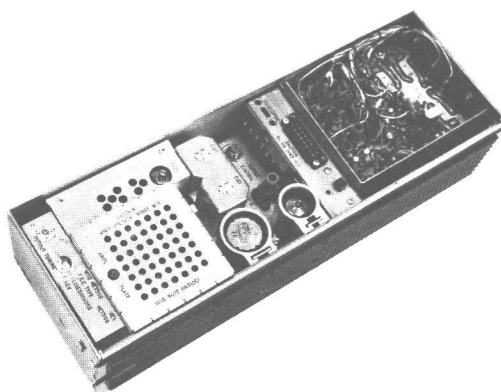


# MASTR

## PROGRESS LINE

470-512 MHz, 30 & 60-WATT TRANSMITTER MODELS 4ET59H30 & 4ET60H30-41



### SPECIFICATIONS \*

FCC Filing Designation:

**ET-59-H-5**

**ET-60-H-5**

Frequency Range:

470-512 MHz

470-512 MHz

Power Output

30 watts minimum  
(20 watts minimum  
in 6-volt systems)

60 watts minimum

Crystal Multiplication Factor:

36

36

Frequency Stability:

$\pm 0.0005\%$  ( $-30^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ )

Modulation:

Adjustable from 0 to  $\pm 5$  kHz (Narrow Band)  
and 0 to  $\pm 15$  kHz (Wide Band) swing with  
instantaneous modulation limiting.

Modulation Sensitivity:

50 to 100 Millivolts

Audio Frequency Characteristics

Within  $+1$  dB to  $-3$  dB of a 6 dB/octave  
preemphasis from 300 to 3000 Hertz per  
EIA standards. Post limiter filter per  
FCC and EIA.

Distortion:

Less than 5%

Tubes & Transistors:

Transmitter with no Options:

3 tubes  
8 silicon transistors  
4 diodes & 2 varactors

Maximum Frequency Spacing:

0.2%

Duty Cycle:

Mobile -

20% transmit (one minute transmit, four  
minutes off)

Station-

Continuous

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

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#### 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

The MASTR Progress Line FM Transmitters Types ET-59-H and ET-60-H are crystal-controlled, phase-modulated transmitters designed for one-, two-, or four-frequency operation within the 470 - 512 megahertz band. The transmitters consist of the following modules:

- Transistorized Exciter Board, with audio, oscillator, modulator, amplifier and multiplier stages,
- Multipliers, IPA and power amplifier stages,
- Optional transistorized Channel Guard Low-Pass filter.

All input leads to the transmitters are individually filtered by the 20-pin feed-through by-pass connector J101. The output passes through a two-section, band-pass filter, followed by a low-pass filter.

## CIRCUIT ANALYSIS

Eight silicon transistors and only three tubes are used in the transmitters. The frequency of the crystals used ranges from 13.05 - 14.2 megahertz, and the crystal frequency is multiplied 36 times.

A centralized metering jack (J102) is provided for use with General Electric Test Set 4EX3A10. The Test Set meters the multiplier, amplifier and PA stages as well as filament and regulated supply voltages. The metering jack also provides access to audio, microphone and push-to-talk leads.

## POWER INPUTS

The following supply voltages are connected from the power supply to the transmitter through the 20-pin by-pass connector J101:

- Pin 3 - Filament voltage
- Pin 4 - +300 volts MULT & IPA B+
- Pin 5 - -45 volts bias
- Pin 14- +10 volts for Channel Guard option
- Pin 15- -20 volts for Exciter Board

### NOTE

The PA B-plus voltage will vary due to the difference power supplies used (both mobile and station, and due to the power input limitations of different services. Refer to the PA Plate Voltage Chart on the Transmitter Schematic Diagram for the different operating conditions.

## OSCILLATOR

A transistorized Colpitts oscillator (Q3) is used in the transmitter. The oscillator crystal is thermistor-compensated at both ends of the temperature range to provide instant frequency compensation, with a frequency stability of  $\pm 0.005\%$  without crystal ovens or warmers.

