x 1/4"; 2 req'd; 1-80717A73 SCREW & KNOB ASSY, 4-40 x 1/2" WASHER, "C" 4-806071 WASHER, .016" thick 4-82113D01 WASHER, .032" thick, 42-864148 CLAMP, cable 3-132127 SCREW, tapping; No. 6 x 3/4" plain hex head
W401	1-80744A37	CABLE ASSY, special purpose; incl: 30-858553 CABLE, power; 1 cond; No. 12 ga. RED 22-1/2 ft. req'd 29-832116 LUG, for 3/8" stud, ref parts F401 and XF401
W402	1-864643	incl: 30-858552 CABLE, power; 1 cond; No. 12 ga. BLK; 5-1/2 ft. req'd 29-832116 LUG, for 3/8" stud
W403	1-80705A19	incl: 29-824456 LUG, for No. 10 stud 37-82603D20 SLEEVE, coded No. 20 29-82602D01 CONNECTOR, plug; 1 cond; ref part XF402
W404	1-80744A39	incl: 29-865065 LUG, for 3/8" stud 37-82603D19 SLEEVE, coded No. 19 29-82602D01 CONNECTOR, plug; 1 cond, ref part XF403
W405	30-858513 or30-864650	CABLE, special purpose; 13 cond 17 ft req'd 1-freq 17 cond 17 ft req'd 2- & multi-freq
XF401		FUSE HOLDER incl: 14-82882A01 BODY 14-82883A01 CAP, 42-82884A01 CLIP, fuse; 2 req'd; 41-82885A01 SPRING
XF402	1-80705A07	incl: 14-82882A01 BODY 14-82883A01 CAP, 41-82885A01 SPRING 1-80705A08 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 10-145 LEAD, elect; 1 cond No. 18 ga; ORG; 57" req'd 1-80705A09 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 30S10310A62 LEAD, elect; 1 cond; No. 18 ga; ORG; 9" req'd ref part F402
XF403	1-80744A38	incl: 14-82882A01 BODY 14-82883A01 CAP, 41-82885A01 SPRING 1-80705A12 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 10-145 LEAD, elect; 1 cond; No. 18 ga; GRN; 97" req'd 1-80705A12 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 30S10310A62 LEAD elect; 1 cond; No. 18 ga; GRN; 9" req'd ref part F403

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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NON-REFERENCED ITEMS		
29-82602D01	CONNECTOR, plug; male; single cont; 19 req'd	
37-82603D01	SLEEVE, coded	
37-82603D02		
37-82603D03		
37-82603D04		
37-82603D05		
37-82603D06		
37-82603D07		
37-82603D08		
37-82603D09		
37-82603D10		
37-82603D11		
37-82603D12		
37-82603D13		
37-82603D14		
37-82603D15		
37-82603D16		
37-82603D17		
37-82603D18		
37-82603D21		

NOTE:

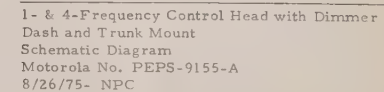
Replacement diodes and transistors must be ordered by
Motorola part number only for optimum performance.

TCN6098CJ Control Head Trunk Mount 4-Frequency
Dual Purpose with Dimmer PL-1237-A

CR505	48-83461E45	SEMICONDUCTOR DEVICE, diode: (SEE NOTE) dual Zener type; 25 V
DS501, 502	65S4151	LAMP, incandescent; min. bay. 6-8 V; 0.2 A; type No. 51
J501	9K830418	CONNECTOR, receptacle; female; 4 contact; does not incl. 4S7699 LOCKWASHER; 13/16" internal; 2A482070 NUT, machine; ring (knurled)
R501	18K857840	RESISTOR, fixed ±10%; 1/4 W; unl. stated
R504	6R5581	var; 25k ±30%; 0.33 W
R506	6R6320	3.3k; 1/2 W
R507	18K868896	10k; 1/2 W
R512	656336 17D82117B05	var; 25k ±30%; 0.33 W; incl S501 270; 1 W 50; 5 W
S501	40C83624D01	SWITCH, rotary dpst (p/o R506)
S502		1 pole; 4 position
TB501	31C83826D01	TERMINAL BOARD 35 female contact terminals
XDS501, 502	9B863168	LAMPHOLDER min. bay.

NON-REFERENCED ITEMS		
61B83678D01	LENS, indicator light; RED	
61B83678D02	LENS, indicator light; GRN	
3A82670A01	SCREW, machine; special type (2 req'd)	
36K858652	KNOB control (2 req'd) (VOL.SQ)	
36B82869D01	KNOB, control (F1-F4)	
15C8240D01	COVER, housing	
15D83576D03	HOUSING, control head	
13D82286C23	ESCUTCHEON, cont. hd.	

MICROPHONE



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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CONTROL HEADS

WITH DIMMER
DASH-MOUNT
1-FREQ. & 4-FREQ.

TCN6141AE (Carrier Squelch, 1-Freq.)
TCN6141AG ("Private-Line" Tone-Coded Squelch, 1-Freq.)
TCN6141AJ (Carrier Squelch, 4-Freq.)
TCN6141AK ("Private-Line" Tone-Coded Squelch, 4-Freq.)

PL-766-O

DS501, 502	6S4151	LAMP, incandescent: min. bay.; 6-8 V; 0.2 A; type No. 51
F501	65K86099	FUSE, cartridge: 1-1/4" x 1/4"; 32 V;
F502	65S61682	7.5 A
F503	65B475247	25 A
		6-1/4 A
J501	9K830418	CONNECTOR, receptacle: female; 4-contact; does not include: 487699 LOCKWASHER; 13/16" internal 2A482070 NUT, machine; ring type (knurled)
J502	9C801050	female; 19-contact
P501	9B855112	CONNECTOR, plug: female; 2-contact; does not include 15B855111 SHELL, connector
R503	18K857840	RESISTOR, fixed: $\pm 10\%$; 1/2 W;
R504	6S5581	unt stated
R505	6S6320	variable: 25K $\pm 30\%$; 0.33 W
R506	18K868896	3.3K
		10K
		variable: 25K $\pm 30\%$; 0.33 W;
		includes switch 5501
		(TCN6141AE, AJ)
		variable: 25K $\pm 30\%$; 0.33 W
		(TCN6141AG, AK)
R507	6S6336	270; 1 W
R512	17D82177B05	50; 5 W
S501		SWITCH:
		dpat: p/o R506 (TCN6141AE, AJ)
S502	or40K80247	toggle: dpat (TCN6141AG, AK)
	40C83624D01	rotary: 1-pole; 4-position;
S503	40A80246	non-shorting
		toggle: dpat
W501	1V80754A18	CABLE ASSEMBLY, power: includes F501, XF501 and the following items:
		10S345 CABLE, power; No. 18
		ga., str.; GRN; 107" length
		req'd; 29K865065 LUG, ring-
		tongue
W502	1V80705A13	includes F502, XF502 and the following items:
		30K813233 CABLE, power; No
		10 ga., str.; RED; 9-1/2 ft.
		length req'd.
W503	1V80705A06	includes F503, XF503 and the following items:
		10M343 CABLE, power; No. 18
		ga., str.; ORG; 66" length req'd
W504	30K031572	CABLE, power:
		No. 10 ga., str.; BLK; 10 ft.
		length req'd.
W505	30C83155H02	2-conductor; each conductor
		No. 18 ga., str.; 36" length
		req'd.
XDS501, 502	9B863168	LAMPHOLDER: miniature bayonet type
XF501, 502, 503		FUSEHOLDER: "in-line" type; consists of:
		14A82882A01 BODY
		14A82883A02 CAP
		42A82884A01 CLIP, contact:
		2 req'd.; 41A82885A01 SPRING, compression

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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NON-REFERENCED ITEMS

61B8367D01	LENS, indicator light: RED
61B8367D02	LENS, indicator light: GRN
3A82670A07	SCREW, machine; special type; 2 req'd. (control head mounting)
36B82629H02	KNOB, control: (2 req'd. for TCN6141AE, AG; 3 req'd. for TCN6141AJ, AK)
26B83806D01	SHIELD, light: (for light-dependent resistor located on "dimmer" board)
3A82227A02	SCREW, machine; special type; 4 req'd.
1V80705B72	COVER, housing: (back)
15D8357AD07	HOUSING, control head
13D857971	ESCUTCHEON (TCN6141AE)
13D857975	ESCUTCHEON (TCN6141AG)
13D82286C23	ESCUTCHEON (TCN6141AJ)
13D82286C22	ESCUTCHEON (TCN6141AK)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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CONTROL HEADS

WITH DIMMER
TRUNK-MOUNT
1-FREQ. & 4-FREQ.

TCN6098BE (Carrier Squelch, 1-Freq.)
TCN6098BG ("Private-Line" Tone-Coded Squelch, 1-Freq.)
TCN6098BJ (Carrier Squelch, 4-Freq.)
TCN6098BK ("Private-Line" Tone-Coded Squelch, 4-Freq.)

