

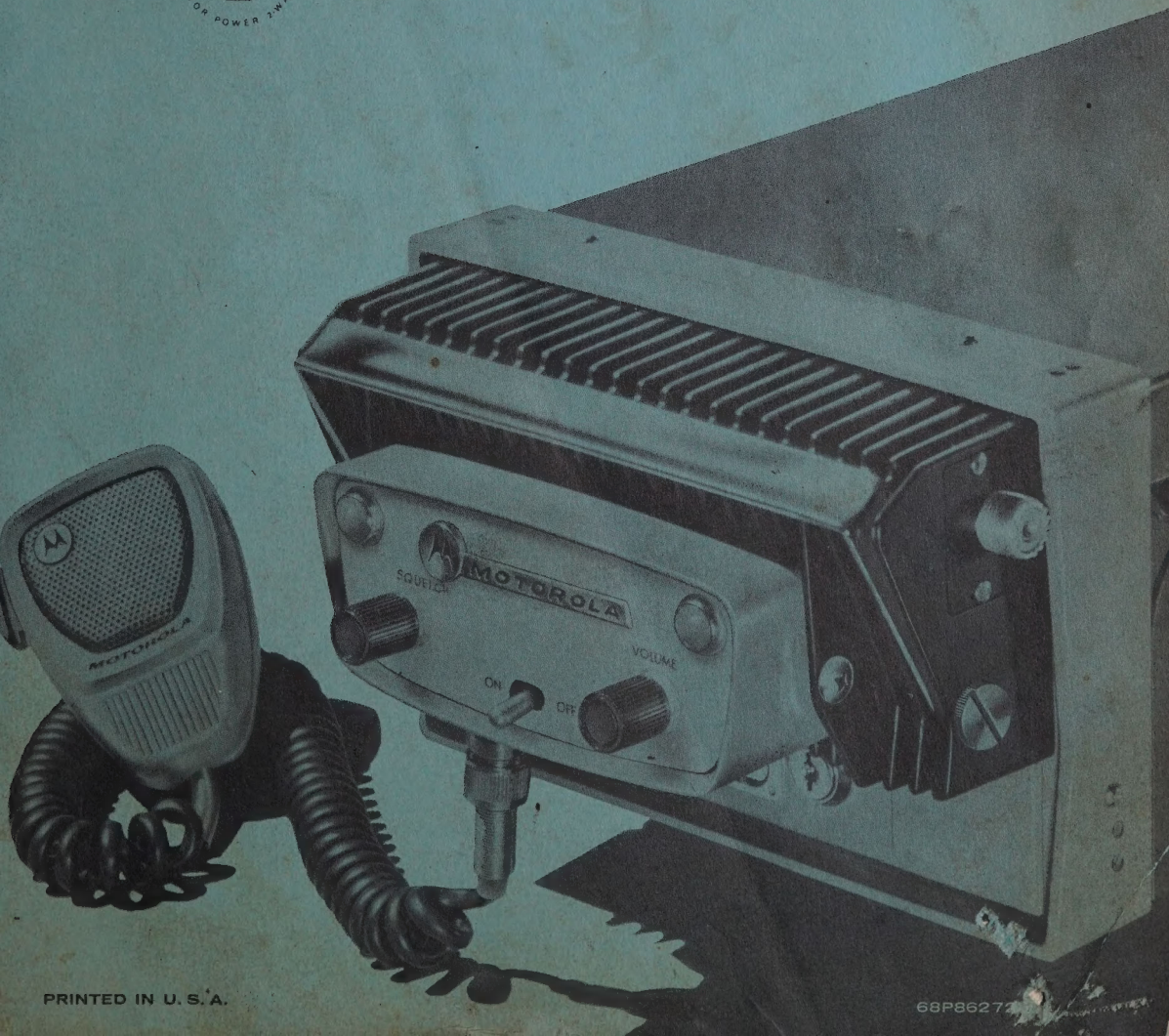


Mobile FM Two-Way Radio

25-54 MC

50 W RF POWER

12 VDC



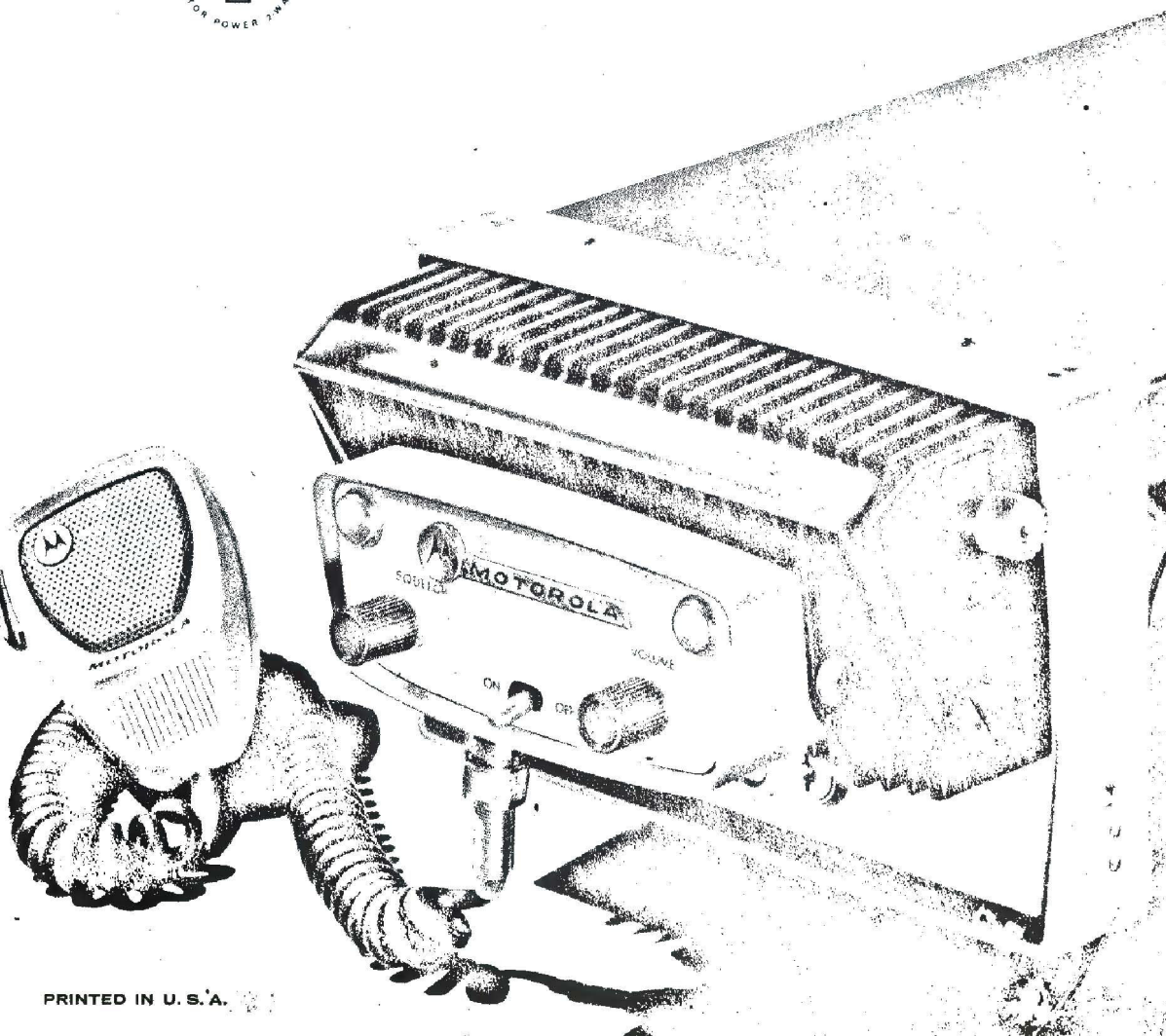


Mobile FM Two-Way Radio

25-54 MC

50 W RF POWER

12 VDC



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MOTOROLA, INCORPORATED

Communications Division

4501 W. AUGUSTA BOULEVARD

CHICAGO 51, ILLINOIS

ATTN: D. E. NOBLE

Serial

No 60912

Printed in U.S.A. NeP. 54K68616

MOTOROLA

"T-POWER" MOBILE

FM TWO-WAY RADIO

50 W RF POWER

25-54 MC

12 VDC

DESCRIPTION

INSTALLATION
& OPERATION

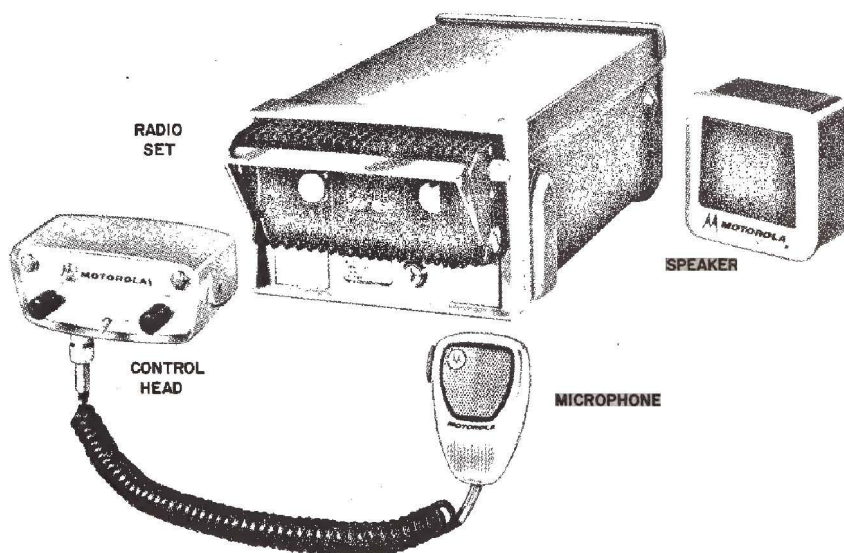
RECEIVER

TRANSMITTER

POWER SUPPLY

MAINTENANCE

NOISE
SUPPRESSION



RADIO
SET

CONTROL
HEAD

MICROPHONE

SPEAKER



MOTOROLA INC.

COMMUNICATIONS DIVISION

Engineering Publications

4501 W. Augusta Blvd.

Chicago 51, Illinois

Printed in U. S. A.
11/5/59-RCS

68P862725
Issue - A

AEPD-1403-O (MC3971)

GUARANTEED PERFORMANCE SPECIFICATIONS

MODELS		U51GGT-1000 Series
INSTALLATION		Front Mount or Trunk Mount
FREQUENCY		25-54 mc
TRANSMITTER RF POWER OUTPUT		50 watts minimum
TRANSMITTER MODULATION		40F3: ± 15 kc for 100% at 1000 cps or 20F3: ± 5 kc for 100% at 1000 cps
RECEIVER SENSITIVITY		Less than 0.3 microvolt for 20 db quieting 50 ohms RF input impedance
RECEIVER SELECTIVITY		-100 db at ± 15 kc (20 kc channel spacing) -100 db at ± 32 kc (40 kc channel spacing)
RECEIVER MODULATION ACCEPTANCE		± 5 kc (20 kc channel spacing) ± 15 kc (40 kc channel spacing)
METERING		Chassis mounted metering sockets on the transmitter and receiver facilitate convenient metering of all circuits essential to tuning and checking. A MOTOROLA portable test set or a 0-50 micro-ampere meter can be used for this purpose.
INPUT VOLTAGE		12 VDC Positive or Negative Ground
CURRENT DRAIN (TOTAL)	Standby	6.1 amps
	Transmit	16 amps
INTERMITTENT DRAIN		Each crystal heater: 0.65 amps
POWER SUPPLY		Fully transistorized
WEIGHT		Approximately 47 lbs. (including accessories)
DIMENSIONS		Trunk Mount: 6" high x 9-7/8" wide x 19-1/4" long overall Front Mount: 6" high x 9-7/8" wide x 20-3/4" long overall
LICENSING INFORMATION		The MOTOROLA 2-way radio equipment described in this manual meets or exceeds all requirements for FCC licensing, and is included in the FCC "List of Equipment Acceptable for Licensing in the Radio Services other than Broadcast". Identification of "Transmitter Type" (XMTR TYPE) appears on the equipment nameplate and on the transmitter chassis and is: Type Number..... CC1008 (25-54 MC) for licensing under FCC rule parts 10, 11, 16, and 21.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

FOREWORD

PURPOSE OF THE MANUAL

This manual offers the serviceman complete installation, operation, maintenance and service information on the MOTOROLA 2-way radio models described in it.

The manual will serve as a ready reference for the experienced technician and also as a step-by-step guide for the inexperienced man.

For convenience and quick reference, the manual is divided into separate sections. Each section has complete alignment, service and maintenance information on its chassis and/or kits and includes its own diagrams, details and parts lists. For example, the Receiver section contains complete information on the receiver models described in it. Installation and operation of the complete radio set are covered in a separate section. All major section paragraph headings and diagrams are listed for the serviceman's use in the Table of Contents.

THE "RADIO SET"

MOTOROLA 2-way radio equipment is packaged as a radio set plus accessories. The radio set is assigned a model number for identification purposes. It includes the transmitter, receiver, and power supply chassis in a single housing. This model number describes the package specifically. Use the model number in its entirety when making inquiries about the equipment.

Example: U51GGT-1000A - describes a trunk mount, 25-54 mc, 40 kc channel spaced set with a 50 watt, one frequency transmitter, and a transistorized power supply.

It is evident that the model number is easier to use and is more specific than a word description.

The accessories are identified by an accessory group number which includes those other items essential to completing the radio installation such as; antenna, speaker, cables, etc. Use this number when referring to a specific group of accessories.

Example: DA1100C - describes an accessory group which includes a one-frequency control head and microphone, 12 v d-c cable kit, in-

stallation kit for a 10-inch housing, antenna, and a speaker.

In addition to these model and group numbers, Motorola has assigned identifiers to all chassis and kits. These are for inventory and stock control purposes and should be used by the serviceman when requesting information on them or when ordering replacements. Use the assigned number identifiers. It will be to your benefit. These are the only sure means of describing the radio equipment and its many parts.

The radio set model number is metal stamped on the equipment nameplate along with the transmitter type number, serial number and type of primary power. Chassis and kit numbers are rubber stamped on the chassis or kit itself.

For the serviceman's use, breakdown cross reference charts on radio set models and accessory groups are located in the front matter section of the manual.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision numeral is assigned to the chassis or kit affected, e.g.; TA234 becomes TA234-1, with the first revision. This chassis number complete with revision numeral is stamped on the chassis at the time of production, and the revision numeral becomes an integral part of the chassis identifier.

A schematic diagram number complete with its issue letter is also stamped on each chassis. This establishes direct correlation between the chassis and its schematic. The schematic issue is advanced each time a change occurs in the chassis. The most recent issue is stamped on the chassis.

INSTRUCTION MANUAL REVISION BULLETINS

Those changes which occur after an instruction manual is printed are covered by the Instruction Manual Revision Bulletins. These bulletins give the reader complete information on the change including pertinent parts listing data from which the instruction manual can be corrected.

NATIONAL SERVICE ORGANIZATION

Motorola is a nation-wide service organization. Through its maintenance and installation

program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.



The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations, manned with several thousand F.C.C. Licensed Personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
4501 W. Augusta Blvd.
Chicago 51, Illinois

REPLACEMENT PARTS ORDERING

MOTOROLA maintains parts and service depots in Dallas, Texas, and Burlingame, California, to supplement the activities of the Parts and Service Department in Chicago. The table outlines the services provided by these facilities:

Factory: Crystal Service Department,
916 N. Kilbourn Ave.,
Chicago 51, Illinois

Chicago Parts and Service Department:
4910 West Flournoy Street
Chicago 44, Illinois

Dallas Parts Depot: 7138 Envoy Court,
Dallas 35, Texas

Burlingame Parts Depot:
1616 Rollins Road,
Burlingame, California

Area Served	Parts & Service	Crystals	Resonant Reeds
Central and Eastern area	Chicago Parts Dept	Factory	Factory
Southern area	Dallas	Factory	Dallas
Western area	Burlingame	Factory	Burlingame

These offices are fully equipped to give this service. When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and insure receipt of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal orders should specify crystal type number, crystal frequency, carrier frequency and the chassis model number in which the crystal is to be used.

Orders for "Vibrasender" and "Vibrasponder" Resonant Reeds should specify the type number and frequency and should identify the owner and operator of the "private-line" network in which these items are to be used.

CAREFUL USE OF THE INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED RADIO EQUIPMENT.

THE EQUIPMENT DESCRIBED IN THIS MANUAL IS MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING MOTOROLA U.S. PATENTS:

RE-24, 110	2,547,027	2,688,059	2,759,052	2,830,200
D, 159, 182	2,566,759	2,691,094	2,759,103	2,833,994
2,343,115	2,583,032	2,691,560	2,770,721	2,834,879
2,404,359	2,602,842	2,699,425	2,777,950	2,835,794
2,439,408	2,608,648	2,705,281	2,784,263	2,846,596
2,439,412	2,608,649	2,713,664	2,799,001	2,852,730
2,459,675	2,626,384	2,731,555	2,799,010	2,860,239
2,472,021	2,636,652	2,738,466	2,799,832	2,864,943
2,524,300	2,637,782	2,740,891	2,808,507	2,883,521
2,524,534	2,650,333	2,743,144	2,809,236	2,888,652
2,547,023	2,652,542	2,743,361	2,810,068	2,899,547
2,547,025	2,662,942	2,750,451	2,811,590	2,901,601
				2,905,909

Other U.S. Patents Pending

CONTENTS

<u>SECTION</u>	<u>NUMBER</u>
Guaranteed Performance Specifications	Page ii
Radio Set Cross Reference Chart	EPD-1233
Accessory Group Cross Reference Chart	EPD-1883
DESCRIPTION	68P862726
Introduction	Page 1
General Description	Page 1
Description of Radio Set Items	Page 2
Description of Standard Accessories	Page 3
Optional Accessories	Page 4
INSTALLATION AND OPERATION	68P862727
<u>Installation</u>	Page 1
<u>Operation</u>	
Pre-operational Checks and Adjustments	Page 1
Operator's Instructions	Page 3
Circuit Description	Page 4
<u>Diagrams</u>	
Simplified Functional Diagram	63E856476
Front Mount Intercabling Diagram and Parts List	63E856474
Rear Mount Intercabling Diagram and Parts List	63E856475
RECEIVER	68P854950
Description	Page 1
Guaranteed Performance Specifications	Page 2
Operation	Page 4
Operating Adjustments	Page 6
Alignment Procedure	Page 6
Pre-operational Notes	Page 6
Comprehensive Alignment Procedure	EPD-869
Single-Frequency Receiver Schematic Diagram, Parts Location Detail and Parts List	63E854952
Two-Frequency Receiver Schematic Diagram, Parts Location Detail and Parts List	63E854953
TRANSMITTER	68P854610
Description	Page 1
Guaranteed Performance Specifications	Page 2
Chassis Complement	Page 3
Circuit Operation	Page 3
Adjustment of the IDC Control	Page 6
Alignment Procedure	Page 7
Bench Alignment	EPD-950
Schematic Diagram, Parts Location Detail and Parts List	63E854612
POWER SUPPLY	68P856461
Introduction	Page 1
Performance Specifications	Page 2
Description	Page 2

SECTIONNUMBER

Operation	Page 2
Transistor Checking	Page 5
Parts Location Detail	AEPD-1312
Schematic Diagram and Parts List	63E856462

ROUTINE MAINTENANCE	68P856479
Introduction.	Page 1
Maintenance Checks	Page 3
Housing Parts Identification Detail	EPD-1285

SUPPRESSION OF IGNITION NOISE IN MOBILE EQUIPMENT	68P856127
Noise Suppression	Page 1
Source	Page 1
Radio Equipment Power Source	Page 1
Ignition	Page 2
Resistance Type Suppressors	Page 2
Spark Plug Leads	Page 2
Contacts	Page 2
Coupling	Page 2
Distributor	Page 3
D-C Generating System	Page 3
Generator	Page 3
Voltage Regulator	Page 4
Gauges	Page 4
Oil Sender	Page 4
Static Charges	Page 4
Bonding	Page 4
Counterphasing or Noise Balancing	Page 4
Summary	Page 5
Noise Identification and Suppression Chart	Page 6
Typical Noise Suppression Detail	69C854657

MOTOROLA

MODEL CHART RADIO SET

CARRIER SQUELCH "T" POWER MODELS
25 - 54 MC 12 VDC OPERATION

CODE:

- ☒ = ITEM INCLUDED IN RADIO SET
- ☒ = ITEM INCLUDED WITH ORDERS FOR FIVE (OR LESS) RADIO SETS
- ☒ = ALTERNATE ITEMS DEPENDING UPON FREQUENCY RANGE
- ☒ = TWO ITEMS SUPPLIED

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

MODEL	NO. OF RCVR. FR.	NO. OF XMTR. FR.	CHANNEL SPACING	ACCESSORY GROUPS	ITEM	DESCRIPTION	REFERENCE DIAGRAM
U51GGT-1000A	1	1	40 KC	DA, DB, DE OR DF	*TRB1080AA/TA235W	RECEIVER, 1-FREQUENCY, 40 KC CHANNEL SPACING (25-54 MC)	63E54952
U51GGT-1010A	1	2	40 KC	DA, DB, DE OR DF	*TRB1080AC/TA235W-R2	RECEIVER, 2-FREQUENCY, 40 KC CHANNEL SPACING (25-54 MC)	63E54953
U51GGT-1030A	2	2	40 KC	DA, DB, DE OR DF	*TRB1080AB/TA235S	RECEIVER, 1-FREQUENCY, 20 KC CHANNEL SPACING (25-54 MC)	63E54952
U51GGT-1100A	1	1	20 KC	DA, DB, DE OR DF	*TRB1080AD/TA214S-R2	RECEIVER, 2-FREQUENCY, 20 KC CHANNEL SPACING (25-54 MC)	63E54953
U51GGT-1110A	1	2	20 KC	DA, DB, DE OR DF	*TRB1080AA/TA214	TRANSMITTER, 1-FREQUENCY (25-54 MC)	63E54612
U51GGT-1130A	2	2	20 KC	DA, DB, DE OR DF	*TRB1080AB/TA214-C2	TRANSMITTER, 2-FREQUENCY (25-54 MC)	63E54612
					TK285	POWER SUPPLY	63E55462
					TK601	SUB-PANEL KIT	
					TK605	FRONT PANEL KIT	
					K-9122	HOUSING	
					RM14A/RP14A	TUNING TOOL KIT	63E54781
					RM13A/RP15A	TRANSMITTER CONTROL CRYSTAL	63E54959
					G34	RECEIVER CONTROL CRYSTAL (25-40 MC)	
					TLNG155A	RECEIVER CONTROL CRYSTAL (40-54 MC)	
						RECEIVER I-F CRYSTAL	
						FILTER KIT, 2-FREQUENCY	

25-54 MC 12VDC OPERATION

■ = ALTERNATE ITEM DEPENDING
UPON FREQUENCY RANGE

Motorola No. EPD-1883-A
11/5/59-RCS

DESCRIPTION

1. INTRODUCTION

The new MOTOROLA T-POWER mobile FM two-way radio sets incorporate several design features which reduce maintenance and provide full interchangeability between front and rear mount radio sets. These features are:

- (1) transistorized power supply
- (2) interchangeable radio set drawer assembly
- (3) "plug-in" control head

a. Transistorized Power Supply

The new MOTOROLA fully transistorized power supply uses long-life power transistors in place of conventional vibrator units. The transistorized supply provides operating voltages for both transmitter and receiver. The use of transistors eliminates the cost of replacing vibrators and improves overall operation of the radio set.

b. Interchangeability

The radio set housing mounts either under the vehicle dash or in the trunk of the car. The same drawer assembly, including transmitter, receiver and power supply, slides into the housing in either type of installation. In mobile radio fleets where both front- and rear-mount installations are used, this design provides full flexibility of exchange between vehicles. Rear mount radio sets are remotely controlled by means of a dash-mounted control head. The drawer assemblies can be interchanged between vehicles with positive or negative ground electrical systems.

c. Plug-In Control Head

In dash-mount installations the control head plugs into a receptacle on the front of the radio set drawer assembly. Two lock screws secure it in place. In trunk-mount installations the control head mounts on the vehicle dash and a cable kit makes the connections between the control head and the receptacle on the front of the radio set. Thus, the same radio set drawer assembly can be easily exchanged between front and rear-mount housings.

2. GENERAL DESCRIPTION

a. T-POWER "Radio Set"

The basic radio set consists of a transmitter, receiver, power supply and housing. The transmitter, receiver and power supply are assembled together to form a drawer unit which slides into the housing. External connections are made through receptacles on the front of the housing. The radio set can be installed either under the dash (front) or in the trunk (rear) of the vehicle.

Various T-POWER models are available, providing either one or two-frequency transmitters, and with either 20 kc or 40 kc channel spacing receivers. The radio set cross reference chart, which precedes this section of the manual, shows the available models and summarizes the equipment supplied with each variation.

b. Accessory Groups

In addition to the basic radio set, an "accessory group" is required to complete the installation. The accessory group includes the control



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head, cable kit, antenna, mounting hardware and other required items. Accessory groups are classified for either rear-mount or front-mount installations.

(1) Rear-Mount Accessory Groups

Rear-mount accessory groups include a control head designed for mounting on the vehicle dash and a cable kit for interconnecting the radio set and control head. Control heads are available either with or without microphones. Models supplied less microphone have a four-pin receptacle for connecting a detachable microphone or handset. Models supplied with microphone have a palm-type microphone wired-in at the factory. Rear-mount accessory groups include either a 3-ohm permanent magnet speaker or the new MOTOROLA POWER-VOICE speaker with built-in booster amplifier. This speaker provides an audio output of 15 watts from the normal radio set receiver output.

Accessory groups are listed in the accessory group cross reference chart in the front of this manual.

(2) Front-Mount Accessory Groups

Front-mount accessory groups include a plug-in control head which mounts directly on the radio set front panel. These control heads are available for use with detachable microphones or complete with factory wired-in microphones as described for rear-mount control heads. The accessory group includes either a 3-ohm PM speaker or the new MOTOROLA 15-watt POWER VOICE speaker with built-in transistorized audio amplifier.

These accessory groups are listed in the accessory group cross reference chart at the front of this manual.

3. DESCRIPTION OF RADIO SET ITEMS

The items included in the radio set are summarized on the model chart at the front of this manual. Major units, such as the receiver, transmitter and power supply are fully described in the various sections of this manual, as indicated in the table of contents. Items not covered in separate sections are described in the following paragraphs.

a. Sub-panel Kit

The TK603 Sub-panel Kit is used with the radio sets covered in this manual. This kit includes the

front and rear tie-plates and the hardware required to assemble the transmitter, receiver and power supply into a single mechanical unit. This three chassis assembly then slides into the housing as a drawer unit. The power supply connector mounts on the front sub-panel of this kit, making the receptacle available for an external mating plug. A coaxial cable which interconnects the receiver r-f circuit to the antenna relay is also included with this kit.

b. Housing

The 50 watt T-POWER radio sets are housed in the K-9045 Housing. This housing is 9-7/8 inches wide x 18-1/2 inches deep x 6 inches high. The housing is a heavy gauge steel cabinet designed to house the receiver, power supply and transmitter assembly as a drawer unit. The housing is finished in an automotive type baked enamel. Housing tops are removable for access to components mounted on the chassis.

c. Front Panel

The TK661 Front Panel forms the exterior front panel of the drawer unit. This panel includes an extruded aluminum heat radiator and the two power transistors used with the power supply. A chrome-plated bar on this panel is a carrying handle when pulled up and outward. Spring catches on the heat radiator fins secure the handle when not in use. A key-lock mounted on this panel secures the radio set against unauthorized personnel. Metering ports give access to the transmitter and receiver meter sockets. The 19-pin power supply receptacle is accessible through a hole in this panel. The antenna receptacle for the radio set is mounted on this panel. A coaxial cable connects this receptacle to the ANT. receptacle on the transmitter chassis.

d. Crystals

The crystals used in the radio set are listed in the radio set cross reference chart at the front of this manual. If crystals are re-ordered refer to the REPLACEMENT PARTS ORDERING paragraph in the FOREWORD of this manual.

e. Alignment Tool Kit

The K-9322 Alignment Tool Kit is included with the radio set at the rate of one kit per five sets (or less, if less than five are ordered). This kit includes the tool required for aligning the transmitter and receiver.

4. DESCRIPTION OF STANDARD ACCESSORIES

a. Cable Kits

Cable kits are not supplied as part of the radio set model, but are included in the accessory group, which must be ordered separately for each type of installation. The type of cable kit used depends upon front or rear mount installation and upon one-frequency or two-frequency operation. The cable kits available are listed in the accessory chart.

b. Installation Kit

The installation kit includes a distributor suppressor, by-pass capacitors, cable clamps and mounting hardware for installing the radio sets. It is used for front and trunk mount models.

c. Antennas

The TU304 and TU305 Series Spring Base Antennas are designed for 25-54 mc mobile radio installations. The antenna consists of a 1/4 wavelength stainless steel rod, a universal spring base swivel mount and a coaxial lead-in cable. Antenna rods are cut to length at the factory for specific frequencies. TU304 antennas have a 5-ft. lead-in; TU305 antennas have a 20-ft. lead-in. The available antennas are as follows:

<u>Model No.</u>	<u>Frequency Range</u>	<u>Type of Installation</u>
TU304-H	30-54 mc.	Rear Mount
TU304-L	25-30 mc.	Rear Mount
TU305-H	30-54 mc.	Front Mount
TU305-L	25-30 mc.	Front Mount

d. Speaker

The TU324A Trunion Mount Speaker is designed for mounting on a suitable flat surface in

the vehicle. It can be mounted directly on the fire wall or dashboard. It can be mounted on the steering column when the TK395 Adapter Kit is used. The unit consists of a 3-ohm, 5 inch PM speaker installed in a louvered steel housing. An eight-foot, 2-conductor cable is included.

e. POWER-VOICE Speaker

The Model TU433A-12V POWER VOICE Speaker is a combination speaker and transistorized audio amplifier in a louvered steel housing. Two power transistors in a transformer-coupled, push-pull circuit boost the receiver audio output to a 15-watt level with less than 10% distortion. This unit is especially desirable for all high ambient noise applications or where the receiver must be monitored at some distance from the vehicle.

f. Control Heads

The control head provides the required control facilities for operation of the radio set. Two basic models are available for front mount radio sets and two are available for rear mount models. Model variations include one or two-frequency operation and "wired-in" microphone or provisions for detachable microphone.

Front-mount models are designed for direct plug-in connection to the radio set front panel. Control heads for rear-mount models are mounted on the vehicle dash with an adjustable angle bracket.

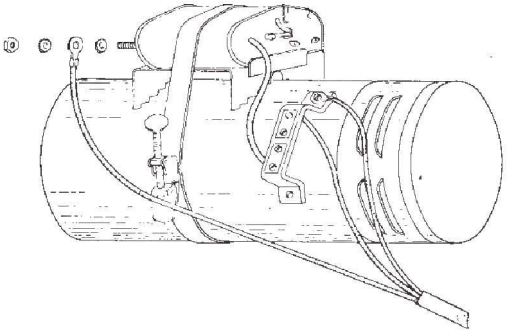
Refer to the intercabling diagrams in this instruction manual for wiring details of the control heads.

OPTIONAL ACCESSORIES



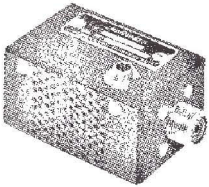
TU546 SERIES PORTABLE TEST SET

For testing and alignment of Motorola transmitters and receivers. Cable and plug mate with METER sockets on radio chassis.



P-346 GENERATOR FILTER

Used to attenuate generator interference. Rated at 40 amperes.



**P-7208 WATTMETER
DUMMY LOAD**

Used with portable test set to measure transmitter rf power output.

SPECIAL PURPOSE KITS

K-8292 Hood Wiper--Suppressor. Used to reduce interference from noise generated in the vehicle.

K-7257 Extension Cable. Provides full length ground return from rear-mount radio set to battery. Consists of two 17-foot lengths No. 4 cable with lugs at each end.

Long Cable Kits. For limousine and truck installations. With 20-ft cables instead of 17-ft. cables. Fully interchangeable.



**"PLUG-IN" UNITS
TU353A MICROPHONE
TU475 TELEPHONE
HANDSET**

For control heads with 4-pin MIC receptacle. Built-in transistorized pre-amplifier. Moving coil element for improved voice reproduction. 12' coiled tinsel cord. DPST push-to-talk switch. Mic. and handset interchangeable.

EPD-1491

EPD-1742 (CE1070)

MC1971

EPD-1741 (CE044)

INSTALLATION AND OPERATION

INSTALLATION

Installation instructions are packed and shipped with the radio set accessories.

OPERATION

1. PRE-OPERATIONAL CHECKS AND ADJUSTMENTS

a. Purpose

The purpose of the pre-operational check is to ascertain that the mobile radio set is operating properly when initially placed in service.

The equipment has been accurately aligned at the factory for optimum performance. It is possible, however, that mishandling in transit may have disturbed some of the adjustments. It is essential, therefore, that a pre-operational check be made to assure proper operation when the equipment is installed.

b. Pre-Installation Bench Check

The radio set can be checked before installation using a bench test set-up with permanently installed cabling and control facilities and a battery or battery eliminator. The dc supply must

be a 12-volt source. An antenna dummy load, rf wattmeter or operational antenna must be connected to the radio set ANTENNA connector on the front panel. A test set for metering the transmitter and receiver should be available. This type of laboratory set-up is particularly useful where many sets must be checked, however, it does not give a complete check of the actual cables, control unit and speaker to be used.

The ideal set-up for a pre-installation check is a bench test in which the radio set, cable kit, control head, speaker and antenna are assembled to form a complete facsimile of the vehicular installation. The pictorial cabling diagrams in the installation instructions packed with the cable kit show how to interconnect the various items.

Once the test set-up is assembled the equipment can be turned on and operated as described in the following paragraphs.



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c. Installation Checks

Before placing this radio set in operation make the following installation checks:

(1) General

Be sure all cable connections and bolted connections are secure. Make sure all fuses are in place and all tubes are firmly seated.

(2) DC Input

(a) Be sure the equipment is connected with the proper polarity to a 12-volt dc electrical system. Set the ON-OFF toggle switch to the ON position. This applies the dc input to the radio set.

(b) The green pilot lamp should be lit and all tube filaments should be energized. To check filaments, unlock the drawer assembly and slide the drawer out or lift the top of the housing. After making this check keep the radio set open for the following checks.

(3) Check Receiver

(a) Meter Readings

Check receiver meter readings against the STAGE MEASUREMENT CHART in the RECEIVER section (noise input readings only). Use the Motorola portable test set or equivalent 0-50 microamp. test meter. The cable of the portable test set plugs directly into the metering socket of the receiver chassis. Check meter readings in the various test positions as indicated on the chart. If any of the readings are beyond the given limits, re-align the receiver as described in the RECEIVER section.