In single-frequency transmitters, a jumper (from H1 to H2) connects the F1 crystal keying lead to ground to forward bias diode CR3. Forward biasing the diode reduces its impedance, and the crystal

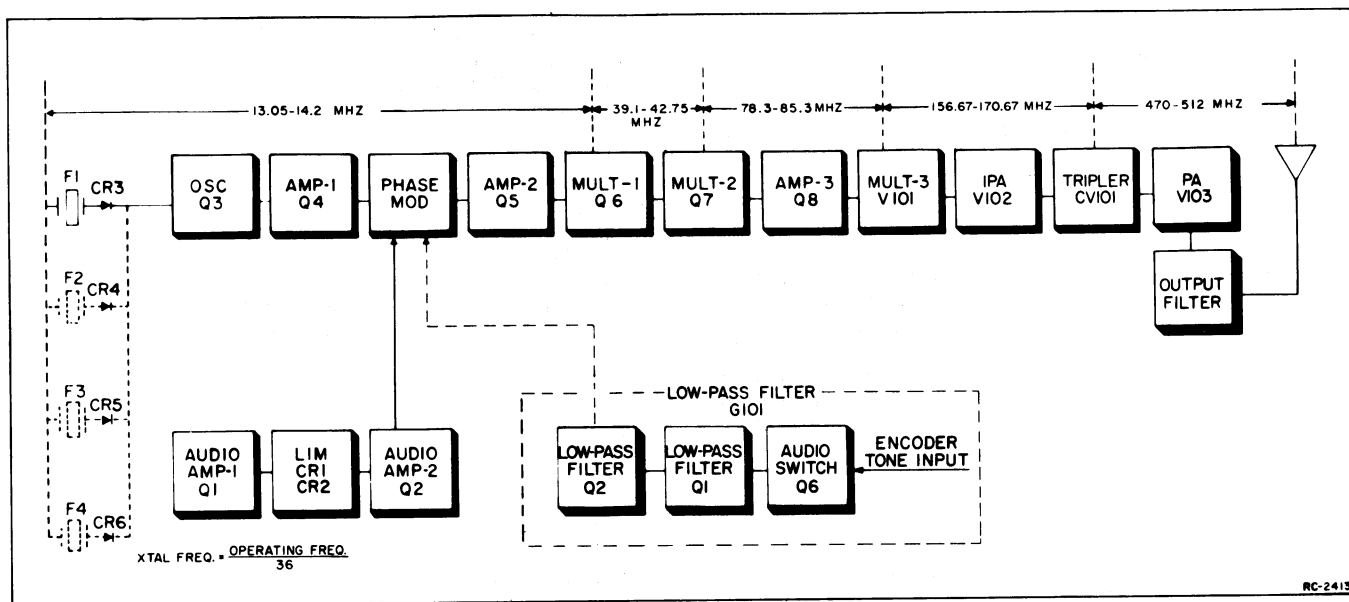


Figure 1 - Transmitter Block Diagram

frequency is applied to the base of oscillator Q3. Feedback for the oscillator is developed across C34. The oscillator output is coupled through an impedance matching emitter-follower amplifier stage (Q4) to the phase modulator.

In multi-frequency transmitters, the single oscillator transistor is used, and up to three additional crystal circuits, identical to the F1 crystal circuit, can be added. The keying jumper is removed and the proper crystal frequency is selected by switching the crystal keying lead to ground by means of a frequency selector switch on the Control Unit.

#### AUDIO AMPLIFIERS AND LIMITER

An audio signal from the microphone is coupled through C1 to the base of Class A audio amplifier Q1. The design of the microphone, in conjunction with C2 and R3, produces a 6-dB audio pre-emphasis. RF decoupling is provided by C75.

The amplified audio signal is RC coupled to the diode limiters CR1 and CR2. These diodes operate in series and are normally in a forward conducting state. An audio signal of sufficient amplitude to cause limiting takes the diodes out of conduction, so that one diode conducts only on positive cycles and the other conducts only on negative cycles.