PL-767-A

CR505	48D83461E45	SEMICONDUCTOR DEVICE, diode: SEE NOTE
		dual, Zener type: 25 V
DS501, 502	6S4151	LAMP, incandescent: min. bay.; 6-8 V; 0.2 A; type No. 51
J501	9K830418	CONNECTOR, receptacle: female; 4-contact; does not include: 487699 LOCKWASHER; 13/16" internal; 2A482070 NUT, machine; ring type (knurled)
		RESISTOR, fixed: $\pm 10\%$; 1/2 W;
		unt stated
R503	18K857840	variable: 25K $\pm 30\%$; 0.33 W
R504	6S5581	3.3K
R505	6S6320	10K
R506	18K868896	variable: 25K $\pm 30\%$; 0.33 W;
		includes switch 5501
		(TCN6098BE, BJ)
		variable: 25K $\pm 30\%$; 0.33 W
		(TCN6098BG, BK)
R507	6S6336	270; 1 W
R512	17D82177B05	50; 5 W
S501		SWITCH,
		dpat: p/o R506 (TCN6098BE, BJ)
S502	or40K80247	toggle: dpat (TCN6098BG, BK)
	40C83624D01	rotary: 1-pole; 4-position;
S503	40A80246	non-shorting
		toggle: dpat
TB501	31C83826D01	TERMINAL BOARD: 35 female contacts
XDS501, 502	9B863168	LAMPHOLDER: miniature bayonet type
NON-REFERENCED ITEMS		
	61B8367D01	LENS, indicator light: RED
	61B8367D02	LENS, indicator light: GRN
	3A82670A01	SCREW, machine; special type; 2 req'd. (control head mounting)
	36K858652	KNOB, control: 2 req'd. (VOL & SQ.)
	36B82869D01	KNOB, control: (freq. selector)
	26B83806D01	SHIELD, light: (for light-dependent resistor located on "dimmer" board)
	3A82227A02	SCREW, machine; special type; 4 req'd.
	15C82401D01	COVER, housing: (back)
	15D83576D03	HOUSING, control head
	13D857971	ESCUTCHEON (TCN6098BE)
	13D857975	ESCUTCHEON (TCN6098BG)
	13D82286C23	ESCUTCHEON (TCN6098BJ)
	13D82286C22	ESCUTCHEON (TCN6098BK)
	1B82400D01	BRACKET, control head mounting
	3S7302	SCREW, machine: 10-32 x 3/8" plain hex head; 2 req'd. (for mounting control head on bracket)
	3S7544	SCREW, tapping: No. 8 x 1/2" plain hex head; 3 req'd. (for mounting bracket)

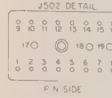
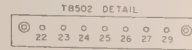
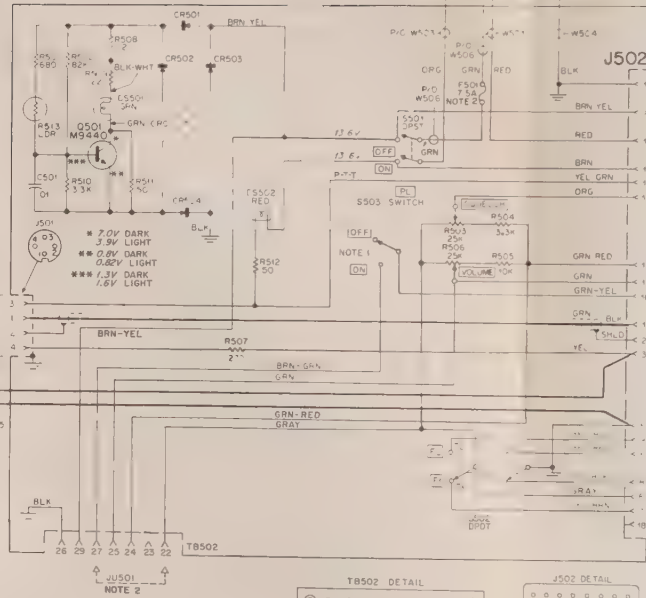
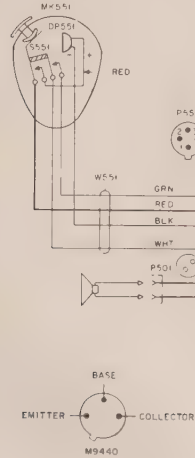
NOTE:

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

DASH-MOUNT CONTROL HEAD

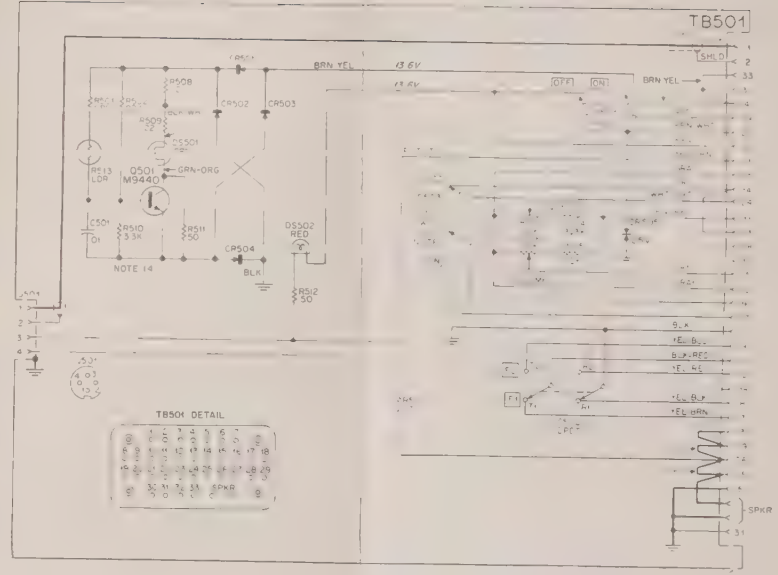
TRUNK-MOUNT CONTROL HEAD

MICROPHONE



- NOTES:
1. S503 AND ASSOCIATED WIRING USED IN "PRIVATE-LINE" MODELS ONLY.
 2. J501 USED IN "PRIVATE-LINE" MODELS ONLY.

EPS-1591-C



EEPS-3282-B

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM
Control Head with Dimmer
Schematic Diagram Used in
2-Frequency Radio Sets
Motorola No. PEPS-3539-C
8/26/75- NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

CONTROL HEADS

DASH-MOUNT WITH DIMMER, 2-FREQUENCY

TCN6141AF (Carrier Squelch) Tone-Coded Squelch PL-926-B
TCN6141AH ("Private-Line")

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR505	45D83461E45	SEMICONDUCTOR DEVICE, diode: SEE NOTE dual Zener type: 25V
DS501, 502	65K4151	LAMP, incandescent: min. bay: 6-8 V; 0.2 A; type No. 51
F501	65K86099	FUSE, cartridge: 1-1/4" x 1/4"; 32 V; 7.5 A
F502	65S61682	25 A
F503	65B475247	6-1/4 A
J501	9K830418	CONNECTOR, receptacle: female: 4-cont; does not incl. 487699 LOCKWASHER: 13/16" internal, 2A482070 NUT, machine: ring type (knurled) female: 19 contact
J502	9C801050	RESISTOR, fixed: ±10%; 1/2 W unl. stated var: 25K ±30%; 0.33 W 3.3K 6S6320 10K var: 25K ±30%; 0.33 W; incl. switch S501 (TCN6141AH) var: 25K ±30%; 0.33 W (TCN6141AF) 270; 1 W 50; 5 W
R501	18K857840	SWITCH: dpst; p/o R506 (TCN6141AH) toggle dpst (TCN6141AF) toggle: dpst slide: dpst
R504	65S581	
R505	6S6320	
R506	18K868896	
R507	or 18C857698	
R512	6S6336	
	17D82177B05	
S501	or 40K80247	
S502, 503	40A80246	
S504	40B83444D01	
W501	1Y80764A18	CABLE ASSEMBLY, power: includes F501, XF501 and the following items: 10S345 CABLE power: no. 18 ga., str.; GRN; 107" length req'd. 29K865065 LUG, ring tongue incl. F502, XF502 and the following items: 30K813233 CABLE, power: No. 10 ga. str.; RED; 9-1/2 ft. length req'd. incl. F503, XF503 and the following items: 10M343 CABLE, power: No. 18 ga. str.; ORG; 66" length req'd
W502	1Y80705A13	CABLE, power: No. 10 ga. str.; BLK; 10 ft. length req'd 2-cond; each cond No. 18 ga. str; 36" length req'd
W503	1Y80705A06	LAMPHOLDER: miniature bayonet type
W504	30K831572	FUSEHOLDER: "in-line" type: c/o; 14A82882A01 BODY, 14A82883A02 CAP, 42A82884A01 CLIP, cont; 2 req'd, 41A82885A01 SPRING, compression
W505	30C82155H02	
XDS501, 502	9B863168	
XF501, 502, 503		

NON-REFERENCED ITEMS

61B83678D01	LENS, indicator light: RED
61B83678D02	LENS, indicator light: GRN
3A82670A01	SCREW, machine: special type 2 req'd (control head mtg)
36B82629H02	KNOB, control: 3 req'd
26B83806D01	SHIELD, light (for light de- pendent resistor located on "dimmer" board)

CONTROL HEADS

TRUNK-MOUNT WITH DIMMER, 2-FREQUENCY

TCN6098BF (Carrier Squelch) Tone-Coded Squelch PL-925-B
TCN6098BH ("Private-Line")

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
CR505	48D83461E45	SEMICONDUCTOR DEVICE, diode: SEE NOTE dual Zener type: 25 V
DS501, 502	65K4151	LAMP, incandescent: min. bay: 6-8 V; 0.2 A; type No. 51
J501	9K830418	CONNECTOR, receptacle: female: 4-cont; does not incl. 487699 LOCKWASHER: 13/16" internal, 2A482070 NUT, machine: ring type (knurled)
R503	18K857840	RESISTOR, fixed: ±10%; 1/2 W; unl. stated var: 25K ±30%; 0.33 W 3.3K 6S6320 10K var: 25K ±30%; 0.33 W; incl. switch S501 (TCN6098BH) var: 25K ±30%; 0.33 W (TCN6098BF) 270; 1 W 50; 5 W
R504	65S581	
R505	6S6320	
R506	18K868896	
R507	or 18C857698	
R512	6S6336	
	17D82177B05	
S501	or 40K80247	
S502, 503	40A80246	
S504	40B83444D01	
TB501	31C83826D01	SWITCH: dpst; p/o R506 (TCN6098BH) toggle: dpst (TCN6098BF) toggle: dpst slide: dpst
XDS501, 502	9B863168	TERMINAL BOARD: 35 female contacts