(b) Check for Normal Operation

With the receiver properly aligned, the dc input applied to the equipment and the antenna connected, the receiver should be in full operation. Check for proper operation as follows: Turn the VOLUME control to the full clockwise position. Turn the SQUELCH control to the full counterclockwise position (open). You should hear either a loud, rushing noise in the speaker or signals from any on-frequency station which may be on the air at this time. In the absence of any received signals the loud, rushing noise is a normal indication of receiver operation with "open" squelch.

(c) To Set the VOLUME Control

There are two controls involved in adjusting the audio level to the speaker. These controls must be adjusted in the presence of a normal, fully deviated signal from the base station transmitter (or other mobile located at an average distance). To adjust these controls proceed as follows:

With a signal being received, set the VOLUME control on the control head to maximum volume (fully clockwise). Then adjust the audio level control on the receiver chassis to a setting just below the point where distortion becomes audible. Now, reset the control head VOLUME control for the desired listening level.

The use of two controls in the audio circuits permits future readjustment of the speaker level at the control head without resetting the receiver audio level control.

(d) To Set the SQUELCH Control

Turn the SQUELCH control in the clockwise direction until the noise is squelched (cuts out).

(4) FCC Regulations

The operation of the transmitter in this radio set is covered by FCC rules and regulations. Several provisions of these rules are briefly summarized in this paragraph. For complete information, refer to the current FCC regulations covering the applicable type of service and equipment. FCC regulations excerpts:

(a) Transmitter frequency and deviation must be checked before a transmitter is placed in service and at least every six months thereafter. A suitable procedure shall be employed to ascertain that the transmitter is on the assigned carrier frequency and that the transmitter crystal actually controls the frequency of the radiation. Modulation deviation is limited to ± 15 kc for 40 kc, 60 kc and 120 kc channel spacing operation and to ± 5 kc for 20 kc and 30 kc channels.

(b) The rf power output of a transmitter shall be no more than required for satisfactory technical operation considering the conditions of its use.

(c) Only duly authorized radio operators or personnel working directly under their supervision may tune or adjust a radio transmitter.

(5) Check Transmitter

(a) Operational Check

The transmitter must be checked for proper operation before the equipment can be placed in service. Connect a dummy load lamp, rf wattmeter or the regular mobile radio set antenna to the ANTENNA receptacle on the front panel. Set the HI-LO switch on the power supply chassis to the HI position. Press the microphone push-to-talk button momentarily and listen for relay operation. The transmit-receive relay on the power supply chassis and the antenna relay on the transmitter chassis must operate. Check for indication of rf power output. The dummy load lamp should glow or the rf wattmeter, if used, will show the rf power output. If the regular mobile antenna is used, the transmitter should radiate signals to receivers of other sets on the same frequency.

CAUTION

Do not key the transmitter more than a few seconds at a time while making these operational tests.

If the operational test is satisfactory, proceed to the next step. If there is no indication of rf output, some troubleshooting must be done before proceeding. The simplified functional diagram in this section shows the overall operation of the radio set and gives the step-by-step sequence of operations. The inter-cabling diagrams trace the various circuits from chassis-to-chassis. Schematic diagrams of each chassis are included in the various sections of the manual. With these diagrams, the technician can understand how the radio set works and can isolate troubles to a specific chassis or stage thereof.

(b) Meter Readings

Refer to the alignment procedure in the TRANSMITTER section of this manual. With the HI-LO switch in the HI position check meter readings against the values given in the FINAL METER READINGS CHART. The transmitter must be keyed to obtain readings. Use the microphone push-to-talk button or the switch on the Motorola portable test set. To check readings consult the chart and set the switch to a

given position. Then key the transmitter just long enough to observe the reading. Readings can be taken in any order. If the readings in positions 2, 3, 4, 5 or 6 are below the minimum values given, re-align the transmitter as described in the alignment procedure. The reading in the PA position is not too important at this point, however, if it is above the maximum value given, do not key the transmitter any more than absolutely necessary.

It is advisable to follow the complete alignment procedure at this point, since the next step requires a repeak of the transmitter adjustments to obtain full rf output.

(c) Loading to Antenna

Set the HI-LO switch to LO and load the transmitter to the antenna as described in the last three steps of the alignment procedure.

d. Deviation Check

FCC regulations require a deviation check before a transmitter is placed in service. This check is described in the TRANSMITTER section.

2. OPERATOR'S INSTRUCTIONS

a. To Turn "ON" Equipment:

Place the ON-OFF switch in the ON position. The green indicator will become illuminated. The receiver is now in full operation and the transmitter filaments are "on".

NOTE

If multi-channel transmitter and/or receiver is used, place frequency selector switch in desired frequency position.

b. To Receive:

(1) Turn the VOLUME control to the full clockwise position.

(2) Turn the SQUELCH control to the full counterclockwise position.

(3) Adjust the SQUELCH control, by turning the control slowly clockwise until the noise is just squelched (cuts out). Turning the control beyond this point will increase the minimum signal necessary to open the squelch circuit.

(4) Set the control head VOLUME control to the desired speaker level with a received signal.

c. To Transmit:

(1) Remove the microphone from the hanger bracket and press the push-to-talk button. The red indicator lamp will become illuminated, indicating the transmitter is "on". If a military or noise cancelling type microphone is used, hold the microphone at approximately a 30° angle from the lips and speak clearly and distinctly across the microphone in a normal or loud voice. If a handset microphone is used, speak directly into the mouthpiece of the handset. The TRANSMITTER CANNOT BE OVER-MODULATED BY SPEAKING LOUDLY.

(2) To receive reply, release the push-to-talk button. The red indicator lamp will go "off" indicating that the transmitter circuits are no longer energized. The received reply may now be heard over the speaker and/or the handset earpiece (if used).

(3) When the transmission is completed, release the push-to-talk button and hand the microphone on the hanger bracket.

d. To Turn "OFF" the Equipment:

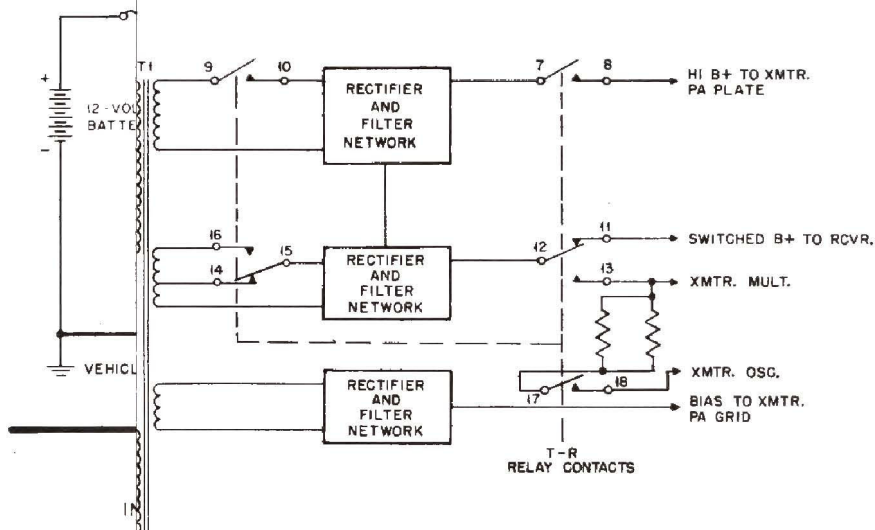
Place the ON-OFF switch in the OFF position. The green lamp will be turned "off".

3. CIRCUIT DESCRIPTION

The operation of the radio set as a whole is illustrated in the simplified functional diagram in this section. Refer first to the SEQUENCE OF OPERATIONS table for the various steps, then to the components as identified on the diagram. The diagram applies to both front-mount installations and rear-mount installations. The only differences between these two types of installations are in the control head and dc input circuit. The power supply, transmitter and receiver are the same for both installations.

Once the simplified diagram is clearly understood refer to the POWER SUPPLY section of this manual for full information on the transistor multivibrator and relay action. For detailed description of the transmitter and receiver, refer to the TRANSMITTER and RECEIVER sections. For exact intercabling connections between the various chassis, refer to the intercabling diagrams in this section.

FUNCTIONAL DIAGRAM
WITH DETAILS ALL
INCLUDED



SEQUENCE OF OPERATIONS

"TURN-ON" OPERATION	"TURN-OFF" OPERATION
1. ON-OFF SWITCH SET TO ON POSITION. 2. FRONT-MOUNT-SWITCH APPLIES DC TO RADIO SET. GREEN LAMP GOES ON. REAR-MOUNT-SWITCH ENERGIZES "A" RELAY. RELAY APPLIES DC TO RADIO SET. GREEN LAMP GOES ON. 3. FILAMENTS ENERGIZED. TRANSISTOR MULTIVIBRATOR OPERATES. RECEIVER IN FULL OPERATION ("STANDBY" CONDITION). 4. MIC. P-T-T BUTTON PRESSED. 5. TRANSMIT-RECEIVE RELAY AND ANTENNA RELAY OPERATES 6. TRANSMITTER ON AIR. RECEIVER MUTED. RED LIGHT ON ("ON-THE-AIR" CONDITION).	1. P-T-T BUTTON RELEASED. 2. TRANSMIT-RECEIVE RELAY AND ANTENNA RELAY RELEASES. 3. TRANSMITTER OFF, RECEIVER BACK IN OPERATION. RED LIGHT GOES OUT ("STANDBY" CONDITION).

c. To Transmit:

(1) Remove the microphone from the hanger bracket and press the push-to-talk button. The red indicator lamp will become illuminated, indicating the transmitter is "on". If a military or noise cancelling type microphone is used, hold the microphone at approximately a 30° angle from the lips and speak clearly and distinctly across the microphone in a normal or loud voice. If a handset microphone is used, speak directly into the mouthpiece of the handset. The TRANSMITTER CANNOT BE OVER-MODULATED BY SPEAKING LOUDLY.

(2) To receive reply, release the push-to-talk button. The red indicator lamp will go "off" indicating that the transmitter circuits are no longer energized. The received reply may now be heard over the speaker and/or the handset earpiece (if used).

(3) When the transmission is completed, release the push-to-talk button and hand the microphone on the hanger bracket.

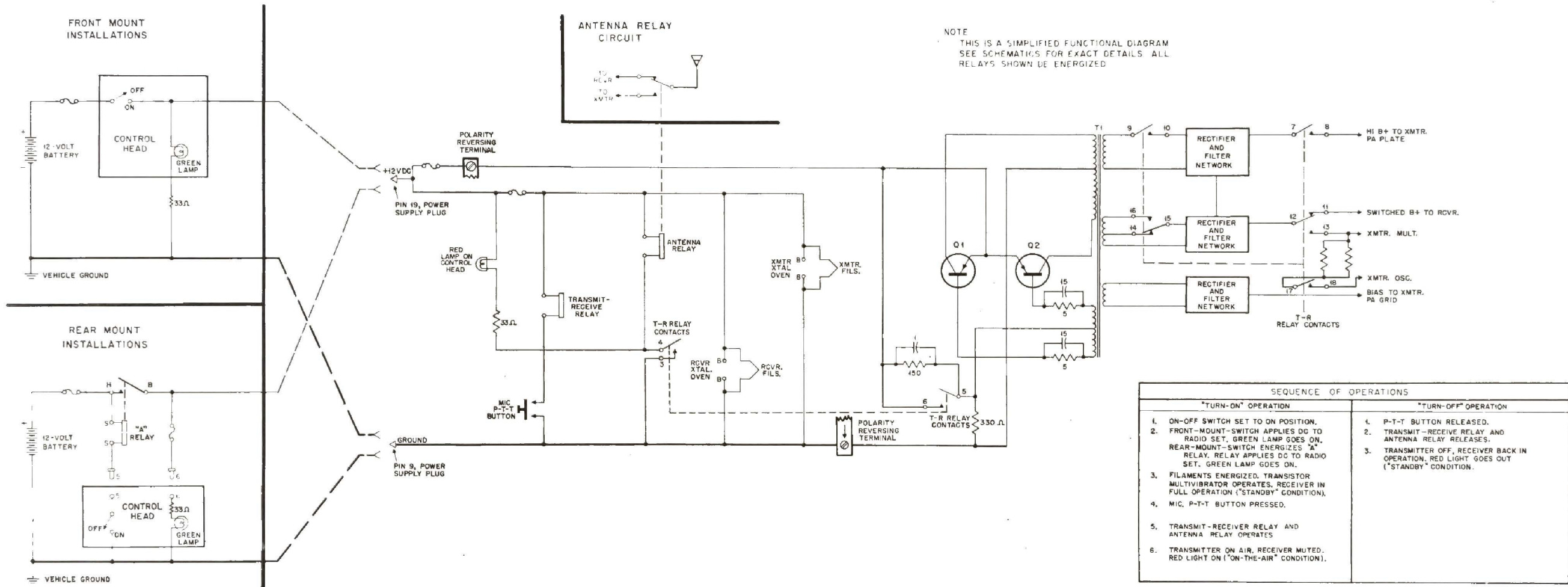
d. To Turn "OFF" the Equipment:

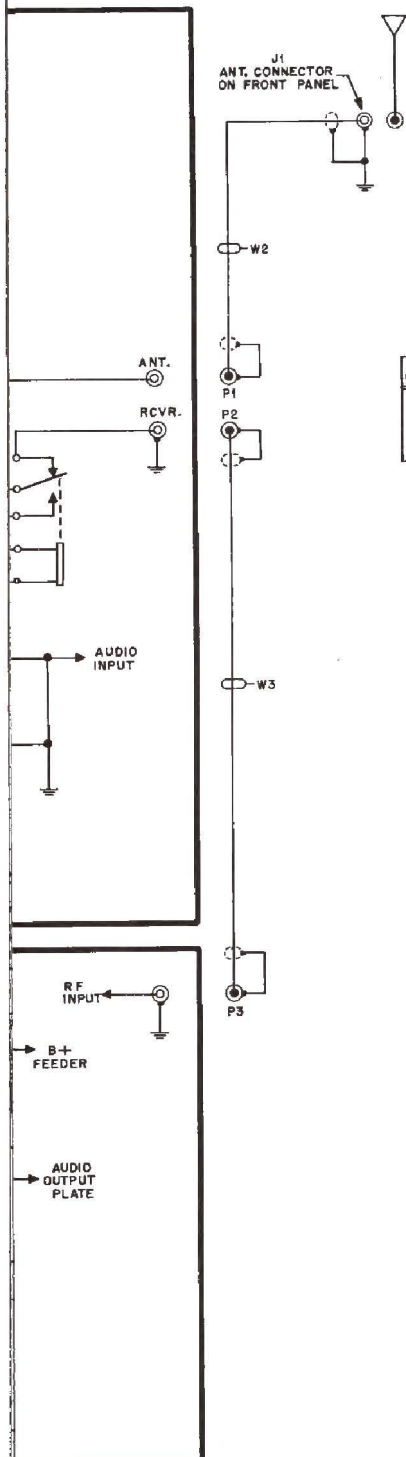
Place the ON-OFF switch in the OFF position. The green lamp will be turned "off".

3. CIRCUIT DESCRIPTION

The operation of the radio set as a whole is illustrated in the simplified functional diagram in this section. Refer first to the SEQUENCE OF OPERATIONS table for the various steps, then to the components as identified on the diagram. The diagram applies to both front-mount installations and rear-mount installations. The only differences between these two types of installations are in the control head and dc input circuit. The power supply, transmitter and receiver are the same for both installations.

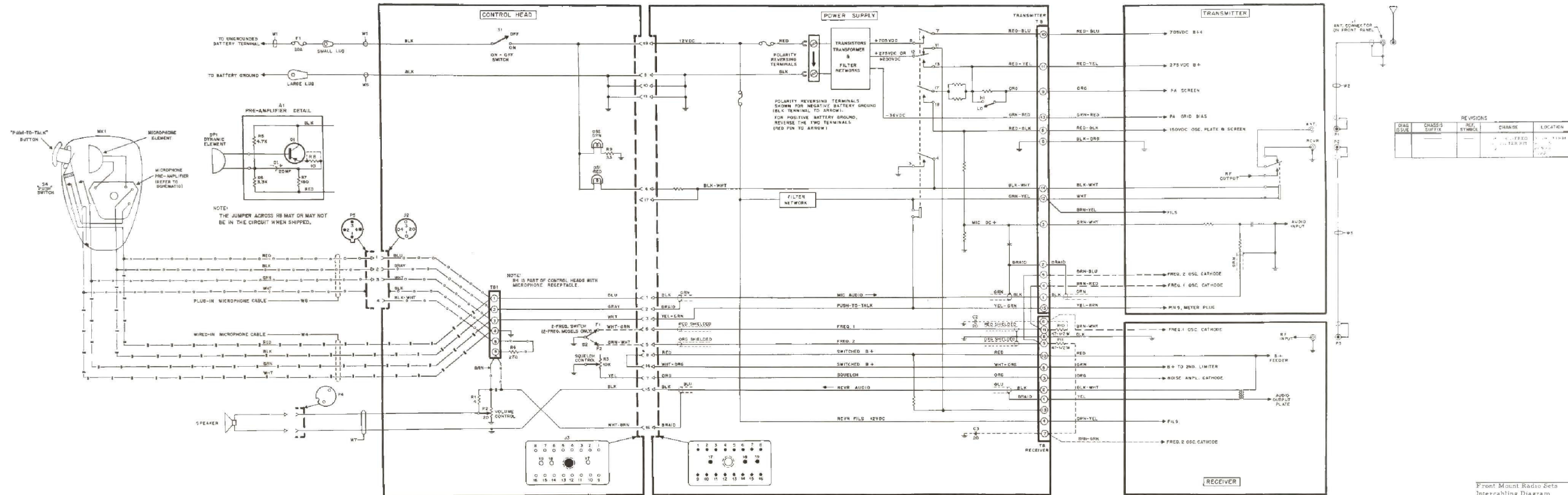
Once the simplified diagram is clearly understood refer to the POWER SUPPLY section of this manual for full information on the transistor multivibrator and relay action. For detailed description of the transmitter and receiver, refer to the TRANSMITTER and RECEIVER sections. For exact intercabling connections between the various chassis, refer to the intercabling diagrams in this section.

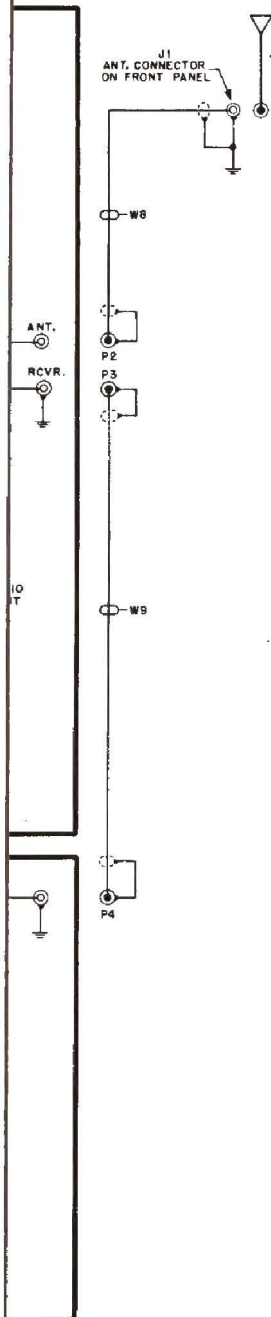




REVISIONS

DIAG. ISSUE	CHASSIS SUFFIX	REF. SYMBOL	CHANGE	LOCATION
D			TLN6155A 2-FREQ. RCVR FILTER KIT ADDED	RCVR. TERM. BD. ON POWER SUPPLY





REVISIONS

DIAG. ISSUE	CHASSIS SUFFIX	REF. SYMBOL	CHANGE	LOCATION
C	—	—	TLN6155A 2-FREQ. RCVR FILTER KIT ADDED	RCVR. TERM. BD. ON POWER SUPPLY

PARTS LIST for Interconnecting Diagram 63E856474-D

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
A1	1V861317	AMPLIFIER, AF: microphone pre-amplifier; assembly; includes 1V85594 BOARD, circuit; eyeletted assembly; includes soldering lug terminals Reference parts C1, Q1, R5, R6, R7, R8
C1	23C855013 or 23B844927 23C855013	CAPACITOR, fixed, electrolytic: tubular; 20 uf +100-10%; 25 vdcw
C2		tubular; 20 uf +100-10%; 25 vdcw
C3		same as C2
DP1	54C852603	CARTRIDGE, microphone: magnetic, dynamic type; 175 ohm impedance at 1 kc
DS1	65R4151	LAMP, incandescent: 5-8 volt; 2 ampere; single contact bayonet base; globular glass, type 51
DS2		same as DS1
F1	65K52482	FUSE, cartridge, one time, paper: 20 ampere, 250 volt; 2 1/2" long x 9/16" dia
J1	1V855055	CONNECTOR, receptacle, female: assembly; includes mounting bracket and single contact, coaxial connector
J2	9B16345	4 contact, polarized; round molded black phenolic base; chassis mounted, includes 457699 LOCKWASHER; 13/16" internal 2KX180 NUT, ring
J3	9C801050	10 contact, polarized; rectangular mid. blk. phenolic base; chassis mid.; does not include 70K55113 BRACKET, connector mtg., nor 64C851013 PLATE, connector mtg.; bracket and plate must be ordered separately
MK1	1V854033 ("plug-in") or 1V852400 ("wired-in")	MICROPHONE, dynamic: palm type; contains transistor amplifier and "push-to-talk" switch; includes reference parts A1, DP1, S4, W8 palm type; contains transistor amplifier and "push-to-talk" switch; includes reference parts A1, DP1, S4, W4
P1	28A474006	CONNECTOR, plug: male; single contact; round bak- elite wafer insulator; cable mounted; connects to Trans- mitter Antenna Relay Antenna Connector
P2		same as P1 except connects to Transmitter Antenna Relay Receiver Connector
P3		same as P1 except connects to Receiver Antenna Connector
P4	9B855112	female; 2 contact; polarized; round phenolic wafer insulator; cable mounted; does not include 15B85111 SHIELD, connector; shield must be ordered separately

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
P5	28A16370	CONNECTOR, (cont'd) male; 4 contact; polarized; round molded phenolic insulator; cable mounted; includes 41K838823 SPRING, cable strain relief
Q1	48A124317	TRANSISTOR: type MN30; does not include 1A8A1190 INSULATOR, transistor; insulator must be ordered separately
R1	17K852469	RESISTOR, fixed, carbon; 40%
R2	18K855108	1/2 w. ins.; unless otherwise stated
R3	18K855107	wire-wound; 4 ohm 20%; 1 w
R4	6R6336	variable; wire-wound; 20 ohm
R5	6R6080	40%; 2 w
R6	6R5581	variable; wire-wound; 10K; 2 w
R7	6R5660	270 ohm; 1 w
R8	6R5661	4.7K
R9	6R488016	3.3K
R10	6R5950	180 ohm
R11		10 ohm
S1	40B858304	33 ohm; 2 w
S2	40A80248	47 ohm same as R10
S3		SWITCH
S4	40B857174	toggle; spot toggle; spot; does not include 28S382 NUT, machine; 15/32-32 x 9/16" hex; 2 required; nuts must be ordered separately
TB1	31A890699	NOT USED push; spot
W1	1V832063	BOARD, terminal: 6 screw terminals
W2	1V855051	LEAD, electrical: Battery to Fuseholder; includes: 30K81372 CABLE, power; single conductor; #10 ga.; stranded; ins.; coded BLK; 2 ft. length required 29K832116 LUG, ring tongue; for 3/8" stud and #10 wire 29K824154 LUG, ring tongue; for #10 stud and #10 wire
W3	1K800193	LINE, RF transmission: assembly; Antenna to transmitter Antenna Relay; includes: 1V855054 ASSEMBLY, cable and plug; includes: 30B475378 CABLE, RF; coaxial; RG-58A/U; 6" length required Reference part P1 Reference part J1 Transmitter Antenna Relay to Receiver Antenna Input; includes: 30B475378 CABLE, RF; coaxial; RG-58A/U; 24" length required Reference parts P2, P3
W4	1V854036	CORD, microphone: assembly; includes: 30K852742 CORD, coiled; tinsel 41A852707 SPRING, strain relief 11M2506 TUBING, extruded, #9 BLK; 1" length req'd

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
W5	30K831572	CORD, microphone: (cont'd) 29A847033 LUG, terminal; wire mounted; insulation piercing; 8 req'd
W6		CABLE, power: single conductor, #10 ga. stranded ins.; coded black; 9 ft. length req'd does not include 29K824154 LUG, ring tongue; for #10 wire and #10 stud; lug must be ordered separately
W7	30A825430	same as W5 except does not include 29K832116 LUG, ring tongue; for #10 wire and 3/8" stud; lug must be ordered separately
W8	1V854034	2 conductor; rubber covered; each conductor; #18 ga. stranded; 41" length req'd
		CORD, microphone: assembly; includes: 30K852742 CORD, coiled; tinsel 41A852707 SPRING, strain relief 11M2506 TUBING, extruded, #9 BLK; 2" length req'd 29A847033 LUG, terminal; wire mounted; insulation piercing; 4 req'd 29A847034 LUG, terminal; wire mounted; insulation piercing; 4 req'd 37K480513 SLEEVE, rubber Reference part P5
NON-REFERENCED ITEMS		
The following are replaceable parts which do not appear on the interconnecting diagram		
XDS1	9A859619	LAMPHOLDER: single contact; miniature; bayonet base same as XDS1
XDS2		
XP1	67K892616	FUSEHOLDER: single fuse mounting rectangular porcelain base; chassis mounted; for fuse 2" long x 9/16" dia.
		TLN6000A Installation Kit: includes the following items:
	1V859627	Cable Clamp Kit: includes: 42A19376 CLAMP, cable; 4 req'd 387451 SCREW, tapping; #8 x 3/8" plain hex; 4 req'd
	1V849628	Mounting Hardware Kit: includes: 38125947 SCREW, tapping; #14 x 3/4" plain hex; 4 req'd 45119131 LOCKWASHER; 1/4" split; 4 req'd

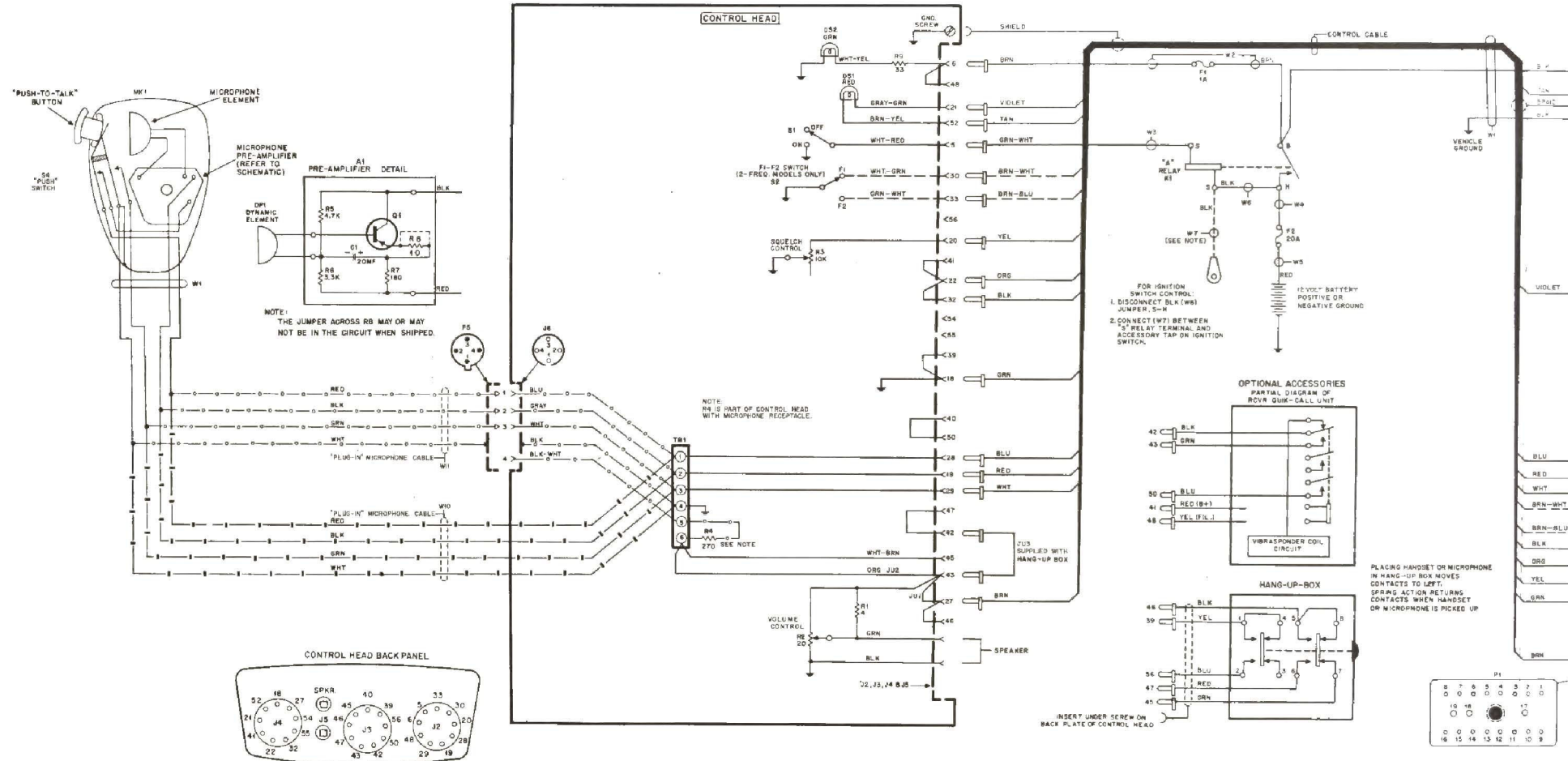
REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
		TLN6000A Installation Kit: includes the following items:
1V84019		Noise Filter Kit: includes: 8A821889 CAPACITOR, generator hask filter; fixed; paper tubular; 5 uf ±20%; 150 vdcw; one lead grounded; one lead insulated; 2 supplied 6A4141 SUPPRESSOR, noise; resistor; screw type 457670 LOCKWASHER; 1/4" internal; 2 req'd
		TR611 Cable Kit: includes reference parts F1, XF1, W1 and the following items:
32A880952	1V474596	GASKET, fuseholder Mounting Hardware Kit, fuseholder; includes: 4A81863 WASHER, cushion; 2 supplied 35A0465 SCREW, tapping; #10 x 3/4" unthread round head; 2 supplied 457658 LOCKWASHER; #10 internal; 2 supplied 451706 WASHER; 3/8" x .203 x .033"; 2 supplied
		Control Heads
		Items which are common to all control heads are listed first. Items which are not common to all control heads are listed under the model number of the particular control head concerned.
		Items common to all control heads include reference parts DS1, DS2, J1, F4, R1, R2, R3, R4, R5, T81, W5, W6, W7, XDS1, XDS2, and the following items:
28B382		NUT, machine; 15/32-32 x 9/16" hex; 2 req'd
61B859620		LENS, indicator: RED
61B859621		LENS, indicator: GRN
457694		LOCKWASHER; 3/8" internal
28B364		NUT, machine; 3/8-32 x 1/2" hex; 2 req'd
64C855103		PLATE, connector mounting (back cover)
78B55113		BRACKET, connector mounting
42A855115		CLAMP, cable
26A857812		SHIELD, indicator lamp; 2 req'd
35122080		LOCKSCREW; 6-32 x 1/4" plain hex; 6 req'd
36B8595027		KNOB, control; 2 req'd
		Each control head model includes the items shown for the model, plus items listed above.

