MOBILE RADIO

MAINTENANCE MANUAL

Audio Oscillator MODEL 4EX6A10
COMBINATION NUMBERS TE31, TE34, TE35 & TE36

SPECIFICATIONS *

Dimensions (H x W x D)	3" x 5-1/2" x 2-1/2"
Input Power	2.4 milliamps at 14 volts (two 7-volt mercury batteries)
Output Voltage	0 - 3 volts RMS (variable from panel control)
Output Frequencies	1000 Hz ±5% 1811 Hz ±5%
Distortion	5% maximum
Temperature Range	0° C to 45° C (+32° F to 113°F)

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

COMBINATION INDEX

COMBINATION NUMBER		USED WITH
TE31	Includes: 4EX6A10 with batteries and 19C311189G1 Cable.	MASTR Progress Line Professional & Executive Series and Progress Line.
TE34	Includes: 4EX6A10 with batteries and 19C311189G1 & G2 Cables.	MASTR Progress Line Professional & Executive Series, Progress Line, and PORTA-MOBIL.
TE35	Includes: 4EX6A10 with batteries and 19C311189G2 Cable.	PORTA-MOBIL.
TE36	Includes: 4EX6A10 with batteries and 19C311189G4 Cable.	MASTR II
Option 7747	Includes: 19C311189G3 Cable.	Available with all combinations for use with Transistorized Progress Line.
Option 9030	Includes: 19C311189G4 Cable.	Available with all combinations for use with MASTR II.

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

General Electric Test Set Model 4EX6A10 is a transistorized, battery-operated audio oscillator designed to facilitate the test and servicing of two-way radio communication equipment.

Two audio frequencies (1000 and 1811 hertz) are generated by the unit. The 1000-Hz output is for setting transmitter modulation, checking 600-ohm lines, testing audio amplifiers and performing similar test operations. The 1811-Hz output is for checking deviation meter calibration by the Bessel Null method (see OPERATION section).

All controls and output connections are conveniently located on the front of the audio oscillator. The FREQ-kHz switch is a 4-position, rotary switch that provides the ON-OFF function and selects the output frequency. The LEVEL control sets the signal output to any desired level between 0 and 3-volt RMS.

A 6-pin microphone connector provides termination facilities for the associated cables that are available with the unit (See Combination Index). Meter connections or special cable connections can be made to the red and black binding posts located beneath the 6-pin connector.

OPERATION

PROCEDURE (General)

1. Connect output cable between the six-pin connector on Test Set (or binding posts if standard cable is not used) and the unit under tests.

NOTE

Cables available with the Test Set include:

19C311189G1 - for MASTR Progress Line Professional & Executive Series and Progress Line;
19C311189G2 - for PORTA-MOBIL;
19C311189G3 - for Transistorized Progress Line.
19C311189G4 - for MASTR II

These cables have connectors which fit the microphone jack or microphone test jack on the radio control unit.

2. Select the desired output frequency with FREQ-kHz Switch. (Positions 3 and 4 on the switch provide transmitter keying in addition to frequency selection).

3. Set LEVEL Control for desired output level.

DEVIATION METER CALIBRATION CHECK (Bessel Null Method)

In FM Radio Systems, the application of a pure audio tone to the transmitter will cause the carrier to completely disappear at certain deviation settings. The Bessel Functions give the exact relationship between the points of carrier null, deviation and audio frequencies. The 1811-Hz output is a mathematically chosen audio frequency for use in calibrating deviation measuring equipment by the Bessel Null method. Two procedures follow: one using a FM transmitter; and one using a FM Signal Generator. Additional information, on measuring FM deviation by the Bessel Null Method, may be obtained in Data-File Bulletin 10008-5.

NOTE

A General Electric Model 4EX7A10 or 4EX9A10 IF Generator Test Set (or equivalent) is required for the following procedures.