Following the limiter stage is a second Class A amplifier, Q2. The output of Q2 is coupled through MOD ADJUST potentiometer R12 to a combined post-limiter filter and de-emphasis network. This network consists of R15, R16, R17, C4, C7 and C8. The output of the filter and de-emphasis network is applied directly to the phase modulator.

#### PHASE MODULATOR

The phase modulator uses varactor CV1 (voltage variable capacitor) in series with tuneable coil L1. This network appears as a series-resonant circuit to the RF output of the oscillator. An audio signal applied to the modulator varies the bias of CV1, resulting in a phase-modulated output. The output of the modulator is coupled through blocking capacitor C41/C45 to the base of the second amplifier. For Channel Guard transmitters, a second modulator stage (L3 and CV2) is cascaded with the first modulator. The output of the Channel Guard encoder is fed through CHANNEL GUARD MOD ADJUST R34 to the tone modulator stage.

#### AMPLIFIERS AND 1ST AND 2ND MULTIPLIERS

The second amplifier (Q5) isolates the modulator from the loading effects of the first amplifier and provides amplification. The output is DC coupled to the first multiplier.

Following Q5 are two inductively coupled Class C, common-emitter multiplier stages (Q6 and Q7). Q6 is a tripler, with collector tank T1 tuned to three times the crystal frequency. Metering resistor R37 is for metering the MULT-1 stage at centralized metering jack J102-

Q7 operates as a doubler stage, with collector tank T3 tuned to six times the crystal frequency. Resistor R39 is for metering the MULT-2 stage at J102. The output of Q7 is inductively coupled through T3 and T4 to amplifier Q8. In 494 - 512 megahertz transmitters, capacitor C58 provides some high-side capacitive coupling.

Third amplifier Q8 is a neutralized straight-through amplifier. Feedback through C65 from the output link on T5 provides neutralization. This stage is metered at J102-3 across R43. The output is coupled to the grid tank of multiplier V101.

#### 3RD MULTIPLIER

The output of the transistorized Exciter is coupled by a short length of RF cable to the grid tank (Z102) of beam pendode V101. This stage operates as a doubler with the plate tank tuned to twelve times the crystal frequency.

Bias voltage (approximately -18 volts) is supplied to the grid of V101 through R108 to protect the tube against loss of drive. Grid voltage is metered by metering network R105 and R106 with a residual reading of approximately 0.18 volts without any drive, caused by fixed bias voltage to the grid of V101. The plate tank is tuned by C104 with plate voltage supplied through L101.

#### IPA AND TRIPLER

The output of the MULT-3 stage is coupled by a pi-network consisting of C104, L103 and C107/C108 to the grid of the IPA, a compactron beam power amplifier.

Approximately 45 volts of bias voltage is supplied to the grid of V102 through R112 and a tap on L103 to protect the stage against loss of drive. A residual reading of 0.28 volt without any drive to the stage indicates the presence of fixed bias. Grid voltage and the tripler varactor bias voltage are metered simultaneously at J201-5.

The IPA plate tank is tuned by C115, and plate voltage is supplied through L105. The stage is neutralized by C110.

RF from the IPA is coupled through C120/C123 to a passive tripler stage. The tripler consists of three tuned stages (C115 & L109/L108, C121 & L110/L114 and C122 & L113) which are coupled together through the common impedance of varactor CV101.

The IPA output if fed to the tripler, where the first tuned stage resonates at the fundamental frequency. The second tuned circuit (an "idler" circuit) is tuned to twice the input signal, and mixes with the input signal to produce the desired third harmonic (or operating frequency). The third tuned circuit is tuned to the operating frequency.

#### POWER AMPLIFIER

Drive from the tripler stage is link-coupled to the grid circuit of V103 through L115 and L116. V103 is a coaxial element, conduction-cooled beam power tetrode operating as a neutralized Class C amplifier.