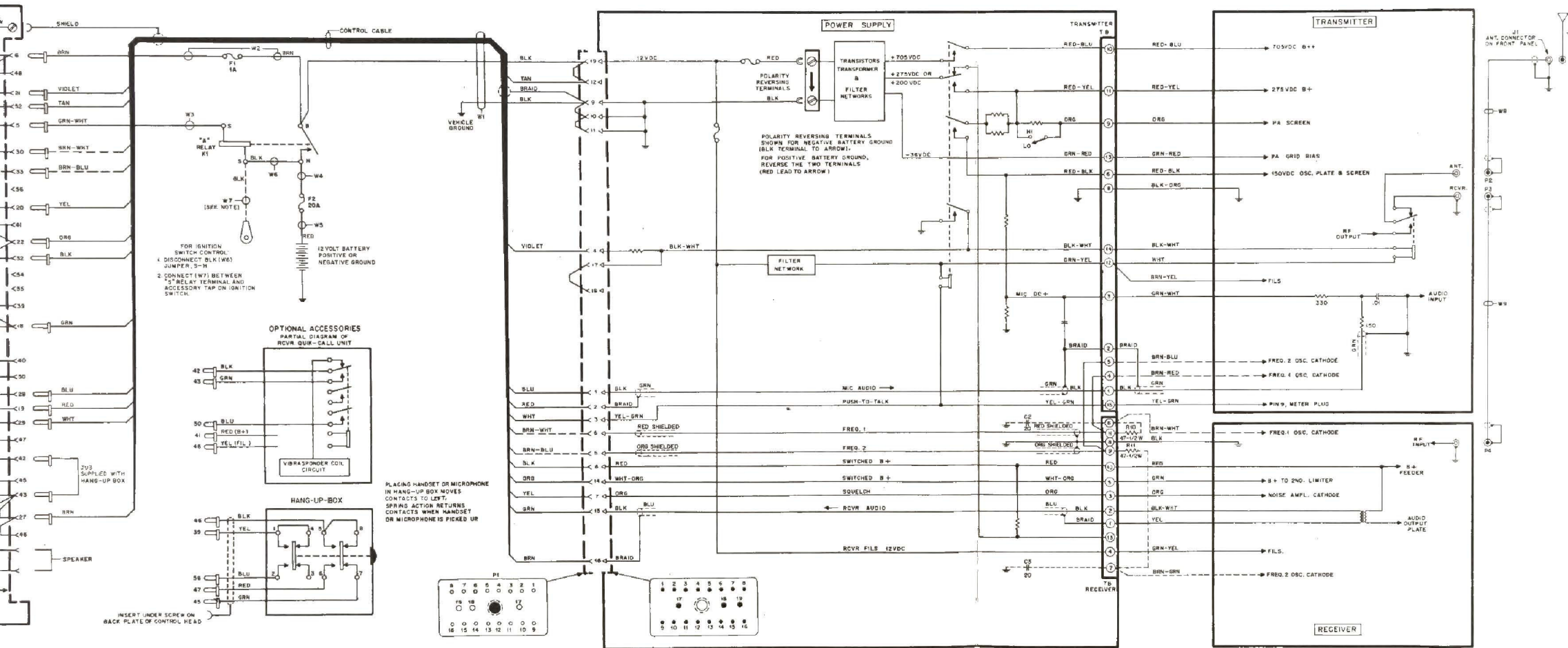
REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
		TCN6000AA (1-freq. with "wired- in" microphone): includes the following items: MICROPHONE (reference part MK1) BUTTON, plug GROMMET, rubber; for 7/16" dia hole
1V852490		
36A857093		
37K106352		
		TCN6000AB (2-freq. with "wired- in" microphone): includes reference part S2 and the following items: MICROPHONE (reference part MK1) BUTTON, plug GROMMET, rubber; for 7/16" dia hole
1V852400		
36A857093		
37K106352		
		TCN6000AC (1-freq. with receptacle for "plug-in" microphone): includes reference parts J2, R4 and the following items: LOCKWASHER; 3/8" internal LUG, soldering; 7/8"
457691		
29R5279		
		TCN6000AD (2-freq. with receptacle for "plug-in" microphone): includes reference parts J2, R4, S2 and the following items: LOCKWASHER; 3/8" internal LUG, soldering; 7/8"
457691		
29R5279		
		Microphones
		Items which are common to all microphones are listed first. Items which are not common to all microphones are listed under the model number of the particular microphone concerned.
		Items common to all microphones include the following parts:
		NOTE These items are part of reference part MK1 (both 1V854033 and 1V852400).
1V854005		BACK HOUSING AND HANG-UP STUD ASSEMBLY
15124693		LOCKSCREW; 6-32 x 1/4"; Phillips round head; 3 req'd
42A852710		STRAP, strain relief
38A852699		BUTTON, push
15D852566		FRONT HOUSING
13B852703		GRILLE
35A852701		CLOTH, grille
32B852702		GASKET, rubber
14A857136		INSULATOR; used for insulating printed circuit assembly
42A852705		CLAMP, used for securing microphone cartridge
14A857137		INSULATOR; used between clamp and microphone cartridge
48K82762		WASHER, insulating; used as a spacer
35127924		LOCKSCREW; 6-32 x 5/16" Phillips round head

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
		35127481 SCREW, machine; 6-32 x 7/8"; Phillips round head; 2 required
		4547425 LOCKWASHER; #6 split; 2 required
		Each microphone model includes the items shown for the model, plus items listed above
		1V852400 Microphone ("wired-in" type) includes reference part MK1 (1V852400)
		TU353A Microphone includes reference part MK1 (1V854033) and the following items:
1V16241		Mounting Kit, microphone; includes 64A85156 microphone hang-up 35122810 SCREW, tapping #8 x 1/2"; 2 req'd

CASE NO.	EQUIPMENT USED*				CIRCUIT OPERATION	JUMPERS		
	MIC.	HANDSET	HANG-UP BOX	QUICK-CALL		JU1	JU2	JU3
1	EITHER		---	---	Basic operation. Radio Set Speaker in circuit at all times	USED	USED	OMIT
2	---	X	X	---	Handset picked up connects audio to handset earpiece ----- Handset picked up connects audio to handset earpiece, speaker in circuit.	OMIT	OMIT	USED
3	X	---	X	X	Audio to speaker when microphone is removed or hung up. Alarm circuit energised. "Quick-call" disabled.	OMIT	USED	OMIT
4	---	X	X	X	Audio switched from speaker to handset earpiece. Alarm circuit energised ----- Audio switched from "quick-call" to speaker and handset. Alarm circuit energised.	OMIT	OMIT	OMIT
5	EITHER		---	X	"Quick-call" used for alarm purposes only. Audio to speaker at all times.	USED	USED	OMIT

* X = item used
--- = item not used





PARTS LIST for Interconnecting Diagram 63E56475-C

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
A	1V85017	AMPLIFIER, AF microphone pre-amplifier assembly, includes: 1V85017 BOARD, circuit; 1V85017 ASSEMBLY, includes: soldering lug terminals Reference parts: C1, Q1, R5, R6, R7, R8
C1	2C85013	CAPACITOR , fixed, electrolytic; 20 μ F, 10V, 10% tolerance
C2	2C85013	tubular, 24 of +100-10% 25 volt same as C2
CH	59C85013	CARTIDGE , microphone; magnetic, dynamic type 175 ohm impedance at 1 k
CH	65R4151	LAMP , vacuum fluorescent; 6.3 volt, 2 ampere; single contact bayonet base; glass; type 51 same as J51
CH	65R52861	FUSE , cartridge; one time, glass, 1 ampere, 250 V -1/4" long x 1/8" dia.
CH	65R52862	one time, paper, 20 ampere; 250 V 2" long x 9/16" dia.
CH	65R52863	CONNECTOR , receptacle; female; assembly, includes mounting bracket and single contact, round connector
CH	65R53150	7 contact, polarized, round molded black phenolic insulator saddle mounted same as J2
CH	65R53151	2 contact, rectangular molded black bakelite insulator; chassis mounted
CH	65R53152	4 contact, polarized, round molded black phenolic base; chassis mounted; includes 65R53152 LOCKWASHER; 1/16" internal 2R8180 NUT, ring
CH	65R53153	LEAD , electrical; copper; for reference only for reference only for reference only

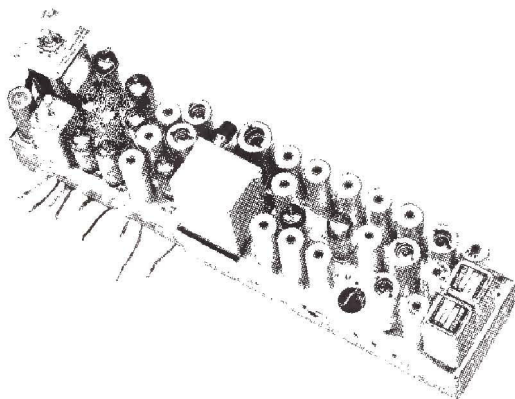
REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
A	59K85010	RELAY , electromechanical; 12 Vdc; contact arrangement, 1 form "A"; coil resistance 76.5-93.5 ohm
CH	1V85013	MICROPHONE , dynamic; palm type, contains transmitter amplifier and "push-to-talk" switch, includes reference parts A1, D1, S4, W11
CH	1V85014	palm type, contains transmitter amplifier and "push-to-talk" switch, includes reference parts A1, D1, S4, W10
CH	9C85010	CONNECTOR , plug; female; 19 contact; polarized; rectangular, molded mica filled phenolic base; cable mounted; connects to Power Supply; does not include the following component parts which must be ordered separately: 15B80067 SHELL, connector 15B80067 COVER, connector shell 14A80067 INSULATOR, connector shell, small 14B80067 INSULATOR, connector shell, large 42A80067 CLAMP, cable 5A1102 WASHER, 1/2" 4A80071 WASHER 3B40061 SCREW, connector; extending; includes knurled head 35T20V SCREW, 6-32 x 1/8; 2 required 35T14 SCREW, 6-32 x 1/2; 2 required male, coaxial; round bakelite water insulator; cable mounted same as P2 same as P2 male, 4 contact; polarized; includes metal shell and 41K8182 SPRING, cable strain relief
P2	28A87006	
P3	28A16370	
P4		
Q1	48A124317	TRANSISTOR , type MN30, does not include 48A1108 INSULATOR; insulator must be ordered separately
R	17R85010	RESISTOR , fixed, carbon; 10K; 1/2 W, 5% tolerance; unless otherwise stated; wire-wound; 4 ohm 25W; 1 W variable wire-wound; 25 ohm 25W; 2 W variable wire-wound; 10K; 2 W 250 ohm; 1 W 4.7K 3.3K 100 ohm 10 ohm 10 ohm 33 ohm 2 W 47 ohm 6R550
R	17R85010	same as R10

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
S1	40B85010	SWITCH , toggle; spst; does not include 28R362 NUT, machine; 15/32-32 x 9/16" hex; 2 req'd
S2	40B85010	same as S1
S3	40B85010	same as S1
S4	40B85010	same as S1
S5	40B85010	same as S1
S6	40B85010	same as S1
S7	40B85010	same as S1
S8	40B85010	same as S1
S9	40B85010	same as S1
S10	40B85010	same as S1
S11	40B85010	same as S1
S12	40B85010	same as S1
S13	40B85010	same as S1
S14	40B85010	same as S1
S15	40B85010	same as S1
S16	40B85010	same as S1
S17	40B85010	same as S1
S18	40B85010	same as S1
S19	40B85010	same as S1
S20	40B85010	same as S1
S21	40B85010	same as S1
S22	40B85010	same as S1
S23	40B85010	same as S1
S24	40B85010	same as S1
S25	40B85010	same as S1
S26	40B85010	same as S1
S27	40B85010	same as S1
S28	40B85010	same as S1
S29	40B85010	same as S1
S30	40B85010	same as S1
S31	40B85010	same as S1
S32	40B85010	same as S1
S33	40B85010	same as S1
S34	40B85010	same as S1
S35	40B85010	same as S1
S36	40B85010	same as S1
S37	40B85010	same as S1
S38	40B85010	same as S1
S39	40B85010	same as S1
S40	40B85010	same as S1
S41	40B85010	same as S1
S42	40B85010	same as S1
S43	40B85010	same as S1
S44	40B85010	same as S1
S45	40B85010	same as S1
S46	40B85010	same as S1
S47	40B85010	same as S1
S48	40B85010	same as S1
S49	40B85010	same as S1
S50	40B85010	same as S1
S51	40B85010	same as S1
S52	40B85010	same as S1
S53	40B85010	same as S1
S54	40B85010	same as S1
S55	40B85010	same as S1
S56	40B85010	same as S1
S57	40B85010	same as S1
S58	40B85010	same as S1
S59	40B85010	same as S1
S60	40B85010	same as S1
S61	40B85010	same as S1
S62	40B85010	same as S1
S63	40B85010	same as S1
S64	40B85010	same as S1
S65	40B85010	same as S1
S66	40B85010	same as S1
S67	40B85010	same as S1
S68	40B85010	same as S1
S69	40B85010	same as S1
S70	40B85010	same as S1
S71	40B85010	same as S1
S72	40B85010	same as S1
S73	40B85010	same as S1
S74	40B85010	same as S1
S75	40B85010	same as S1
S76	40B85010	same as S1
S77	40B85010	same as S1
S78	40B85010	same as S1
S79	40B85010	same as S1
S80	40B85010	same as S1
S81	40B85010	same as S1
S82	40B85010	same as S1
S83	40B85010	same as S1
S84	40B85010	same as S1
S85	40B85010	same as S1
S86	40B85010	same as S1
S87	40B85010	same as S1
S88	40B85010	same as S1
S89	40B85010	same as S1
S90	40B85010	same as S1
S91	40B85010	same as S1
S92	40B85010	same as S1
S93	40B85010	same as S1
S94	40B85010	same as S1
S95	40B85010	same as S1
S96	40B85010	same as S1
S97	40B85010	same as S1
S98	40B85010	same as S1
S99	40B85010	same as S1
S100	40B85010	same as S1

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
W1	1V85010	CABLE ASSEMBLY , special purpose; includes reference part P1 and the following items: 30C81012 CABLE, 12 conductor; stranded, ins.; lead; shield; black plastic covered; 17 ft. length req'd 28R362 NUT, machine; 15/32-32 x 9/16" hex; 2 req'd 28R362 WASHER, 1/2" 28R362 SPRING, cable strain relief also includes: the following connectors which are the same as above part number: 28R362 NUT, machine; 15/32-32 x 9/16" hex; 2 req'd 28R362 WASHER, 1/2" 28R362 SPRING, cable strain relief also includes: the following connectors which are the same as above part number: 28R362 NUT, machine; 15/32-32 x 9/16" hex; 2 req'd 28R362 WASHER, 1/2" 28R362 SPRING, cable strain relief
W2	1V85010	same as W1
W3	1V85010	same as W1
W4	1V85010	same as W1
W5	1V85010	same as W1
W6	1V85010	same as W1
W7	1V85010	same as W1
W8	1V85010	same as W1
W9	1V85010	same as W1
W10	1V85010	same as W1
W11	1V85010	same as W1
W12	1V85010	same as W1
W13	1V85010	same as W1
W14	1V85010	same as W1
W15	1V85010	same as W1
W16	1V85010	same as W1
W17	1V85010	same as W1
W18	1V85010	same as W1
W19	1V85010	same as W1
W20	1V85010	same as W1
W21	1V85010	same as W1
W22	1V85010	same as W1
W23	1V85010	same as W1
W24	1V85010	same as W1
W25	1V85010	same as W1
W26	1V85010	same as W1
W27	1V85010	same as W1
W28	1V85010	same as W1
W29	1V85010	same as W1
W30	1V85010	same as W1
W31	1V85010	same as W1
W32	1V85010	same as W1
W33	1V85010	same as W1
W34	1V85010	same as W1
W35	1V85010	same as W1
W36	1V85010	same as W1
W37	1V85010	same as W1
W38	1V85010	same as W1
W39	1V85010	same as W1
W40	1V85010	same as W1
W41	1V85010	same as W1
W42	1V85010	same as W1
W43	1V85010	same as W1
W44	1V85010	same as W1
W45	1V85010	same as W1
W46	1V85010	same as W1
W47	1V85010	same as W1
W48	1V85010	same as W1
W49	1V85010	same as W1
W50	1V85010	same as W1
W51	1V85010	same as W1
W52	1V85010	same as W1
W53	1V85010	same as W1
W54	1V85010	same as W1
W55	1V85010	same as W1
W56	1V85010	same as W1
W57	1V85010	same as W1
W58	1V85010	same as W1
W59	1V85010	same as W1
W60	1V85010	same as W1
W61	1V85010	same as W1
W62	1V85010	same as W1
W63	1V85010	same as W1
W64	1V85010	same as W1
W65	1V85010	same as W1
W66	1V85010	same as W1
W67	1V85010	same as W1
W68	1V85010	same as W1
W69	1V85010	same as W1
W70	1V85010	same as W1
W71	1V85010	same as W1
W72	1V85010	same as W1
W73	1V85010	same as W1
W74	1V85010	same as W1
W75	1V85010	same as W1
W76	1V85010	same as W1
W77	1V85010	same as W1
W78	1V85010	same as W1
W79	1V85010	same as W1
W80	1V85010	same as W1
W81	1V85010	same as W1
W82	1V85010	same as W1
W83	1V85010	same as W1
W84	1V85010	same as W1
W85	1V85010	same as W1
W86	1V85010	same as W1
W87	1V85010	same as W1
W88	1V85010	same as W1
W89	1V85010	same as W1
W90	1V85010	same as W1
W91	1V85010	same as W1
W92	1V85010	same as W1
W93	1V85010	same as W1
W94	1V85010	same as W1
W95	1V85010	same as W1
W96	1V85010	same as W1
W97	1V85010	same as W1
W98	1V85010	same as W1
W99	1V85010	same as W1
W100	1V85010	same as W1

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
W10	1V85006 "4-pin" mic.	CORD, microphone: includes 30K852742 CORD, coiled; tinsel; 4 conductor 41A862707 SPRING, strain relief 11M2508 TUBING, extruded; #8 21/32" 1" length req'd 25A8A7033 LUG, terminal; wire mounted; insulation piercing; 8 req'd
W11	1V85008 "4-pin" mic.	includes 30K852742 CORD, coiled; tinsel; 4 conductor 41A862707 SPRING, strain relief 11M2508 TUBING, extruded; #8 CLEAR, 2" length req'd 25A8A7033 LUG, terminal; wire mounted; insulation piercing; 4 req'd 25A8A7034 LUG, terminal; wire mounted; insulation piercing; 4 req'd 37E480513 SLEEVE, rubber Reference part F3
NON-REFERENCED ITEMS		
The following are replaceable parts which do not appear on the inter-cabling diagram		
XDS1	5A855117	LAMPHOLDER: single contact miniature bayonet base
XDS2		same as XDS1
XF1	51E847158	FUSEHOLDER: cable mounted; male and female retainers; single fuse mounting; includes #16 gage wire leads stretched; insulated; coded BURN; length .68" overall for 1-1/4" long x 1/8" dia fuse; includes reference part F1
XF2	1V859445	includes reference part F1, W5, W1, W6, and the following items: 14E855670 BOARD, mounting; welded phenolic 62A855674 RETAINER, fuse; (top) 62A861334 RETAINER, fuse; (bottom, closed end) 15E861390 COVER, mounting board
TKN6066A Cable Kit:		
includes reference parts F2, K1, W3 to W7, and the following items:		
1V859447	INSTALLATION KIT: includes: 55S153 SCREW, tapping; #8 x 1/4" plain hex head; 3 required 35T542 SCREW, tapping; #8 x 1/8" slotted blind head; 4 req'd 62A19374 CLAMP, cable; 4 req'd 37K107234 GROMMET, rubber;	

RECEIVER



TA235W-R2 RECEIVER

MODEL CHART

MODEL NUMBER	NUMBER OF FREQUENCIES	CHANNEL SPACING
TRB1080AA/ TA235W	1	40 KC
TRB1080AC/ TA235W-R2	2	40 KC
TRB1080AB/ TA235S	1	20 KC
TRB1080AD/ TA235S-R2	2	20 KC
TA235X	1	120 KC
TA235X-R2	2	120 KC

1. DESCRIPTION

a. Application

The receivers listed in the model chart are designed to receive FM signals on one (or two)

fixed, crystal-controlled frequencies in the 25-54 mc band. The receivers obtain operating voltages from the power supply which is part of the overall radio set.

b. Design

The receiver incorporates a double-conversion superheterodyne circuit. The chassis has 15 tubes and 17 tuned circuits, excluding the plastic-sealed circuits of the PERMAKAY IF filter. The IF wave filter is the major factor in determining the signal reception bandwidth. On models designed for 20 kc channel spacing operation the signals are attenuated -100 db at ± 15 kc. On 40 kc models the signals are attenuated -100 db at ± 32 kc. On 120 kc models the attenuation is -100 db at ± 120 kc.

c. Basic Receiver Circuitry

The basic receiver circuit consists of the following stages: an RF amplifier, a first local oscillator, a first mixer, a first IF amplifier, a second local oscillator, a second mixer, three second IF amplifiers, two limiters, a discriminator and two stages of audio amplification.

d. Two-Frequency Models

The two-frequency receiver is the same as the single-frequency receiver except for the addition of another first oscillator and control crystal. Two-frequency models receive signals on two specific, crystal-controlled frequencies in the band. Only one frequency



MOTOROLA INC.

Engineering Publications

COMMUNICATIONS DIVISION

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GUARANTEED PERFORMANCE SPECIFICATIONS

MODEL NUMBER	TRB1080AB/TA235S, TRB1080AD/TA235S-R2	TRB1080AA/TA235W, TRB1080AC/TA235W-R2	TA235X, TA235X-R2
CHANNEL SPACING	20 kc	40 kc	120 kc
SELECTIVITY	-100 db at <u>+15</u> kc	-100 db at <u>+32</u> kc	-100 db at <u>+120</u> kc
MODULATION ACCEPTANCE	<u>+5</u> kc	<u>+15</u> kc	<u>+15</u> kc
TUNED CIRCUITS	29 including 12 plastic-sealed in Permakay filter	29 including 12 plastic-sealed in Permakay filter	20 including 3 plastic-sealed in Tri-K filter
SENSITIVITY	Less than 0.30 microvolt for 20 db quieting; 50 ohms rf input impedance		
FREQUENCY STABILITY AND TEMPERATURE RANGE	Oven type crystal maintains oscillator stability within <u>+0.0005%</u> from -30° C. to +60° C. ambient (+25 C. reference)		
SPURIOUS AND IMAGE REJECTION	More than 100 db		
SQUELCH	Noise compensated type, adjustable sensitivity, threshold sensitivity of 0.10 microvolt		
TUBE COMPLEMENT AND FUNCTION	6AK5 - RF amp. *6CB6 - oscillator 6AB4 - 1st mixer 6BH6 - 1st IF amp. 6679/ 12AT7 - 2nd osc.-mixer 6CB6 - 2nd IF amp. (1) 6CB6 - 2nd IF amp. (2) 6CB6 - 2nd IF amp. (3) 6BH6 - 1st limiter 6BJ6 - 2nd limiter 6AL5 - discriminator 6BH6 - noise amp. 6C4 - noise rect. 6679/ 12AT7- audio and squelch amp. 6AQ5 - audio output *two for 2-frequency models		
AUDIO OUTPUT	2 watts to a 3 ohm speaker at less than 10% distortion		
AUDIO RESPONSE	From +1 db to -8 db of 6 db/octave de-emphasis characteristic from 300-3000 cps		

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

can be received at a time. The two-frequency receivers are designed for operation with a frequency separation between channels as great as 120 kc. without any change in performance specifications. An external switch is used to select frequencies. The switch is connected into the cathode circuits of the two first local oscillator stages. In the F1 position the switch grounds the cathode of the #1 oscillator, permitting that stage to operate normally. At the same time it opens the cathode of the #2 oscillator to disable the #2 stage. In the F2 position the switch reverses the connections and selects

the #2 local oscillator. The F1-F2 switch is part of the control head in mobile radio sets.

e. Chassis Complement

Each receiver consists of a basic chassis and a number of other items depending upon the frequency range, number of operating frequencies and channel spacing operation. The receivers are factory assembled from the sub-assemblies to form a compact single unit. The items included in each receiver are summarized in the following chart.

MODEL NUMBER	FREQ.		BASIC CHASSIS				*COIL KIT		FILTER			**CRYSTAL(S) REQUIRED	
	1-FREQ.	2-FREQ.	TU533	TU553-R2	TU553S	TU553S-R2	TK117C	TK117C-R2	TU540W	TU540S	TU540X	G04 (1F)	RM/RP-14A or RM/RP-15A (CONTROL)
TRB1080AA/ TA235W	X		X				X		X			1	1
TRB1080AC/ TA235W-R2		X		X				X	X			1	2
TRB1080AB/ TA235S	X				X		X			X		1	1
TRB1080AD/ TA235S-R2		X				X		X		X		1	2
TA235X	X		X				X				X	1	1
TA235X-R2		X		X				X			X	1	2

X = 1 used

2 = 2 used

* Coil kit designations include an L, M, H or HH suffix to indicate frequency range:

L = 25-30 mc, M = 30-40 mc, H = 40-50 mc, HH = 50-54 mc

** The crystal used with the radio set depends upon the operating frequency:

RM/RP-14A is for 25-40 mc

RM/RP-15A is for 40-54 mc

2. OPERATION

a. Stage Analysis

This receiver operates in accordance with basic FM receiver operation theory. The stage analysis given in these instructions is but a brief summary of the salient points. To follow the discussion refer to the block diagram included in this section of the manual. This diagram shows stage-by-stage signal flow and operating frequencies.

b. RF Amplifier

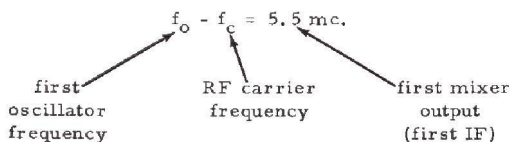
The carrier signals received at the antenna are coupled to the grid of the RF amplifier by the impedance-matching network in the input circuit. The RF stage provides some amplification of the signals, however, its main purpose in the circuit is to improve sensitivity and selectivity. The gain of this stage is designed to provide the optimum signal-to-noise ratio in the signals sent to the first mixer. In the output of this stage three hi-Q, critically coupled tuned circuits provide very high selectivity in the signals which pass on to the mixer.

c. First Oscillator and Mixer

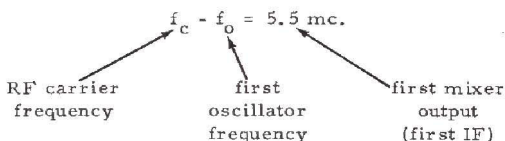
The first oscillator generates a signal of the correct frequency for direct injection into the mixer without multiplication. This frequency is heterodyned with the incoming rf carrier in the first mixer stage. The difference between these two frequencies is used as the mixer output. This output is a 5.5 mc. signal which carries the modulation originally impressed on the incoming rf carrier.

The local oscillator frequency is above the rf carrier in sets tuned to the 25-40 mc. range. The local oscillator is below the RF carrier when the receiver operates in the 40-54 mc. range. These frequency relationships can be expressed as follows:

For the 25-40 mc. range:



For the 40-54 mc. range:



In these formulas the carrier frequency is the frequency assigned to the transmitter which this receiver is intended to receive. The first oscillator operates at a specific frequency in the 30.5 to 48.5 mc. range, depending upon the rf carrier frequency. When the assigned carrier frequency is known, the oscillator frequency can be calculated as follows:

For the 25-40 mc. range:

$$f_o = f_c + 5.5 \text{ mc.}$$

For the 40-54 mc. range:

$$f_o = f_c - 5.5 \text{ mc.}$$

The first oscillator frequency is crystal-controlled to maintain oscillator stability within $\pm 0.0005\%$ from -30°C to $+60^\circ\text{C}$ ambient (25°C reference). The crystal element is mounted in a thermostatically-controlled heating oven to maintain proper operating temperature.

The first oscillator frequency is mixed with the carrier to provide the first IF, 5.5 mc., which is passed on to the first IF amplifier stage.

d. First IF and Second Mixer

The signals are amplified in the first IF amplifier and applied to the second mixer along with an injection frequency generated in the second local oscillator. The second local oscillator frequency is controlled by the IF crystal. This frequency is 5955 kc., the same for all receivers regardless of rf carrier frequency. The difference between the second local oscillator frequency and the first IF is the second mixer output. This output is a 455 kc. signal which carries the audio modulation. The frequency relationships of these three stages are as follows:

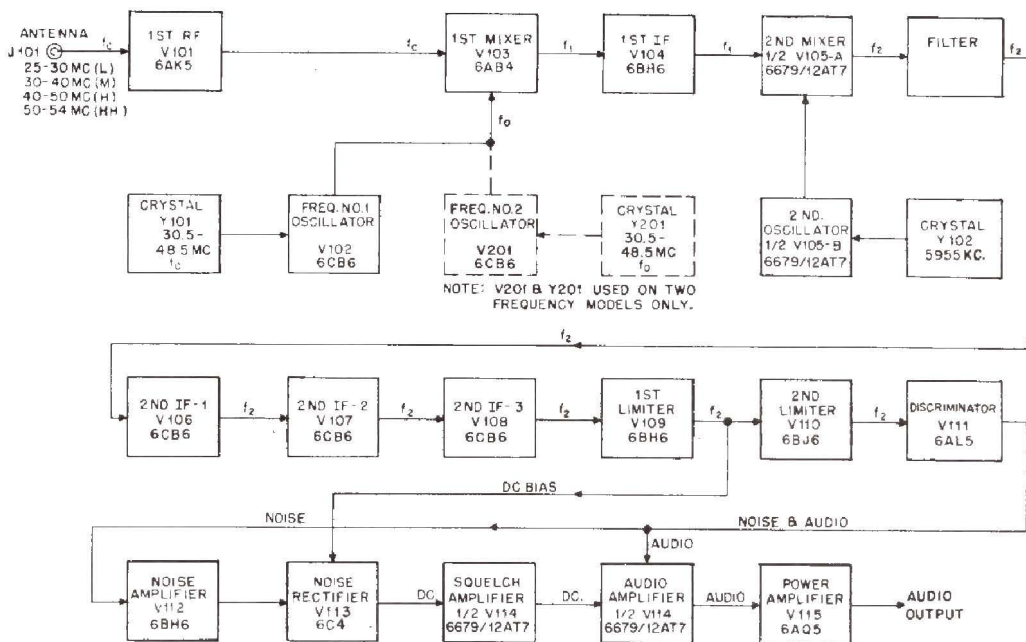
Second local oscillator

freq. 5955 kc.

First intermediate freq. . . . 5500 kc.

Difference freq.

(second IF) 455 kc.



LEGEND:

f_c = CARRIER FREQUENCY (SEE TABLE)

f_o = 1ST OSCILLATOR FREQUENCY (SEE TABLE)

f_1 = 1ST INTERMEDIATE FREQUENCY = 5.5 MC.

f_2 = 2ND INTERMEDIATE FREQUENCY = 455 KC.

FORMULAS

BAND	f_o	f_c
L M	$f_c + f_1$	$f_o - f_1$
H HH	$f_c - f_1$	$f_o + f_1$

e. Second IF

A PERMAKAY IF filter is used in the second IF before the amplification stages. This filter is permanently sealed in polyester-styrene and is unconditionally guaranteed for the life of the receiver provided the seal is unbroken and the housing is not tampered with. This filter is the major factor in determining the bandwidth of the receiver. It greatly attenuates the signal outside the pre-determined pass-band. Signals leaving the filter are amplified by three stages of second IF amplification (tubes V106, V107 and V108) and applied to the limiter stages.

f. Limiters Discriminator and Audio Stages

The two limiter stages, tubes V109 and V110, clip the tops and bottoms of the incoming

signals, thereby virtually eliminating the noise which characteristically "rides" the signals in the form of amplitude modulation. These stages are largely responsible for the "quieting" effect inherent in the FM communications receiver when it picks up an on-frequency signal. The limiter output is sent to the discriminator, tube V111, which translates frequency deviations into corresponding amplitude variations, thereby detecting the audio modulation. The audio amplification stage provides two watts audio output to a three ohm load.

g. Noise-Actuated Squelch Circuit

The noise-actuated squelch circuit consists of a noise amplifier, a noise rectifier, a dc amplifier and associated circuit components, as shown on the schematic diagram. The discriminator output is applied to the input of the noise

amplifier, V112. The input r-c network greatly attenuates the low-frequency components but passes frequencies above 3000 cps. These random frequencies are applied as a signal to the grid of V112 and amplified like other types of signal inputs. In the cathode of the noise amplifier the variable SQUELCH control varies the gain of the tube by adjusting its bias. The setting of this control is covered in the following paragraph.

The output of the noise amplifier drives the noise rectifier, V113. The rectified noise signal appears as positive voltage across the load resistor, R152. This positive voltage is added to a steady negative bias taken from the second limiter stage. The resultant of these two voltages is applied to the grid of the dc amplifier tube. In the no-signal condition, i.e., noise alone, the resultant voltage is zero or somewhat positive. The dc amplifier conducts and cuts off the audio amplifier tube. This keeps the speaker silent when signals are not being received. When signals are received the noise is greatly reduced and the rectified noise output is not enough to overcome the steady negative bias on the grid of the dc amplifier. In this condition, the dc amplifier is cut off and the audio amplifier operates, passing on the received audio signals.

h. Squelch Control Setting

The SQUELCH control limits the gain of the noise amplifier tube. In practice, this control is adjusted for a "threshold" setting. This is the point where the rectified noise voltage will bias the grid of the DC amplifier so that the audio amplifier is just barely cut-off. Then, when a weak signal is received a slight reduction in noise will cut off the DC amplifier and allow the audio amplifier to conduct.

3. OPERATING ADJUSTMENTS

a. Audio Level Adjustments

The audio level control on the receiver chassis is used to set the maximum audio level available at the VOLUME control on the control unit. This permits future adjustments to compensate for variations in tube characteristics, resistor and capacitor tolerances and transmitter deviation. This control has more than adequate range of audio drive to the 3 ohm PM speaker. It should be adjusted with the VOLUME control on the control unit set at maximum volume. Then, the re-

ceiver audio level control is adjusted to a point just below the setting where distortion becomes audible. This provides a full volume range for the control head VOLUME control. If the receiver audio level control must be adjusted in a laboratory test set-up where a speaker is not available, a setting of approximately 90 per cent full volume will approximate the normal adjustment.

4. ALIGNMENT PROCEDURE

A complete receiver alignment procedure, in chart form, is included in this section. Test set-up information, using a MOTOROLA portable test set, is also included with the alignment procedure.

Any 0-50 microampere meter with an equivalent series resistance of 20,000 ohms may be used as a metering device. The meter should be connected from chassis ground to the pin receptacle of the metering socket corresponding to the stage being measured. Refer to the applicable schematic diagram for specific metering pin receptacle information.

5. PRE-OPERATIONAL NOTES

The receiver is aligned to its exact operating frequency before it is shipped from the factory. It should, however, be checked for proper operation before it is placed in service. Make the frequency check described in step 9 of the ALIGNMENT CHART in this section. Also take meter readings for the first five entries in the stage measurement chart. If the readings are beyond the allowable limits, realign the receiver according to the ALIGNMENT CHART.

a. Laboratory Sensitivity Check

Quieting signal is that input signal necessary to reduce the output noise at speaker 20 db. Quieting measurements should be made in a well shielded location in the absence of extraneous electrical noise.

This measurement is important in that it indicates in one measurement that the unit is working normally.

The actual measurement is made by observing the noise voltage at the speaker without any carrier at the antenna. Sufficient carrier is then introduced at the antenna to reduce the output voltage to 1/10 its former value.

To measure the quieting signal accurately, a signal generator, Motorola Model T1034A Series or equivalent, and a Motorola Portable Test Set are required. Employment of a VTVM or db output meter suitable for accurate measurement of receiver audio output, is also recommended.

(1) Turn the signal generator "on" and stabilize by a "warm-up" period of 1-1/2 to 2 hours.

(2) Connect the meter plug from the Portable Test Set to the meter receptacle on the chassis.

(3) Place the REC-XMTR-O, 50 us switch in the REC position and the GRID CURRENT-METER-FIELD STRENGTH switch in the METER position on the Test Set.

(4) Connect the signal generator, adjusted to the desired carrier frequency to the antenna input connector using the coaxial lead and 6 db. pad. The exact carrier frequency will be indicated by a zero reading on the test set with the meter switch in position +4 or -4.

(5) Connect the output meter across the voice coil leads (terminals 1 and 2 on the termi-

nal board of the power supply or adapter chassis).

NOTE

If an output meter is not available, the test set may be used to measure receiver output by placing the test set selector switch in position 8 or 11, depending upon the test set used. (Test set measurements are purely relative and will not constitute actual output level readings.)

(6) Turn the SQUELCH control fully counterclockwise (off).

(7) With no signal input to the receiver (signal generator ATTENUATOR control set for zero output) adjust the VOLUME control on the receiver chassis for 0.5 volts of noise output on the audio output meter. (Adjust for a reading of 10.0 if the test set is used for this measurement).

(8) Adjust the output level of the signal generator until the receiver audio output is decreased 20 db. (to 0.05 volts on audio output meter) from the reading in step (7). Adjust for a reading of 1.0 if the test set is used for this measurement.

b. Stage Measurement Chart

APPROX. MICROVOLT INPUT	INPUT TO	FREQ. IN MC.	METER POSITION	METER READING OR DB.
Noise	Antenna	-	1	-0.1 to -1
Noise	Antenna	-	2	-10 to -30
Noise	Antenna	-	4	0 to +1
Noise	Antenna	-	5	-12 to -16
Noise	Antenna	-	6	-12 to -40
0.30 or less	Antenna	F_c	*DB Meter	20 db. (quieting)
2.5	Antenna	F_c	1	-5
3.0	Pin 1 of V 101	F_c	*DB Meter	20 db. (quieting)
30	1st RF	F_c	1	-5
3	Pin 6 of V 103	5.5	*DB Meter	20 db. (quieting)
80	1st Mixer	5.5	1	-5
5	Pin 1 of V 104	5.5	*DB Meter	20 db. (quieting)
300	1st IF	5.5	1	-5
5000	Filter	.455	1	-5
2000	Pin 1 of V 106	.455	1	-5
	2nd IF-1			
150,000	Pin 1 of V 107	.455	1	-5
	2nd IF-2			

NOTE

A model T1034A Signal Generator was used when taking readings on V101, and V104. A Model 65B Signal Generator with a Type H-4595 output cable was used when taking all other readings except filter input reading.