4EX7A10 - Used with MASTR, and Porta-Mobile (455 kHz), Progress Line and Transistorized Progress Line (290 kHz)

4EX9A10 - Used with MASTR II (9.4 or 11.2 MHz)

Procedure Using FM Transmitter

1. Make equipment connections as illustrated in Figure 1.

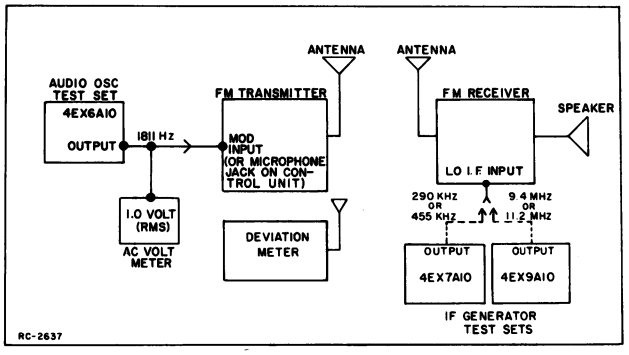


Figure 1
Equipment connections Using FM Transmitter

2. Set transmitter modulation adjustment for minimum level.

3. Set output frequency of IF Generator Test Set to 455 kHz (for MASTR and PORTA-MOBIL) or 290 kHz (for Progress Line and Transistorized Progress Line, or 9.4/11.2 MHz (for MASTR II). Turn IF Test Set LEVEL control to a mid-position.

4. While transmitting an unmodulated carrier, adjust receiver 1st oscillator to obtain a "beat" frequency of approximately 400 Hz from the speaker.

5. Select 1811-Hz output on Audio Oscillator Test Set and set LEVEL control for 1-volt RMS output.

6. Slowly increase the transmitter modulation adjustment until a null is produced in the 400-Hz "beat" frequency heard from the speaker. The first null occurs at ±4.35 kHz carrier deviation. A second null (useful in wide band applications) occurs at ±10.0 kHz-carrier deviation.

NOTE

It is necessary to concentrate on the 400-Hz tone to avoid error, because other tones are also present in the speaker output.

7. The transmitter can now be used to calibrate a deviation meter. A 1-volt RMS, 1811-Hz (or 1000-Hz if desired) signal input will produce a carrier deviation of ±4.35 kHz or ±10.0 kHz depending on the null selected in step 6.

8. Be certain to re-net the receiver to the transmitter frequency before returning it to operation.

Procedure Using FM Signal Generator

The internal deviation meter on a FM Signal Generator (Measurements M560 or equivalent) can be checked in the following manner. For this test, a transformer must be inserted in the audio oscillator output for voltage step-up and impedance matching purposes. (Figure 2 provides GE Part Number and interconnection information for the transformer).

1. Make equipment connections as illustrated in Figure 3.

2. Set FM signal generator output to receiver frequency and turn modulation control to minimum.

3. Set output frequency IF Generator Test Set to 455 kHz (for MASTR and PORTA-MOBIL) or 290 kHz (for Progress Line and Transistorized Progress Line) or 9.4/11.2 MHz (for MASTR II). Turn IF Test Set Level control to mid-position.

4. While applying an on-frequency, unmodulated signal, adjust receiver 1st oscillator to obtain a "beat" frequency of approximately 400 Hz from the speaker.

5. Select 1811-Hz output on Audio Oscillator Test Set and set LEVEL control for maximum.

6. Slowly increase the FM Signal Generator modulation control until a null is produced in the 400-Hz "beat" frequency heard from the speaker. The first null occurs at ±4.35-kHz signal deviation. A second null (useful in wide band applications) occurs at ±10.0-kHz signal deviation.

NOTE

It is necessary to concentrate on the 400-Hz tone to avoid error, because other tones are also present in the speaker output.