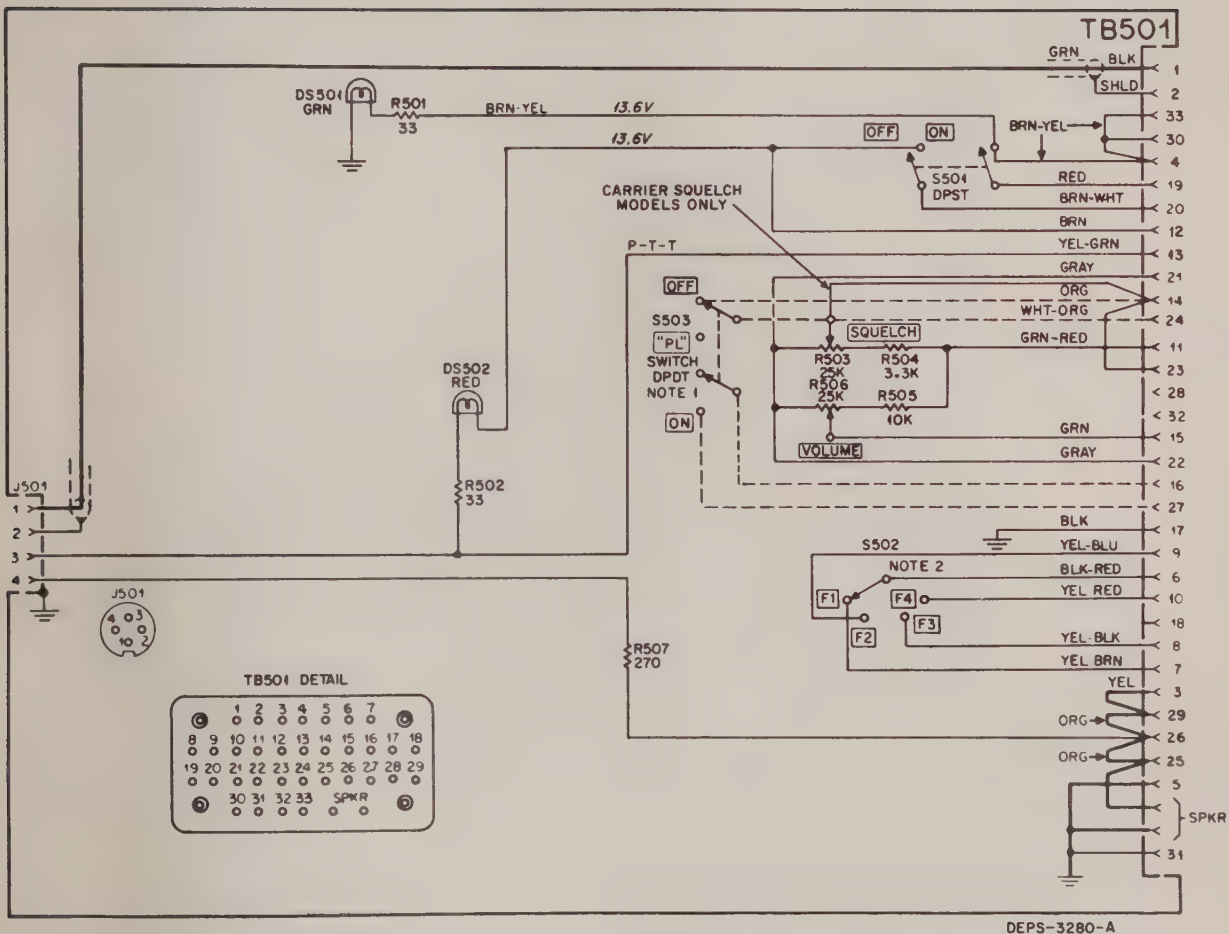
NON-REFERENCED ITEMS

61B83678D01	LENS, indicator light: RED
61B83678D02	LENS, indicator light: GRN
3A82670A01	SCREW, machine: special type: 2 req'd (control head mtg)
36K858652	KNOB, control: 2 req'd (VOL & SQUELCH)
26B83806D01	SHIELD, light (for light de- pendent resistor located on "dimmer" board)
3A82227A02	SCREW, machine: special type: 4 req'd COVER, housing: (back) HOUSING, control head ESCUTCHEON (TCN6098BF) ESCUTCHEON (TCN6098BH) BRACKET, control head mtg
15C82401D01	SCREW, machine: 10-32 x 3/8" plain hex head: 2 req'd (for mtg control head on bracket)
15D83576D03	SCREW, tapping: No. 8 x 1/2" plain hex head: 3 req'd (for mtg bracket)
13K857972	
13K857976	
7B82400D01	
3S7302	
3S7544	

NOTE:

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

TRUNK-MOUNT CONTROL HEAD



DEPS-3280-A

NOTES:

1. S503 AND ASSOCIATED WIRING (DASHED LINES) USED IN "PRIVATE-LINE" MODELS ONLY.
2. S502 AND ASSOCIATED WIRING USED IN MULTIPLE FREQUENCY MODELS ONLY.

EPS-3591-A

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Control Head Schematic Diagram
Used in 1- & 4-Frequency Radio Sets
Motorola No. PEPS-3537-C
8/26/75- NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

CONTROL HEADS

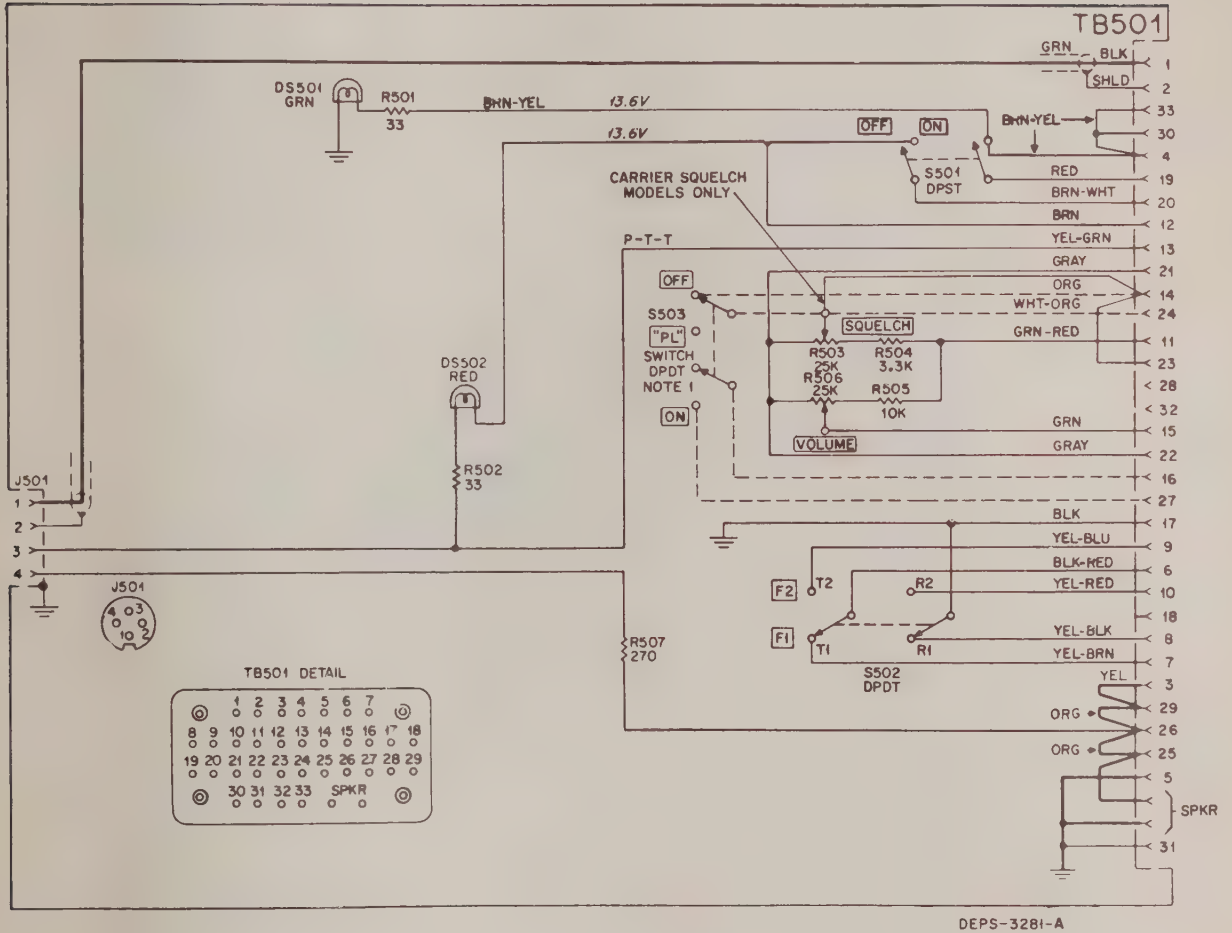
TRUNK-MOUNT
1-FREQ. & 4-FREQ.

TCN6026AE (Carrier Squelch, 1-Freq.)
TCN6026AG ("Private-Line" Tone-Coded Squelch, 1-Freq.)
TCN6026AJ (Carrier Squelch, 4-Freq.)
TCN6026AK ("Private-Line" Tone-Coded Squelch, 4-Freq.)

