



communications

MAINTENANCE MANUAL

Audio Oscillator MODEL 4EX6A10

COMBINATION NUMBERS TE31, TE34 & TE35



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 cps $\pm 5\%$ 1811 cps $\pm 5\%$
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

257
80
12

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COMBINATION INDEX		
COMBINATION NUMBER		USED WITH
TE31	Includes: 4EX6A10 with batteries and 19C311189-G1 Cable.	MASTR Progress Line Professional & Executive Series and Progress Line.
TE34	Includes: 4EX6A10 with batteries and 19C311189-G1 & G2 Cables.	MASTR Progress Line Professional & Executive Series, Progress Line, and PORTA-MOBIL.
TE35	Includes: 4EX6A10 with batteries and 19C311189-G2 Cable.	PORTA-MOBIL..
Option 7447	Includes: 19C311189-G3 Cable.	Available with all combinations for use with Transistorized Progress Line.

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 cycles per second) are generated by the unit. The 1000-cps output is for setting transmitter modulation, checking 600-ohm lines, testing audio amplifiers and performing similar test operations. The 1811-cps 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-KC 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:

- 19C311189-G1 - for MASTR Progress Line Professional & Executive Series and Progress Line;
- 19C311189-G2 - for PORTA-MOBIL;
- 19C311189-G3 - for Transistorized Progress Line.

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-KC 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-cps 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.

NOTE

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

Procedure Using FM Transmitter

1. Make equipment connections as illustrated in Figure 1.

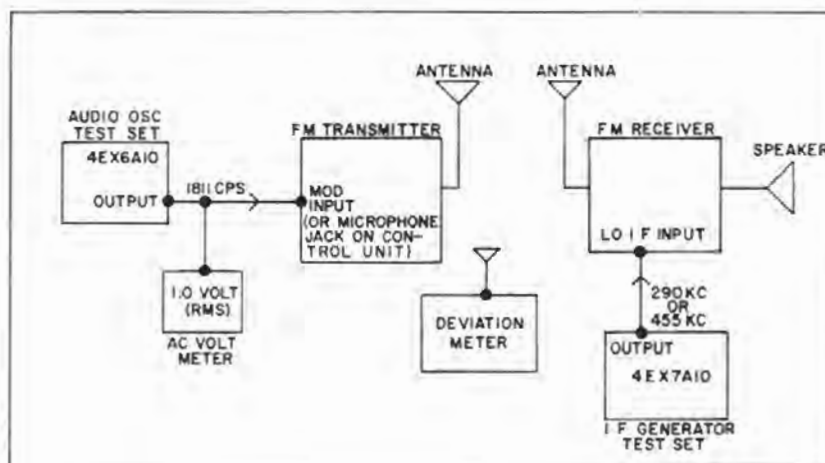


Figure 1 - Equipment Connections Using FM Transmitter

2. Set transmitter modulation adjustment for minimum level.
3. Set output frequency of IF Generator Test Set to 455 KC (for MASTR and PORTA-MOBIL) or 290 KC (for Progress Line and Transistorized Progress Line). 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 cps from the speaker.
5. Select 1811-cps 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-cps "beat" frequency heard from the speaker. The first null occurs at ± 4.35 KC carrier deviation. A second null (useful in wide band applications) occurs at ± 10.0 KC-carrier deviation.

NOTE

It is necessary to concentrate on the 400-cps 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-cps (or 1000-cps if desired) signal input will produce a carrier deviation of ± 4.35 KC or ± 10.0 KC, 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 G-E Part Number and interconnection information for the transformer).