7. Note the reading of the FM generator's interval deviation meter at the null points for use in future test procedures.

8. Re-net the receiver to the associated transmitter frequency before returning it to operation.

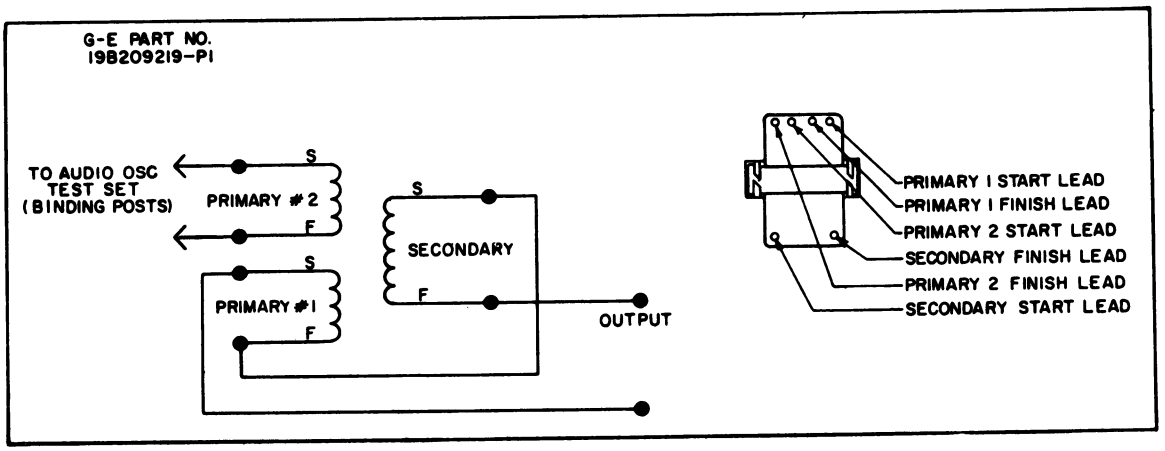


Figure 2 - Transformer Schematic & Interconnection Diagram

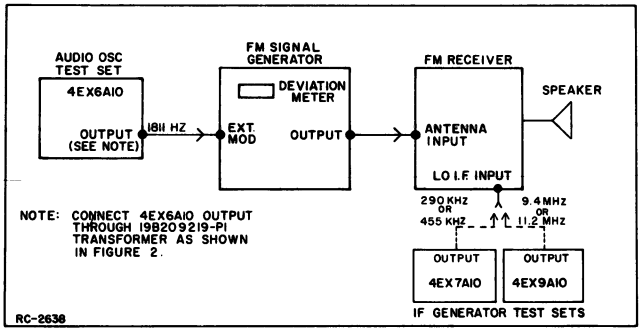


Figure 3 - Equipment Connections Using FM Signal Generator

CIRCUIT ANALYSIS

Audio frequencies of 1000 and 1811 Hz are generated by a battery-operated Colpitts audio oscillator Q1. The desired frequency is obtained by changing the LC time constant of the oscillator feedback circuit with FREQ-kHz switch S1001.

Selecting a frequency with FREQ-kHz switch S1001 connects positive battery voltage to the collector of Q1 through L1. Positive base bias is established by a voltage divider consisting of R1 and R2. Under these conditions, Q1 conducts.

As current flows in the collector circuit of Q1, regenerative feedback is provided from tank circuit L1, C1, and C2 to the emitter of Q1. The winding tap selected on L1 determines the oscillator frequency.

The output of Q1 connects through LEVEL control R1001 to a Class B, push-pull audio amplifier circuit consisting of Q2 and Q3. CR1, R3, and R4 maintain proper bias for Q2 and Q3. The amplifier output is connected through C4 to pin 2 of OUTPUT jack J1001.

MAINTENANCE

BATTERY REPLACEMENT

To replace batteries, take out the two screws holding the front plate and carefully remove the housing. Then remove the old batteries and insert the new batteries (Eveready No. E165 or equivalent) being certain to maintain the same polarity.