PL-772-C

DS501, 502	65K4151	<u>LAMP, incandescent:</u> min. bay.; 6-8 V; 0.2 A; type No. 51
J501	9K830418	<u>CONNECTOR, receptacle:</u> female; 4-contact; does not include: 4S7699 LOCKWASHER; 13/16" internal; 2A482070 NUT, machine: ring type (knurled)
R501, 502	17C82350A04	<u>RESISTOR, fixed: ±10%; 1/2 W:</u> unl stated 33 ±10%; 2 W
R503	18K857840	variable: 25K ±30%; 0.33 W
R504	6S5581	3.3K
R505	6S6320	10K
R506	18K868896	variable: 25K ±30%; 0.33 W; includes switch S501 (TCN6026AE, AJ)
	or 18C857698	variable: 25K ±30%; 0.33 W (TCN6026AG, AK)
R507	6S6336	270; 1 W
S501		<u>SWITCH:</u> dpst; p/o R506 (TCN6026AE, AJ)
S502	or 40K80247	toggle: dpst (TCN6026AG, AK)
	40C83624D01	rotary: 1-pole; 4-position; non-shorting
S503	40A80246	toggle: dpdt
TB501	31C83826D02	<u>TERMINAL BOARD:</u> 35 female contacts
XDS501, 502	9B863168	<u>LAMPHOLDER:</u> miniature bayonet type
NON-REFERENCED ITEMS		
	61B83678D01	LENS, indicator light: RED
	61B83678D02	LENS, indicator light: GRN
	3A82670A01	SCREW, machine: special type; 2 req'd (control head mounting)
	36K858652	KNOB, control: 2 req'd (VOL & SQ.)
	36B82869D01	KNOB, control: (freq. selector)
	26B83806D01	SHIELD, light: (for light- dependent resistor located on "dimmer" board)
	3A82227A02	SCREW, machine: special type: 4 req'd
	15C82401D01	COVER, housing: (back)
	1V868494	HOUSING, control head
	13D857971	ESCUTCHEON (TCN6026AE)
	13D857975	ESCUTCHEON (TCN6026AG)
	13D82286C23	ESCUTCHEON (TCN6026AJ)
	13D82286C22	ESCUTCHEON (TCN6026AK)
	7B82400D01	BRACKET, control head mounting
	3S7302	SCREW, machine: 10-32 x 3/8" plain hex head; 2 req'd (for mounting control head on bracket)
	3S7544	SCREW, tapping: No. 8 x 1/2" plain hex head; 3 req'd. (for mounting bracket)

TRUNK-MOUNT CONTROL HEAD



NOTE:

1. S503 AND ASSOCIATED WIRING (DASHED LINES) USED IN "PRIVATE-LINE" MODELS ONLY.

EPS-3592-A

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

Control Head Schematic Diagram
Used in 2-Frequency Radio Sets
Motorola No. PEPS-3538-C
8/26/75-NPC

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST

CONTROL HEADS

TRUNK-MOUNT, 2-FREQUENCY

TCN6026AF (Carrier Squelch)

TCN6026AH ("Private-Line" Tone-Coded Squelch)

PL-775-D

DS501, 502	65K4151	<u>LAMP, incandescent:</u> min. bay.; 6-8 V; 0.2 A; type No. 51
J501	9K830418	<u>CONNECTOR, receptacle:</u> female; 4-contact; does not include: 4S7699 LOCKWASHER; 13/16" internal; 2A482070 NUT, machine: ring type (knurled)
R501, 502	17C82350A04	<u>RESISTOR, fixed: ±10%; 1/2 W:</u> unl stated
R503	18K857840	33 ±10%; 2 W
R504	6S5581	variable: 25K ±30%; 0.33 W
R505	6S6320	3.3K
R506	18K868896	10K
		variable: 25K ±30%; 0.33 W; includes switch S501 (TCN6026AH)
	or 18C857698	variable: 25K ±30%; 0.33 W (TCN6026AF)
R507	6S6336	270; 1 W
S501		<u>SWITCH:</u>
	or 40K80247	dpst; p/o R506 (TCN6026AH)
S502, 503	40A80246	toggle: dpst (TCN6026AF)
		toggle; dpdt
TB501	31C83826D02	<u>TERMINAL BOARD:</u> 35 female contacts
XDS501, 502	9B863168	<u>LAMPHOLDER:</u> miniature bayonet type
NON-REFERENCED ITEMS		
	61B83678D01	LENS, indicator light: RED
	61B83678D02	LENS, indicator light: GRN
	3A82670A01	SCREW, machine: special type; 2 req'd (control head mounting)
	36K858652	KNOB, control: 2 req'd (VOL & SQ.)
	3A82227A02	SCREW, machine: special type; 4 req'd.
	15C82401D01	COVER, housing: (back)
	1V868494	HOUSING, control head
	13K857972	ESCUTCHEON (TCN6026AF)
	13K857976	ESCUTCHEON (TCN6026AH)
	7B82400D01	BRACKET, control head mounting
	3S7302	SCREW, machine: 10-32 x 3/8" plain hex head; 2 req'd (for mounting control head on bracket)
	3S7544	SCREW, tapping: No. 8 x 1/2" plain hex head; 3 req'd (for mounting bracket)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PARTS LIST CABLE KIT

TKN6055A Cable Kit (1-Freq., 12 V)
TKN6056A Cable Kit (2- & Multi-Freq., 12 V) EPD-9982-L

F401	65-61682	FUSE, cartridge; 25 amp; 32 v
F402	65-475247	6-1/4 amp, 32 v
F403	65-86099	7.5 amp, 32 v
J402	1-80715A24	CONNECTOR, plug; incl: 9-801050 CONNECTOR, plug; 19-cont; female 15-82075D03 HOUSING L.H. 15-82075D01 HOUSING R.H. 3-131758 SCREW, 4-40 x 1-1/8" 2 req'd 2-129924 NUT, hex; 4-40 x 1/4"; 2 req'd; 1-80717A73 SCREW & KNOB ASSY. 4-11722 WASHER, "C" 4-800671 WASHER, .016" thick 4-82113D01 WASHER, .032" thick; 42-864148 CLAMP, cable 3-132127 SCREW, tapping; No. 6 x 3/4" plain hex head
W401	1-80744A37	CABLE ASSY, special purpose incl: 30-858553 CABLE, power; 1 cond No. 12 ga; RED 22-1/2 ft. req'd 29-832116 LUG, for 3/8" stud; ref parts F401 and XF401
W402	1-864643	incl: 30-858552 CABLE, power; 1 cond; No. 12 ga; BLK; 5-1/2 ft. req'd 29-832116 LUG, for 3/8" stud
W403	1-80705A19	incl. 29-824456 LUG, for No. 10 stud 37-82603D20 SLEEVE, coded No. 20 29-82602D01 CONNECTOR, plug; 1 cont; ref part XF402
W404	1-80744A39	incl: 29-865065 LUG, for 3/8" stud 37-82603D19 SLEEVE, coded No. 19 29-82602D01 CONNECTOR, plug; 1 cont; ref part XF403
W405	30-858513 or 30-864650	CABLE, special purpose; 13 cond 17 ft req'd 1-freq 17 cond 17 ft req'd 2- & multi-freq. FUSEHOLDER: incl: 14-82882A01 BODY 14-82883A01 CAP; 42-82884A01 CLIP, fuse; 2 req'd; 41-82885A01 SPRING incl: 14-82882A01 BODY 14-82883A01 CAP 41-82885A01 SPRING 1-80705A08 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 10-343 LEAD, elect; 1 cond No. 18 ga. ORG; 57" req'd 1-80705A09 FUSE CLIP AND LEAD ASSY; incl. 42-82884A01 CLIP, fuse 30S10310A62 LEAD, elect 1 cond No. 18 ga; ORG; 9" req'd ref part F402
XF401		incl: 14-82882A01 BODY 14-82883A01 CAP 41-82885A01 SPRING 1-80705A11 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 10-345 LEAD, elect; 1 cond; No. 18 ga. GRN; 97" req'd 1-80705A12 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 30S10310A62 LEAD elect; 1 cond; No. 18 ga; GRN; 9" req'd ref part F403
XF403	1-80744A38	incl: 14-82882A01 BODY 14-82883A01 CAP 41-82885A01 SPRING 1-80705A11 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 10-345 LEAD, elect; 1 cond; No. 18 ga. GRN; 97" req'd 1-80705A12 FUSE CLIP AND LEAD ASSY; incl: 42-82884A01 CLIP, fuse 30S10310A62 LEAD elect; 1 cond; No. 18 ga; GRN; 9" req'd ref part F403

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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NON-REFERENCED ITEMS		
29-82602D01	CONNECTOR, plug; male; single cont; 19 req'd	
37-82601D01	SLEEVE, coded:	
37-82603D02	1	
37-82603D03	2	
37-82603D04	3	
37-82603D05	4	
37-82603D06	5	
37-82603D07	6	
37-82603D08	7	
37-82603D09	8	
37-82603D10	9	
37-82603D11	10	
37-82603D12	11	
37-82603D13	12	
37-82603D14	13	
37-82603D15	14	
37-82603D16	15	
37-82603D17	16	
37-82603D18	17	
37-82603D19	18	
37-82603D21	21	

NOTE:

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

Antenna Switch		PL-2322-A
K202	TLN4476A	SWITCH ASSEMBLY, magnetic read; special type; includes J403
		NOTE Field-replacement of compo- nents within this unit is not recommended. For replace- ment, order entire unit.