*Refer to paragraph 5. a. , Laboratory Sensitivity Check, when making this measurement.

	ALIGNMENT FREQUENCY	ADJUSTMENT	TU546 TEST SET SWITCH POSITION	METER READING
DETAIL A, lower left). Set the ON-OFF switch to be in its position and place	455 kc., sharp tuning	T1 bottom slug	5	Maximum
reading (selector switch in	455 kc., sharp tuning	T1 top slug	4	Zero
nal loosely so that an in- in position to keep the input	455 kc., sharp tuning	L16	2	Maximum
with the selector switch in	455 kc., broad tuning	L15	1	Maximum
test set ON-OFF switch in	455 kc., sharp tuning	L14	1	Maximum
elow the illustration. After 1 (pin 1) of V104. The signal Adjust L13 for a maximum nd when the slug is nearest ter reading (position 1 or 2).	5.5 mc., sharp tuning	L13, L12 and L11	1 or 2	Maximum
6) of V103 and adjust L10,	5.5 mc., sharp tuning	L10, L9 and L8	1 or 2	Maximum
wdriver adjustment slot is e selector switch in posi- ch in the F2 position while	Receiver crystal frequency, sharp tuning	L5 (L201)	6	Maximum
o receive. A zero meter nal setting by rotating s rotated. Set C109 for	Carrier frequency, sharp tuning	C109 (C205)	4	Zero
ollow the procedure out- 3 instead of pin 7, V105.	Carrier frequency, sharp tuning	L7	1 or 2	Maximum
ely to the grid (pin 1) of	Carrier freq., sharp tuning	L4, L3 and L2	1 or 2	Maximum
, 50 ohm, attenuation	Carrier freq., sharp tuning	L1	1 or 2	Maximum
making the adjustments. signal generator or rn VOLUME control Set the selector T reduce the	Carrier frequency, <u>slight adj.</u>	L14	2	Reduce audible noise

b. Stage Measurement Chart

APPROX. MICROVOLT INPUT	INPUT TO	FREQ. IN MC.	METER POSITION	METER READING OR DB.
Noise	Antenna	-	1	-0.1 to -1
Noise	Antenna	-	2	-10 to -30
Noise	Antenna	-	4	0 to +1
Noise	Antenna	-	5	-12 to -16
Noise	Antenna	-	6	-12 to -40
0.30 or less	Antenna	F_c	*DB Meter	20 db. (quieting)
2.5	Antenna	F_c	1	-5
3.0	Pin 1 of V 101	F_c	*DB Meter	20 db. (quieting)
30	1st RF	F_c	1	-5
3	Pin 6 of V 103	5.5	*DB Meter	20 db. (quieting)
80	1st Mixer	5.5	1	-5
5	Pin 1 of V 104	5.5	*DB Meter	20 db. (quieting)
300	1st IF	5.5	1	-5
5000	Filter	.455	1	-5
2000	Pin 1 of V 106	.455	1	-5
	2nd IF-1			
150,000	Pin 1 of V 107	.455	1	-5
	2nd IF-2			

NOTE

A model T1034A Signal Generator was used when taking readings on V101, and V104. A Model 65B Signal Generator with a Type H-4595 output cable was used when taking all other readings except filter input reading.

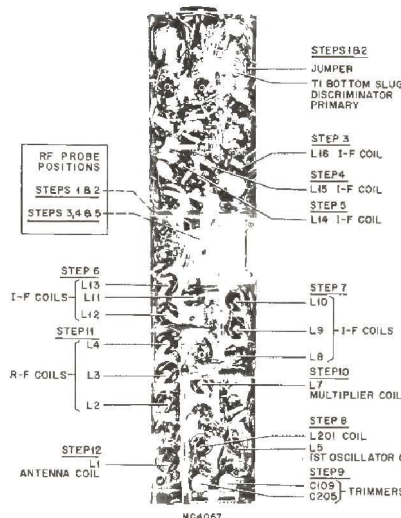
*Refer to paragraph 5. a. , Laboratory Sensitivity Check, when making this measurement.

HOW TO SET UP THE P-8500 AND P-8501 SERIES TEST SETS FOR DISCRIMINATOR AND 455 KC ALIGNMENT

- Set the REC.-XMTR. -050 UA switch to the REC. position.
- Plug a 455 kc crystal into the two-pin crystal socket.
- Set the GRID CURRENT-METER-FIELD STRENGTH selector switch to the GRID CURRENT position.
- Set the ATTENUATOR control for maximum output (10).
- Place the test set ON-OFF switch in the ON position. (Test set operates on internal battery. Conserve battery life by keeping switch OFF when set is not in use.)
- Adjust the frequency control (ADJ) for a maximum meter reading.
- Set the ON-OFF switch to the OFF position.
- Set the GRID CURRENT-METER-FIELD STRENGTH switch to the METER position.
- Plug the test set metering cable into the METER receptacle on the receiver chassis.
- Connect one end of the test set extension cable to the RF OUTPUT jack on the test set. Connect the other end of the extension cable to the RF probe cable.

TEST SET SELECTOR SWITCH POSITIONS

P-8500 & P-8501 SERIES TEST SETS	1	2	+4, -4	5	6
TU546 SERIES TEST SETS	1	2	4	5	6
CIRCUIT METERED	2nd IF #3 Grid	1st Lim. Grid	Discr. Output	Discr. Input	1st Osc Grid



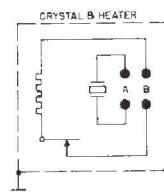
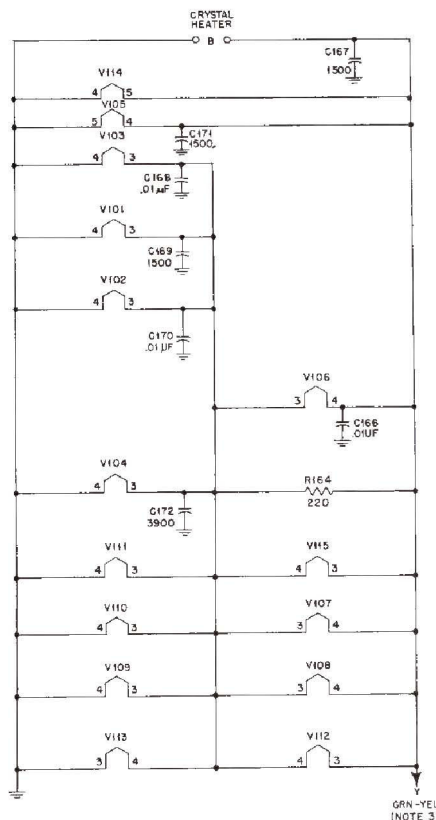
RE INDICATED IN OHMS, 1/10%, 1/2 WATT
TED. K = 1000 OHMS.

ARE INDICATED IN MICROMICROFARADS
ATED.

S.
O WITH A VTVM (8+ - 200V) WITH SQUELCH AT
WISE) AND DC VOLUME AT MAXIMUM (CLOCKWISE)

ER IN VALUE FOR THE VARIOUS RECEIVER MODELS
IS APPLICABLE.
ILE FOR SPECIFIC IDENTIFICATION.

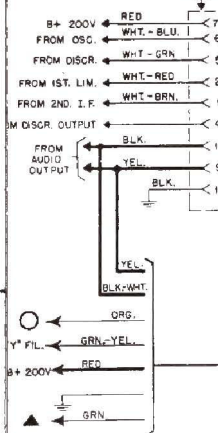
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TA235 W-L	TA235X
TA235 W-M	TRB1081AB/TA235S-L
TA235 W-H	TRB1082AB/TA235S-M
TA235 W-HH	TRB1083AB/TA235S-H
	TRB1084AB/TA235S-HH
OW	TUS40X
	100K
	15K
	580
	220
	560K
	1MEG
	56K
	180K
	56K
	180K



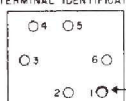
TO PIN 4
(METER
SOCKET)



V102
METER
SOCKET



T1
TERMINAL IDENTIFICATION



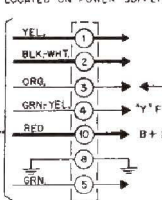
BOTTOM VIEW
OF COILS

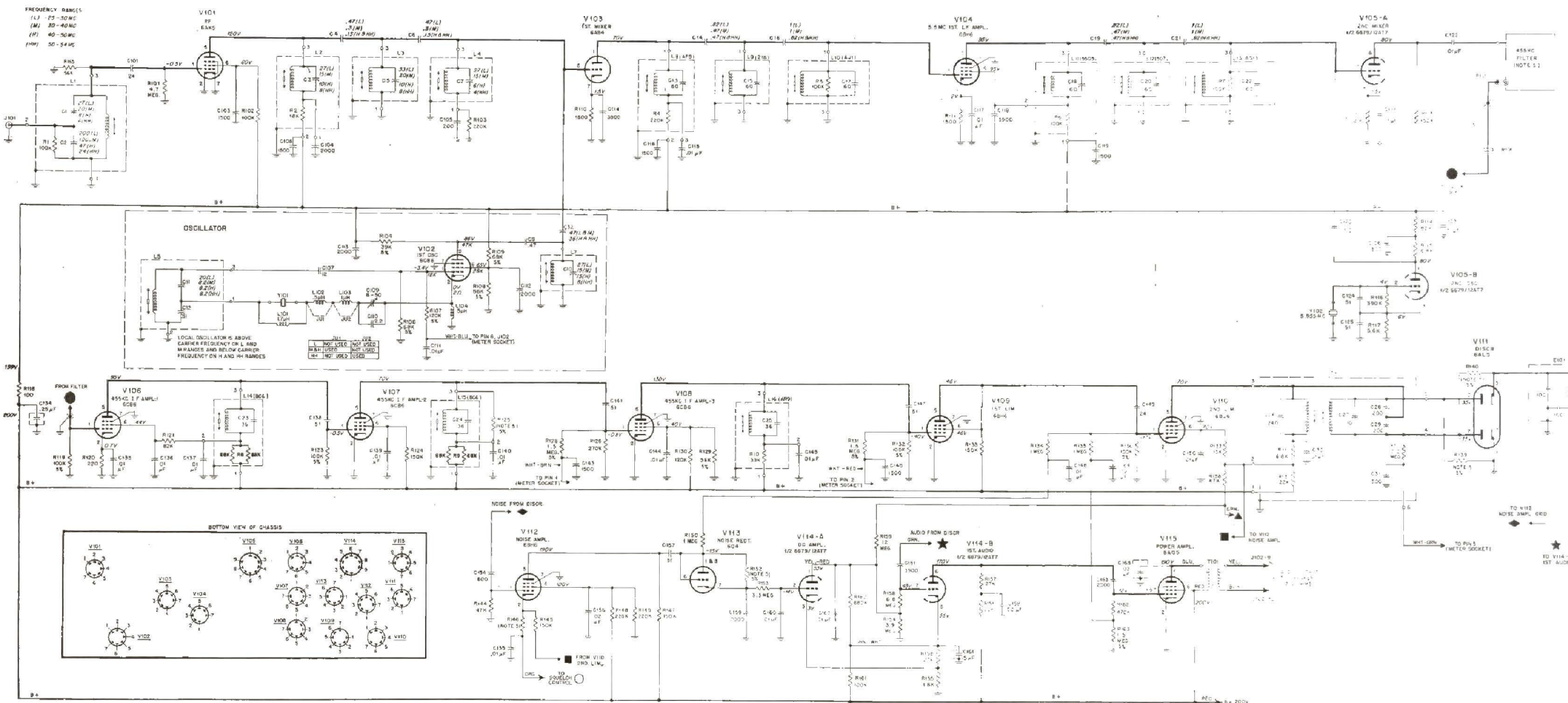
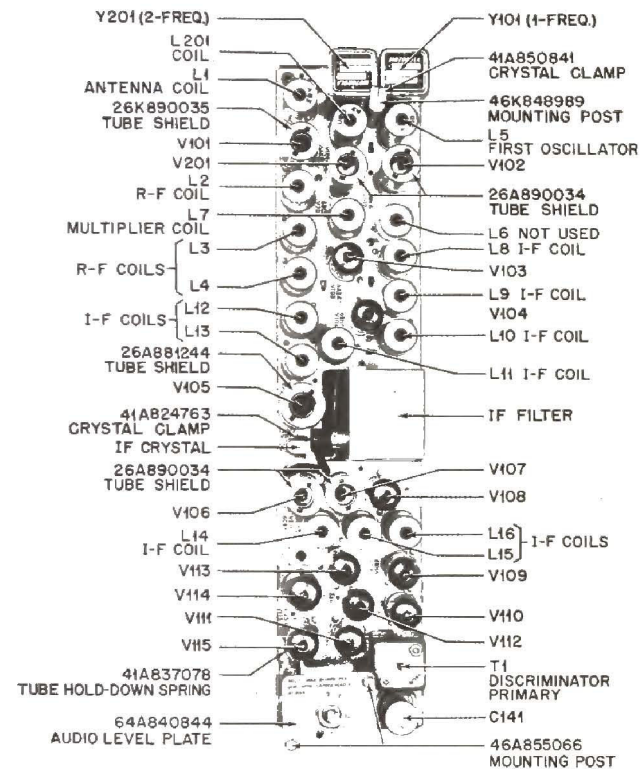


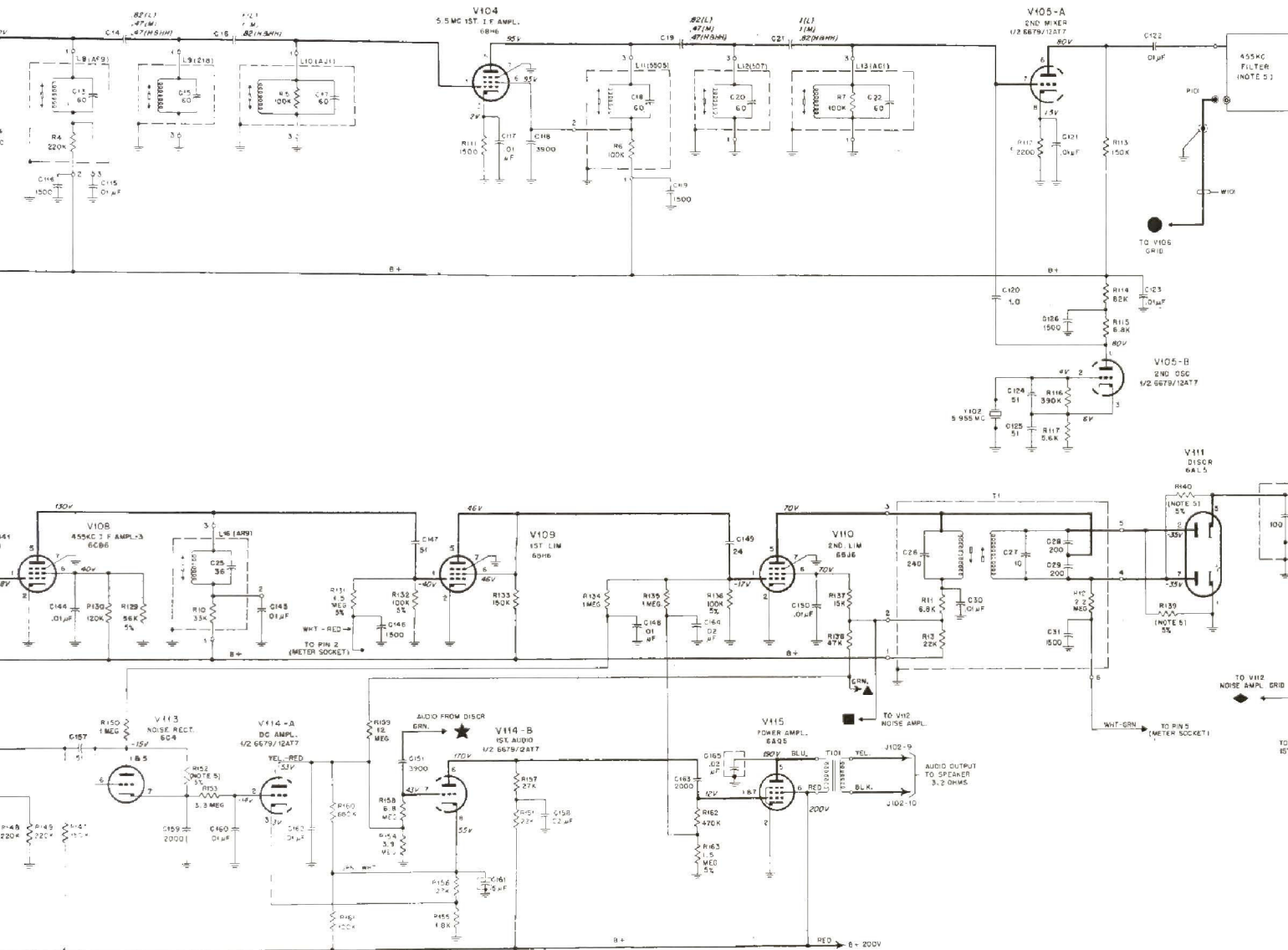
MODEL TABLE

ONE - FREQUENCY	CHASSIS SUFFIX	FREQ-RANGE	CHANNEL SPACING
TRB1081AA/TA235 W-L	3	25 - 30 MC	40 KC
TRB1082AA/TA235 W-M	3	30 - 40 MC	40 KC
TRB1083AA/TA235 W-H	3	40 - 50 MC	40 KC
TRB1084AA/TA235 W-HH	3	50 - 64 MC	40 KC
TRB1081AB/TA235S-L	3	25 - 30 MC	20 KC
TRB1082AB/TA235S-M	3	30 - 40 MC	20 KC
TRB1083AB/TA235S-H	3	40 - 50 MC	20 KC
TRB1084AB/TA235S-HH	3	50 - 64 MC	20 KC
TA235X	2	25 - 64 MC	120 KC

TERMINAL BOARD
LOCATED ON POWER SUPPLY

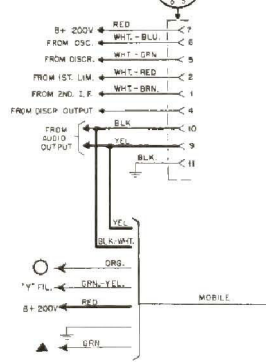
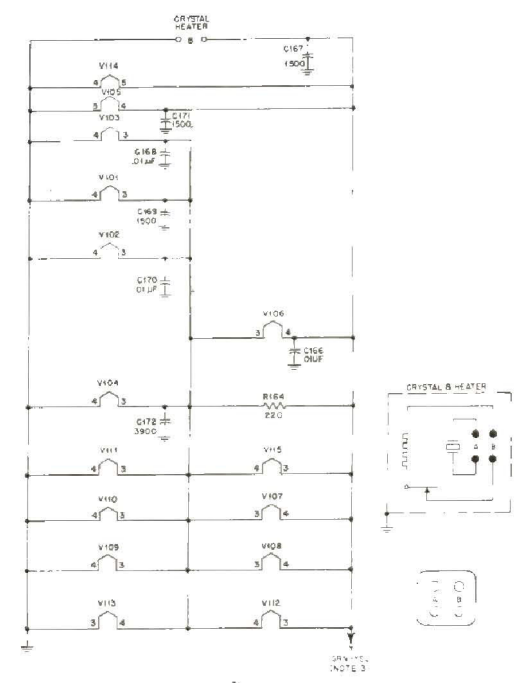






- NOTES:
1. ALL RESISTOR VALUES ARE INDICATED IN OHMS, 10'S, 1/2 WATT UNLESS OTHERWISE STATED. K=1000 OHMS.
 2. ALL CAPACITOR VALUES ARE INDICATED IN MICROMICROFARADS UNLESS OTHERWISE STATED.
 3. "Y" HEATER IS 12.6 VOLTS.
 4. ALL VOLTAGES MEASURED WITH A VTVM (10-200V) WITH SQUELCH AT MINIMUM (CLOCKWISE) AND DC VOLUME AT MAXIMUM (CLOCKWISE).
 5. COMPONENTS NOTED DIFFER IN VALUE FOR THE VARIOUS RECEIVER MODELS FOR WHICH THIS DIAGRAM IS APPLICABLE. REFER TO FOLLOWING TABLE FOR SPECIFIC IDENTIFICATION.

COMPONENT	MODELS		
	TRB1080A/TA235-W-L TRB1080A/TA235-W-M TRB1080A/TA235-W-H TRB1080A/TA235-W-HH	TA235K	TRB1080A/TA235-L TRB1080A/TA235-M TRB1080A/TA235-H TRB1080A/TA235-HH
FILTER	TU540W	TU540K	TU540S
R 122	8K	8K	100K
R 142	500	500	250
R 152	500K	500K	1MEG
R 139	50K	50K	100K
R 140	50K	50K	100K



MODEL TABLE

ONE-FREQUENCY	ONE-FREQUENCY	FREQ-RANGE	CHANNEL
TRB1080A/TA235-W-L	5	25-30MC	40 KC
TRB1080A/TA235-W-M	5	30-40MC	40 KC
TRB1080A/TA235-W-H	5	40-50MC	40 KC
TRB1080A/TA235-W-HH	5	50-64MC	40 KC
TRB1080A/TA235-L	5	25-30MC	20 KC
TRB1080A/TA235-M	5	30-40MC	20 KC
TRB1080A/TA235-H	5	40-50MC	20 KC
TRB1080A/TA235-HH	5	50-64MC	20 KC
TA235K	5	25-30MC	40 KC

DESCRIPTION
ystal; female; square; molded akelite base; chassis 1 rectangular; black phen- e; chassis mounted

AY" IF Filter; hannel Spacing AY" IF Filter; hannel Spacing AY" IF Filter; Channel Spacing

radio Set
receiver
ust be
ystal type
quency
dering

<u>ITT, quartz:</u> Control: 40 mc carrier freq; s 6 volt heater unit 54 mc carrier freq; s 6 volt heater unit F; 5.955 mc

ARE INDICATED IN OHMS, $\pm 10\%$, 1/2 WATT
TED. K = 1000 OHMS.

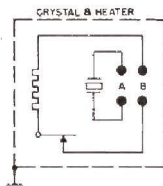
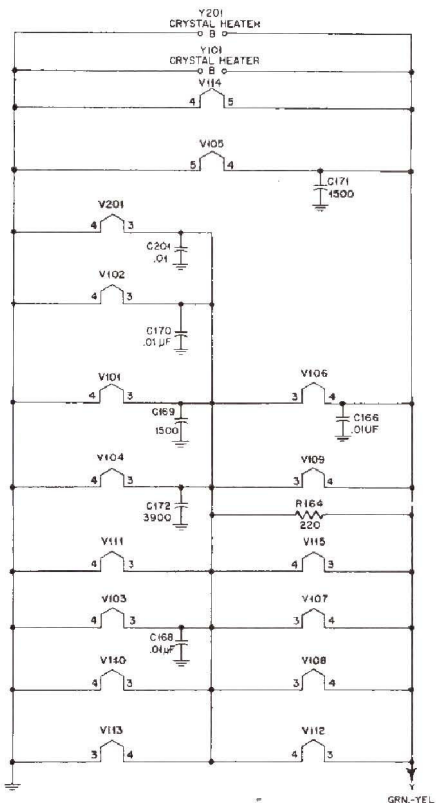
ARE INDICATED IN MICROMICROFARADS
TED.

FS.

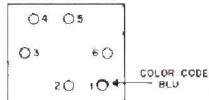
D WITH A VTVM (8+ 200V) WITH SQUELCH AT
WISE) AND DC VOLUME AT MAXIMUM (CLOCKWISE).

BR IN VALUE FOR THE VARIOUS RECEIVER MODELS
IS APPLICABLE.
BLE FOR SPECIFIC IDENTIFICATION.

MODELS		
35W-R2-L	TRB1081AD/TA235S-R2-L	TA235X-R2
35W-R2-M	TRB1082AD/TA235S-R2-M	
35W-R2-H	TRB1083AD/TA235S-R2-H	
35W-R2-NH	TRB1084AD/TA235S-R2-NH	
	TU540S	TU540X
	100K	15K
	220	680
	1MEG	560K
	180K	56K
	180K	56K



TERMINAL IDENTIFICATION



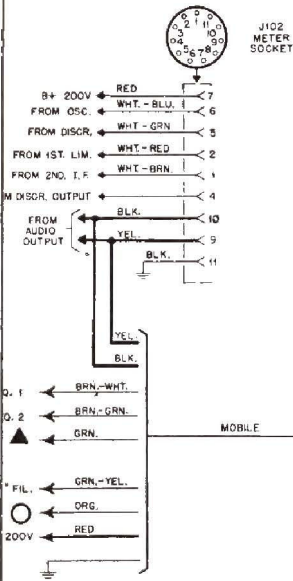
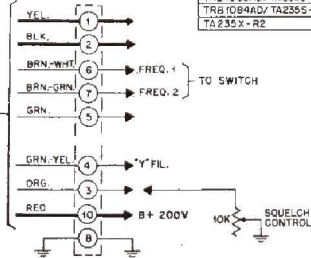
BOTTOM VIEW OF COILS



MODEL TABLE

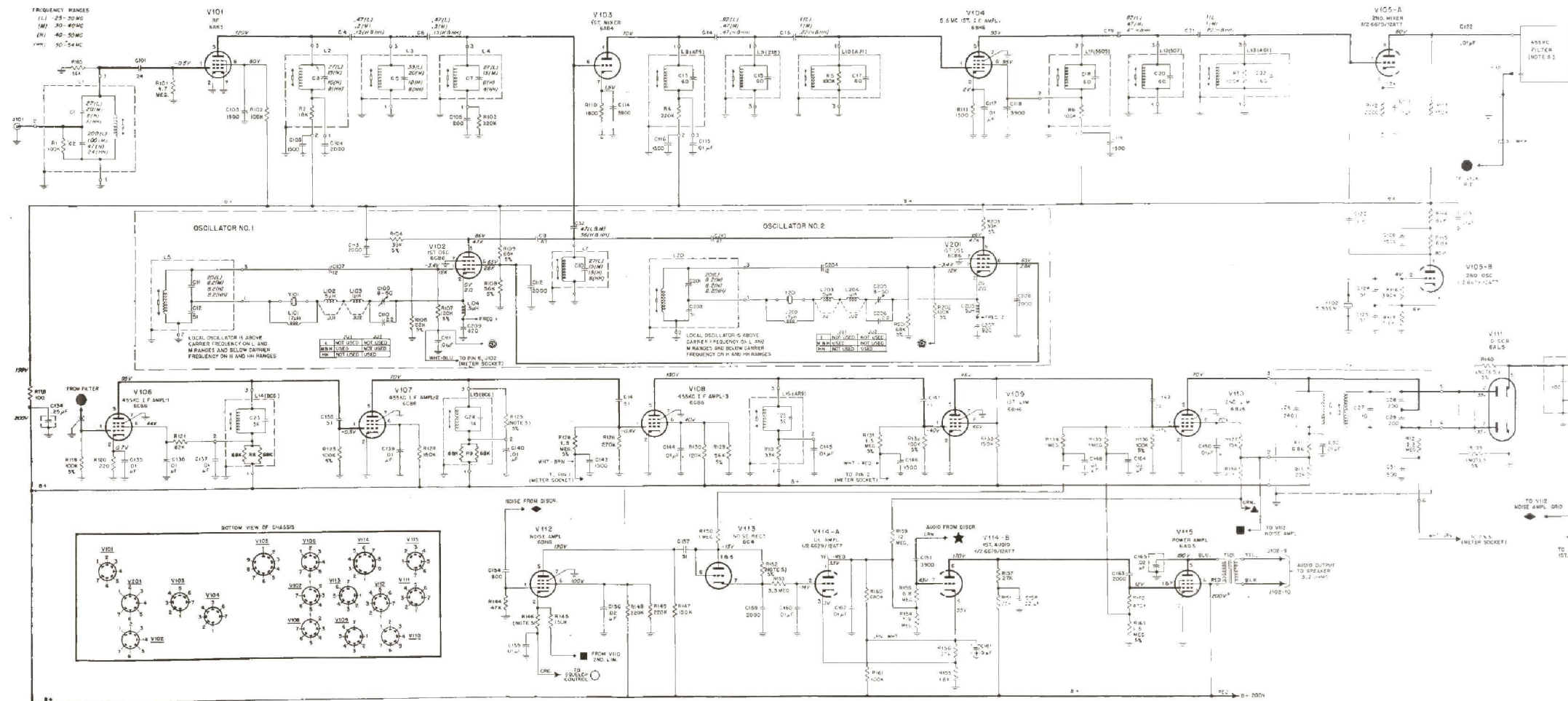
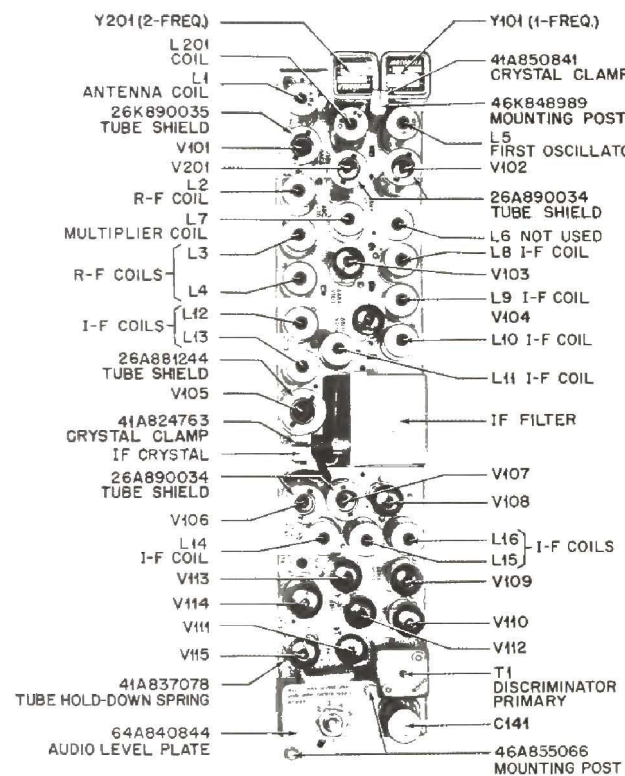
TWO-FREQUENCY	SUFFIX	FREQ. RANGE	CHANNEL SPACING
TRB1081AC/TA235W-R2-L	3	25-30MC	40KC
TRB1082AC/TA235W-R2-M	3	30-40MC	40KC
TRB1083AC/TA235W-R2-H	3	40-50MC	40KC
TRB1084AC/TA235W-R2-NH	3	50-54MC	40KC
TRB1081AD/TA235S-R2-L	3	25-30MC	20KC
TRB1082AD/TA235S-R2-M	3	30-40MC	20KC
TRB1083AD/TA235S-R2-H	3	40-50MC	20KC
TRB1084AD/TA235S-R2-NH	3	50-54MC	20KC
TA235X-R2	2	25-54MC	120KC