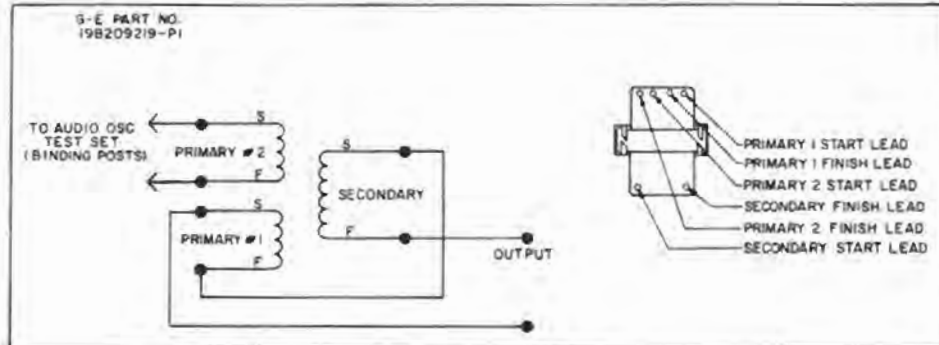


Figure 2 - Transformer Schematic & Interconnection Diagram

1. Make equipment connections as illustrated in Figure 3.

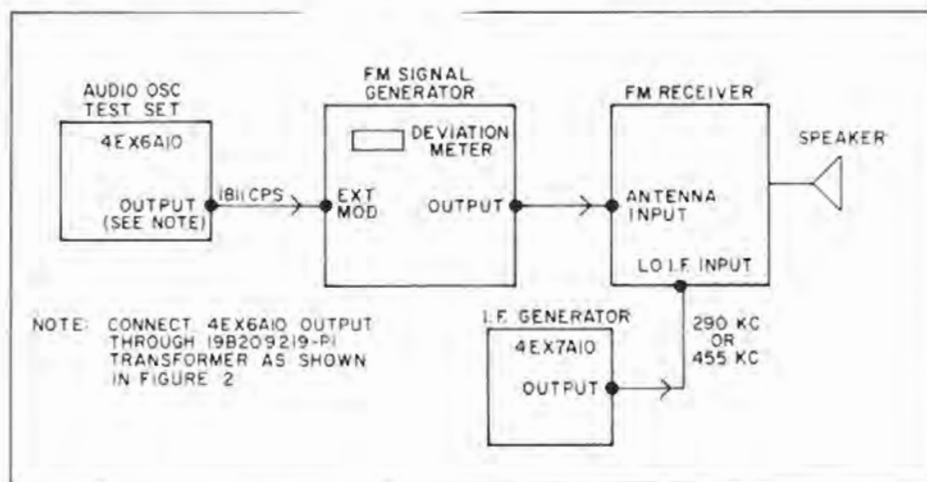


Figure 3 - Equipment Connections Using FM Signal Generator

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 KC (for MASTR and PORTA-MOBIL) or 290 KC (for Progress Line and Transistorized Progress Line). 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 cps from the speaker.
5. Select 1811-cps 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-cps "beat" frequency heard from the speaker. The first null occurs at ± 4.35 -KC signal deviation. A second null (useful in wide band applications) occurs at ± 10.0 -KC signal deviation.

NOTE

It is necessary to concentrate on the 400-cps 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.

CIRCUIT ANALYSIS

Audio frequencies of 1000 and 1811 cps 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 RATE-KC switch S1001.

Selecting a frequency with FREQ-KC 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 and C5 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

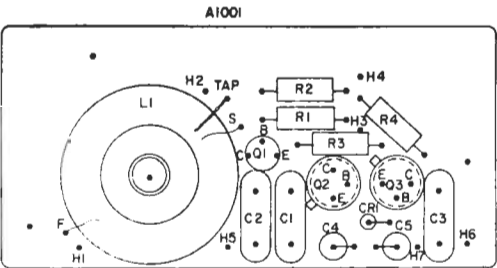
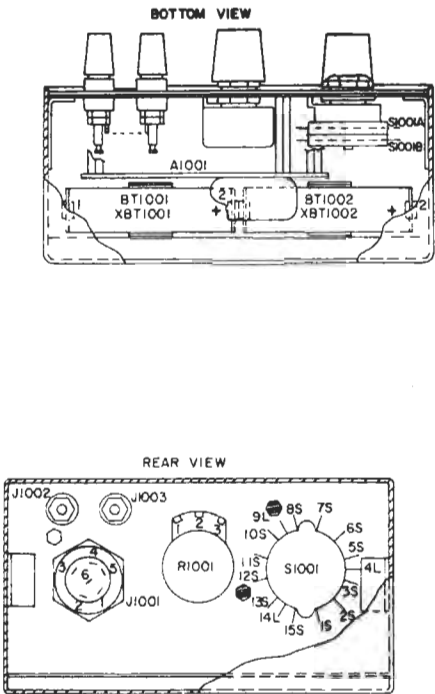
Troubleshooting procedures are outlined in the following chart. Also refer to voltage and resistance readings on the Outline and Schematic Diagrams.

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

OUTLINE DIAGRAM

LB1-3790

(19C311319, Rev. 0)



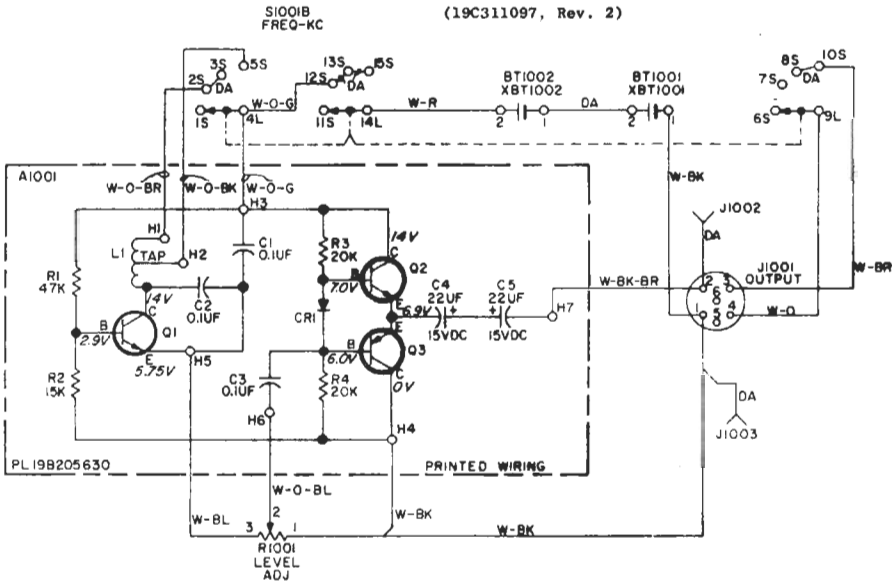
TRANSISTOR	E	B	C
Q1	10K	10K	10K
Q2	10K	10K	10K
Q3	10K	10K	10K