NEGATIVE GROUND KIT
TKN8427A Negative Ground Kit PL-2116-O

CR401	48-82525G07	SEMICONDUCTOR DEVICE, diode; silicon
P401		CONNECTOR, plug; includes: 14-82337A05 BODY 29-82335A01 TERMINAL, contact; male 15-83622E02 COVER (imprinted) 14-83179H05 INSULATOR, cover

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
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PILOT LIGHT DIMMER BOARD
1V80700B07 Light Dimmer Board PL-151-A

C501	21D82428B62	CAPACITOR, fixed; .01 uF +80-20%; 200 V
CR501 thru 504	48CS2466H01	SEMICONDUCTOR DEVICE, diode; (SEE NOTE) silicon
Q501	48R869440	TRANSISTOR, N-P-N; type M9440
R501	eS6040	RESISTOR, fixed; 680 ±10%; 1/2 W
R502	6S129145	82K ±10%; 1/4 W
R503	17C82036G03	2 ±5%; 3 W
R504	17D83122D09	22 ±5%; 3 W
R510	6S129231	3.3K ±10%; 1/4 W
R511	17C82291B15	50 ±5%; 3 W
R513	6C83828D01	light dependent type; 6.4K-10K @ 25°C
NON-REFERENCED ITEM		
1V80765A48		CIRCUIT BOARD ASSY. (less components)

NOTE:

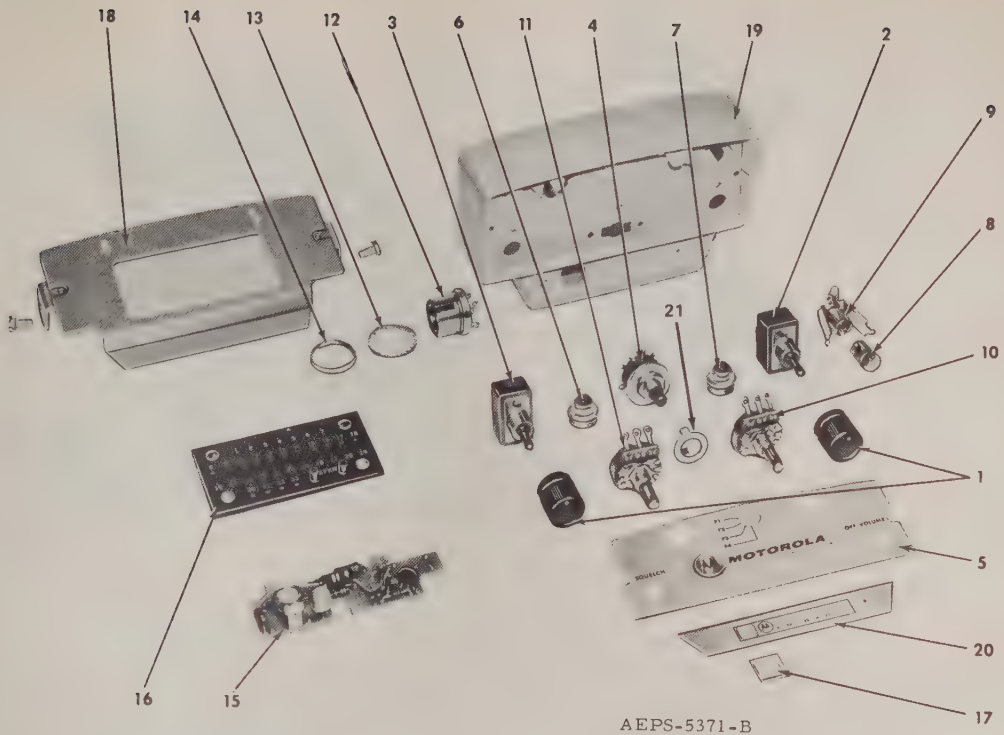
Replacement diodes must be ordered by Motorola part number only for optimum performance.

TKN6627B Interconnect Cable Kit (1-Freq.)
TKN6628B Interconnect Cable Kit (Multi-Freq.) PL-4205-O

C498,499	21-82355B07	CAPACITOR, fixed; 30 pF ±5%; 500 V; N330
J402	28-802820	CONNECTOR, receptacle; male; 19-contact
NON-REFERENCED ITEMS		
1-80708B32	LEAD & LUG ASSY. (BLK) 9"	
1-80708B33	LEAD & LUG ASSY. (BLK) 10"	
1-80708B36	LEAD & LUG ASSY. (GRAY) 25"	
1-80709B16	LEAD & LUG ASSY. (RED) 23"	
1-80709B17	LEAD & LUG ASSY. (GRAY- WHT) 7"	
1-80709B18	LEAD & LUG ASSY. (RED- WHT) 16"	
1-80709B19	LEAD & LUG ASSY. (RED- BLU) 15"	
1-80709B20	PLUG & LEADS ASSY. (Multi- Freq.) includes C498, C499, J402	
1-80709B21	PLUG & LEADS ASSY. (1-Freq.) includes C498, C499, J402	
42-10217A02	STRAP, cable harness; 26 req'd.	

Chassis & Hardware Kit (P/O Model TLN5058B) PL-4209-O

K201	80-84569A01	RELAY, armature; 3-form "C"; coil res. 100 ohms
R200	6-124C53	RESISTOR, fixed; 1.5k ±10%; 1/4 W



AEPS-5371-B

PARTS LIST

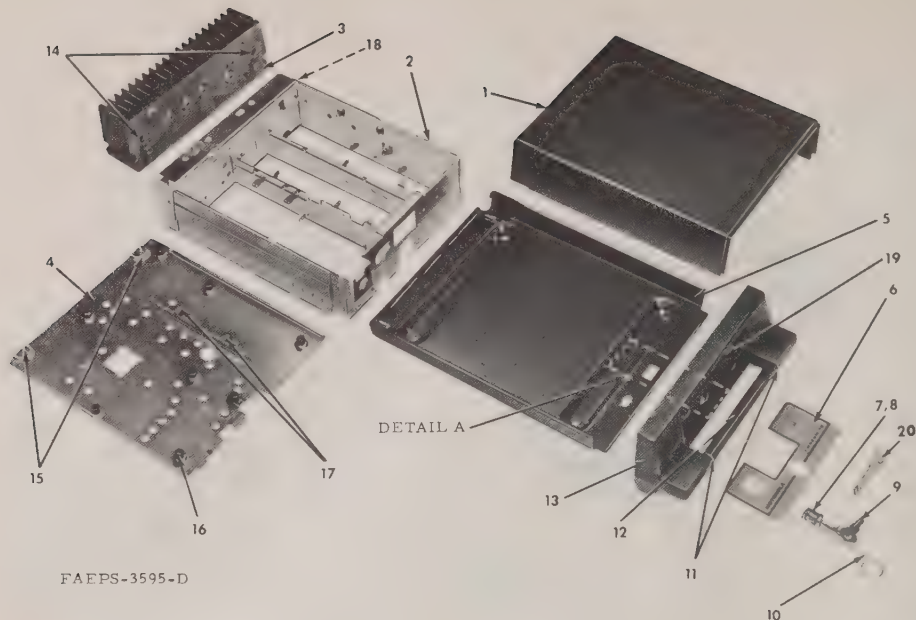
IMPORTANT

USE ONLY THE FOLLOWING MOTOROLA
PART NUMBERS WHEN ORDERING
REPLACEMENT PARTS

PL-1270-B

CODE	MOTOROLA PART NO.	DESCRIPTION
1	36B82869D01	Knob (Frequency Select; 4-Freq. models)
2	36K858652 40A80246	Knob (VOLUME; SQUELCH) Switch, Toggle (F1-F2; 2-freq. models)
3	40K80247	Switch, Toggle (ON-OFF) (2-freq.)
4	40C83624D01	Switch, rotary (Frequency Select; 4-freq. models)
5	13D857971 13K857972 13D82286C23	Escutcheon - 1F Dual Purpose Escutcheon - 2F Dual Purpose Escutcheon - 4F Dual Purpose
6	61B83678D01	Cap and Jewel (Red)
7	61B83678D02	Cap and Jewel (Green)
8	65S4151	Bulb
9	9B863168	Lampholder
10	18C857698 18K868896	Potentiometer (VOLUME) Potentiometer (VOLUME) (w/ ON-OFF switch)
11	18K857840	Potentiometer (SQUELCH)
12	9K830418	Microphone Receptacle
13	4S7699	Lockwasher
14	2A482070	Retaining Nut
15	1V80700B07	Dimmer Circuit Board
16	31C83286D01	Terminal Board
17	26B83806D01	Light Shield
18	15C82401D01	Back Cover
19	15D83576D03	Housing
20	33C83646D07 33C83646D04	Nameplate (dimmer type) Nameplate (non-dimmer type)
21	64-83625D01	INDEX, plate (switch)

Dual-Purpose Control Heads
Mechanical Parts Detail
Motorola No. PEPS-5369-E
3/24/76-NPC