WARNING

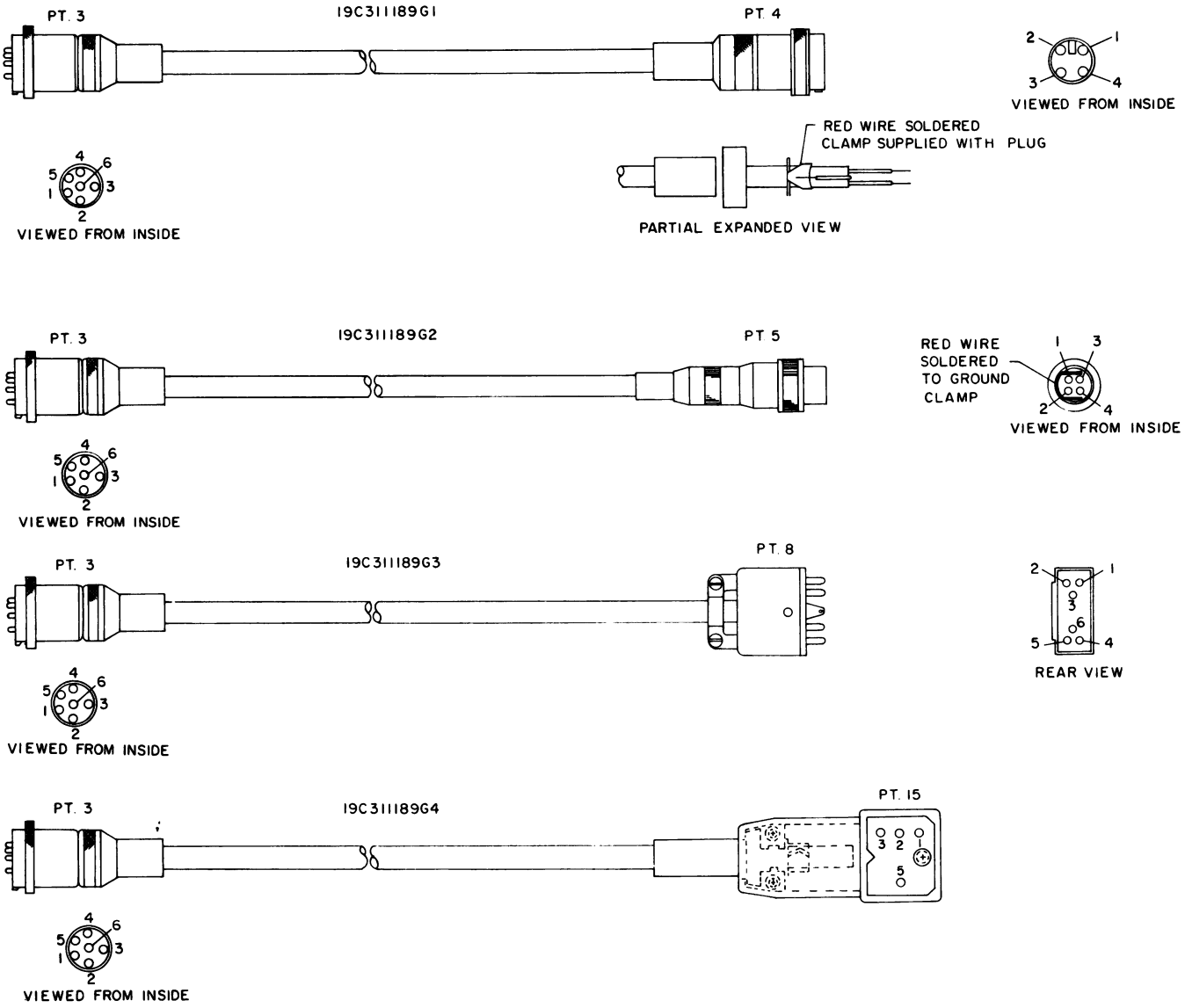
Do not dispose of mercury batteries by burning them, since they may explode.

TROUBLESHOOTING PROCEDURE

Troubleshooting procedures are outlined in the following chart. Also refer to voltage and resistance readings on the Outline and Schematic Diagrams.

TROUBLESHOOTING PROCEDURE CHART

SYMPTOM	CHECK THE FOLLOWING
NO OUTPUT	1. Batteries 2. Switch S1001 for open 3. Q1, Q2, and Q3
HALF-WAVE OUTPUT	1. CR1 for open 2. Q2 and Q3
EXCESSIVE CURRENT DRAIN ON BATTERY	1. CR1 for short 2. Q2 and Q3 for shorts
WILL NOT KEY TRANSMITTER	1. Cable for open 2. S1001 for open



CONNECTIONS TABLE								
WIRE	GROUP 1		GROUP 2		GROUP 3		GROUP 4	
BLACK	PT.3 - PIN 1	PT. 4 - PIN 1	PT. 3 - PIN 1	PT. 5 - PIN 1	PT. 3 - PIN 1	PT. 8 - PIN 1	PT. 3 - PIN 1	PT. 15 - PIN 1
GREEN	PT. 3 - PIN 2	PT. 4 - PIN 2			PT. 3 - PIN 2	PT. 8 - PIN 2		
WHITE	PT. 3 - PIN 3	PT. 4 - PIN 3	PT. 3 - PIN 3	PT. 5 - PIN 3	PT. 3 - PIN 3	PT. 8 - PIN 3	PT. 3 - PIN 3	PT. 15 - PIN 3
RED	PT. 3 - PIN 4	PT. 4 - GND.	PT. 3 - PIN 4	PT. 5 - GND.	PT. 3 - PIN 4	PT. 8 - PIN 4	PT. 3 - PIN 4	PT. 15 - PIN 5
BROWN			PT. 3 - PIN 2	PT. 5 - PIN 2			PT. 3 - PIN 2	PT. 15 - PIN 2

(19D424043, Rev. 0)