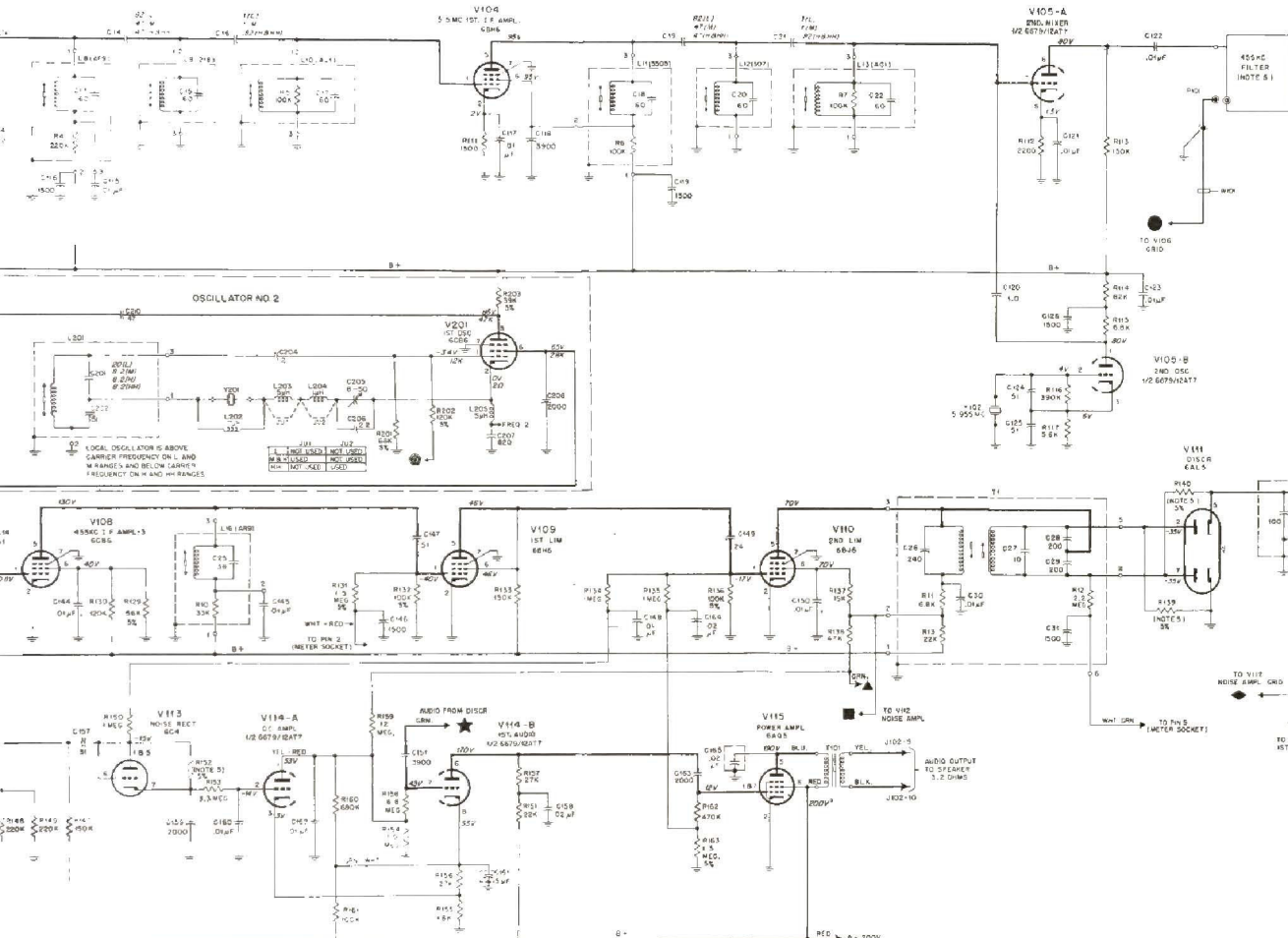
TERMINAL BOARD LOCATED ON POWER SUPPLY OR ADAPTER CHASSIS



SCHEMATIC DIAGRAM PARTS LIST

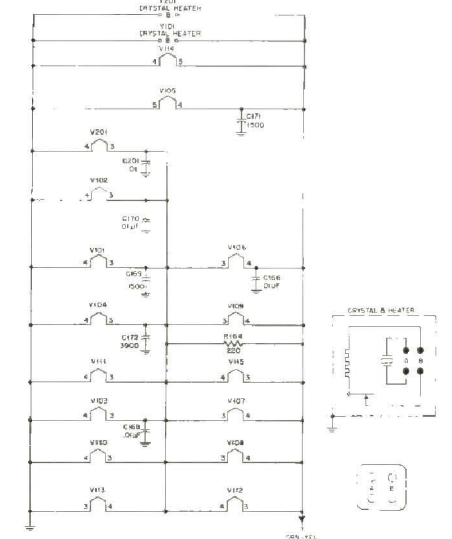
Reference Schematic Diagram 03581487-E			SYMBOL	PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
COL	21R134440	CAPACITOR, fixed, unless otherwise stated	C17	C18	C19	C154	BA82986	CAPACITOR, fixed, unless otherwise stated	L1M	24K824722	COIL	L5H	L5H	RESISTOR, fixed, carbon, unless otherwise stated	R10	R107	RESISTOR, fixed, carbon, unless otherwise stated	XY100	9K67508	SOCKET, type female	XY100	9K67508	SOCKET, type female
COL	21R14461	ceramic, tubular, 27 ufd 45%, 500 vdc	C20	C21	C22	C155		oil filled, tubular, .25 ufd 45%, 400 vdc	L1H	24K825514	COIL	L5H	L5H	same as R10	R108	R109	same as R10						
COL	21R14461	ceramic, tubular, 20 ufd 45%, 500 vdc	C23	C24	C25	C156		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R110	R111	same as R10						
COL	21R14461	ceramic, tubular, 8 ufd 45%, 500 vdc	C26	C27	C28	C157		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R112	R113	same as R10						
COL	21R14461	ceramic, tubular, 8 ufd 45%, 500 vdc	C29	C30	C31	C158		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R114	R115	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C32	C33	C34	C159		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R116	R117	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C35	C36	C37	C160		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R118	R119	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C38	C39	C40	C161		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R120	R121	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C41	C42	C43	C162		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R122	R123	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C44	C45	C46	C163		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R124	R125	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C47	C48	C49	C164		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R126	R127	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C50	C51	C52	C165		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R128	R129	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C53	C54	C55	C166		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R130	R131	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C56	C57	C58	C167		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R132	R133	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C59	C60	C61	C168		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R134	R135	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C62	C63	C64	C169		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R136	R137	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C65	C66	C67	C170		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R138	R139	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C68	C69	C70	C171		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R140	R141	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C71	C72	C73	C172		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R142	R143	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C74	C75	C76	C173		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R144	R145	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C77	C78	C79	C174		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R146	R147	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C80	C81	C82	C175		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R148	R149	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C83	C84	C85	C176		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R150	R151	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C86	C87	C88	C177		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R152	R153	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C89	C90	C91	C178		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R154	R155	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C92	C93	C94	C179		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R156	R157	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C95	C96	C97	C180		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R158	R159	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C98	C99	C100	C181		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R160	R161	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C101	C102	C103	C182		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R162	R163	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C104	C105	C106	C183		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R164	R165	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C107	C108	C109	C184		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R166	R167	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C110	C111	C112	C185		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R168	R169	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C113	C114	C115	C186		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R170	R171	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C116	C117	C118	C187		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R172	R173	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C119	C120	C121	C188		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R174	R175	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C122	C123	C124	C189		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R176	R177	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C125	C126	C127	C190		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R178	R179	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C128	C129	C130	C191		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R180	R181	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C131	C132	C133	C192		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R182	R183	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C134	C135	C136	C193		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R184	R185	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C137	C138	C139	C194		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R186	R187	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C140	C141	C142	C195		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R188	R189	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C143	C144	C145	C196		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R190	R191	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C146	C147	C148	C197		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R192	R193	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C149	C150	C151	C198		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R194	R195	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C152	C153	C154	C199		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R196	R197	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C155	C156	C157	C200		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R198	R199	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C158	C159	C160	C201		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R200	R201	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C161	C162	C163	C202		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R202	R203	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C164	C165	C166	C203		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R204	R205	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C167	C168	C169	C204		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R206	R207	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C170	C171	C172	C205		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R208	R209	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C173	C174	C175	C206		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R210	R211	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C176	C177	C178	C207		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R212	R213	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C179	C180	C181	C208		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R214	R215	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C182	C183	C184	C209		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R216	R217	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C185	C186	C187	C210		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R218	R219	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C188	C189	C190	C211		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R220	R221	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C191	C192	C193	C212		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R222	R223	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C194	C195	C196	C213		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R224	R225	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C197	C198	C199	C214		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R226	R227	same as R10						
COL	21R14461	ceramic, tubular, 10 ufd 45%, 500 vdc	C200	C201	C202	C215		same as C154	L1H	24K825514	COIL	L5H	L5H	same as R10	R								



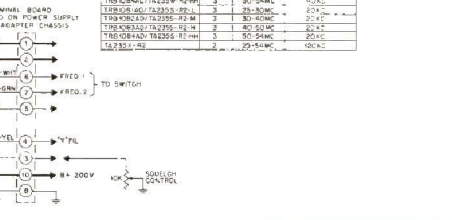


- NOTES:
1. ALL RESISTOR VALUES ARE INDICATED IN OHMS, K-100, OR WATT UNLESS OTHERWISE STATED. IN OHM OHMS.
 2. ALL CAPACITOR VALUES ARE INDICATED IN MICROFARADS UNLESS OTHERWISE STATED.
 3. "H" HEATER IS 40.6 VOLTS.
 4. ALL VOLTAGES MEASURED WITH A VTVM (B+ = 200V) WITH SQUELCH AT MINIMUM SCATTERED LOW FREQUENCY AND 100 MC WAVELENGTH MODULATOR.
 5. COMPONENTS NOTED DIFFER IN VALUE FOR THE VARIOUS RECEIVER MODELS FOR WHICH THIS DIAGRAM IS APPLICABLE. REFER TO FOLLOWING TABLE FOR IDENTIFICATION.

COMPONENT	TRB1080/TA235-RS	TRB1080/TA235-RS	TRB1080/TA235-RS	TRB1080/TA235-RS
1. FILTER	TUNING	TUNING	TUNING	TUNING
2. R101	10K	10K	10K	10K
3. R102	10K	10K	10K	10K
4. R103	10K	10K	10K	10K
5. R104	10K	10K	10K	10K
6. R105	10K	10K	10K	10K
7. R106	10K	10K	10K	10K
8. R107	10K	10K	10K	10K
9. R108	10K	10K	10K	10K
10. R109	10K	10K	10K	10K



- TERMINAL IDENTIFICATION
- | TERMINAL | IDENTIFICATION |
|----------|----------------|
| 1 | RED |
| 2 | RED |
| 3 | RED |
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| 99 | RED |
| 100 | RED |

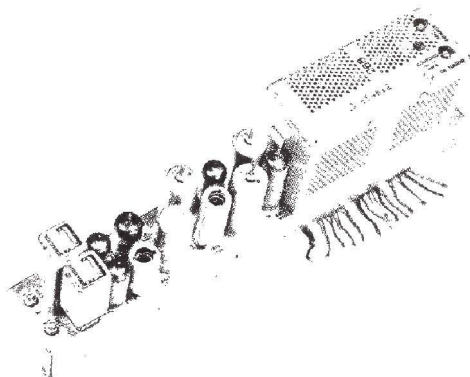


TRB1080/TA235 Two-Frequency Receiver
Schematic Diagram
Motorola No. 63E854953-G
11/5/59-RCS

Y" IF Filter;
channel Spacing
Y" IF Filter;
channel Spacing
Y" IF Filter;
channel Spacing

Y101	Type RM14A or Type RP14A or Type RM15A or Type RP15A	CRYSTAL UNIT, quartz: Receiver Control: for 25-40 mc carrier freq; includes 6 volt heater unit for 40-54 mc carrier freq; includes 6 volt heater unit
Y102	Type G04	Receiver IF: 5.955 mc
Y201		same as Y101

TRANSMITTER



MODEL TA234-C2
TWO FREQUENCY TRANSMITTER

MODEL CHART

MODEL NUMBER	NUMBER OF FREQUENCIES	CRYSTALS REQUIRED
TTB1030AA/ TA234	1	one RN3-A
TTB1030AB/ TA234-C2	2	two RN3-A

1. DESCRIPTION

The Model TTB1030AA/TA234 is an FM radio transmitter designed for operation in the 25-54 mc band. The transmitter requires a separate power supply to provide operating voltages. The r-f power output of the transmitter is 25 watts or 50 watts, depending upon the power supply used. The

r-f carrier frequency is crystal-controlled for maximum stability.

The basic transmitter components include a crystal-controlled oscillator, an angular phase modulator controlled by the MOTOROLA IDC (instantaneous deviation control) circuit, three stages of frequency multiplication, a final amplifier and a "T" section harmonic filter.

The MOTOROLA IDC circuit limits the modulation deviation to 100 percent. The deviation limit is set as required for the particular channel spacing application.

The TTB1030AB/TA234-C2 is a two-frequency version of the TTB1030AA/TA234 Transmitter. This unit transmits signals on two specific crystal-controlled frequencies in the 25-54 mc band. Only one frequency can be transmitted at a time. The two-frequency transmitter is the same as the single-frequency transmitter except for the addition of a second r-f oscillator deck and control crystal. An external switch is required for changing frequencies. This switch permits either the frequency #1 or the frequency #2 oscillator to function normally while it disables the other. This is done by grounding the oscillator cathode of the stage being used. The oscillator cathode circuit of the stage not in use is left open, i.e., the ground circuit is not complete. The two-frequency switch is ordinarily incorporated into the control unit used with the transmitter.

The two-frequency transmitter can be operated on frequencies which are separated by as much as 300 kc from circuit resonance without degradation of the single-frequency performance specifications. The circuits of the two-frequency transmitter are normally aligned to the higher of the two carrier frequencies to be transmitted.



MOTOROLA INC.

Engineering Publications

COMMUNICATIONS DIVISION

4501 W. Augusta Blvd.

Chicago 51, Illinois

DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION	REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
CAPACITOR, fixed, unless otherwise stated			CAPACITOR, fixed, unless otherwise stated			COIL			RESISTOR, fixed, carbon, unless otherwise stated			TRANSFORMER			CAPACITOR, fixed, unless otherwise stated			CRYSTAL						
name as C13			name as C13			name as L1			name as R1			name as T1			name as C11			name as Y101						
same as C12			same as C12			same as L2			same as R2			same as T2			same as C12			same as Y102						
same as C14			same as C14			same as L3			same as R3			same as T3			same as C13			same as Y103						
same as C15			same as C15			same as L4			same as R4			same as T4			same as C14			same as Y104						
same as C16			same as C16			same as L5			same as R5			same as T5			same as C15			same as Y105						
same as C17			same as C17			same as L6			same as R6			same as T6			same as C16			same as Y106						
same as C18			same as C18			same as L7			same as R7			same as T7			same as C17			same as Y107						
same as C19			same as C19			same as L8			same as R8			same as T8			same as C18			same as Y108						
same as C20			same as C20			same as L9			same as R9			same as T9			same as C19			same as Y109						
same as C21			same as C21			same as L10			same as R10			same as T10			same as C20			same as Y110						
same as C22			same as C22			same as L11			same as R11			same as T11			same as C21			same as Y111						
same as C23			same as C23			same as L12			same as R12			same as T12			same as C22			same as Y112						
same as C24			same as C24			same as L13			same as R13			same as T13			same as C23			same as Y113						
same as C25			same as C25			same as L14			same as R14			same as T14			same as C24			same as Y114						
same as C26			same as C26			same as L15			same as R15			same as T15			same as C25			same as Y115						
same as C27			same as C27			same as L16			same as R16			same as T16			same as C26			same as Y116						
same as C28			same as C28			same as L17			same as R17			same as T17			same as C27			same as Y117						
same as C29			same as C29			same as L18			same as R18			same as T18			same as C28			same as Y118						
same as C30			same as C30			same as L19			same as R19			same as T19			same as C29			same as Y119						
same as C31			same as C31			same as L20			same as R20			same as T20			same as C30			same as Y120						
same as C32			same as C32			same as L21			same as R21			same as T21			same as C31			same as Y121						
same as C33			same as C33			same as L22			same as R22			same as T22			same as C32			same as Y122						
same as C34			same as C34			same as L23			same as R23			same as T23			same as C33			same as Y123						
same as C35			same as C35			same as L24			same as R24			same as T24			same as C34			same as Y124						
same as C36			same as C36			same as L25			same as R25			same as T25			same as C35			same as Y125						
same as C37			same as C37			same as L26			same as R26			same as T26			same as C36			same as Y126						
same as C38			same as C38			same as L27			same as R27			same as T27			same as C37			same as Y127						
same as C39			same as C39			same as L28			same as R28			same as T28			same as C38			same as Y128						
same as C40			same as C40			same as L29			same as R29			same as T29			same as C39			same as Y129						
same as C41			same as C41			same as L30			same as R30			same as T30			same as C40			same as Y130						
same as C42			same as C42			same as L31			same as R31			same as T31			same as C41			same as Y131						
same as C43			same as C43			same as L32			same as R32			same as T32			same as C42			same as Y132						
same as C44			same as C44			same as L33			same as R33			same as T33			same as C43			same as Y133						
same as C45			same as C45			same as L34			same as R34			same as T34			same as C44			same as Y134						
same as C46			same as C46			same as L35			same as R35			same as T35			same as C45			same as Y135						
same as C47			same as C47			same as L36			same as R36			same as T36			same as C46			same as Y136						
same as C48			same as C48			same as L37			same as R37			same as T37			same as C47			same as Y137						
same as C49			same as C49			same as L38			same as R38			same as T38			same as C48			same as Y138						
same as C50			same as C50			same as L39			same as R39			same as T39			same as C49			same as Y139						
same as C51			same as C51			same as L40			same as R40			same as T40			same as C50			same as Y140						
same as C52			same as C52			same as L41			same as R41			same as T41			same as C51			same as Y141						
same as C53			same as C53			same as L42			same as R42			same as T42			same as C52			same as Y142						
same as C54			same as C54			same as L43			same as R43			same as T43			same as C53			same as Y143						
same as C55			same as C55			same as L44			same as R44			same as T44			same as C54			same as Y144						
same as C56			same as C56			same as L45			same as R45			same as T45			same as C55			same as Y145						
same as C57			same as C57			same as L46			same as R46			same as T46			same as C56			same as Y146						
same as C58			same as C58			same as L47			same as R47			same as T47			same as C57			same as Y147						
same as C59			same as C59			same as L48			same as R48			same as T48			same as C58			same as Y148						
same as C60			same as C60			same as L49			same as R49			same as T49			same as C59			same as Y149						
same as C61			same as C61			same as L50			same as R50			same as T50			same as C60			same as Y150						
same as C62			same as C62			same as L51			same as R51			same as T51			same as C61			same as Y151						
same as C63			same as C63			same as L52			same as R52			same as T52			same as C62			same as Y152						
same as C64			same as C64			same as L53			same as R53			same as T53			same as C63			same as Y153						
same as C65			same as C65			same as L54			same as R54			same as T54			same as C64			same as Y154						
same as C66			same as C66			same as L55			same as R55			same as T55			same as C65			same as Y155						
same as C67			same as C67			same as L56			same as R56			same as T56			same as C66			same as Y156						
same as C68			same as C68			same as L57			same as R57			same as T57			same as C67			same as Y157						
same as C69			same as C69			same as L58			same as R58			same as T58			same as C68			same as Y158						
same as C70			same as C70			same as L59			same as R59			same as T59			same as C69			same as Y159						
same as C71			same as C71			same as L60			same as R60			same as T60			same as C70			same as Y160						
same as C72			same as C72			same as L61			same as R61			same as T61			same as C71			same as Y161						
same as C73			same as C73			same as L62			same as R62			same as T62			same as C72			same as Y162						
same as C74			same as C74			same as L63			same as R63			same as T63			same as C73			same as Y163						
same as C75			same as C75			same as L64			same as R64			same as T64			same as C74			same as Y164						
same as C76			same as C76			same as L65			same as R65			same as T65			same as C75			same as Y165						
same as C77			same as C77			same as L66			same as R66			same as T66			same as C76			same as Y166						
same as C78			same as C78			same as L67			same as R67			same as T67			same as C77			same as Y167						
same as C79			same as C79			same as L68			same as R68			same as T68			same as C78			same as Y168						
same as C80			same as C80			same as L69			same as R69			same as T69			same as C79			same as Y169						
same as C81			same as C81			same as L70			same as R70			same as T70			same as C80			same as Y170						
same as C82			same as C82			same as L71			same as R71			same as T71			same as C81			same as Y171						
same as C83			same as C83			same as L72			same as R72			same as T72			same as C82			same as Y172						
same as C84			same as C84			same as L73			same as R73			same as T73			same as C83			same as Y173						
same as C85			same as C85			same as L74			same as R74			same as T74			same as C84			same as Y174						
same as C86			same as C86			same as L75			same as R75			same as T75			same as C85			same as Y175						
same as C87			same as C87			same as L76			same as R76			same as T76			same as C86			same as Y176						
same as C88			same as C88			same as L77			same as R77			same as T77			same as C87			same as Y177						
same as C89			same as C89			same as L78			same as R78			same as T78			same as C88			same as Y178						
same as C90			same as C90			same as L79			same as R79			same as T79			same as C89			same as Y179						
same as C91			same as C91			same as L80			same as R80			same as T80			same as C90			same as Y180						
same as C92			same as C92			same as L81			same as R81			same as T81			same as C91			same as Y1						

GUARANTEED PERFORMANCE SPECIFICATIONS

BASIC UNIT	TTB1030AA/TA234 Series (25-54 mc)
RF POWER OUTPUT	25 watts, 30 watts or 50 watts - depending upon power supply used.
CRYSTAL MULTIPLICATION	Twelve (12) times
POWER SUPPLY	Separate transistorized power supply operating from a 12 volt dc positive or negative ground source.
SPURIOUS AND HARMONIC EMISSION	All spurious and harmonic emissions are attenuated more than 60 db. below carrier level.
FREQUENCY STABILITY AND TEMPERATURE RANGE	oven type crystal unit maintains carrier within $\pm 0.0005\%$ of assigned center frequency from -30 C. to +60 C. ambient (+25 C. reference)
MODULATION	40F3: ± 15 kc deviation for 100% at 1000 cycles 20F3: ± 5 kc deviation for 100% at 1000 cycles
AUDIO INPUT LEVEL	factory connection: 0.25 volt ± 3 db for 100% modulation at 1000 cps (approximately -17 db) optional connection: 0.18 volt ± 3 db for 100% modulation at 1000 cps (approximately -20 db)
TUBE COMPLEMENT AND FUNCTION	(1) 6AK6 - Oscillator (1-Freq.) 6AQ5 - Doubler Driver or (2) 6AK6 - Oscillator (2-Freq.) 6146 - Power Amplifier (1) 12AT7 - Mod. Buffer-Doubler 6BH6 - I. D. C. Amplifier 6AK6 - Tripler 6AL5 - Clipper
NUMBER OF TUNED CIRCUITS	9 following the modulator including 3 double permeability tuned multiplier stages, a multiple adjusted output circuit and an output harmonic filter.
DIMENSIONS	2-3/8" wide x 5-1/4" high x 15" long
WEIGHT	3-3/4 lbs.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

F. C. C. License Designation: CC1008

2. CHASSIS COMPLEMENT

The Model TTB1030AA/TA234 single-frequency transmitter chassis consists of the following items:

One Model TU548 Single-Frequency Transmitter basic chassis, which includes:

One TK119 Coil Kit

The coil kit used depends upon the assigned frequency of the transmitter. The coil kit model number is assigned a letter suffix symbol. Refer to the parts list in back of the transmitter schematic diagram for a complete list of coil kit designations.

One type RN3-A Control Crystal is required for use with this transmitter. The crystal is a

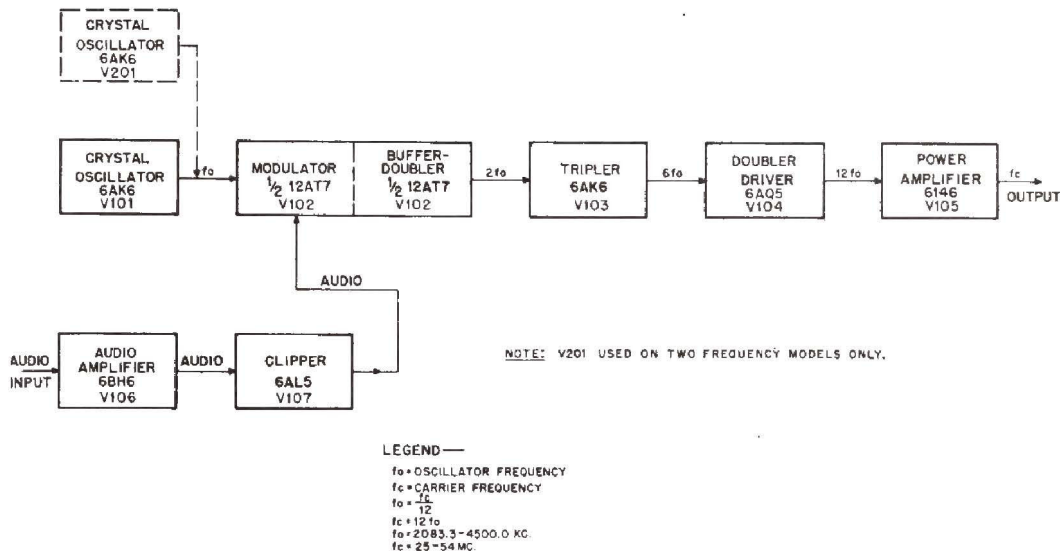
separate item and is not included as part of the transmitter. See the FOREWORD of this manual for ordering information.

The Model TTB1030AB/TA234-C2 two-frequency transmitter chassis includes a Model TU548-C2 Basic two-frequency transmitter chassis; however, the same coil kit is used in the two-frequency model as for the single-frequency model.

Two type RN3-A Control Crystals are required for use with the two-frequency transmitter. The crystal is a separate item and is not included as part of the transmitter. See the FOREWORD of this manual for ordering information.

3. CIRCUIT OPERATION

Stage-by-stage signal flow and operating frequencies are shown on the transmitter block diagram.



a. Audio Input and Amplifier Stage

Refer to the diagram below for a simplified illustration of the audio input circuit.

(1) Circuit Paths

There are two circuit paths involved in the transmitter audio input circuit. These are: (a) microphone dc input, and, (b) microphone audio output.

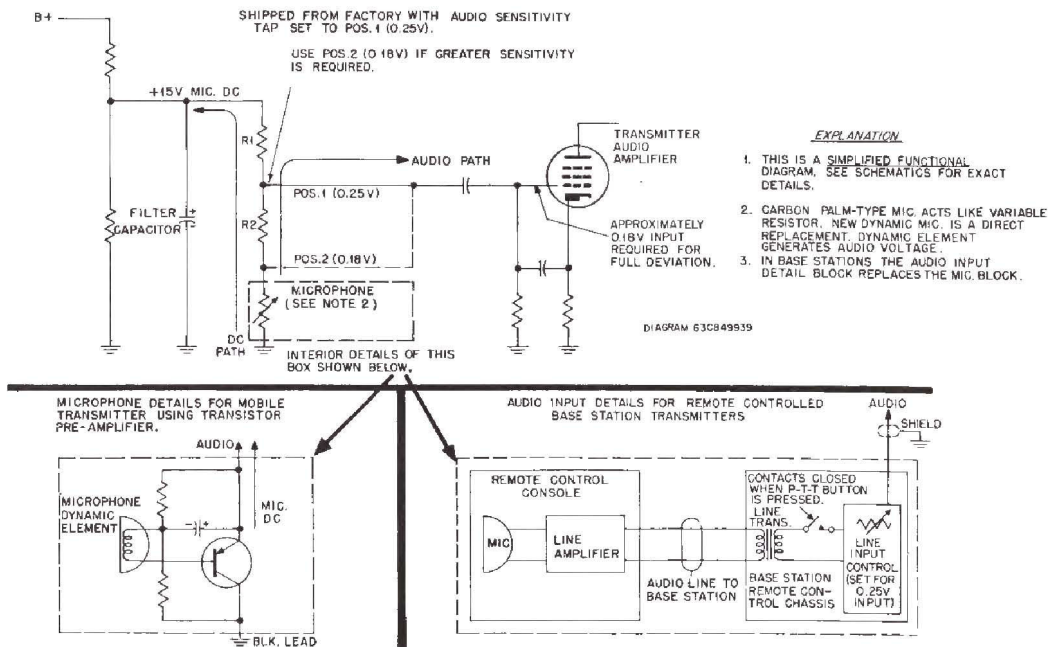
(a) Microphone Dc Input

The microphone dc input (called "talking current") is taken from a B+ voltage source in the transmitter. A resistor network drops the microphone dc voltage to approximately 15 volts dc. A relatively large capacitor is connected across the circuit to provide additional filtering. The dc path leads through two resistors, R1 and R2, to the microphone. These resistors drop the voltage to about 4 volts at the microphone input. The dc path leads through the microphone cartridge, returning to ground through the cable shield.

(b) Microphone Audio Output

The microphone acts like a voltage generator in the circuit. Sound waves received by the microphone element vary the voltage in accordance with the voice frequency and intensity. This results in voltage changes at the microphone output as a person speaks into the microphone.

There are two "audio sensitivity" taps in the microphone output circuit. As it is shipped from the factory, the circuit is wired so that position 1 tap is used. The lower tap, position 2, connects the full output to the transmitter audio amplifier input. However, the currently produced MOTOROLA microphones develop a sufficiently high audio input level to provide full transmitter deviation across resistor R2. Placing the tap on the other side of R2 permits a lower microphone level to operate the transmitter. Generally speaking the position 1 tap is used for all base station and mobile applications in current production. The position 2 tap can be used if greater audio sensitivity is required in special applications.



SIMPLIFIED AUDIO INPUT

The microphone audio output is connected through a coupling capacitor to the grid of the transmitter audio amplifier. The signals are then passed through the IDC circuit and used to modulate the transmitter.

(2) Microphone and Audio Input Details

The boxed-in detail in the lower left hand side of the diagram shows the mobile transmitter application. This is an enlarged drawing of the microphone shown in the upper half of the diagram. The audio output shown in the detail connects to the lower end of R2, the same as shown for the microphone output.

The dynamic microphone incorporates a transistorized pre-amplifier which brings the output up to the 0.25 volt level. The microphone dc input supplies the current for energizing the transistor.

b. IDC Circuit

To trace the IDC circuitry refer to Schematic Diagram 63E854612 which is part of this section.

The incoming signals from the audio amplifier, are coupled to the clipper tube. The clipper stage limits the amplitude of the signals which pass on to the modulator stage. The clipping level is set so that some clipping of peaks will occur in the normal input signal. Signals applied to the clipper below the clipping level are unaffected by the clipper; signals which exceed the clipping level are clipped at the top and bottom. A small amount of clipping produces a trapezoidal waveform; a large amount of clipping produces a square wave (see Fig. 1).

The clipper output is integrated, producing an approximately triangular waveform. The approach to the triangular shape depends upon the amount of clipping; the more clipping, the nearer the output approaches the triangular form.

The integrating network has the additional function of limiting signal amplitude in proportion to signal frequency. As the frequency increases, the amplitude is reduced in proportion.

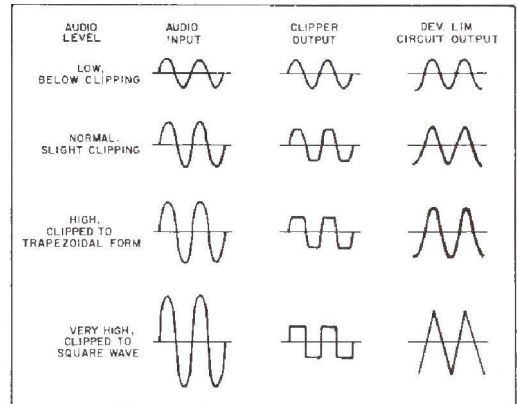


Figure 1.
Effect of Clipper and Integrator on
Sine Waves of Different Amplitudes

The integrator output is amplified and applied to the IDC control, which limits the amplitude of the signals which reach the modulator. The IDC control limits deviation by controlling the maximum slope (or steepness) of the signal waveform which reaches the modulator (see Fig. 2).

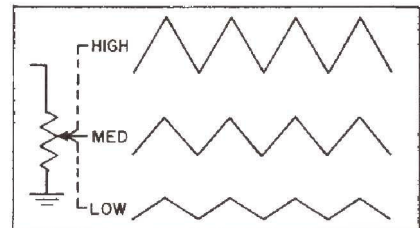


Figure 2.
How IDC Control Sets Steepness of
Integrated Square Wave

In the incoming signal from the microphone, wavefront steepness depends upon both amplitude and frequency. The over-all effect of the IDC circuitry is to place a barrier upon the maximum wavefront steepness which can pass into the modulator. The slope of high amplitude signals is controlled by clipping and integrating the square waves which they produce. The slope of high frequency signals is limited to the allowable maximum by reducing the amplitude of these signals (Adjustment of the IDC control is covered in a subsequent paragraph of this instruction section).

c. Modulator Stage to Power Output Stage

The crystal oscillator generates a specific frequency in 2.083 to 4.500 mc range. The exact frequency depends upon the assigned carrier frequency. The oscillator output is sent to the modulator stage where the voice modulation is impressed upon it. This signal is combined in the modulator to provide a modulated output at the crystal frequency. The modulator output is sent to the first doubler where the signals are amplified and doubled in frequency. They are further amplified and tripled in frequency in the tripler stage and doubled once more in the doubler-driver. The doubler-driver stage develops the required signal power to drive the final amplifier to its rated output RF power. The signals reaching the final amplifier have been multiplied twelve times from the original frequency generated by the oscillator.

4. ADJUSTMENT OF THE IDC CONTROL

Correct setting of the IDC control is an important factor in the overall operation of the two-way radio communication system. The correct settings are as follows:

	<u>Deviation</u>
For 120 kc channel spacing . .	+15 kc
For 40 kc channel spacing . .	+15 kc
For 20 kc channel spacing . .	+ 5 kc

The actual measurement of transmitter deviation involves two important considerations;

First: the accuracy of the test equipment being used.

Second: understanding the characteristics of the test equipment.

a. Test Equipment

In this text we shall use the MOTOROLA F4M-24B Series Frequency Monitor as the basic test instrument. This unit offers the degree of accuracy required for measurement of transmitter deviation.

b. Instrument Characteristics

In using the F4M-24B Series Frequency Monitor it is important to understand the action

of the meter. The meter movement actually responds to average voltage. The meter scale, however, is calibrated in terms of peak voltage based on a sine wave signal. When the input waveform departs from a pure sine wave the meter reading does not indicate the true energy level of the signal. This energy level can be expressed as the ratio of average voltage to peak voltage of the incoming waveform. If this value is above the value for the sine wave, the meter reads high; if this value is below the sine wave value, the meter reads low.

c. Use of Oscilloscope

An oscilloscope can be used along with the frequency monitor to set the IDC control accurately. The oscilloscope is a highly reliable deviation indicator since it is instantaneous in action and the peak reading is unaffected by the waveform. It is strongly recommended that an oscilloscope be used wherever it is available. If no oscilloscope is available refer to the ALIGNMENT PROCEDURE CHART for setting of the IDC control by means of the frequency monitor alone.

Set up the equipment as described in the MEASUREMENT section of the frequency monitor manual. Connect the scope across the discriminator output as shown in Diagram 69B810633 in the frequency monitor manual. Modulate the transmitter with a 1000 cps tone connected across the microphone input terminals at the transmitter. Connect an AC VTVM across these terminals also.

Calibrate the 'scope as follows: Turn the IDC control to the full clockwise position. Adjust the tone modulation level for a reading of 10 kc. deviation on the monitor deviation meter. With a sine wave pattern on the screen use the vertical gain control to set the overall height to a convenient size, e.g., 10 full squares on the screen. This calibrates the 'scope for a reading of 1 square for each kc. deviation.

Increase the tone level to a minimum of one volt at the audio input terminals. Now turn the IDC control slowly counterclockwise until the height of the pattern represents the required transmitter deviation (15 kc. for 40 kc. or 120 kc. channel spacing, 5 kc. for 20 kc. channel spacing operation).

5. ALIGNMENT PROCEDURE

The transmitter is tuned and adjusted for its exact operating frequency prior to shipment from the factory. Unless damaged or abused in transit it should require no further adjustment before placing it in service, other than to align the final RF amplifier stage to the antenna. If alignment is required, refer to the alignment procedure in this section.

Any 0-50 microampere meter with an equivalent series resistance of 20000 ohms may be used as a metering device. The meter should be connected from chassis ground to the pin receptacle of the metering socket corresponding to the stage being measured. Refer to the schematic diagram for specific metering pin receptacle information.

FINAL METER READINGS

Each time a transmitter is aligned or tested, final meter readings should be made and entered in a logbook.

All readings given in the table below are minimum except PA, which is maximum. DO NOT exceed the value given for the PA current. This is the maximum plate current to which the unit can be safely tuned.

Readings 1 through 6 are purely relative and do not give actual current or voltage measurement.

When using the P-8500 or the P-8501 series test sets, position 7 is a d-c voltmeter with 1000 volts full scale. Actual B+ reading is obtained by multiplying the microampere scale reading by 20. The TU546 series test sets have a 0-1000 volt d-c scale from which the B+ is read directly.

When using the P-8500 or the P-8501 series test sets, position 8 indicates d-c relay control voltage when the transmitter is not keyed. Multiply the microampere scale reading by 0.3 to obtain the actual value of the d-c voltage. When using the TU546 series test sets, the relay control voltage is read directly with the position selector switch in position 10.

For all three series portable test sets, multiply the scale reading by 5 to obtain the actual PA plate current in milliamperes.

SWITCH POSITION	P-8500 & P-8501 SERIES	1	2	3	-4	5	6	7	8	PA(+4)
	TU546 SERIES	1	2	3	4	5	6	9	10	7
METER READING	30 WATTS	-	-	-	4	18	14	20	-	30
	50 WATTS	-	-	-	4	18	18	20	-	25

PRE-ALIGNMENT NOTES

EXCERPTS FROM FCC REGULATIONS

- Radio transmitters may be tuned or adjusted only by duly authorized radio operators or by personnel working directly under their supervision.
- The RF power output of a station shall be no more than required for satisfactory technical operation considering the area to be covered and the local conditions.