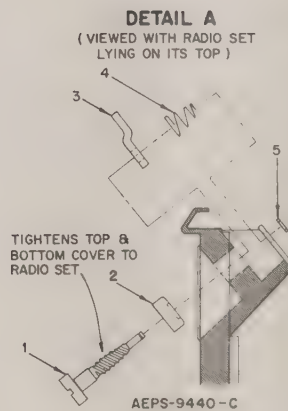


FAEPS-3595-D

PARTS LIST

PL-4208-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	1-84741E01	HOUSING ASSEMBLY
2	27-84585B01	CHASSIS
3	26D84020B01	RADIATOR (heatsink) 136-174 MHz
	or 26D84913A01	RADIATOR (heatsink) 25-50 MHz
4	15-84491B01	COVER, bottom; 136-174 MHz
	or 15-84492B01	COVER, bottom; 25-50 MHz
5		Part of CODE 1
6	13-83590F02	ESCUTCHEON
7	55-84912A03	LOCK ASSEMBLY (complete)
8	55-84912A01	BARREL AND NUT (P/O code 7)
8A	55-84912A02	CYLINDER AND KEY (P/O code 7)
		NOTE: Code 8A (cylinder and key) must be removed using code item 10 (TOOL, lock-cylinder removal) before the front panel can be removed.
9	55-893872	KEY (P/O code 7)
10	66A84909B01	TOOL, for removal of lock
11	3-138803	SCREW, special; for handle
12	55C84909A01	HANDLE
13	1V80708B66	FRONT PANEL, does not include CODE 7, 11, 12
14	3S135031	SCREW, special
	42A82234G01	RETAINER
	4S115362	LOCKWASHER
15	3B84948B01	SCREW,
	42A82388C02	RETAINER
	4S115362	LOCKWASHER
16	75-10606A01	BUMPER, rubber
17	43B82721C03	BUSHING, snap
	3S135111	SCREW, tapping; No. 4-40 x 3/8"
18	14C84656C01	GUIDE, tuning tool
19	3-138806	SCREW, machine: 8-32 x 5/16"
20	55-84530B01	BOLT, locking; nylon



AEPS-9440-C

CODE	MOTOROLA PART NO.	DESCRIPTION
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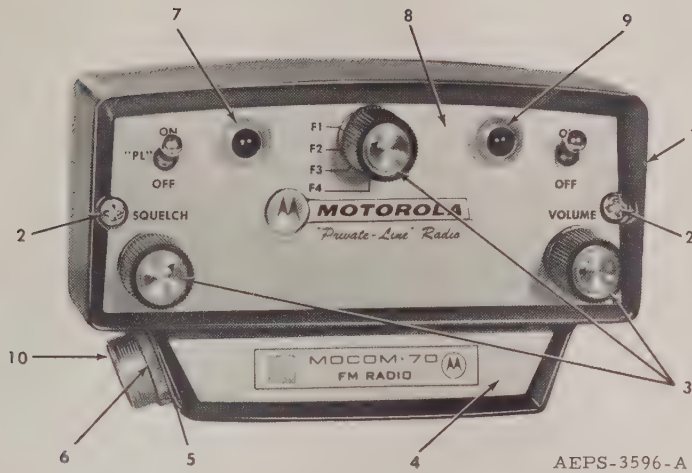
Front Panel Latching Kit

PL-1943-O

#1	3B84460G01	SCREW, latching
2	4A84362B01	WASHER, cup
#3	45B84461G01	CAM, latching
4	41A822468	SPRING, Locking plate
5	42A82388C03	RING, retaining ("E" type)

* Codes 1 & 3 must be replaced together

Heatsink and Housing Detail
Universal Model Radio Set
Motorola No. PEPS-20539-O
2/24/76-NPC



AEPS-3596-A

PARTS LIST

PL-1459-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	15D83576D07 or 15D83576D03	HOUSING, dash-mount HOUSING, trunk mount
2	3A82670A07 or 3A82670A01	SCREW, special: dash-mount SCREW, special: trunk mount
3	36B82629H02 or 36K858652	KNOB, control; dash-mount KNOB, control; trunk mount
4	33B83646D07 or 33C83646D08	NAMEPLATE (dimmer) NAMEPLATE (non-dimmer)
5	4S7699	WASHER, lock; 13/16" INT.
6	2A482070	NUT, ring
7	61B83678D01	LENS, indicator light (RED)
8	13D857971 or 13K857972 or 13D82286C23 or 13K857975 or 13K857976 or 13D82286C22	ESCUTCHEON, 1 freq. (carrier squench) ESCUTCHEON, 2 freq. (carrier squench) ESCUTCHEON, 4 freq. (carrier squench) ESCUTCHEON, 1 freq. ("Pri- vate-Line") ESCUTCHEON, 2 freq. ("Pri- vate-Line") ESCUTCHEON, 4 freq. ("Pri- vate-Line")
9	61B83678D02	LENS, indicator light (GREEN)
10	9K830418	CONNECTOR, receptacle: female: 4 contact

Control Head Escutcheon and
Housing Detail
Motorola No. PEPS-9448-O
2/24/76-NPC

REDUCTION OF INTERFERING NOISE IN MOBILE OPERATION

1. INTRODUCTION

Noise generated by the electrical system of the vehicle, as well as local ambient noise, might interfere with normal operation of two-way mobile radios. To overcome these interferences, various noise reduction procedures are required. These requirements vary from one vehicle to another, depending on system frequency, vehicle type and required coverage area. If the operating area is sufficiently small (received signal levels always high), less noise reduction is required. Conversely, for maximum range coverage and operation into weak signal areas, noise reduction becomes very important.

Before attempting any noise reduction procedures, determine the noise source. Then, follow a systematic method of elimination until

the interference is removed or appreciably reduced.

2. NOISE REDUCTION

a. Noise Reduction Kits

The Model TLN8845A Noise Reduction Kit is available for all vehicles equipped with two-way radios. For vehicles with generators or with severe noise problems, Model TLN6252A Noise Reduction Kit is recommended. See Figures 1 and 2.

b. General Information

Impulse noise is most noticeable in installations of narrow bandwidth receivers because of ringing associated with the steep-sided selectivity characteristics. This equipment has been designed to minimize the ringing effect of impulse noise as much as possible.



MOTOROLA INC.

SERVICE PUBLICATIONS

1301 E. ALGONQUIN ROAD

Communications Division

SCHAUMBURG, ILLINOIS 60172

TLN6252A NOISE REDUCTION KIT

Reference Number	Quantity	Motorola Part Number	Description
1	3	1V839913	Lead & Lug Assembly
2	1	1V80700A88	Lead & Lug Assembly
3	1	8C82571B02	Capacitor, Coaxial (.1 uF - 100 V)
4	3	8C82571B01	Capacitor, Coaxial (.5 uF - 100 V)
5	1	1V80700A89	Generator Field Suppressor Assembly
6	1	30A502396	Ignition Coil Suppressor Cable
7		1V80700A91	Hood Wipers and Mounting Kit Hardware

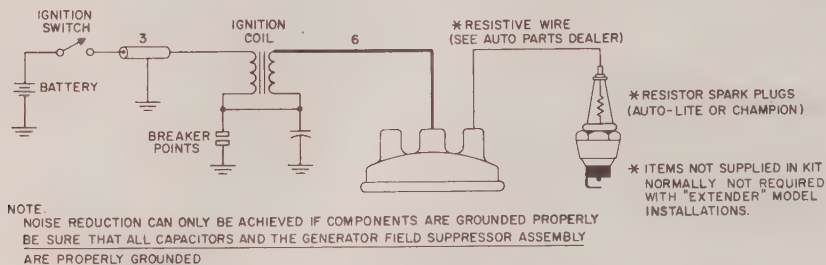


Figure 1. Typical Noise Reduction Detail Using TLN6252A Noise Reduction Kit

TLN8845A NOISE REDUCTION KIT

Quantity	Motorola Part Number	Description
1	1V839913	Lead & Lug Assembly
1	8C82571B02	Capacitor, Coaxial (.1 uF, 100 V)
1	30A502396	Ignition Coil Suppressor Cable
1	1V80782A52	Hood Wipers and Mounting Hardware Kit

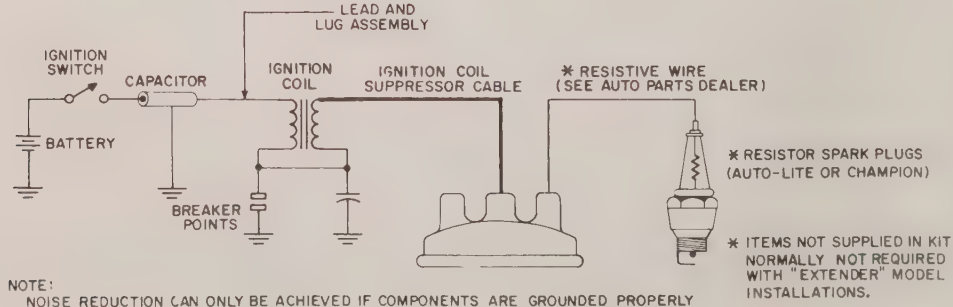


Figure 2. Typical Noise Reduction Detail Using TLN8845A Noise Reduction Kit

The useful range of radio receivers can be seriously affected by noise interference which prevents the reception of a clear, easily-understandable signal. A certain amount of noise interference may be tolerated when operating in a strong signal area. However, in weak signal areas such as fringe area operation, serious noise interference can cause a complete failure in reception.

c. Noise Sources

The source of noise can generally be determined by its sound in the speaker. For best results in locating noise, the unit should be receiving a weak signal which produces not less than 10 dB nor more than 30 dB noise quieting.

Noise interference is usually traced to one of the following sources:

(1) Ignition Noise

An automobile electrical system provides the primary source of electrical interference to radio communications in mobile installations. Radio interference can be generated in the spark plugs, distributor contacts, generator armature, voltage regulator, electrical gauges, wheel static and any part of the car where friction may exist due to intermittent contact between any two members of the car's mechanical structure.

In a mobile installation, the prime source of electrical interference with radio communications is in most cases the result of a spark discharge or arc created in the electrical system. Whenever a spark discharge takes place through air, high frequency oscillations are generated in a range of frequencies from a few kilohertz to hundreds of megahertz. These oscillations are generally radiated and therefore received through the antenna. However, they may also be induced in associated wiring and transferred to other electrical wiring in the system including that of the radio installation.

Suppressing all arcing that can develop in the electrical system may pose a difficult problem. For example, in an 8 cylinder engine operated at 2000 rpm, arcing in the engine system can be at the rate of 8,000 sparks per minute or 133 per second. These arcs, after being extended because of ringing, can create a blanket of noise which will block out weak signals at the radio receiver.