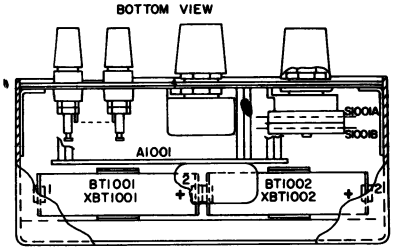
OUTLINE DIAGRAM

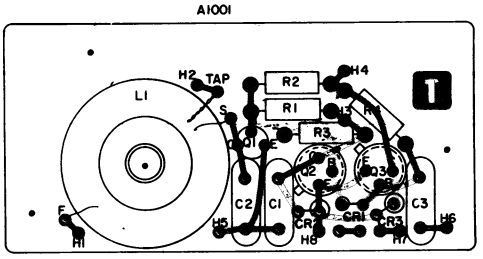
CABLE MODEL 4EX6A10

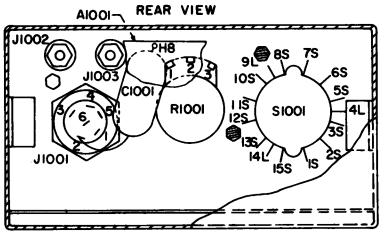
4 Issue 1

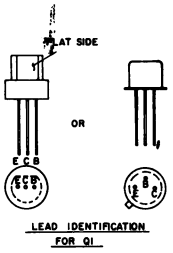
OUTLINE DIAGRAM

(19C311319, Rev. 2)
(19B205656, Sh. 1, Rev. 1)
(19B205656, Sh. 2, Rev. 1)









TRANSISTOR	E		B		C	
	−	+	−	+	−	+
Q1	4.6K	5K	15K	6.6K	12K	INF
Q2	50K	1.1K	75K	15K	50K	16K
Q3	50K	1.1K	650Ω	20K	0	0

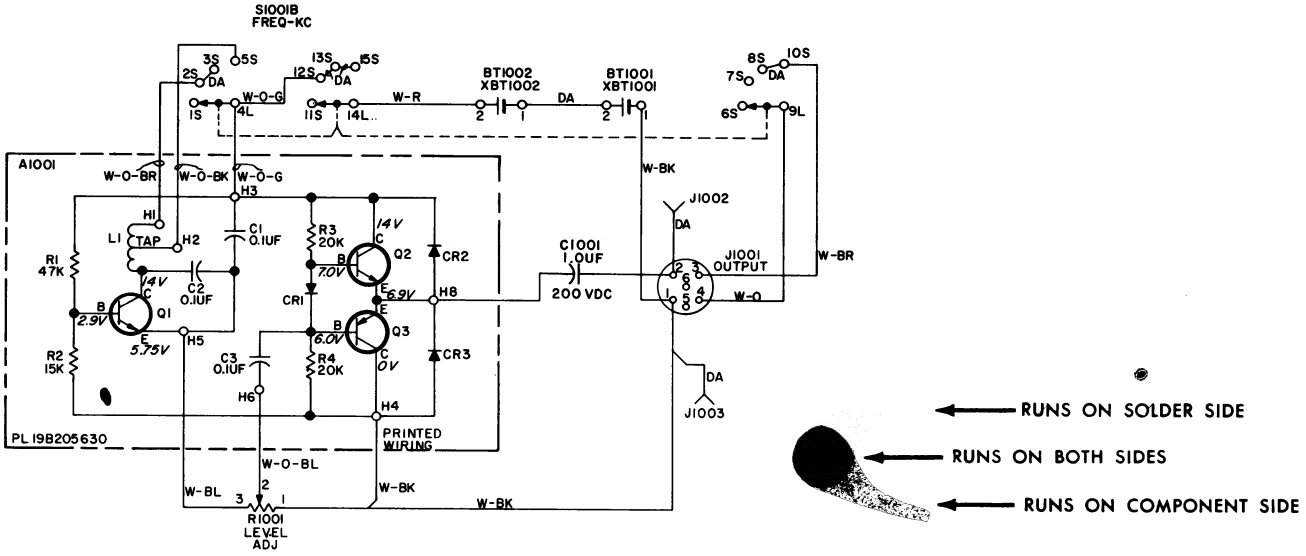
ALL READINGS ARE TYPICAL READINGS MEASURED FROM TRANSISTOR PINS TO GRD. + OR − SIGN SHOWS METER PROBE GROUNDED. READINGS ARE TAKEN WITH THE BATTERIES REMOVED AND A JUMPER BETWEEN XBT1001-1 AND XBT1002-2.

CAUTION

REMOVE THE JUMPER BETWEEN XBT1001-1 & XBT1002-2 BEFORE REPLACING BATTERIES.