TEST EQUIPMENT REQUIRED

- MOTOROLA Portable Test Set (P-8500 series, P-8501 series or TU546 series)
- MOTOROLA K-9322 Alignment Tool Kit
- MOTOROLA T1100A Series Frequency Monitor (for oscillator alignment and deviation adjustment)
- RF wattmeter or dummy antenna
- Power Supply (preferably the one designed for the transmitter under test)

HOW TO SET UP THE P-8500 SERIES AND THE P-8501 SERIES TEST SETS

- Connect the dummy antenna or r-f wattmeter to the transmitter ANT. jack.
- Connect the test set cable plug to the transmitter METER jack.
- Place the test set REC. - XMTR. -0-50 UA switch in the XMTR. position.
- Place the GRID CURRENT-METER-FIELD STRENGTH switch in the METER position.
- Connect the power supply to the transmitter as shown on the interconnecting diagram for the equipment.
- If the power supply chassis has a HI-LO switch place it in the LO position.
- Turn the equipment on. Allow 30 seconds for the tubes to warm up.

HOW TO SET UP THE TU546 SERIES TEST SET

- Connect the dummy antenna or r-f wattmeter to the transmitter ANT. jack.
- Connect one end of the metering cable to the test set and the other end to the transmitter METER receptacle.
- Place the Function Selector Switch in the XMTR. position.
- Place the oscillator and meter reversing switch in the OFF position.
- Connect the power supply to the transmitter as shown on the interconnecting diagram for the radio set.
- Place the HI-LO switch on the power supply in the LO position.
- Turn the equipment on. Allow 30 seconds for the tubes to warm up.

TEST SET SWITCH POSITIONS

P-8500 & P-8501 Series	1	2	3	4	5(PA)	6	7	8
TU546 Series	1	2	3	4	7	5	6	9
Circuit Metered	—	—	—	Tripler Grid	PA Plate Current	Doubler Driver Grid	PA Grid	PA Plate Voltage
								Push-to-Talk

HOW TO KEY THE TRANSMITTER

- Use the XMTR-ON switch of the test set to place the unmodulated carrier on the air for meter reading and adjustment.
- Use the MOTOROLA TU353A Microphone (or equivalent) to key the transmitter and modulate the carrier as required.

CAUTION

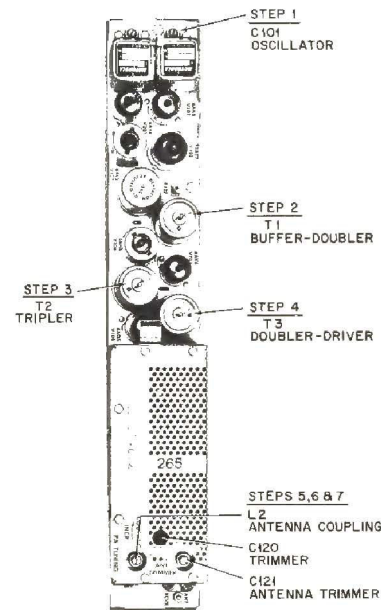
Do not key the transmitter for more than a few seconds at a time until it is properly tuned. Plate current is excessive in untuned stages and may damage the unit. Turn the transmitter on for brief periods while reading the meter and making the adjustments.

FREQUENCY CALCULATIONS

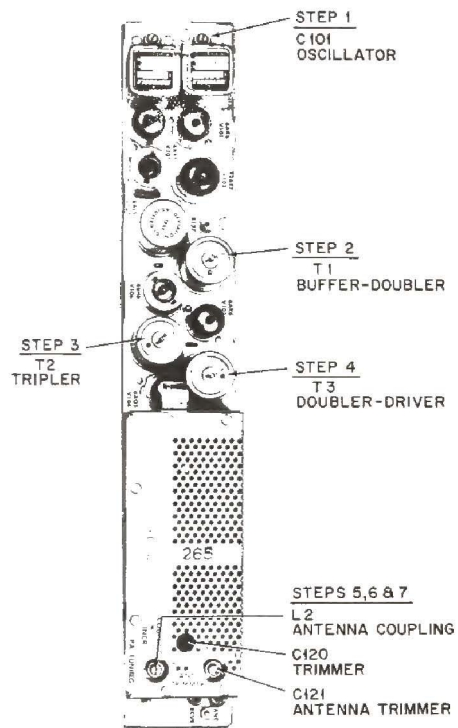
$$f_0 = \frac{f_c}{12} \text{ where: } f_0 = \text{crystal frequency, and } f_c = \text{carrier frequency}$$

IDC CONTROL SETTING

- Set up T1100A Series Frequency Monitor for voice modulation measurement. (If an oscilloscope is available see text for IDC setting using the scope.)
- Turn transmitter on and modulate with 1000 cps tone.
- Adjust the IDC control (R127) on the transmitter chassis until the MODULATION DEVIATION meter on the station monitor reads as outlined in the following paragraphs.
 - When the transmitter is intended for operation on a 40 kc or 120 kc channel spacing, the IDC control should be adjusted for an approximate 17 kc reading on the station monitor MODULATION DEVIATION METER. Note that the MODULATION DEVIATION METER reads average voltage but is calibrated in peak voltage. The setting of 17 kc corresponds to a peak of 15 kc.
 - When the transmitter is intended for operation on a 20 kc channel spacing, the IDC control should be adjusted for an approximate 5-1/2 kc reading on the station monitor MODULATION DEVIATION METER.



STEP	SWITCH POS. TEST SET	ADJUSTMENT	METER READING	STAGE, CONDITIONS AND PROCEDURE
1		C101	Maximum On-frequency	OSCILLATOR. Place the HI-LO switch in the LO position. Adjust only when primary or secondary frequency standard is available (MOTOROLA T1100A Series may be used). Set up frequency monitor. Loosen locknut, adjust C101 for "on-frequency" reading on monitor. Tighten locknut.
2	4	T1	Maximum	BUFFER-DOUBLER. Adjust primary slug from bottom. Adjust secondary slug from top. The circuit frequency is two times the crystal frequency.
3	5	T2	Maximum	TRIPLER. Adjust primary slug from bottom. Adjust secondary slug from top. The circuit frequency is six times the crystal frequency. Repeat T1 with the meter switch in position 4.
4	6	T3	Maximum	DOUBLER-DRIVER. Adjust primary slug from bottom. Adjust secondary slug from top. Tune for a definite peak. The meter will always show the fixed bias in this position. A definite peak reading indicates proper alignment. The circuit frequency is twelve times the crystal frequency.
5	7	C120, C121	Minimum (Dip)	POWER AMPLIFIER. Loosen locknuts on C120 and C121. Set ANT. TRIMMER C121 for minimum plate current. Turn COUPLING adjustment (L2) fully counterclockwise (decoupled). Tune C120 for a dip. Set power supply HI-LO switch to HI.
6	7	C121	Maximum	ANTENNA INPUT. Adjust ANT. TRIMMER C121 for maximum meter reading.
7	7	C120, C121, L2	Maximum RF Output NOTE DO NOT EXCEED 150 ma	ANTENNA COUPLING. Remove test lead and connect antenna 1. Using field strength meter: Make adjustments with transmitter shielded as much as possible by housing. Place RF probe near antenna. Adjust C121 and COUPLING (L2) for maximum RF indication on meter. Do not exceed 150 ma. 2. Without field strength meter: Turn COUPLING (L2) counterclockwise, increasing gradually while retuning C120 for dip. Increase coupling until only a slight dip is apparent. DO NOT overcouple. This causes the dip to disappear and reduces power output. Recheck setting of C121. DO NOT EXCEED 150 ma. Repeat T1, T2 and T3. Tighten locknuts on C120 and C121.



STEP	SWITCH POS. TU546 TEST SET	ADJUSTMENT	METER READING	STAGE, CONDITIONS AND PROCEDURE
1		C101	Maximum On-frequency	OSCILLATOR. Place the HI-LO switch in the LO position. Adjust only when primary or secondary frequency standard is available (MOTOROLA T1100A Series may be used). Set up frequency monitor. Loosen locknut, adjust C101 for "on-frequency" reading on monitor. Tighten locknut.
2	4	T1	Maximum	BUFFER-DOUBLER. Adjust primary slug from bottom. Adjust secondary slug from top. The circuit frequency is two times the crystal frequency.
3	5	T2	Maximum	TRIPLER. Adjust primary slug from bottom. Adjust secondary slug from top. The circuit frequency is six times the crystal frequency. Repeat T1 with the meter switch in position 4.
4	6	T3	Maximum	DOUBLER-DRIVER. Adjust primary slug from bottom. Adjust secondary slug from top. Tune for a definite peak. The meter will always show the fixed bias in this position. A definite peak reading indicates proper alignment. The circuit frequency is twelve times the crystal frequency.
5	7	C120, C121	Minimum (Dip)	POWER AMPLIFIER. Loosen locknuts on C120 and C121. Set ANT. TRIMMER C121 for minimum plate current. Turn COUPLING adjustment (L2) fully counter-clockwise (decoupled). Tune C120 for a dip. Set power supply HI-LO switch to HI.
6	7	C121	Maximum	ANTENNA INPUT. Adjust ANT. TRIMMER C121 for maximum meter reading.
7	7	C120, C121, L2	Maximum RF Output NOTE DO NOT EXCEED 150 ma	ANTENNA COUPLING. Remove test load and connect antenna. 1. Using field strength meter: Make adjustments with transmitter shielded as much as possible by housing. Place RF probe near antenna. Adjust C121 and COUPLING (L2) for maximum RF indication on meter. Do not exceed 150 ma. 2. Without field strength meter: Turn COUPLING (L2) counterclockwise, increasing gradually while retuning C120 for dip. Increase coupling until only a slight dip is apparent. DO NOT overcouple. This causes the dip to disappear and reduces power output. Recheck setting of C121. DO NOT EXCEED 150 ma. Repeat T1, T2 and T3. Tighten locknuts on C120 and C121.

FINAL METER READINGS

Each time a transmitter is aligned or tested, final meter readings should be made and entered in a logbook.

All readings given in the table below are minimum except PA, which is maximum. DO NOT exceed the value given for the PA current. This is the maximum plate current to which the unit can be safely tuned.

Readings 1 through 6 are purely relative and do not give actual current or voltage measurement.

When using the P-8500 or the P-8501 series test sets, position 7 is a d-c voltmeter with 1000 volts full scale. Actual B+ reading is obtained by multiplying the microampere scale reading by 20. The TU546 series test sets have a 0-1000 volt d-c scale from which the B+ is read directly.

When using the P-8500 or the P-8501 series test sets, position 8 indicates d-c relay control voltage when the transmitter is not keyed. Multiply the microampere scale reading by 0.3 to obtain the actual value of the d-c voltage. When using the TU546 series test sets, the relay control voltage is read directly with the position selector switch in position 10.

For all three series portable test sets, multiply the scale reading by 5 to obtain the actual PA plate current in milliamperes.

SWITCH POSITION	P-8500 & P-8501 SERIES	1	2	3	-4	5	6	7	8	PA(+4)
	TU546 SERIES	1	2	3	4	5	6	9	10	7
METER READING	30 WATTS	-	-	-	4	18	14	20	-	30
	50 WATTS	-	-	-	4	18	18	20	-	25

41A85084
CRYSTAL CLAMP

Y201 (2-FREQ)

V20

26K89003
TUBE SHIELD

V10

26A89003
TUBE SHIELD

V10

T
TRIPLE

V10

ED IN OHMS AND ARE $\pm 10\%$ ± 2 WATT
000 OHMS.

MICROMICROFARADS UNLESS OTHERWISE

POSITION (AS SHIPPED FROM THE FACTORY.
FOR AUDIO SENSITIVITY IS REQUIRED. REFER TO
FOR FURTHER DETAILS.

MODE CIRCUIT USED ONLY ON SINGLE

IES COMPONENTS ARE INCORPORATED ON

TWO-FREQ. UNITS (REFERENCED C207)
20 UNITS (REFERENCED C105).

EMPLOYED FOR THE 100 KHz FREQUENCY RANGE.
IT DETAILS APPLICABLE TO THIS FILTER
PARTS LIST FOR THE SPECIFIC IDENTIFICATION
ARMONIC FILTERS.

ATION. REFER TO TTB19ML COIL KIT PARTS

NEUTRALIZING CAPACITY INHERENT IN CIRCUIT.

IL KIT PARTS LIST FOR COMPONENT

(S)
(S)

(TTS)
(TTS)

75 VOLTS

15B83040
SHIELD COVER

ATIONS AND 200 FOR 30-54 MC APPLICATIONS.

LICATIONS. AND 100K FOR 40-54MC APPLICATIONS.

R133 (420A) IS REMOVED AND REPLACED WITH

C12
TRIMMER

V & R NOTES

30. VOLTAGE AND RESISTANCE READINGS ARE NOMINAL VALUES AND MAY VARY $\pm 20\%$.

31. ALL VOLTAGE AND RESISTANCE READINGS ARE TAKEN WITH RESPECT TO GROUND
MEASUREMENTS TO BE MADE WITH A VTVM.

32. Y201 IS EMPLOYED ON 2-FREQUENCY MODELS ONLY.

33. READINGS TAKEN WITH A 1 MEG RESISTOR IN SERIES WITH METER LEAD.

34. MICROPHONE IN CIRCUIT.

35. VOLTAGE READINGS FOR V101 & V102 ARE TAKEN WITH FREQUENCY SWITCH IN
APPLICABLE POSITION ON 2 FREQUENCY UNITS.

36. THIS READING IS 100V FOR 40-54 MC OPERATION OR 180V FOR 25-40 MC
OPERATION.

37. THIS READING IS 25V FOR 40-54 MC OPERATION OR 36V FOR 25-40MC OPERATION
THE TRANSMITTER IS CONNECTED TO THE POWER SUPPLY WHILE READINGS
ARE TAKEN.

38. ALL TUBES IN SOCKETS AND METERING TEST SET NOT CONNECTED.

39. NO FILAMENT VOLTAGE APPLIED TO UNIT AND NEGATIVE PROBE OF OHMMETER CONNECTED
TO GROUND.

40. THIS READING WILL VARY WITH ADJUSTMENT OF R427

41. MICROPHONE NOT IN CIRCUIT.

42. AN INITIAL LOW READING MAY BE OBTAINED AT MANY POINTS DUE TO THE CHARGING OF
CAPACITORS IN THE POWER SUPPLY. ALLOW CAPACITORS TO CHARGE TO OBTAIN FULL
READINGS

43. 42 OHMS FOR 1 AND 2 FREQUENCY OPERATION WITH FREQUENCY SWITCH IN APPLICABLE
POSITION.

44. THIS READING IS 420K FOR 40-54 MC OPERATION OR 500K FOR 25-40MC OPERATION

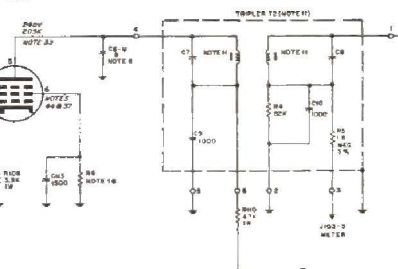
MODEL TABLE

ONE FREQUENCY	SUFFIX	TWO FREQUENCY	SUFFIX	FREQUENCY RANGE
TTB1031AA / TA234L	1	TTB1031AB / TA234-C2L	2	25-30MC
TTB1032AA / TA234ML	1	TTB1032AB / TA234-C2ML	2	30-33MC
TTB1033AA / TA234MM	1	TTB1033AB / TA234-C2MM	2	35-40MC
TTB1034AA / TA234HL	1	TTB1034AB / TA234-C2HL	2	40-45MC
TTB1035AA / TA234HM	1	TTB1035AB / TA234-C2HM	2	45-50MC
TTB1036AA / TA234HN	1	TTB1036AB / TA234-C2HN	2	50-54MC

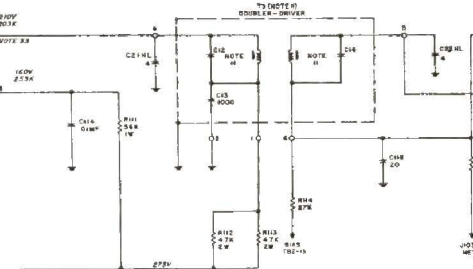
Models TTB1030AA/TA234 and
TTB1030AB/TA234-C2 Transmitters
Schematic Diagram
Motorola No. 63E854612-E
11/5/59-RCS

AEFD-2776-O

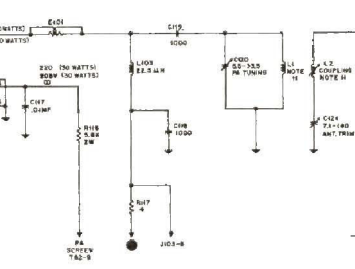
V103
AMPLIFIER
GANG



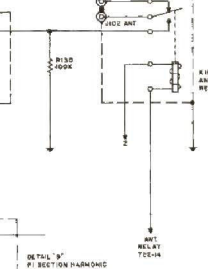
V104
DOUBLER-DRIVER
5A4S



V105
POWER
AMPLIFIER
6X4S



*1 SECTION - AUDIO FILTER (NOTE 7)



ANTENNA
RELAY

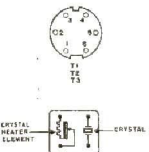
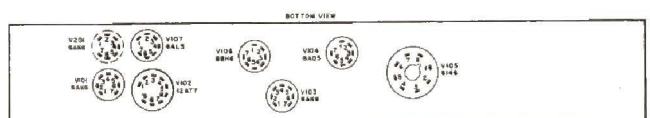
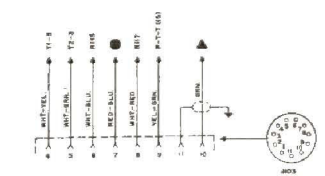
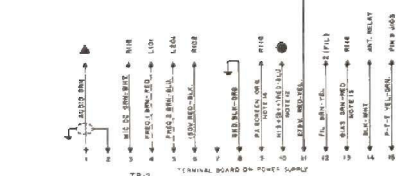


- SYMBOLIC
NOTES:
- ALL RESISTOR VALUES ARE INDICATED IN OHMS AND ARE 5% 1/2 WATT UNLESS OTHERWISE STATED.
 - ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE STATED.
 - CAPACITOR C10 IS CONNECTED TO POSITION 1 AS SHOWN FROM THE FACTORY. CONNECT TO POSITION 2 IF REMOTE AUDIO SENSITIVITY IS REQUIRED. REFER TO THE TRANSMITTER INSTRUCTIONS FOR FURTHER DETAILS.
 - GROUND CONNECTION IN V105 CATHODE CIRCUIT USED ONLY ON SINGLE FREQUENCY MODELS.
 - SHOWN CONDUCTIVITY AND 250 SERIES COMPONENTS ARE INCORPORATED ON TWO-FREQUENCY MODELS ONLY.
 - CAPACITOR C10 IS 100PF FOR TWO-FREQUENCY MODELS (REFERENCE C107) AND IS 200PF FOR SINGLE-FREQUENCY MODELS (REFERENCE C105).
 - A UNIFORM IN SECTION FILTER IS EMPLOYED FOR THE TWO-FREQUENCY RANGE. REFER TO DETAIL "B" FOR CIRCUIT DETAILS APPLICABLE TO THIS FILTER. REFER TO THE TUBE COIL PARTS LIST FOR THE SPECIFIC IDENTIFICATION OF COMPONENTS USED IN THE HARMONIC FILTERS.
 - USED ONLY FOR 30-35 MC OPERATION. REFER TO THERMAL COIL KIT PARTS LIST.
 - C10 IS NOT USED ON THIS MODEL.
 - THIS SYMBOL INDICATES NEUTRALIZE CAPACITANCE IN CIRCUIT.
 - ASPECT TO THE TUBE COIL PARTS LIST FOR COMPONENT IDENTIFICATION.
 - HIGH-PASS: 400 VOLTS (30 WATTS) - 40 VOLTS (10 WATTS)
 - BIAS VOLTAGE: -25 VOLTS (30 WATTS) - 40 VOLTS (10 WATTS)
 - PA SCREEN SOURCE VOLTAGE: 275 VOLTS

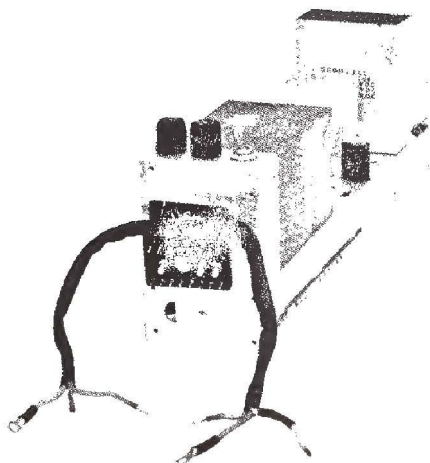
- SYMBOLIC
NOTES:
- ALL TUBES IN SOCKETS AND METER TEST SET NOT CONNECTED.
 - 40 FILAMENT VOLTAGE APPLIED TO UNIT AND NEUTRALIZE PROBE OF OHMMETER CONNECTED TO GROUND.
 - NO THIS READING WILL VARY WITH ADJUSTMENT OF R107.
 - NO MICROPHONE NOT IN CIRCUIT.
 - OPTIMAL LOW READING MAY BE OBTAINED AS MANY POINTS DUE TO THE CHANGING OF CAPACITORS IN THE POWER SUPPLY ALLOW CAPACITORS TO CHARGE TO UPPER FULL READING.
 - 45 OHMS FOR 1 AND 2 FREQUENCY OPERATION WITH FREQUENCY SWITCH IN APPLICABLE POSITION.
 - THIS READING IS 400K FOR 40-54 MC OPERATION OR 300K FOR 35-40 MC OPERATION.

MODEL TABLE			
ONE FREQUENCY	SUPPLY	TWO FREQUENCY	FREQUENCY RANGE
TTB1030AA / TA234A	1	TTB1030AB / TA234A-CFL	1 20-30 MC
TTB1030AA / TA234A	1	TTB1030AB / TA234A-CFL	2 30-40 MC
TTB1030AA / TA234A	1	TTB1030AB / TA234A-CFL	2 40-54 MC
TTB1030AA / TA234A	1	TTB1030AB / TA234A-CFL	2 40-54 MC
TTB1030AA / TA234A	1	TTB1030AB / TA234A-CFL	2 40-54 MC

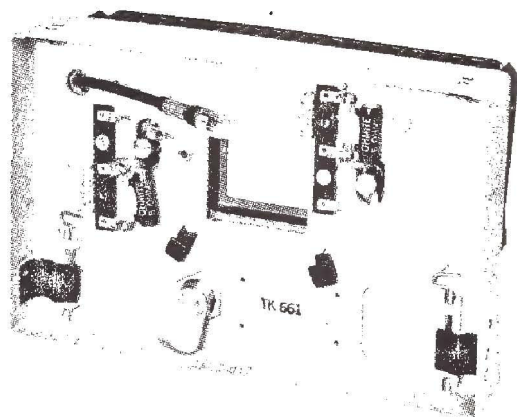
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TRANSISTORIZED POWER SUPPLY



TU588
POWER SUPPLY



TRANSISTORS AND POWER SUPPLY
COMPONENTS
ON RADIO SET FRONT PANEL

1. INTRODUCTION

The TU588 is a fully transistorized power supply with a common emitter circuit. It provides all the plate, screen and bias voltages required by the mobile radio transmitter and receiver. The transistorized circuitry replaces the vibrator circuits commonly used in mobile radio applications.

a. Basic Principle

The transistor circuit of the power supply is essentially a single-pole, double-throw switch, operating back and forth continuously. This

switching action interrupts the flow of battery current through the power supply transformer primary. Interrupting the d-c gives the effect of a-c and the transformer windings step up the voltages as required for the rectified outputs.

The input is connected to the transistor emitters. The opposite ends of the transformer are connected to the transistor collectors, which alternately open and close the circuit to the d-c input. The current flows first through one transistor, then through the other, giving the effect of an alternating current. This circuit effectively duplicates the action of a vibrator and is used to replace the vibrator circuit.



MOTOROLA INC.

Engineering Publications

4501 W. Augusta Blvd.

COMMUNICATIONS DIVISION

Chicago 51, Illinois

SCHEMATIC DIAGRAM PARTS LIST

Reference:
Schematic Diagram
63E854612-E

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
		CAPACITOR, fixed; unless otherwise stated:
C1L	21K813512	ceramic; rectangular; 68 uuf ±10%; 450 vdcw
C1ML	21K2733	molded silver mica; 30 uuf ±10%; 500 vdcw
C1HL	21K2768	molded silver mica; 20 uuf ±10%; 500 vdcw
C1HM	21R38223	ceramic; tubular; 10 uuf ±5%; 500 vdcw
C1H	NOT USED	
C2L	21R482328	ceramic; tubular; 30 uuf ±5%; 500 vdcw
C2ML	21K86392	ceramic; tubular; 16 uuf ±.75 uuf 500 vdcw
C2MM	same as C2ML	
C2HL	21R470324	ceramic; tubular; 6 uuf ±1 uuf; 500 vdcw
C2HM	same as C2HL	
C2H	NOT USED	
C3L	same as C2L	
C3ML	same as C2ML	
C3MM	same as C2ML	
C3HL	same as C2HL	
C3HM	same as C2HL	
C3H	NOT USED	
C4	21K6638	molded mica; 1000 uuf ±20%; 300 vdcw
C5	same as C4	
C6L	NOT USED	
C6ML	21R892897	ceramic; tubular; 8 uuf ±.5 uuf; 500 vdcw
C6MM	NOT USED	
C6HL	NOT USED	
C6HM	NOT USED	
C6H	NOT USED	
C7L	same as C6ML	
C7ML	NOT USED	
C7MM	NOT USED	
C7HL	21K2753	molded silver mica; 3.3 uuf ±.5 uuf; 500 vdcw
C7HM	same as C7HL	
C7H	NOT USED	
C8L	21R891167	ceramic; tubular; 12 uuf ±5%; 500 vdcw
C8ML	NOT USED	
C8MM	NOT USED	
C8HL	same as C7HL	
C8HM	NOT USED	
C8H	same as C4	
C9	same as C4	
C10	NOT USED	
C11L	same as C6ML	
C11MM	NOT USED	
C11H	NOT USED	
C11HM	NOT USED	
C11H	NOT USED	
C12L	same as C2ML	
C12MM	NOT USED	
C12HL	NOT USED	
C12HM	NOT USED	
C13	same as C4	
C14L	same as C1HM	
C14ML	NOT USED	
C14HL	NOT USED	
C14HM	NOT USED	

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
C14HH	21K474952	NOT USED
C15L	21A478274	ceramic; tubular; 4 uuf ±.5 uuf; 500 vdcw
C15ML	same as C15L	
C15MM	NOT USED	
C15HM	same as C15L	
C15HH	NOT USED	
C16L	21K410662	molded silver mica; 170 uuf ±5%; 500 vdcw
C16ML	21R6596	molded silver mica; 150 uuf ±5%; 500 vdcw
C16MM	21K410661	molded silver mica; 130 uuf ±5%; 500 vdcw
C16HL	21K410660	molded silver mica; 110 uuf ±5%; 500 vdcw
C16HM	same as C16HL	
C16HH	NOT USED	
C17L	21R38932	ceramic; tubular; 24 uuf ±5%; 500 vdcw
C17ML	21K474330	ceramic; tubular; 20 uuf ±5%; 500 vdcw
C17MM	same as C17L	
C17HL	same as C17ML	
C17HM	same as C17ML	
C17HH	NOT USED	
C18L	NOT USED	
C18ML	NOT USED	
C18MM	NOT USED	
C18HL	NOT USED	
C18HM	NOT USED	
C18HH	21K803488	molded silver mica; 40 uuf ±3%; 500 vdcw
C19L	NOT USED	
C19ML	NOT USED	
C19MM	NOT USED	
C19HL	NOT USED	
C19HM	same as C8L	
C20L	NOT USED	
C20ML	NOT USED	
C20MM	NOT USED	
C20HL	NOT USED	
C20HM	NOT USED	
C20H	same as C19HH	
C21L	NOT USED	
C21ML	NOT USED	
C21MM	NOT USED	
C21HL	same as C15L	
C21HM	NOT USED	
C21HH	NOT USED	
C22L	NOT USED	
C22ML	NOT USED	
C22MM	NOT USED	
C22HL	same as C15L	
C22HM	NOT USED	
C22H	same as C15L	
C22ML	NOT USED	
C22HM	NOT USED	
C22HH	NOT USED	
C101	19A830230	variable; air; 4.1 uuf min. -21.9 uuf max.
C102	21K840047	same as C8L
C103	21K840047	dipped silver mica; 150 uuf ±5%; 500 vdcw
C104	21K837746	ceramic; disc; 2000 uuf ±10%; 500 vdcw
C105	21K2768	molded silver mica; 20 uuf ±10%; 500 vdcw; used only in 1-freq. moduli; replace with C207 in 2-freq. moduli
C106	21R83198	ceramic; tubular; 51 uuf ±5%; 500 vdcw
C107	same as C7HL	
C108	21R800801	ceramic; disc; .0015 uuf GMV +100% max; 500 vdcw

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
C109	21K832117	CAPACITOR, fixed; unless otherwise stated: electrolytic; tubular; 3 section; consisting of: 20 uuf ±100-10%; 25 vdcw; section Δ 10 uuf ±50-10%; 450 vdcw; section □ 10 uuf ±50-10%; 450 vdcw; section
C109A	same as C109	
C109B	21K832249	same as C109
C109C	same as C109	
C110	21A801139	ceramic; disc; .01 uuf ±80-20%; 600 vdcw
C111	same as C110	
C112	21K845214	dipped silver mica; 510 uuf ±5%; 300 vdcw
C113	same as C108	
C114	same as C110	
C115	same as C105	
C116	same as C110	
C117	same as C110	
C118	21K2727	molded mica; 1000 uuf ±20%; 2000 vdcw
C119	same as C118	
C120	19B830246	variable; air; 6.5 uuf min. -32.5 uuf max.
C121	19A830291	variable; air; 7.1 uuf min. -140 uuf max.
C122	same as C110	
C123	21K890624	electrolytic; tubular; 1 section; 5 uuf ±100-15%; 150 vdcw
C124	21B401029	ceramic; disc; .02 uuf ±80-20%; 600 vdcw
C125	same as C124	
C126	8K836753	oil filled; tubular; .0025 uuf ±10%; 100 vdcw
C127	NOT USED	
C128	same as C124	
C129	21K6720	molded silver mica; 390 uuf ±5%; 500 vdcw
C130	same as C110	
C131	21R410115	ceramic; disc; 220 uuf ±20%; 500 vdcw
C132	same as C110	
C133	same as C108	
C202	same as C108	
C203	same as C8L	
C204	same as C108	
C205	same as C19HH	
C206	23K857384	electrolytic; tubular; 5 uuf ±100-10%; 50 vdcw
C207	21R41867	ceramic; tubular; 15 uuf ±5%; 500 vdcw; replaces C105 (20 uuf) in One-Freq. Operation
C208	same as C206	
E101	6A832263	SUPPRESSOR parasitic
F101	9A87120	CONNECTORS receptacle; female; single contact; round molded mica filled phenolic base; chassis mounted; RECEIVER
F102	same as F101	except connects to ANTENNA
F103	9A880881	receptacle; female; 11 contact; polarized; round molded mica filled phenolic base; saddle mounting; METER
X101	59K854405	RELAY Armature non-formal; contact arrangement: 1 form "C"
L1L	24K832226	COIL RF; tank; 7-1/2 turns
L1ML	24K832077	RF; tank; 9-1/2 turns

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
L1MM	same as L1ML	
L1HL	24A832225	RF; tank; 3-1/2 turns
L1HM	same as L1HL	
L1H	same as L1HL	
L2L	24K832476	RF; output coupling; 4-1/2 turns
L2ML	24K832249	RF; output coupling; 3-1/2 turns
L2MM	same as L2ML	
L2HL	24A830195	RF; output coupling; 2-1/2 turns
L2HM	same as L2HL	
L2H	24A832876	RF; output coupling; 3-1/2 turns
L3L	24K810403	RF; harmonic filter; 8 turns
L3ML	24K810402	RF; harmonic filter; 7 turns
L3MM	24K810401	RF; harmonic filter; 6 turns
L3HL	24K810400	RF; harmonic filter; 5 turns
L3HM	24K832224	RF; harmonic filter; 4 turns
L3H	NOT USED	
L4L	same as L3L	
L4ML	same as L3ML	
L4MM	same as L3MM	
L4HL	same as L3HL	
L4HM	same as L3HM	
L4H	NOT USED	
L5L	NOT USED	
L5ML	NOT USED	
L5MM	NOT USED	
L5HL	NOT USED	
L5HM	same as L3ML	
L5H	same as L3ML	
L101	24A800899	RF; choke; 1.2 millihenries
L102	24A832402	RF; choke; 100 microhenries
L103	24A812542	RF; choke; 22.5 microhenries
L104	25D850336	AF; choke; 5 henries
L201	same as L101	
R1	6R5577	RESISTOR, fixed; carbon; unless otherwise stated: 2.7K ±10%; 1/2 w; ins.
R2	6R6487	37K ±10%; 1/2 w; ins.
R3L	6R5651	680 ohm ±5%; 1/2 w; ins.
R3ML	6R6166	1.2K ±5%; 1/2 w; ins.
R3MM	same as R3ML	
R3HL	same as R3ML	
R3HM	same as R3ML	
R3H	same as R3ML	
R4	6R5644	82, 000 ohm ±10%; 1/2 w; ins.
R5	6R401017	4 megohm ±5%; 1/2 w; ins.
R6L	6R6407	220K ±10%; 1/2 w; ins.
R6ML	same as R6L	
R6MM	same as R6L	
R6HL	same as R6L	
R6HM	same as R6L	
R6H	same as R6L	
R101	6R6376	56K ±10%; 1/2 w; ins.
R102	6R6048	47K ±10%; 1/2 w; ins.
R103	6R6398	150K ±10%; 1/2 w; ins.
R104	6R6393	1.2K ±10%; 1/2 w; ins.
R105	6R6229	1K ±10%; 1/2 w; ins.
R106	6R6269	same as R6HL
R107	6R6269	820 ohm ±10%; 1/2 w; ins.
R108	6R5618	3.9K ±10%; 1 w; ins.
R109	NOT USED	
R110	6R6576	4.7K ±10%; 1 w; ins.
R111	6R6402	56K ±10%; 1 w; ins.
R112	6R5671	4.7K ±10%; 2 w; ins.
R113	same as R112	
R114	6R6434	27K ±10%; 1/2 w; ins.
R115	6R65818	3.3 megohm ±5%; 1/2 w; ins.
R116	6R67816	45K ±10%; 2 w; ins.
R117	17R892469	wire wound; 4 ohm ±2%; 1 w; ins.
or 17B821901		wire wound; 4 ohm ±2%; 3 w; ins.
R118	6R120538	330 ohm ±5%; 1/2 w; ins.
R119	6R6580	4.7K ±10%; 1/2 w; ins.
R120	6R5645	150 ohm ±5%; 1/2 w; ins.