ALL READINGS ARE TYPICAL READINGS MEASURED FROM TRANSISTOR PINS TO GND. $\rightarrow$ OR $\rightarrow$ SIGN SHOWS METER PROBE GROUNDED. READINGS ARE TAKEN WITH THE BATTERIES REMOVED AND A JUMPER BETWEEN BT1001 AND BT1002.

CAUTION
REMOVE THE JUMPER BETWEEN BT1001 & BT1002 BEFORE REPAIRING BATTERIES

SCHEMATIC DIAGRAM

(19C311097, Rev. 2)



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 4EX6A10
REV LETTER

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 MICROFARADS) 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 MEETING 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

Issue 1 7

PARTS LIST

LBI-3790

AUDIO OSCILLATOR TEST SET
MODEL 4EX6A10 PL-19C311184-G1

SYMBOL	G-E PART NO.	DESCRIPTION
A1001		COMPONENT BOARD PL-19B205630-G1
		----- CAPACITORS -----
C1 and C2	5491189-P306	Polyester. 0.1 μ f $\pm$ 5%, 50 VDCW.
C3	19B209243-P7	Polyester. 0.1 μ f $\pm$ 20%, 40 VDCW.
C4 and C5	5496267-P10	Tantalum, dry solid; 22 μ f $\pm$ 20%, 15VDCW; sim to Sprague Type 150D.
		----- DIODES AND RECTIFIERS -----
CR1	4036036-P1	Germanium.
		----- INDUCTORS -----
L1	PL-19B205629-G1	Coil Assembly.
		----- TRANSISTORS -----
Q1	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
Q2	19B200065-P1	Germanium, NPN; sim to Type 2N1302.
Q3	4037993-P1	Germanium, PNP; sim to Type 2N1303.
		----- RESISTORS -----
R1	3R77-P473K	Composition; 47,000 ohms $\pm$ 10%, 1/2 W.
R2	3R77-P153K	Composition; 15,000 ohms $\pm$ 10%, 1/2 W.
R3 and R4	3R77-P203K	Composition; 20,000 ohms $\pm$ 10%, 1/2 W.
		----- BATTERIES -----
BT1001 and BT1002	5492174-P1	Mercury; 7 v; sim to Mallory Type TR-165.
		----- JACKS AND RECEPTACLES -----
J1001	19B209119-P1	Connector, receptacle; 6 contacts; sim to Amphenol 91PC8F-1000 (Female).
J1002	19B209238-P1	Binding post; Red, 15 amp; sim to H H Smith 1517.
J1003	19B209238-P2	Binding post; Black, 15 amp; sim to H H Smith 1517.
		----- RESISTORS -----
R1001	3496A70-P19	Variable; carbon film, 3000 ohms $\pm$ 20%; sim to Mallory LC(SK).
		----- SWITCHES -----
S1001	19C307060-P4	Rotary. 2 section, 4 position, 6 poles; sim to CTS 222-17254-2.
		----- SOCKETS -----
BT1001 and XBT1002	19B200019-P4	Retainer, battery. sim to Keystone Electronics 110.

SYMBOL	G-E PART NO	DESCRIPTION
		CABLE ASSEMBLY PL-19C311189-G1
	7116293-P1	Cable, microphone: 5 conductor, 50 in.
	19B209119-P2	Connector, plug; 6 contacts; sim to Amphenol 91-MC6M (Male).
	7478726-P6	Connector, plug; 4 contacts; sim to Amphenol 91-MC4M.
		CABLE ASSEMBLY PL-19C311189-G2
	7116293-P1	Cable, microphone: 5 conductor, 50 in.
	19B209119-P2	Connector, plug; 6 contacts; sim to Amphenol 91-MC6M (Male).
	19B209201-P3	Connector, plug; 4 contacts; sim to Switchcraft 2504M.
		----- MISCELLANEOUS -----
	7142162-P81	Spacer: (Located between housing and A1001 Board).
	PL-4039182-G2	Knob: (For R1001 and S1001).
	4036555-P1	Insulator, washer: nylon. (For Q2 and Q3).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

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 G-E Part Number.

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

1. G-E 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.

MAINTENANCE MANUAL

LBI-3790

DF-10008

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