SCHEMATIC DIAGRAM

(19C311097, Rev. 4)



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
4EX6A10	B

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

NOTES:
1. ALL WIRES ARE N24 EXCEPT AS NOTED.

VOLTAGE READINGS

READINGS MADE WITH 20,000 OHM-PER-VOLT METER, MEASURED TO BATTERY NEGATIVE.

OUTLINE & SCHEMATIC DIAGRAM

AUDIO OSCILLATOR MODEL 4EX6A10

PARTS LIST

LBI-3796D

AUDIO OSCILLATOR TEST SET
MODEL 4EX6A10 19C311184G1

SYMBOL	GE PART NO.	DESCRIPTION
A1001		COMPONENT BOARD 19B205630G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A116080P207	Polyester: 0.1 µf ±5%, 50 VDCW.
C3	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C4* and C5*	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D. Deleted by REV A.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	4038056P1	Germanium.
CR2* and CR3*	4037822P7	Silicon. Added by REV B.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B205629G1	Coil Assembly.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115889P1	Silicon, NPN.
Q2	19B200065P1	Germanium, NPN; sim to Type 2N1302.
Q3	4037993P1	Germanium, PNP; sim to Type 2N1303.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77P473K	Composition: 47K ohms ±10%, 1/2 w.
R2	3R77P153K	Composition: 15K ohms ±10%, 1/2 w.
R3 and R4	3R77P203J	Composition: 20K ohms ±5%, 1/2 w.
		- - - - - - - - - - BATTERIES - - - - - - - - - -
BT1001 and BT1002	5492174P1	Mercury: 7 v; sim to Mallory Type TR-165.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1001*	19B200230P16	Polyester: 1 µf ±20%, 200 VDCW; sim to TRW Type X663F. Added by REV A.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1001	19B209119P1	Connector, receptacle: 6 contacts; sim to Amphenol 91P. (Female).
J1002	19B209238P1	Binding post: Red, 15 amp; sim to H H Smith 1517.
J1003	19B209238P2	Binding post: Black, 15 amp; sim to H H Smith 1517.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1001	5496870P19	Variable: carbon film, 5K ohms ±20%; sim to Mallory LC(5K).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1001	19C307060P4	Rotary: 2 sections, 4 positions, 6 poles; sim to CTS 222-17254-2.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XBT1001 and XBT1002	19B200019P4	Retainer, battery. sim to Keystone Electronic 110.
		CABLE ASSEMBLY 19C311189G1
	7160478P3	Cable, microphone: 4 conductors, 4 feet long.
	19B209119P2	Connector, plug: 6 contacts; sim to Amphenol 91-MC6M (Male).
	7478726P6	Connector, plug: 4 contacts; sim to Amphenol 91-MC4M.
		CABLE ASSEMBLY 19C311189G2
	19A115469P1	Cable, microphone: 4 conductors, 4 feet long.
	19B209119P2	Connector, plug: 6 contacts; sim to Amphenol 91-MC6M (Male).
	19B209201P3	Connector, plug: 4 contacts; sim to Switchcraft 2504M.
		CABLE ASSEMBLY 19C311189G3
	7160478P3	Cable, microphone: 4 conductors, 4 feet long.
	19B209119P2	Connector, plug: 6 contacts; sim to Amphenol 91-MC6M (Male).
	5495345P13	Connector, plug: 6 contacts; sim to Components Mfg. 6601-M6.
	5495345P21	Hood.
	5495345P22	Pin. (Assembles hood to plug).
	5495345P23	Spring retainer.
		CABLE ASSEMBLY 19C311189G4
	19A115469P1	Cable, microphone: 4 conductors, 4 feet long.
	19B209119P2	Connector, plug: 6 contacts; sim to Amphenol 91-MC6M (Male).
	19D416767P1	Cover.
	19D416766P1	Base.
	19A129435P1	Pin.
	19B219749P1	Flex relief.
	7109043P1	Retainer ring.
	19A116937P1	Cable clamp.
	N136AP905C6	Tap screw, phillips head: No. 4-24 x 5/16. (Quantity 3).
	19B219723G1	Thumb screw. (Quantity 1).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	7142162P81	Spacer: (Located between housing and A1001 Board).
	4039182G2	Knob: (For R1001 and S101).
	4036555P1	Insulator, washer: nylon. (Used with Q2 and Q3).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To permit oscillator to be connected directly to telephone line carrying DC control voltage. Deleted C4 and C5 and added C1001.

REV. B - To add protection for final transistors. Added CR2 & CR3.

ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

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