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
R121	6R2068	RESISTOR, fixed; carbon; unless otherwise stated: 33K ±5%; 1/2 w; ins.
R122	same as R6L	
R123	6R5040	480 ohm ±10%; 1/2 w; ins.
R124	6R5773	820K ±5%; 1/2 w; ins.
R125	6R5475	680K ±10%; 1/2 w; ins.
R126	same as R125	
R127	18K612098	variable; 300K ±20%; 1/4 w
R128	6R2051	180K ±5%; 1/2 w; ins.
R129	6R5766	12K ±10%; 2 w; ins.
R130	same as R6HL	
R131	same as R6HL	
R132	same as R6L	
R133	6R488021	120 ohm ±10%; 1 w; ins.
R201	same as R101	
R202	6R488090	56 ohm ±10%; 2 w; ins.
R203	6R6326	100 ohm ±10%; 1/2 w; ins.
R204	same as R203	
T1L	24K832479	TRANSFORMER RF; Buffer-Doubler; base stamped 479; includes two 46K821425 CORE, adjustable tuning and C2L, C3L, C4, C5, R1, R2, R3L
T1ML	24B832071	RF; Buffer-Doubler; base stamped 071; includes two 46K821425 CORE, adjustable tuning and C2ML, C3ML, C4, C5, R1, R2, R3ML
T1MM	same as T1ML	
T1HL	24B832211	RF; Buffer-Doubler; base stamped 211; includes two 46K821425 CORE, adjustable tuning and C2HL, C3HL, C4, C5
T1HM	same as T1HL	
T1H	24K832456	RF; Buffer-Doubler; base stamped 456; includes two 46K821425 CORE, adjustable tuning and C4, C5, R1, R2, R3HM
T2L	24K832476	RF; Tripler; base stamped 476; includes two 46K821425 CORE, adjustable tuning and C7L, C8L, C9, C10, R4, R5
T2ML	24B832073	RF; Tripler; base stamped 073; includes two 46K821425 CORE, adjustable tuning and C9, C10, R4, R5
T2MM	same as T2ML	
T2HL	24B832212	RF; Tripler; base stamped 212; includes two 46K821425 CORE, adjustable tuning and C7HL, C8HL, C9, C10, R4, R5
T2HM	same as T2HL	
T2H	24K832459	RF; Tripler; base stamped 459; includes two 46K821425 CORE, adjustable tuning and C9, C10, R4, R5
T3L	24K832477	RF; Doubler-Driver; base stamped 477; includes two 46K821425 CORE, adjustable tuning and C12L, C13, C14L
T3ML	24B832072	RF; Doubler-Driver; base stamped 072; includes two 46K821425 CORE, adjustable tuning and C13
T3MM	same as T3ML	

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
T3HL	24B832213	TRANSFORMER RF; Doubler-Driver; base stamped 213; includes two 46K821425 CORE, adjustable tuning and C13
T3HM	same as T3HL	
Y101	6AK6	TUBE Electron
Y102	12AT7	Electron
Y103	same as Y101	
Y104	6AQ5	Electron
Y105	6146	Electron
Y106	6BH6	Electron
Y107	6AL5	Electron
V201	same as Y101	
XV101	9K87124	SOCKET, tube; female; 7 contact; miniature molded mica filled phenolic base; includes center shield; saddle mounting
XV102	9K825586	9 contact; miniature; molded mica filled phenolic base; includes center shield and tube shield base; saddle mounting
XV103	same as XV101	
XV104	same as XV101	
XV105	9B890001	8 contact; brown bakelite wafer base; saddle mounting
XV106	9B834083	7 contact; miniature molded mica filled phenolic base; includes center shield and tube shield base; saddle mounting
XV107	same as XV106	
XV201	24K832456	SOCKET, tube; same as XV101
XY101	9A30451	SOCKET, crystal; female; 4 contact; square molded mica base; bakelite base; chassis mounted
XY201	same as XY101	
		CRYSTALS
		NOTE Crystal Units are part of the Radio Set model. When ordering a transmitter chassis only, crystals must be ordered separately. Crystal type number and operating frequency must be specified when ordering crystal.
Y101	Type RNS-A	CRYSTAL UNIT Quartz Transmitter Oscillator; 2.0835 - 4.5000 MC; with 5 volt heater mount
Y201		same as Y101

PERFORMANCE SPECIFICATIONS

INPUT REQUIRED	12 VDC negative or positive ground.
OUTPUT RATINGS	<u>Transmitter:</u> High B+ 705 v d-c at 120 ma Low B+ 275 v d-c at 60 ma Osc. B+ 150 v d-c at 18 ma Bias -36 v d-c <u>Receiver:</u> B+ 200 v d-c at 70 ma

b. Advantages

The transistorized power supply has several advantages over the conventional vibrator supplies in current use. These advantages are largely due to the life span of the transistor, which greatly exceeds that of even the finest vibrator. This eliminates the cost of vibrator replacement, reduces maintenance, increases the reliability of the radio set and provides higher efficiencies with lower input drains for the same power outputs. With a transistorized power supply there is much less chance of radio failure in service.

In addition, the transistor circuit has a built-in protection factor not found in vibrator supplies. A short in the output does not damage the transistors.

2. DESCRIPTION

The TU588 Power Supply is designed for a 12-volt negative or positive ground electrical system.

The power supply chassis mounts between the transmitter and receiver of the radio set. The d-c input and control circuits are brought in through a 19-pin male connector on the front panel. The various rectified outputs are routed to terminal boards on the wiring side of the chassis for the transmitter and receiver connections. An 18-lug terminal strip on one side is used for the transmitter connections; a 15-lug strip on the other side is for receiver connections.

Two alloy junction PNP transistors--designed for high power audio frequency applications--are

connected in an electronic switching circuit which is basically a multivibrator. The operating frequency is in the audio range.

The transistors are mounted on a cast-aluminum radiator (called a "heat-sink") on the front panel of the radio set. The radiator conducts heat away from the transistors, permitting them to operate safely at relatively high ambient temperatures. The heat-dissipating capacity of the heat-sink provides safe operation under the most adverse temperature conditions normally encountered in mobile radio operation.

CAUTION

A transistor feedback circuit in this power supply is enclosed in a protective cover. The cover prevents accidental shorting of the enclosed components with consequent damage to the transistors. Do not remove this cover unless necessary for servicing components. Always replace the cover before restoring operation. Never operate the power supply with the cover removed.

3. OPERATION

a. Introduction

The function of the mobile power supply is to convert the low-voltage d-c input to the various high-voltage d-c outputs required for operation of the transmitter and receiver. This is accomplished in three stages. First, the transistor

circuit changes the d-c into a-c, then the power transformer steps up the voltage of the a-c, and finally the rectifier-filter network converts the high voltage a-c to d-c.

b. Transistor Multivibrator Circuit

(1) Function

The function of the transistor multivibrator circuit is to change the pure d-c input into pulsating d-c, a form of a-c, so that it can be stepped-up in voltage by transformer action. The operation is illustrated in the simplified functional diagram, Figure 1. The diagram shows a negative ground electrical system. For a positive ground electrical system, reverse the leads to the polarity reversing terminals,

(2) Operation

The ON-OFF switch at the control head connects the 12 volt d-c input to pin #19 of the

(a) Feedback Path

The path through the "receive" feedback network leads to the center tap of the feedback winding of the transformer. The opposite ends of this transformer winding are connected to the two transistor base elements. The 330 ohm starting resistor is connected between the center tap and the d-c input. Current flows through the feedback network and starting resistor, applying a bias to the base elements of each transistor. Due to a slight unbalance in transistor conductivity, one will tend to conduct more heavily than the other. This is the effect which starts the oscillation cycle.

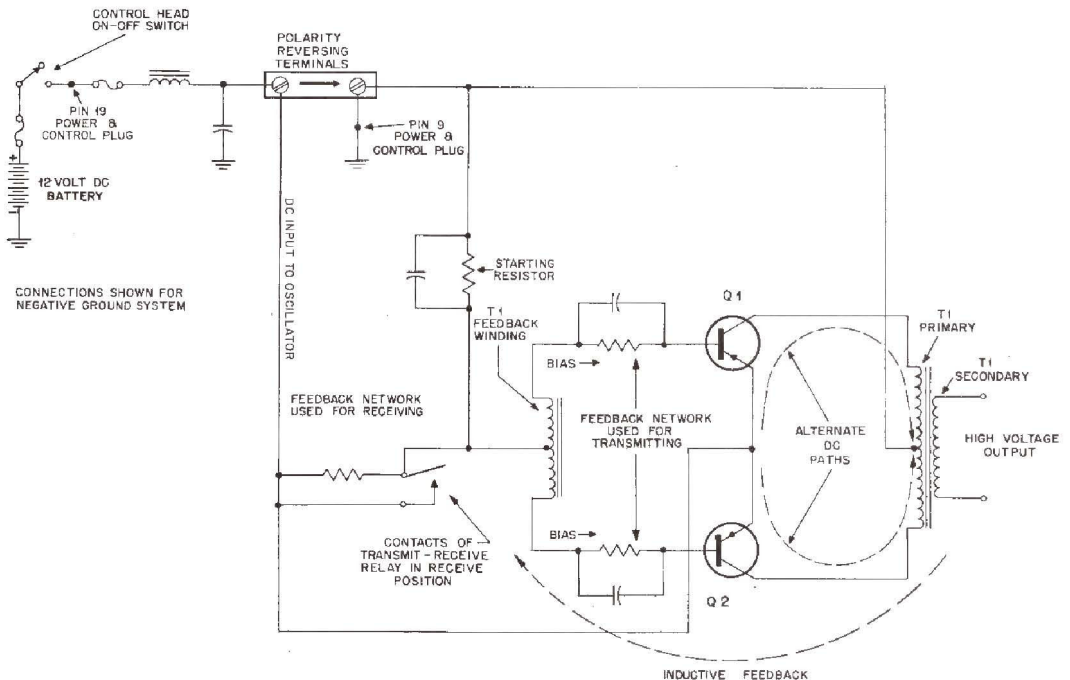


FIGURE 1

(b) Transformer Primary Path

The d-c path through the center tap of the main transformer primary winding leads to the two transistor collector elements, which are connected to opposite ends of the winding. The slight unbalance in transistor conductivity causes more current to flow through one primary half-winding than through the other. The current path is through the primary half-winding and the transistor (emitter to collector) to the d-c input. The current in the transformer half-winding induces voltages in the two feedback half-windings. Polarity is such that the more heavily conducting transistor is quickly biased to full conduction; the other transistor is quickly driven to cut-off.

(3) Oscillation Cycle

The induced feedback voltage drops to zero as the current through the conducting transistor reaches the point of saturating the transformer core. The cut-off transistor begins to conduct, reversing the polarity of the voltage in the feedback windings and conduction through this transistor increases inducing greater feedback bias and quickly cutting off the first transistor. Current through the second transistor then reaches core saturation, completing a cycle of oscillation. The circuitry is designed for self-sustaining, continuous oscillation as long as the d-c input is applied. First one transistor conducts to core saturation, then the other. Thus, the current alternates between the two primary half-windings. The switching action is very rapid and the voltage induced in the feedback winding of the transformer approximates a typical "square wave" pattern. The overall effect of the transistor oscillator circuit is essentially that of a single-pole, double-throw switch operating back-and-forth continuously.

(4) Feedback Networks

Two feedback networks are used in this circuit, one for the "receive" condition, the other for the "transmit" condition. These networks provide the proper bias for both receive and transmit conditions. The transmit feedback network is used in both transmit and receive conditions. However, in transmit condition, closed contacts of the transmit-receive relay by-pass the receive feedback network, thus utilizing only the transmit feedback network.

c. Power Transformer

The main purpose of the power transformer is to provide a high voltage a-c output with a low-voltage a-c input. A special transformer is used

in this power supply to provide the feedback required for the transistor oscillator circuit in addition to the high voltage a-c output. There are two separate high voltage secondaries for the B+ outputs and one low-voltage secondary for the bias supply.

d. Rectifier-Filter Networks

Refer to Schematic Diagram 63E856462.

(1) Receiver B+ Section

The receiver B+ rectifier-filter network converts the high voltage a-c induced in the transformer secondary to a smooth d-c output required for the receiver plate circuits. This section consists of a full-wave silicon bridge rectifier (CR9, CR10, CR11 and CR12) a "pi" section filter and a bleeder resistor.

The high voltage a-c is connected to opposite corners of the bridge circuit. On one half-cycle rectifier CR9 conducts toward the transformer and CR12 conducts in the direction of the filter and load, which completes the circuit to ground. On the other half-cycle CR11 conducts toward the transformer and CR10 conducts current toward the filter. The filter network smoothes out the ripple in voltage and current.

The output of this section is connected to a set of normally closed contacts of relay K1 in the de-energized (receive) condition. These contacts route the output to the B+ terminals of the receiver terminal board. B+ is applied to the receiver continuously except when the transmitter is turned on. Relay K1 is then energized and the receiver is muted, since its B+ circuit is broken. The relay contacts then switch the B+ output to the transmitter terminal board, where the B+ is used for the transmitter oscillator stage during the "transmit" period.

The lamp, IL, in this circuit is essentially a fuse. If an overload occurs, the lamp burns out.

(2) Transmitter B+ Section

The transmitter B+ section provides high and low B+ outputs to the transmitter when the transmit-receive relay (K1) is energized. Pressing the push-to-talk button operates this relay and its contacts complete the circuit to the bridge rectifier, CR1 to CR8. The rectifier bridge output is connected so that its B+ output is added to

the output of the multiplier B+ section, providing a transmitter B+ of approximately 705 volts. This output is filtered and routed through closed contacts of relay K1 to the transmitter PA B+ terminal, TB2-10.

The full winding of the transformer secondary provides an intermediate B+ source for the transmitter multiplier stages. The bridge network consisting of CR9 to CR12 is used as the rectifier in this circuit. The multiplier B+ output is filtered and routed through terminals of relay K1 to the multiplier B+ terminal, TB2-11. The transmitter oscillator voltage is obtained from the same source as the multiplier B+, however, the higher multiplier B+ is fed through a dropping resistor network and through contacts of relay K1 to the transmitter oscillator terminal, TB2-6.

(3) Transmitter Bias Section

The transmitter bias section includes a low-voltage secondary of transformer, T1, rectifier CR13 and a filter network. The -36 volts bias output appears on TB2-13 for connection to the transmitter PA grid circuit.

The HI-LO switch is in the transmitter (PA screen) circuit. The HI position is the normal operating position. The LO position is used for transmitted tuning purposes before the final amplifier of the transmitter is fully aligned.

e. Relay Operation

The transmit-receive relay, K1, is a 12 volt d-c relay. One side of the relay coil is connected to the 12 volt bus. To energize the relay, the other side of the coil must be grounded.

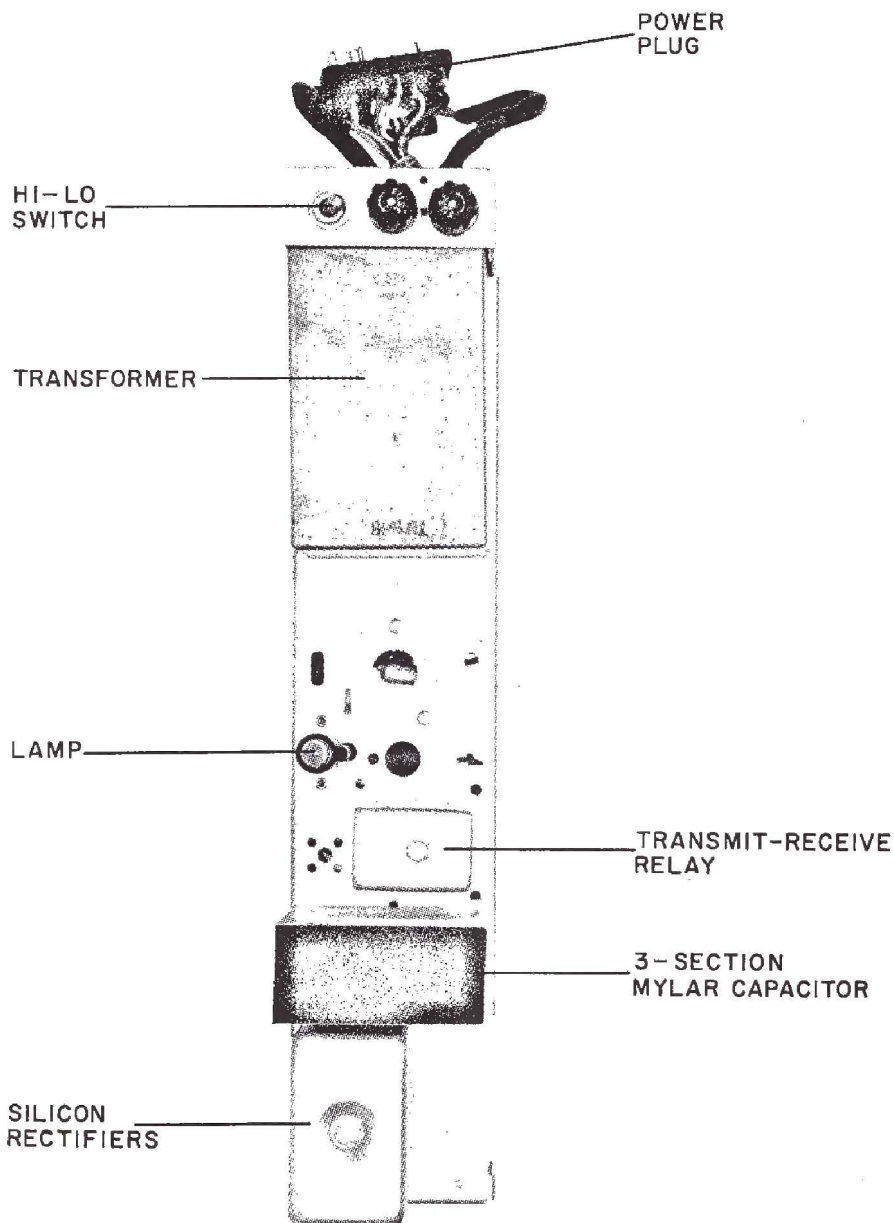
In the de-energized condition, all operating voltages for the receiver are supplied through the contacts of the relay. When the push-to-talk circuit is grounded, the relay becomes energized and the relay contacts are switched. The switching removes the B+ voltage from the receiver and supplies operating voltages to the transmitter final stages. Therefore, the receiver is muted and the transmitter is turned on when the relay is energized.

4. TRANSISTOR CHECKING

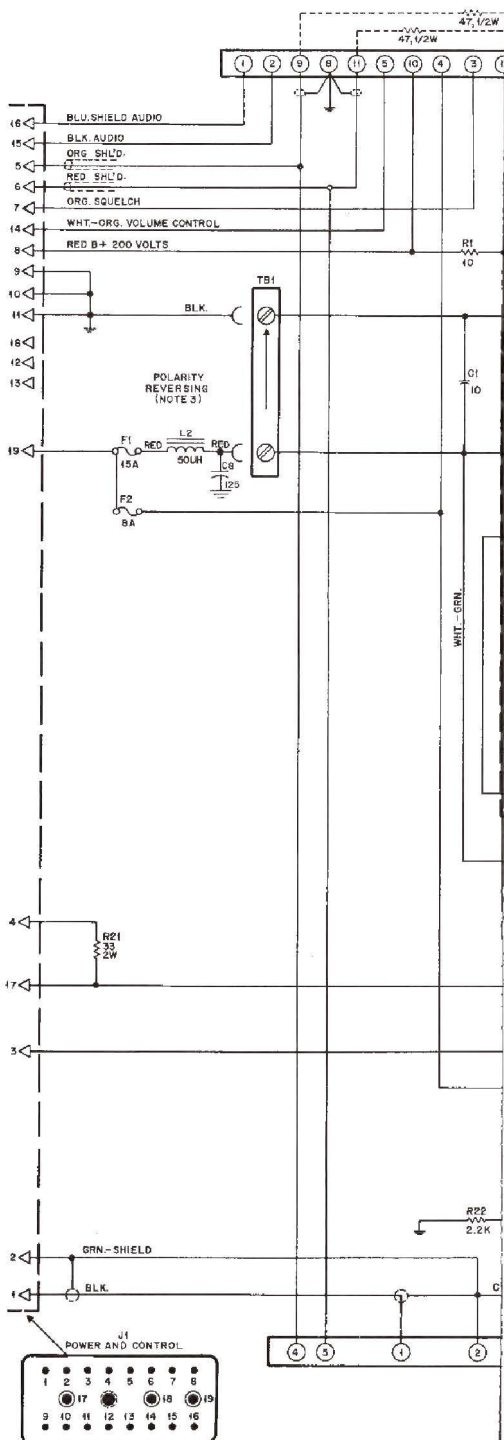
A short in a transistor is the most frequent cause of transistor failure. A simple check can be made as follows:

Connect a multi-meter between the emitter and collector of the transistor. If the transistor is shorted, the meter will read less than one ohm.

If a transistor requires replacement, refer to the INSTALLATION AND OPERATION section of this instruction manual for transistor replacement procedures.

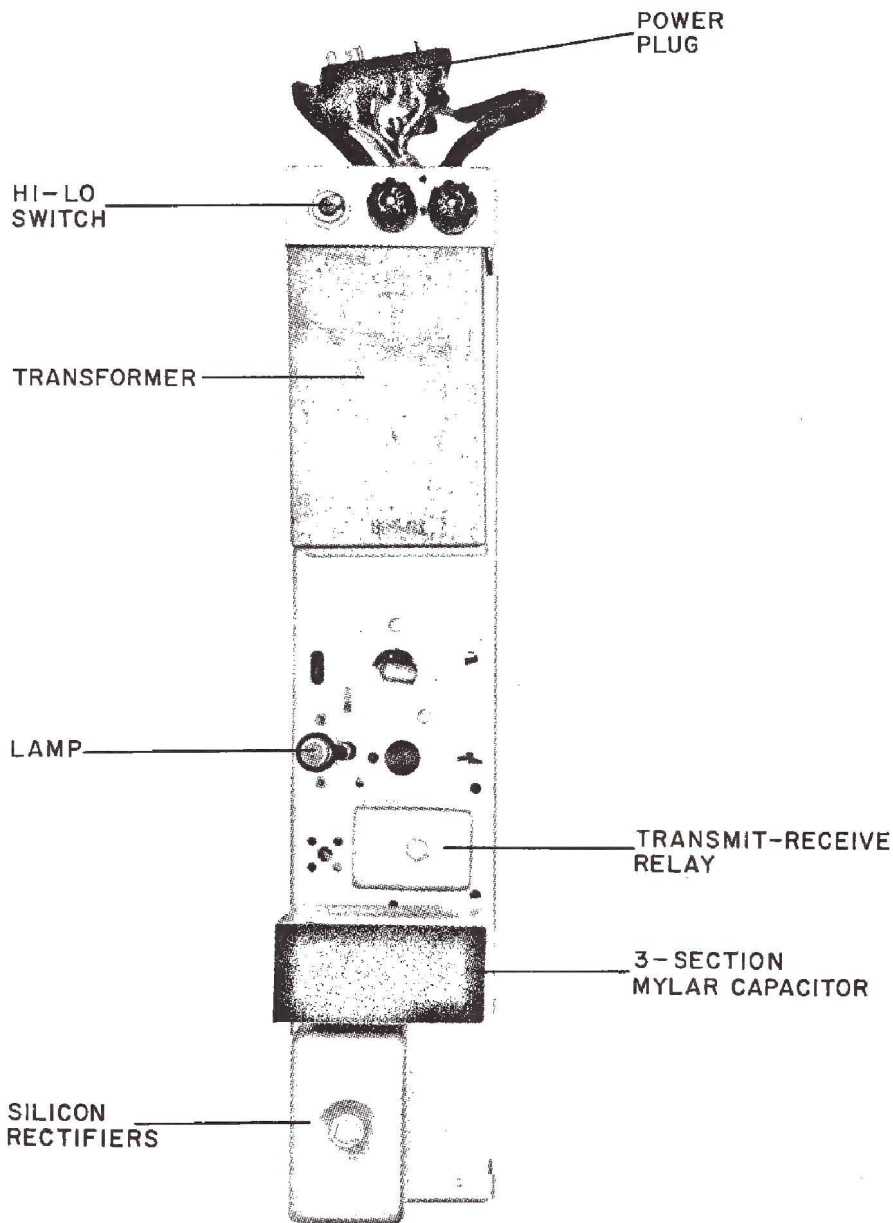


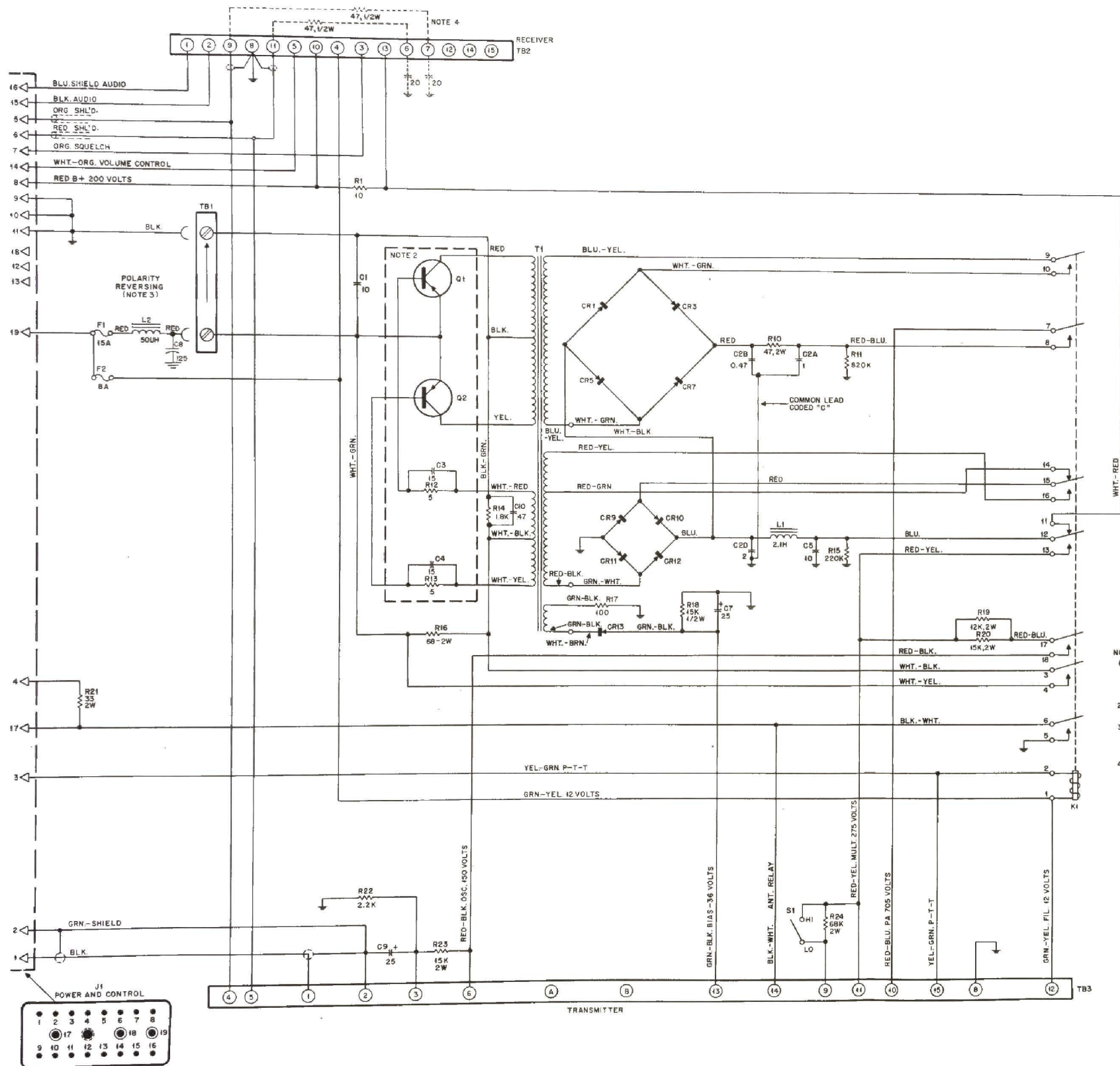
AEPD-1312-O (CE978B)



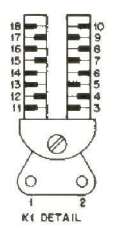
REVISIONS

DIAG. ISSUE	CHASSIS SUFFIX	REF. SYMBOL	CHANGE	LOCATION
C	TU588-3	DS1	LAMP REMOVED	FROM 275 VOLT CIRCUIT IN 12 VOLT LINE HI VOLTAGE OUTPUT CIRCUIT
		L2	WAS 120 oh	
		C2	TYPE CHANGE AND CIRCUIT WAS:	
D	TU588-4	R16	WAS 150 OHMS	PRIMARY VOLTAGE INPUT CIRCUIT IN SERIES WITH F1
		C6	1 uF REMOVED	
		R14	WAS 330 OHMS	PRIMARY OF T1
		C10	.47 uF ADDED	
		L2	RELOCATED, WAS IN SERIES WITH F2	PRIMARY VOLTAGE INPUT CIRCUIT IN SERIES WITH F1
		C8	RELOCATED, WAS IN SERIES WITH F2	
E	TU588-5		TLN6155A 2-FREQ. RCVR. FILTER KIT ADDED TO SCHEMATIC REFERENCE. SEE NOTE 4	TB2 & J1
F	TK661-1	Q1	WAS 48A125286	FRONT PANEL SEE NOTE 2
	TU588-5	Q2	1V859763 MTC. BD. ASSEM. WAS RE-PLACED WITH 1V865695 TERM. BD. ASSEM.	NON-REFERENCE PARTS LIST





MODEL TABLE	
MODEL	DESCRIPTION
TU588-5	TRANSISTOR POWER SUPPLY
TK661-1	FRONT PANEL



REVISIONS

DIAG. ISSUE	CHASSIS SUFFIX	REF. SYMBOL	CHANGE	LOCATION
C	TU588-3	DS1	LAMP REMOVED	FROM 275 VOLT CIRCUIT IN 12 VOLT LINE
		L2	WAS 120 μ h	HI VOLTAGE OUTPUT CIRCUIT
		C2	TYPE CHANGE AND CIRCUIT WAS:	
D	TU588-4	R16	WAS 150 OHMS	PRIMARY VOLTAGE INPUT CIRCUIT IN SERIES WITH F1
		C6	1 μ REMOVED	
		R14	WAS 330 OHMS	PRIMARY OF T1
		C10	.47 μ ADDED	
E	TU588-5	L2	RELOCATED, WAS IN SERIES WITH F2	PRIMARY VOLTAGE INPUT CIRCUIT IN SERIES WITH F1
		C8	RELOCATED, WAS IN SERIES WITH F2	
F	TK661-1	Q1	TLN6155A 2-FREQ. RCVR. FILTER KIT ADDED TO SCHEMATIC REFERENCE. SEE NOTE 4	TB2 & J1
F	TU588-5	Q2	WAS 48A125286	FRONT PANEL SEE NOTE 2
			1V859753 MTC. BD. ASSEM. WAS REPLACED WITH 1V865695 TERM. BD. ASSEM.	NON-REFERENCE PARTS LIST

MOTOROLA PART No.	DESCRIPTION
9B865564	<u>FUSEHOLDER:</u> extractor post type; molded black bakelite bayonet base; single hole chassis mounted; for 1-1/4" long x 1/4" dia. fuse; includes cap, lock- washer and mounting nut same as XF1
NON-REFERENCED PARTS	
1V865695	RECTIFIER MOUNTING BOARD ASSEMBLY, riveted; includes: 31A865187 MOUNTING BOARD ASSEMBLY; includes 4 pairs of terminal clips for mounting 4 diodes; 2 req'd 7B858571 BRACKET, mounting board
7D865605 14A851751	RADIATOR, transistor mounting INSULATOR, transistor; 2 req'd

ROUTINE MAINTENANCE

1. INTRODUCTION

Experience has shown that there is a particular way of maintaining 2-way radio communications equipment that is far superior to any other in achieving maximum operating efficiency and reliability at least cost.

This procedure is known as "System Maintenance", which simply means that the inspection and maintenance of all units constituting the whole is conducted in an established and orderly fashion. The procedure should be conducted at regular intervals in order to yield all of the well-known benefits of preventive maintenance.

All two-way radio communications systems include integrated assemblages. A failure in any one of these would constitute a failure of communications. However, there are three major factors in a mobile radio communications system which require attention:

- a. The primary power source
- b. The basic radio units
- c. The antenna system

Any successful maintenance program must include the entire system. It would be of no consequence to maintain the basic radio units at top efficiency only to ignore the primary power or the antenna. A failure in either one results directly in a failure of radio communications. Therefore, to be successful in preventive maintenance, a program should be developed and closely followed on a basis of all-inclusive system maintenance. Such a program should include

a periodic check on all the factors constituting a radio communications system as follows:

a. Primary Power

Automobile batteries usually fail after a long period of undercharging or overcharging, lack of water, poor connections and old age.

It is important to measure the voltage available at the battery terminals when under a load. A fully charged lead-acid battery will have a measured voltage of approximately 13.0 volts for a 12 volt battery and 6.5 volts for a 6 volt battery. An old sulphated or undercharged battery may show lower voltages. These are battery terminal voltages, not the voltage present at the radio set. The terminal voltage at the radio set will decrease when transmit current is being drawn. The voltage will be lowered approximately 1.1 volts for a 12 volt system and approximately .8 volt for a 6 volt system.

One of the good methods of checking primary power trouble is to measure battery voltage both at the terminals of the battery and at the equipment. An immediate drop in voltage of more than .2 volts measured at the battery on a short transmit cycle would indicate a battery in poor condition. A drop of more than 1 volt measured at the units would point to troubles in the primary circuit--cable, fuse block, relay or chassis return. This voltage drop is excessive and should be investigated fully.

"A" relay contacts wear out, requiring replacement.



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PARTS LIST for Power Supply Diagram 63E856462-F (Rev.)