(2) Impulse noise interference generated by the vehicle electrical system.

This type of interference is generated by commutator and brush action, vibration of electrical contacts and electrical arcing or sparking. This broad-band interference may be propagated via space radiation.

The impulse noise enters the receiver through the antenna and serious interference in the form of tuned circuit "ringing" results even though the impulse may be very brief. "Ringing" may be defined as the shock excitation of a tuned circuit caused by an impulse which extends the duration of the impulse. It is the "ringing", caused by the impulse rather than the impulse itself, which is troublesome.

(3) Noise produced by fluorescent lights, electric motors, electric fences, induction from power lines and similar sources.

This type of interference is generally AM in nature, excluding capture effect. Normally, if signal strength is adequate, all such noise is removed from a received carrier by effective limiting action. Also, a vehicle is able to move out of a high noise level area if this type of noise interferes with radio reception. Thus, such conditions may be tolerated.

NOTE

Thermal agitation noise and noise produced in the receiver have been taken into consideration in the original design of the equipment. Any well designed mobile radio unit will not present any serious problems in this respect.

d. The Ignition System

In order to effectively reduce ignition interference in a car, it is well to understand the operation of an automobile ignition system.

Ignition is necessary in a gasoline engine to ignite the gasoline vapor and the air mixture in its cylinders. The system is made up of the battery, distributor, breaker points, coil, condenser and spark plugs. The battery is the only electrical source of power in an automobile, so the low battery voltage must be stepped up to the high voltage necessary to arc across the spark plug electrodes. This arc ignites the gas mixture.

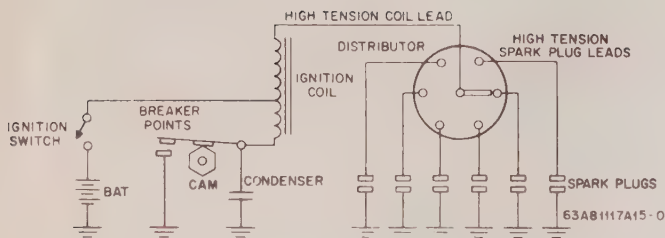


Figure 3.

Typical Vehicular Ignition System, Schematic Diagram

In the conventional ignition system (Figures 3 and 4) a mechanical circuit breaker (points in the distributor) opens the primary circuit of the ignition coil. By transformer action in the coil, high voltage is developed at the coil secondary. This high voltage is synchronized and applied to each spark plug by the distributor.

The battery is connected to the primary winding of the coil through the ignition switch. The primary circuit is returned to the battery through the breaker points, which are bypassed by the condenser. The points are normally closed. As the cam shaft is rotated by the engine, its lobes or corners open and close the points in proper synchronization with each cylinder.

With the ignition switch on and the breaker points closed, coil primary current builds up at a rate determined by coil inductance.

When the breaker points open, primary current decreases and by self-induction, an emf is induced in the primary which is many times greater than the battery voltage. The high voltage induced in the coil secondary causes a spark across the spark plug gap for a short interval of time. When the breaker points open, the condenser reduces arcing of the points.

The secondary circuit of the ignition coil, including the spark gap, is much like a spark transmitter used in the early days of radio. It is the main source of ignition interference. All that is needed to simulate the spark transmitter is an inductance and capacitance in series with the spark gap. The lead inductance and stray

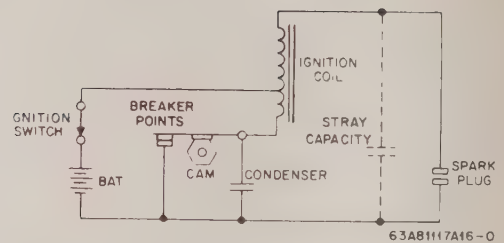


Figure 4.

Typical Vehicular Ignition System, Simplified Schematic Diagram

capacitance provides a tuned circuit. Because the discharge of the circuit is through a low resistance (ionized spark gap), the circuit tends to oscillate. The frequency and amplitude of oscillation that is developed vary as current changes in the spark gap.

e. Noise Reduction Technique

It has long been known by ignition engineers that the addition of a series resistance adjacent to a spark discharge will damp out the troublesome oscillation which causes interference. The type of spark plug suppression used in noise reduction should always be in accordance with the recommendations of the car manufacturer, i. e., if spark plugs are to be replaced with built-in suppressor types, they should be in the proper heat ranges and thread sizes for the particular engine. In each ignition system there is a maximum amount of resistance that may be connected between the distributor and a spark plug. If resistance-type ignition wire is used, the length of each wire must be limited so its resistance does not exceed the allowable maximum. In addition to spark plug suppressors or resistance wire, an economical basic kit of noise reduction items can consist of the following: special coaxial capacitors, combinations of resistor and capacitor assemblies and hood wiper springs.

NOTE

In all cases where coaxial capacitors are mentioned, they should not be substituted by standard bypass capacitors; the standard bypass displays a resonance effect at about 2 MHz. The coaxial type is non-inductive and has high attenuation, up into the uhf region.

The importance of such noise reduction items is greatly increased by their application at the right terminal points in the car's electrical system. Following is an outline of the important points to be considered and a step by step procedure for ignition noise reduction.

NOTE

Noise reduction can only be achieved if components are properly grounded. BE SURE THAT ALL CAPACITORS AND THE GENERATOR FIELD SUPPRESSOR ASSEMBLY ARE PROPERLY GROUNDED.

On some vehicles, standard bypass capacitors might have been installed at locations referred to in these instructions. Where the instructions call for coaxial capacitors, remove the standard bypass capacitor and install the coaxial type.

In the development of a noise reduction kit, it was not necessary to include resistance cable or suppressor resistors in the wiring harness. Such items are generally found as a standard part of present day motor vehicles. However, the omission of such items from a basic noise kit does not imply that these items are nonessential to noise reduction. Spark plug noise reduction is one of the most important points to be covered in the elimination of radio interference in any vehicle.

(1) Generator Interference (Generator Equipped Vehicles Only)

The generator is a source of electrical interference frequently blamed on the ignition system. Electrical current passing between the brushes and commutator in the generator creates many small arcs as the armature rotates. Generator noise is characterized by a high pitched "whine" that varies with engine speed. A .5 uF coaxial capacitor should be placed in series with the generator armature to reduce interference.

NOTE

If the vehicle is supplied with an alternator, the capacitor is not necessary.

(2) Voltage Regulator Interference

The modern voltage regulator is a precise mechanism containing three separate control systems operating with breaker contacts. Vibrating breaker contacts cause arcing which

may result in annoying interference. This interference is usually in the form of erratic popping in the receiver which changes only slightly in frequency with increase in engine speed.

To reduce voltage regulator noise, two .5 uF coaxial capacitors and a resistor-capacitor assembly are used.

CAUTION

Disconnect the battery ground terminal before attempting to connect components to the battery terminal of the voltage regulator.

(3) Ignition Coil Interference

A .1 uF coaxial capacitor should be placed at the BAT side of the ignition coil to eliminate impulses from the low voltage leads. (Refer to Figures 1 and 2.)

(4) Distributor Interference

Sparking in the distributor itself is a source of radio interference. As the rotor rotates in the cap, sparking occurs between the rotor and the distributor cap inserts. An effective way to reduce this interference is to use resistance-type ignition wire to connect the distributor cap to the ignition coil.

(5) Battery Connection

Connecting the radio set primary power lead directly to the battery instead of the starter relay can help to keep noise off the "A" lead. The battery acts as a large capacitor (about 1 farad for 50 amp capacity batteries), and serves as a very effective bypass. The battery ground return should be bonded to the frame. To minimize the possibility of inducing undesirable parallel ground currents, utilize the vehicle frame as a common ground point whenever it is practical to do so.

(6) Hood Wipers

Ground returns for the electrical circuits are provided through the body and frame of the automobile. Differences in conductivity, inadequate bonds between adjacent conductors, and unequal current distributions result in potential differences throughout the vehicle. The miniature arcs thus created can be avoided by eliminating the potential differences. Effective use of copper bonding braid and brass contact wipers as hood bonds will minimize interference from this source.

(7) Ignition System Interference

Ignition Noise can often be reduced by proper engine maintenance and tune-up. The following points should be considered if the noise interference from the ignition system is severe.

(a) The distributor points and condenser should be in good condition.

(b) Ignition timing should be properly adjusted.

(c) The distributor cap and rotor should be replaced at least every 30,000 miles.

(d) Spark plug wires should make good contact at each end and should be routed as far as possible from low voltage leads.

(e) Many late-model automobiles are equipped with a shield over the distributor points. Check to see that this shield is in place properly and is securely attached.

f. Additional Noise Reduction Techniques

In some radio installations, it might be necessary to obtain maximum noise reduction. In such installations, the following possible sources of noise interference should be explored and the following appropriate remedy applied.

(1) Ammeter to battery lead. (Bypass with .5 uF capacitor. Motorola part #8A821889.)

(2) Gauges, oil signal, gasoline and temperature. (Bypass with .5 uF capacitor. Motorola part #8A821889.)

(3) Ignition switch. (Bypass with .5 uF capacitor. Motorola part #8A821889.)

(4) Headlight, tail light, or dome light leads. (Bypass with .5 uF capacitor. Motorola part #8A821889.)

(5) Accessory wiring, electrical windshield wipers, heater motor, window openers and others. (Bypass with .5 uF capacitors. Motorola part #8A821889.)

(6) Wheel static. (Use wheel static collector rings on both front wheels. Motorola part numbers 1K534254 Regular Type; 1K563173 Small Type.)

(7) Acute cases of generator noise. (Install a .5 uF capacitor in series with the armature lead. Motorola part #8A821889.)

(8) For severe cases of ignition interference, Hallett Ignition Shielding Kits are available through Motorola on separate order. These special shielded harnesses, available for most automobile and truck engines, provide improved communication in fringe areas and essentially waterproof the ignition system. Supply the following information when ordering Hallett Ignition Shielding Kits.

(a) Make and year of vehicle.

(b) Auto or truck and number of cylinders.

(c) Engine cubic inch displacement.

(d) Type of ignition system: Auto-Lite, Chrysler, etc.

NOTE

Fire truck engine shielding requires more detailed information to assist in supplying the proper kit. Write first for the special "fire truck shielding form" from your nearest Motorola Parts Depot.

(9) A generator-regulator shield is available to further reduce generator and regulator noise. It is not required on alternator-equipped vehicles. Follow the same ordering procedure when requesting this item.

g. Conclusion

The level to which ignition noise interference will need to be reduced will depend on the environmental conditions of operation of the radio system. The factors involved are the strength of the received carrier at various points within range of the fixed station, and the clarity of signals at the fringe areas. However, in most cases ignition noise interference can be substantially reduced, resulting in excellent performance of the radio equipment under most operating conditions.

The reduction of ignition noise interference, in many cases, is essential to good system performance. Therefore, it must be given full consideration in the initial installation of the radio

equipment. The components required to successfully reduce ignition noise interference may well prove to be a necessary part of the communications system. Indeed, no mobile radio installation is complete until the remedy for bothersome ignition noise interference has been successfully applied.

Certain noise sources may be isolated to some extent, through consideration of conditions. When the vehicle is standing still with the ignition switch off, any noise heard will probably be external to the vehicle. Static discharge noise will be added when the vehicle is moving. If the vehicle is coasting in gear but with the ignition switch off, generator noise, if present, will be added to the others. Noise produced by inadequate bonding will be most noticeable when maximum current is being drawn from the battery, and may be increased when the vehicle is in motion. Care should be used to be sure that noise tests are made both with and without weak signals.

One effective way to find the hottest sources of interference is to use a pickup loop about one inch in diameter, connected to a radio receiver or oscilloscope powered from a source separate from the vehicle ignition system. Use the pickup loop as a search probe. Be sure the loop has sufficient insulation to prevent the input of the test equipment from coming into direct contact with high voltage points in the vehicle ignition system. This pickup loop technique is also a good way to determine the effectiveness of a particular noise reduction method.

It is impossible to give an exact procedure to counteract noise in all cases; too many variables exist. With an understanding of some of the sources of noise, an intelligent approach will often save considerable time. Ignition noise reduction can add to both operational efficiency and operator satisfaction.

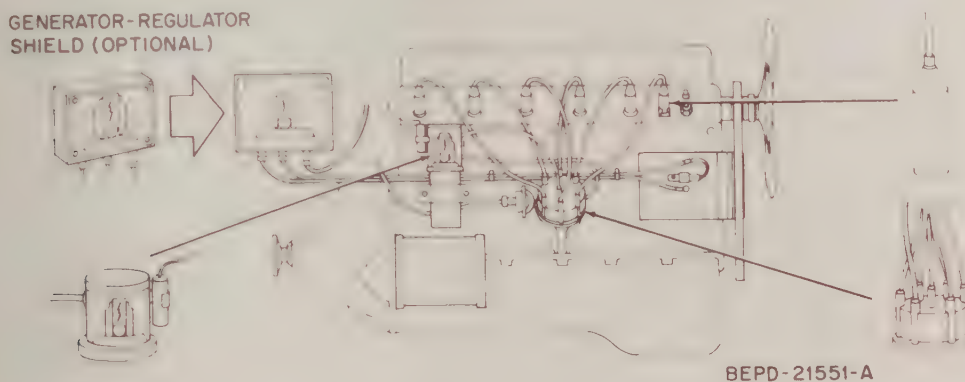


Figure 5. Typical Ignition Shielding Kit

NOISE IDENTIFICATION AND REDUCTION CHART

Characteristics of Noise at Speaker	Source of Noise	How to Check Source of Noise	How to Reduce Noise
Identified as popping sound	Ignition	Noise varies in frequency with engine speed and will disappear when ignition is switched off.	1. Check to be sure: (a) Distributor breaker points and distributor cap are in good condition. (b) Ignition capacitor is in good condition. (c) All ignition system connections are free of corrosion & making good contact. (d) There is dc continuity in high voltage leads. (e) There are sufficiently high spark plug breakdown voltages. (f) Spark plug electrodes are properly spaced and in good condition. 2. Bond each corner of the motor block to chassis ground using a heavy copper grounding braid. 3. Damp the high voltage by installing a resistor suppressor in the distributor rotor lead, or suppressors in the ignition cables or on top of the spark plugs. 4. Install resistor spark plugs or resistance ignition cables.
Identified as a high pitched whine	Generator/ Alternator	Noise varies with engine speed and will persist if ignition is switched off while engine is running at a moderate speed.	Install a .5 uF coaxial capacitor at the generator in series with the armature lead.
Identified as a raspy sound	Voltage Regulator	Look for arcing voltage regulator contacts	Install .5 uF coaxial capacitors, Motorola Part No. 8A821889 at the battery (BAT.) terminal in series with the battery lead and at the generator (ARM) terminal in series with the armature lead.

NOISE IDENTIFICATION AND REDUCTION CHART (Cont'd)

Characteristics of Noise at Speaker	Source of Noise	How to Check Source of Noise	How to Reduce Noise
Identified as raspy sound (continued)			Install RC Filter (1V80700A89) composed of a 3.3 Ohm resistor in series with a .002 uF capacitor (Maximum allowable capacity) in series with the field (F) terminal of the voltage regulator to a common ground.
Identified as a popping sound	Heater and Air Conditioning Fan Motors	With engine off, turn fan motors on and check for noise.	Install .5 uF coaxial capacitor at the motor in series with the battery lead.
Identified as a hissing or crackling sound	Gauges	Noise may be detected by jarring the individual gauges while the ignition is on.	Install .5 uF bypass capacitors where needed. (Motorola part #8A821889)
Identified as a low-pitch clicking	Oil Sender	Noise rate varies with oil pressure and stabilizes at point of maximum oil pressure.	Install .5 uF bypass capacitor (Motorola Part #8A821889) from gauge lead terminal on oil sender to chassis ground.
Identified as an irregular popping	Wheel Static	Noise disappears when brakes are lightly applied.	Install suitable grounding brushes or springs such as front wheel static eliminators (Motorola Part #1K534254 regular type, 1K563174 small type).
Identified as a more regular or sharper popping sound.	Tire Static	Noise becomes much worse at 30-50 mph.	Use anti-static power in tires with innertube.

ANTI-SKID BRAKING PRECAUTIONS

1. GENERAL

The following recommended transmitter installation and test procedures are suggested for vehicles with electronic anti-skid braking systems.

2. INSTALLATION SUGGESTIONS

Locate the braking modulator box in the vehicle. The braking modulator box is located in the trunk in Chrysler Corporation cars and either in the trunk or under the dash in General Motors and Ford Corporation automobiles. A service manual may be helpful to aid in the location of the braking modulator box. Perform transmitter installation in accordance with the following recommended procedures:

a. If the braking modulator box is mounted on the right side of the vehicle, mount the transmitter on the left side of the trunk to give it as much space as possible between the braking modulator box and the transmitter. If the braking modulator box is mounted on the left side, reverse the procedure.

b. Use the shortest practical length of Motorola coaxial cable.

c. The antenna should be mounted on the opposite side of the car trunk from the braking modulator box.

d. Route all cables along the center or on the opposite side of the vehicle from the braking modulator box.

e. Do not operate the transmitter while the vehicle is in motion with the trunk lid open.

3. TEST PROCEDURE

This test is divided to cover several different types of interference. Disturbance of the electronic anti-skid device can usually be detected in several different ways concerning the vehicle's braking system, i.e., by the lights, any irregular audible sounds, any change in the performance of the braking system itself, etc.

During checks a. thru f., however, none of the above conditions should be observed if the radio set is properly installed.

a. With car stationary (gear selector in PARK) and the engine running at a fast idle, key (turn the carrier on and off) the transmitter with and without modulation with your foot off of the brake pedal.

b. Repeat the preceding with your foot on the brake pedal.

c. When making this test, while the car is stationary, allow at least 2 car lengths and possibly even more of clear area in front of the vehicle. With your foot on the brake with just enough pressure to keep the vehicle from moving, place the car in a forward gear with the engine at a fast idle, then key the transmitter with and without modulation.

WARNING

Disruption of the anti-skid braking system may cause the vehicle to move forward in addition to the lights and audible sounds mentioned above.

d. Driving at a moderate speed (15-25 mph) with your foot off of the brake pedal, have



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an assistant key the transmitter with and without modulation.

e. Repeat step 4 with foot slightly on the brake pedal to turn on the brake lights.

f. While making a moderate deceleration stop from 25-30 mph, have an assistant key the transmitter with and without modulation.

WARNING

Severe disruption of the electronic anti-skid braking system may cause loss of control of the vehicle during the following test.

g. While making "panic" stops from 20 mph have an assistant key the transmitter with and without modulation.

If no interference or disruption is noticed, repeat by making "panic" stops from 30 mph.

If no malfunctions are observed after the above tests are performed, it can be assumed no apparent problem exists and the car can be released to the customer.

If any of the above tests results in a brake malfunction, contact the car manufacturer service department as soon as possible and remove the radio from the vehicle. Do not complete installation.