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
C1 C2 C2A	23K859299 8K861326	<u>CAPACITOR, fixed:</u> tantalum; 10 uf +75-15%; 25 vdcw mylar; consists of: 1 uf ±20%; 900 vdcw; coded "A"
C2B		.47 uf ±20%; 900 vdcw; coded "B"
C2C C2D C3	23K858677	common connection; coded "C" 2 uf ±20%; 400 vdcw; coded "D"
C4 C5 C6	23K837903	electrolytic; tubular; 15 uf +100-10%; 10 vdcw same as C3 electrolytic; tubular; 10 uf +50-10%; 450 vdcw NOT USED
C7 C8 C9 C10	23K839917 23K840707 23K850516 8K861614	electrolytic; tubular; 25 uf +100-10%; 100 vdcw electrolytic; tubular; 125 uf +100-10%; 18 vdcw electrolytic; tubular; 25 uf +100-10%; 50 vdcw mylar; tub; .47 uf ±10%; 100 vdcw
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR12 CR13	48K859727 48K859708 48K859726	<u>CRYSTAL UNIT, rectifying:</u> silicon junction; cartridge type 1N1223 NOT USED same as CR1 NOT USED same as CR1 NOT USED same as CR1 NOT USED type 1N1222 same as CR9 same as CR9 same as CR9 type 1N1219
F1 F2	65K804906 65K475248	<u>FUSE, cartridge; one time;</u> slow blow type; glass; 15 ampere, 32 volt; 1-1/4" long x 1/4" dia. slow blow type; glass; 8 ampere; 32 volt; 1-1/4" long x 1/4" dia.
J1	28C802820	<u>CONNECTOR, receptacle:</u> male; 19 contact; polarized; rectangular molded black phenolic insulator; chassis mounted
K1	80K858550	<u>RELAY, armature:</u> dual stack; contact arrangement: 1st stack, 1 form "A", 2 form "C", 2nd stack, 4 form "A"; coil resistance 100 ohms; does not include 15K848892 COVER, relay, nor 7A811735 BRACKET, relay cover mounting; cover and bracket must be ordered separately

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
L1	25B837416	<u>REACTOR:</u> filter; 2.1 henries at 100 ma. dc
L2	25B861375	<u>COIL, AF:</u> choke; 50 microhenry
Q1 Q2	48A124376	<u>TRANSISTOR:</u> P-N-P same as Q1
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24	6R118205 6R488035 6R2053 17K858769 6R5620 6R5574 6R118239 6R6415 6R6477 6R5766 6R5732 6R488016 6R6409 6R2079	<u>RESISTOR, fixed; carbon; ±10%;</u> 1 w; ins.; unless otherwise stated 10 ohm ±20% NOT USED NOT USED NOT USED NOT USED NOT USED NOT USED NOT USED 47 ohm; 2 w 820K wire-wound; 5 ohm; 5 w same as R12 1.8K ohm 220K 68 ohm; 2 w 100 ohm 15K; 1/2 w 12K; 2 w 15K; 2 w 33 ohm; 2 w 2.2K same as R20 68K; 2 w
S1	40A482097	<u>SWITCH, toggle:</u> S. P. S. T.
T1	25D858644	<u>TRANSFORMER, power:</u> transistor controlled; consists of the following windings: primary #1: YEL, RED leads with BLK center tap; total resistance .031 ohms primary #2: WHT-RED, WHT-YEL leads with WHT- BLK center tap; total resistance .040 ohms secondary #1: BLU-YEL, BLU-YEL leads; resistance 21.5 ohms secondary #2: RED-BLK, RED-YEL leads with RED-GRN tap; total resistance 12.6 ohms secondary #3: GRN-BLK, GRN-BLK leads; resistance 2.26 ohms
TB1 TB2 TB3	31A858723 31B802699 31B851408	<u>BOARD, terminal:</u> 2 screw terminals 14 solder lug terminals; board coded 1 to 15 17 solder lug terminals; board coded B, A, and 1 to 16

REFERENCE SYMBOL	MOTOROLA PART No.	DESCRIPTION
XF1 XF2	9B865564	<u>FUSEHOLDER:</u> extractor post type; molded black bakelite bayonet base; single hole chassis mounted; for 1-1/4" long x 1/4" dia. fuse; includes cap, lock- washer and mounting nut same as XF1
NON-REFERENCED PARTS		
	1V865695 7D865605 14A851751	RECTIFIER MOUNTING BOARD ASSEMBLY, riveted; includes: 31A865187 MOUNTING BOARD ASSEMBLY; includes 4 pairs of terminal clips for mounting 4 diodes; 2 req'd 7B858571 BRACKET, mounting board RADIATOR, transistor mounting INSULATOR, transistor; 2 req'd

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Fuses get tired, sometimes even when new they may have too much resistance. Check and replace if voltage drop exceeds .1 volt.

Connections loosen as a result of vibration. Tighten or resolder.

Fuse Holders also loosen because of vibration. They lose their temper because of heat resulting from poor contact. Acid causes corrosion. Accumulation of oil and dirt increases contact resistance and the remedial action is to clean contacts, tighten or replace.

Keeping voltage drops to a minimum in a primary circuit is very essential to good system operation. The same rules apply to other sources of power. Dry batteries especially must be checked under full load. Some knowledge of the number of hours of use must be available as an indication of when they most likely will need to be replaced.

b. Unit Assemblages

These include transmitter, receiver, power supply, and associated units. Very few adjustments need to be made regularly in transmitter and receiver units. To catch a maximum number of incipient troubles, the technician must use his eyes, his ears, his sense of touch, and meter measurements, as well as his good judgment and past experience.

Basically four types of observation are required:

Listening Tests

An experienced technician can often detect warnings of impending trouble by noting the audio quality, the noise background and the squelch operation in relation to the settings of the volume and squelch controls. He will come to know the normal signal level he should obtain at given locations with selected stations in a particular system. Degradation of performance will be immediately apparent to the technician who checks the set periodically, whereas the steady operator may become accustomed to a gradually degraded performance.

Visual Inspections

Look for loose bolts, screws and clamps, worn handset cords, burned out pilot lights, arcing at any point, loose or broken components, burned resistors or loose connections. A good

visual inspection not only is a means of quickly locating the source of trouble, but may prevent more serious trouble from developing later.

Touch

The fingers are good detectors of improper temperature conditions. Fuses, fuse holders, crystal ovens, transformers and relay coils which are too hot mean trouble. Also, a cold crystal oven, tube or resistor that should normally be warm is probably in trouble. Such tests are quick and should be used often.

Meter Measurements

Actual quantitative measurements of "A" and "B" voltages, grid and plate currents, power output, frequency and deviation have no substitute; their meaning is definite. Experience will indicate to what degree variation can be tolerated. Good test equipment is essential to good system performance.

c. Antennas

Visual check of antenna, antenna mount, cable, and connectors should be made periodically, as well as a meter check to find any open or shorted lines. Remember that the antenna must efficiently radiate the power developed in the transmitter chassis and also transfer to the receiver the minute voltages picked up from the distant transmitter to produce a good audible signal. Failure of the antenna or line is a failure of the communications system.

d. Netting

Netting of receivers and transmitters in any system is more important than usually realized. The term "netting" means that all receivers and transmitters in a given system are aligned on the same frequency or frequencies. With modern selectivity requirements, it is more than ever necessary to tune every receiver exactly to the station it must receive. Careful "netting" of all units in an integrated system to the correct frequency is a first order requirement of a modern communications system and will eliminate a prime cause of poor system performance. It is in this field of system operation that the high frequency stability and selectivity stability is of major importance.

Frequent checks of transmitter deviation will improve system operation. A good rule to follow is to check performance frequently and make

adjustments only when actual tests and measurements show improper operation.

2. MAINTENANCE CHECKS

A good preventive maintenance program requires a complete system check at least every three months and it is recommended that individual records be kept of each unit. In a general way the following items should be part of any preventive maintenance routine.

- a. Clean and dust the equipment thoroughly.
- b. Make a thorough mechanical inspection of the entire mobile installation.
- c. Check the battery terminals. Battery connections must be clean and tight at all times to prevent power losses due to excessive voltage drops across loose connections.
- d. Check the fuses. Fuses must fit snugly in the fuse holders to prevent voltage drops at these points.
- e. The vehicle battery should be checked at least once a month, however, it is recommended to make this check weekly to assure that it is properly charged. A specific gravity measurement is recommended for this purpose. The reading obtained should be in agreement with the normal operating specifications stipulated by the battery manufacturer.
- f. Check the A-plus voltage at the battery and at the radio set with the radio equipment turned "on" and the vehicle motor turned "off".
- g. Check the dc resistance from the inner conductor to the outer conductor of the antenna coaxial lead-in cable.
- h. Power Input Cables

Power cable connections may be checked by measuring the overall voltage drop from the battery to the equipment. With the transmitter "on" and the vehicle motor running, the voltage drop from the ground cable of the radio equipment to the battery ground terminal should be negligible. The voltage drop in the power cable from the (hot) battery terminal to the equipment should not exceed 1 volt. Cable voltage drop will be the difference between the voltage reading obtained from the battery terminal to ground and the reading obtained from a voltage input point

on the mobile equipment to ground. These voltage measurements should be made with an accurate dc voltmeter. Proper operation of this equipment depends upon correct input voltage. The input voltage may be measured at the fuse located on the top front end of the power supply chassis (terminal with yellow lead attached). The drawer assembly must be partially pulled out of the mobile housing to permit access to convenient voltage input measuring point.

i. Vehicle Generator and Voltage Regulator

Routine Maintenance Checks should be made on the vehicle generator and voltage regulator to insure proper operation of the radio equipment. Periodic maintenance should include:

- (1) Checks of generator brush condition and replacement if necessary.
- (2) Checks of generator armature condition.
- (3) Check of generator output and voltage regulator setting. This setting should conform to either the car manufacturer's or the generator manufacturer's recommendations.
- (4) Check of generator lubrication and re-lubrication if required.

j. Antenna

Routine preventive maintenance of mobile systems should include a continuity check of the braided lead between the antenna rod and the coaxial lead-in. Ordinarily hidden from view within the base assembly, the lead may become frayed or broken without attracting immediate notice. However, any decrease in RF continuity introduced here will cause a decrease in radiated power and receiver sensitivity. Moreover, intermittent contact can generate undesirable interference in the form of noise caused by:

- (1) high contact resistance.
- (2) imperfect bonding which permits the inherent noise to enter the receiver.

k. Clean the relay contacts.

1. Check all transmitter and receiver stage meter readings and replace any tubes and transistors as required.

Transistors located in the heat sink on the front panel are coated with DC-4 silicone grease. This grease increases the rate of heat transfer.

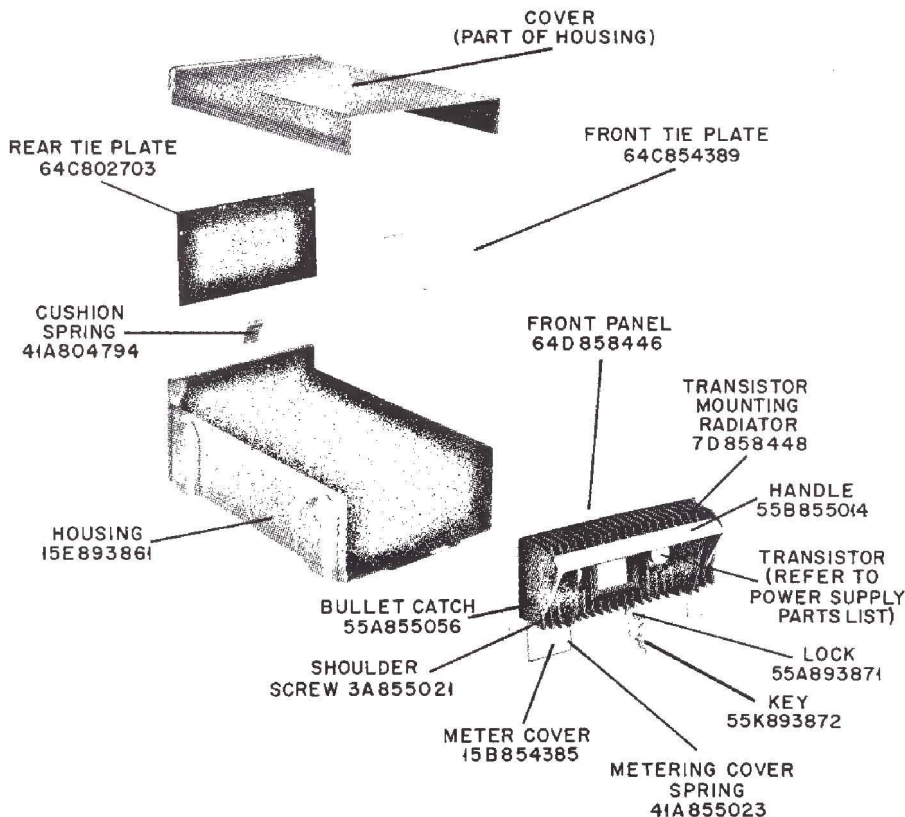
Note that a thin mica insulator is between each transistor and the front panel. When replacing a transistor, first coat it with silicone grease and place the insulator between the transistor and the front panel. There also must be silicone grease between the mica washer and the heat sink. Replace the mica insulator if it is damaged.

m. Check the filament voltage and the B+ voltages.

- n. Set the transmitter oscillators on frequency.
- o. Tune the entire transmitter.
- p. Check the transmitter modulation.
- q. Tune the entire receiver.
- r. Check the audio response against a fixed station.

NOTE

For detailed alignment procedures of the various chassis refer to the pertaining instruction section of this instruction manual.



HOUSING PARTS IDENTIFICATION DETAIL

SUPPRESSION OF IGNITION NOISE IN MOBILE EQUIPMENT

1. NOISE SUPPRESSION

Noise suppression requirements will vary quite widely with different vehicles, types of installation and types of system operation. System use and area coverage often determine how much noise suppression may be necessary. If the operating area is sufficiently small so that signal levels may always be high, less noise suppression will be required. Conversely for maximum range coverage and operation in weak signal areas, it becomes necessary to do a very good job of noise suppression. If the units are operating in areas with high ambient noise, it will not be necessary to do as good a job of vehicle noise suppression. It would obviously be uneconomical to spend time and money on noise suppression if the local ambient noise in the area is going to be higher than the vehicle interference levels. One of the first considerations is to determine that the noise is caused by the vehicle in which the receiver is located.

The Model TEN6018A Noise Suppression Kit is available for all vehicles equipped with two-way radio. Refer to diagram 69C854657 at the end of this section for a typical noise suppression installation.

2. SOURCE

The type of noise can generally be determined by its sound in the speaker. For best results in locating noise, the receiver should be receiving a weak signal which produces not less than 10 db, nor more than 30 db, noise quieting. Greater quieting will mask the noise by limiter action; less quieting will mask the specific noise with inherent receiver thermal noise. Impulse noise will probably be most noticeable between 20 and 30 db, of receiver noise quieting.

Ignition noise is characterized by regular "popping or snapping" heard at the speaker and will vary with the speed of the engine. This noise may be generated in the ignition coil, distributor, or the spark plugs and radiated from any lead connecting these components. A whining noise is probably generator interference. A harsh rasping noise is generated by gauges, particularly the pulsing type temperature gauge. Erratic "popping" while the vehicle is in motion is possibly the result of static electricity discharges from moving insulated parts of the vehicle. Erratic "popping" which increases as lights and other electrical accessories are turned on, can be the result of miniature arcs produced by minute potential differences between portions of the vehicle body, frame and motor block. These potential differences, for the most part, can be corrected by proper bonding practices.

3. RADIO EQUIPMENT POWER SOURCE

Power for the radio equipment should always be obtained directly from the battery rather than some other junction. Feedback and intercoupling can result between interfering currents of the vehicle electrical system and the radio circuits. In some cases these two systems can be intercoupled. It is always best to couple equipment directly to the battery to prevent this coupling as much as possible.

In addition, by connecting the radio's primary power lead directly to the battery instead of the starter key, the battery acts as a large capacitor and by-passes noise to ground. The radio ground return cable requires a secure, clean mechanical and electrical connection to the vehicle frame. The battery ground return should also be bonded to the frame. Utilizing the car frame as a common ground as much as practical, tends to minimize the possibility of inducing many unwanted parallel ground currents.



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4. IGNITION

The vehicular ignition system is the worst offender from the standpoint of noise generation. The impulse noise produced must be kept under control by proper preventive maintenance and addition of suitable noise suppression items. It is necessary to check for: (1) distributor breaker points in good condition, (2) ignition condenser in good condition, (3) all ignition system connections free of corrosion and making good contact, (4) circuit continuity in the high voltage leads, (5) sufficiently high spark plug breakdown voltages, and (6) spark plug electrodes properly spaced and in good condition. Mobile installation kits usually require at least a noise suppressor resistor to be placed in the lead from the ignition coil to distributor and a shielded by-pass capacitor, to be connected from the ignition coil primary to ground.

5. RESISTANCE TYPE SUPPRESSORS

Additional elements in the ignition circuit are commonly used to attenuate the impulses. Resistor type spark plugs or spark plug suppressors, have been found to be of great assistance in many cases. While the manufacturer claims superior engine performance is obtained by using these plugs, it is recommended that a check be made to assure (1) that the proper plugs are being used, and (2) that the engine performance is at least equal to that obtained using standard plugs. The distributor noise suppressor can be eliminated if a distributor with a built-in resistor is substituted for the standard distributor. Resistance ignition cable can be substituted for standard ignition cable to obtain additional attenuation. In some cars, it has been found that excessive resistance in the spark plug circuit may produce rough idling, particularly in cold weather. Thus, it may not be possible to use a distributor noise suppressor, resistance ignition cable and resistor spark plugs simultaneously in all cars. Today some manufacturers are tending to pre-equip new models with either resistance ignition cable or resistor spark plugs, or both. In such cases, substitution need not be made. Later models have much higher ignition voltage and can, therefore, accommodate the higher total resistance.

6. SPARK PLUG LEADS

In stubborn ignition interference problems, be sure to check the continuity of the spark plug leads. Through use of an ohmmeter or some other continuity indicator, such as dry battery

and small bulb, you may find one or more leads open. The first place to check is the spark plug end of the lead. In an ignition system where the end of the lead and the terminal is molded in rubber, the terminal is probably not soldered to the conductor. The connection may be strictly mechanical.

By squeezing the terminal with a pair of pliers, it may register continuity. In this case, the lead is probably satisfactory. With an intermittent indication, it may be necessary to either replace the lead or to open the terminal and solder the lead to the terminal. If the lead is replaced, be sure to check the replacement lead for continuity. If the soldered lead is in the open, be sure to provide suitable protection against weather induced terminal corrosion.

7. CONTACTS

It is always desirable to minimize the number of contacts required in an ignition system, to minimize interference as a result of poor connections. Thus, resistor spark plugs are preferred to standard spark plugs plus spark plug suppressors. Also resistance ignition cable is preferred to standard ignition cable plus series suppressors.

8. COUPLING

Ignition noise can be (1) coupled capacitively from high voltage to low voltage leads, (2) can be radiated from high voltage leads, (3) can be radiated from low voltage leads, (4) can be radiated from other metallic linkages due to shock excitation, (5) can be radiated from ignition leads, and (6) may be radiated from the distributor or ignition coil. Many trial-and-error methods of countering such problems are available, but may consume considerable time and expense in the process. Among the trial-and-error methods are those listed below.

If the lead between the ignition coil and the distributor, or any other ignition lead is a critical length for radiating on the receiver frequency, noise can be reduced by changing its length. Capacitive coupling from high voltage to low voltage leads can be minimized by achieving maximum separation between such leads. For extreme cases it can be minimized by shielding the leads or running the leads in a separate conduit. Complete shielding of the ignition coil and distributor has afforded some relief in a few stubborn cases.

9. DISTRIBUTOR

Ignition noise caused by distributor point sparking and/or radiation taking place and transmitted via associated primary wiring can be reduced by the following:

- a. Install a coaxial .1 mfd capacitor at the battery input of the primary side of the ignition coil.
- b. Great care should always be taken to be sure that all the wires are pushed completely down into the distributor head towers. Or, solder connections in the distributor cap towers to prevent arcs taking place in the secondary circuit.
- c. Install a 10,000 ohm suppressor in the distributor center tower, if a suppressor lead is not used.

10. DC GENERATING SYSTEM

The DC generating system in a car creates a raspy sounding interference and one that is easily recognized by ear. The commutator noise and hash can be eliminated entirely by replacing the DC system with an AC generating system. If this is not contemplated, the following methods may be applied.

11. GENERATOR

Generator noise is characterized by a high pitched "whine" and varies with engine speed. With car in motion check with weak signal, ignition turned off, alternately engaging and disengaging the clutch to drive generator at various speeds.

Noise elimination in the generator system may be as follows:

- a. Generator noise may be the result of dirty or worn commutators. Various manuals have instructions for balancing and dressing down dirty commutators. In some cases, commutators may be cleaned with fine sandpaper or dressing stone. Emery cloth should never be used for cleaning commutators. Generator noise can normally be kept at a low level if the brushes and commutator are kept in good condition.
- b. Install a 0.5 mfd coaxial capacitor at the generator in series with the armature lead.

Keep in mind that the portion of the lead between the condenser and the generator should be kept as short as possible. Any shielding that can be afforded to the armature terminal will be helpful.

- c. Install a 0.5 mfd coaxial capacitor at the generator regulator (ARM) terminal in series with the armature lead to the generator.
- d. Install a 0.5 mfd coaxial capacitor at the generator regulator (BAT) terminal in series with the battery lead. Keeping the leads on the regulator side as short as possible will benefit here also.

CAUTION

Do not connect a bypass capacitor directly from generator field terminal to ground. (See "Voltage Regulator").

- e. In some cases it may be necessary to install shielded wiring between the generator and regulator to stop radiation from the primary winding. In such cases, it is necessary that the braid in shielding over the control wires be extremely well grounded at both ends and very near the connected items. It is necessary to run the shields up very close to the actual connection terminals in order to prevent "hot" areas from radiating interference.
- f. Inductance and capacity "Pi" section filters may be sometimes required. Extremely low resistance RF filter coils, about one inch in diameter with 10 to 20 turns of #10 or #12 enameled wire, with each side bypassed to ground, through a .1 or .01 mfd. mica or good paper capacitor, physically mounted and protected will generally remove the last traces of generator noise. The Motorola P-346 generator filter can be utilized to this end.
- g. Care should be used that all generator covers are free of paint and grease that might prevent good electrical connection with the generator frames.

NOTE

In all cases where coaxial capacitors are mentioned, they should not be replaced by standard by-passes. The standard by-pass displays a resonance effect with high attenuation, at about 2 megacycles. The coaxial type is non-inductive and has high attenuation, up into the U. H. F. region.

12. VOLTAGE REGULATOR

Voltage regulator noise is characterized by a "raspy" sound. Look for arcing of voltage regulator contacts. This noise may be reduced by installing a 3.3 ohm resistor in series with a .002 mfd capacitor (Maximum capacity allowable) in series with the field (F) terminal of the voltage regulator to a common ground with the generator. Resistor must be non-inductive carbon. However, three 10 ohm or 12 ohm resistors in parallel may be substituted. This voltage regulator suppression is often very important, since this noise may be as severe as the generator noise itself.

CAUTION

Never use a capacitor across the field contacts or between field and ground unless you also use the resistor, for such application will result in greatly reduced regulator life.

13. GAUGES

Gauge noise is characterized by a "hissing" or "crackling" sound which may be detected by jarring the individual gauges while the ignition switch is on. The effect of each individual gauge will be made more pronounced by disconnecting the "hot" lead of all gauges, except the one being checked. One of the most frequent offenders, the temperature gauge, can be corrected by bypassing the temperature gauge lead at the motor block with a .25-.5 mfd by-pass capacitor. However, several later models do not have the pulsing type gauge-senders. Many are merely "on" - "off" contacts associated with a red warning light for the abnormal condition.

14. OIL SENDER

Oil sender noise is characterized by a low-pitch clicking sound. The noise rate varies with the oil pressure and stabilizes at the point of maximum pressure. This interference can be eliminated by installing a .25-.5 mfd by-pass capacitor from the oil gauge lead terminal, on the oil sender, to ground.

15. STATIC CHARGES

Any moving part of the vehicle, insulated from the rest of the vehicle, can build up a static electricity potential, which discharges to produce noise. The front wheels, insulated from the axles by a film of grease, are the primary offenders on this score. Standard grounding brushes

or springs, such as front wheel static eliminators, will be satisfactory in most cases where this interference is present.

16. BONDING

In most modern cars and trucks, the vehicle body and frame form the ground return for the electrical circuits. Differences in conductivity, inadequate bonds between adjacent conductors and unequal current distributions result in potential differences throughout the vehicle. The miniature arcs created by these potential differences can be eliminated by eliminating the potential differences themselves. Effective use of copper bonding braid or brass contact wipers will minimize this interference.

Bonding the hood, the exhaust pipe and the muffler, as well as the motor block to the frame will probably provide the greatest improvement. The hood can utilize contact wipers along the edges plus copper braid at the hinge. The copper braid may be placed along the edge of the body so that the hood will mesh into it as it closes. The end of the braid should be connected to the hood with sufficient slack to prevent breakage at the hinge. The exhaust pipe and muffler are often suspended from the frame with a rubber mounting, therefore good contact can be obtained only by additional bonding. Although the engine is already grounded to the frame, with copper braid, additional bonding may be required.

17. COUNTERPHASING OR NOISE BALANCING

It is a characteristic of a FM receiver that, at one point in the alignment, a null point in impulse noise response will be reached. This null may vary from installation to installation. As it leaves the factory, the receiver is tuned to the exact operating frequency and is properly adjusted for proper noise balance. However, if it is found necessary to noise balance the receiver at some future date or in some specific installation, the correct procedure should be used, as follows:

Adjustments should be made with the receiver installed in the mobile vehicle and the vehicle engine running.

- a. Turn the equipment "on" and allow it to warm-up for at least five minutes.

b. Radiate a signal on the frequency of the receiver. The signal can originate from a MOTOROLA portable test set with a built-in crystal-controlled peaking generator and correct transmitter crystal, from a signal generator or from a distant transmitter.

The receiver should be on frequency. The received signal should be just strong enough to produce 10 to 30 db quieting.

c. Turn up the receiver volume to a normal listening level.

d. Start the vehicle and let the engine idle. Connect the portable test set to the receiver metering receptacle. Put the test set in position 2. If a portable test set is not available, Multi-meter AN/PSM-4 may be used.

e. If adjustment of the second mixer coil does not prove effective, adjust any one of the first i-f coils until ignition noise is substantially reduced.

The first i-f coils are very sensitive and may only be adjusted a very slight amount without reducing receiver gain. When making ignition noise balance adjustments, do not decrease the meter reading more than one-half microampere.

f. If satisfactory reduction of audible noise cannot be obtained by the methods previously described, the secondary winding of the discriminator is probably not aligned to exactly 455 kc. Align the discriminator as described in the receiver alignment procedures.

Noise balancing a receiver may result in an appreciable amount of noise reduction, however, this method alone may not reduce all of the apparent ignition noise. Some vehicles with a minimum of ignition noise interference may require only noise balancing the receiver. Whereas other vehicles will require ignition noise suppression in addition to noise balancing.

18. SUMMARY

Even when no specific noise problem exists, countermeasures should be employed to maximize range and intelligibility. These countermeasures should limit the noise at its source.

When noise problems do exist, follow the corrective measures suggested in the instruction manual, and include the following:

1. Check for spark plug breakdown under a compression test.
2. Use resistor spark plugs, spark plug suppressors or resistance ignition cable.
3. Check condition of generator brushes, commutator, armature co-axial and by-pass capacitors. The generator covers should be free of paint and grease that might prevent good electrical connections with the generator frame.
4. Install 3.3 ohm resistor in series with a .002 mfd capacitor from the field terminal (F) of the voltage regulator to a common ground with the generator.
5. Check for the proper bonding, tail pipe grounded to frame with copper braid, motor block grounded to the frame, etc.
6. By-pass oil sender, gauges.
7. Check for open circuits in the high voltage leads between the spark plug and distributor.
8. Check and adjust the distributor points and check the ignition capacitor.
9. See that power for the radio equipment is obtained directly from the battery.
10. Noise balance the vehicle radio receiver.

Specific noise sources may be isolated to some extent, under specific 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 with the ignition switch off. If the vehicle is coasting in gear, with the ignition switch off, generator noise will be added to the others, if present. 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. Also, care should be used to check with squelch control in the unsquelched or maximum sensitivity condition.

Radiating a signal from the Model 80R generator to the vehicle antenna system is most useful in establishing a reference level to determine when any improvement in noise reduction is made.

The use of a co-axial flexible lead, with a probe pick up loop about one inch diameter, connected to a separate powered radio set or oscilloscope and utilized as a search wand to find the hottest areas, has been found to be most useful.

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 suppression can add to both operational efficiency and operator satisfaction.

Other suggestions for noise suppression aids are as follows:

DESCRIPTION	PART NO.
Hood Wiper Kit.....	1V81618
Incl.: 4 Hood Wipers.....	39A4205
4 Tapping Screws (8x3/8).....	3S7516
Wheel Static Collector Assembly.....	1K534254
Incl.: 2 Wheel Static Collectors.....	1K534255
2 Wheel Static Collector Springs...	41B534253
2 Wheel Static Collector Contacts..	39A534252

NOISE IDENTIFICATION AND SUPPRESSION CHART

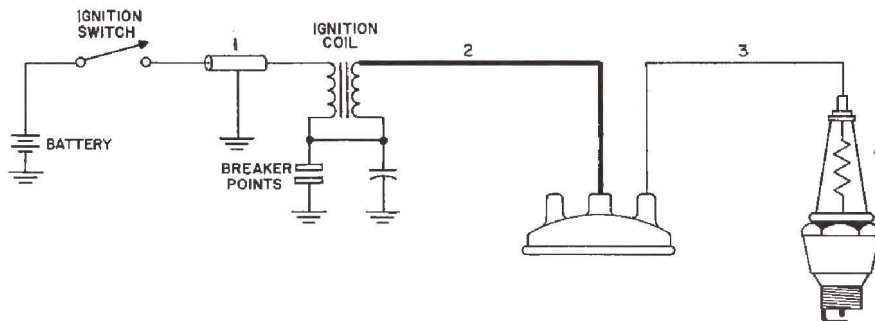
Characteristics of Noise at Speaker	Source of Noise	How to Check Source of Noise	How to Suppress Noise
Identified as popping sound	Ignition	Noise varies in frequency with engine speed and will disappear when ignition is switched off.	1. Check to be sure: (1) Distributor breaker points are in good condition. (2) Ignition condenser is in good condition. (3) All ignition system connections are free of corrosion & making good contact. (4) THERE IS DC CONTINUITY IN HIGH VOLTAGE LEADS. (5) There are sufficient high spark plug breakdown voltages. (6) Spark plug electrodes are properly spaced and in good condition.

NOISE IDENTIFICATION AND SUPPRESSION CHART (Cont'd)

Characteristics of Noise at Speaker	Source of Noise	How to Check Source of Noise	How to Suppress Noise
			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 ignition cables.
Identified as a high pitched whine	Generator	Noise varies with engine speed and will persist if ignition is switched off while engine is running at a moderate speed.	1. Install a .25 - .5 mfd. coaxial capacitor at the generator in series with the armature lead. 2. A hand wound choke in series with the generator field has been used with considerable success. 3. Install a MOTOROLA Model P-346 Generator Filter in series with the armature.
Identified as a raspy sound	Voltage Regulator	Look for arcing of voltage regulator contacts.	Install .25 - .5 mfd. coaxial capacitors at the battery (BAT.) terminal in series with the battery lead and at the generator (ARM) terminal in series with the armature lead.
Identified as a hissing or crackling sound	Gauges	Noise may be detected by jarring the individual gauges while the ignition is on.	Install .25 - .5 mfd. by-pass capacitors where needed.
Identified as a low-pitch clicking sound	Oil Sender	Noise rate varies with oil pressure and stabilizes at point of maximum oil pressure.	Install .25 - .5 mfd. by-pass capacitor from gauge lead terminal on Oil Sender to chassis ground.
Identified as an irregular popping sound	Wheel Static	Noise disappears when brakes are lightly applied.	Install suitable grounding brushes or springs such as front wheel static eliminators.
Identified as a more regular or sharper popping sound	Tire Static	Noise becomes much worse at 30-50 m. p. h.	Use anti-static powder in tire tubes.

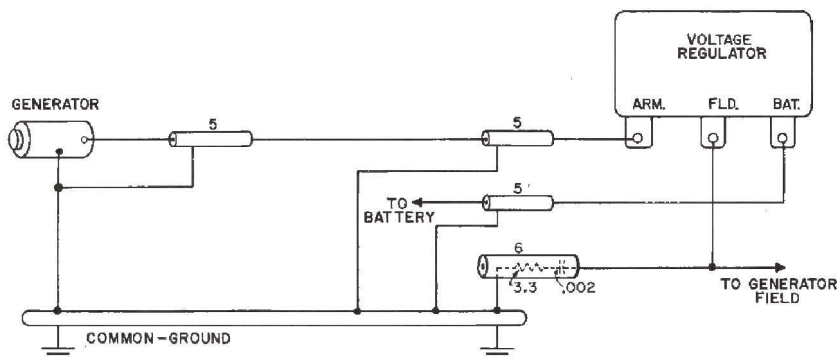
NOTES:

1. THE 0.1UF COAXIAL CAPACITOR SHOULD BE MOUNTED AS CLOSE TO THE IGNITION COIL PRIMARY INPUT AS POSSIBLE.
2. EITHER A SUPPRESSOR CABLE OR A RESISTOR SUPPRESSOR IN THE DISTRIBUTOR ROTOR LEAD OR BOTH MAY BE USED ACCORDING TO THE REQUIREMENTS OR THE LIMITATIONS OF THE INDIVIDUAL INSTALLATION. SEE PARAGRAPH 5 OF THIS SECTION FOR FURTHER DETAILS.
3. EITHER RESISTOR SUPPRESSORS IN THE DISTRIBUTOR SPARK PLUG LEADS, OR RESISTANCE WIRES, OR RESISTANCE SPARK PLUGS OR ANY COMBINATION MAY BE USED ACCORDING TO THE REQUIREMENTS OR THE LIMITATIONS OF THE INDIVIDUAL INSTALLATION. SEE PARAGRAPH 5 OF THIS SECTION FOR FURTHER DETAILS.
4. THE 0.5UF COAXIAL CAPACITORS SHOULD BE MOUNTED AS CLOSE TO THE GENERATOR AND THE REGULATOR AS POSSIBLE.
5. NOISE SUPPRESSION CAN BE ACHIEVED ONLY IF COMPONENTS ARE PROPERLY GROUNDED, BE SURE ALL COMPONENTS ARE PROPERLY GROUNDED.



TYPICAL NOISE SUPPRESSION DETAIL

THIS DIAGRAM IS A SUGGESTED NOISE SUPPRESSION SETUP. IT MAY BE USED IN ITS ENTIRETY OR IN PART, ACCORDING TO THE NEEDS OR LIMITATIONS OF THE INDIVIDUAL INSTALLATION. (SEE TEXT FOR COMPLETE INFORMATION.)



REF. SYM.	DESCRIPTION	PART NO.
1	*COAXIAL CAPACITOR, 0.1UF	8B839908
2	*SUPPRESSOR CABLE	30A502396
3	RESISTIVE WIRE	SEE AUTO PARTS DEALER
4	RESISTOR SPARK PLUG	AUTO-LIGHT OR CHAMPION
5	*COAXIAL CAPACITOR, 0.5UF	8K839909
6	*GENERATOR FIELD SUPPRESSOR ASSEMBLY (3.3Ω RESISTOR & .002UF CAPACITOR)	1V80700A89

* THE TEN608A NOISE SUPPRESSION KIT CONSISTS OF THE ITEMS MARKED WITH AN ASTERISK.