The grid line L128 of V103 is series-tuned by C130 with 20 volts of protective bias supplied through L117 and grid bias resistors R103 and R129. PA grid current is metered across resistor R103 at J102-6 and J102-14.

Neutralization is provided by a fixed series screen inductance (the fingers on the screen by-pass ring) and the screen by-pass capacitors C135, C136, C138 and C140.

The PA Plate tank circuit is comprised of C145 (the plate tank tuning flap), L120 (the copper-plated heat sink on the plate of V103), and mechanically constructed capacitor (with mica dielectric) C143. The plate voltage is supplied through choke L122, which is connected to feed-through capacitor C142.

The PA screen voltage is controlled by OUTPUT CONTROL potentiometer R124 which is in series with R123/R126 in the screen supply circuit. With the OUTPUT CONTROL fully counterclockwise, the plate dissipation of V103 is reduced below the rated tube limit for tuning the power amplifier stage.

Plate current is metered from J102-1 to J102-9 across metering resistor R102 in high-power units. In medium-power units, R101 is added in series with R102.

#### WARNING

The meter leads are at plate potential (high B-plus) when metering the PA Plate.

The output of V103 is link-coupled to band-pass filter FL103/FL104 consisting of two inductively coupled helical resonators. C10/C11 and C12/C13 are the output tuning capacitors. L11 and C9 form an additional low-pass filter section. The RF output is fed through J103 to the antenna change-over relay located on the front of the system frame.

An RF sniffer circuit (CR1, C7, and R1) provides for measuring the relative power output at J102-11. When troubleshooting the transmitter, components of the low-pass

filter and RF sniffer circuit can be checked by removing the plate on the bottom of the filter casing.

#### CHANNEL GUARD

##### Low Pass Filter (G101)

In encode-decode combinations, low-pass filter G101 is assembled on a printed wiring board that mounts on the underside of the MASTR transmitters. The filter is supplied by a regulated +10 volts and a regulated -20 volts. The +10 volts is applied only when the transmitter is keyed.

Keying the transmitter applies the encoder tone (from the receiver) to low-pass filter G101. Transistors Q1 and Q2 form a two-section, active low-pass filter that reduces tone distortion and power supply ripple. Q6 operates as a tone switch, applying the tone input to the filter whenever +10 volts is applied to J1 (Q6 base). Thermistor RT1 keeps the output constant over wide variations in temperature. The filter output is coupled to the tone modulator on the transmitter exciter board through Channel Guard MOD ADJUST R34. Instructions for setting R34 are contained in the Modulation Adjustment section of the Transmitter Alignment Procedure.

The channel can be monitored before transmitting a message by moving the CF-OFF switch on the Control Unit to the OFF position, or by removing the microphone or handset from the operational hang-up bracket.

#### NOTE

When Channel Guard decode only is desired, remove the wire that connects to J6 on the low-pass filter (Encoder Tone Input).

##### Encoder Model 4EH17A10 (Optional)

In encode only combinations, or when different encode and decode frequencies are required, optional encoder Model 4EH17A10 mounts on the underside of the MASTR transmitter. The encoder is supplied by a regulated -10 volts and a regulated -20 volts. The +10 volts is applied to Q3, Q4, and Q5 continuously (even in the STANDBY position). The -20 volts is applied to Q1 and Q2 only when the transmitter is keyed.

The encoder tone is provided by selective oscillators Q3 and Q4, which oscillate continuously at a frequency determined by the tone network (FL1). Negative feedback, applied through the tone network to the base of Q3, prevents any gain in the stage except at the desired encode frequency.

Thermistor-resistor combination R14 and RT2 provides temperature compensation for the oscillator output. Limiter diodes CR1 and CR2 keep the tone amplitude constant.

Keying the transmitter applied -20 volts to the two-stage, active low-pass filter (Q1 and Q2) turning them on. The oscillator output is then coupled through emitter-follower Q5 to the low-pass filter. Thermistor RT1 keeps the filter output constant over wide variations in temperatures.

The output of the filter is applied to the tone modulator on the transmitter exciter board through Channel Guard MOD ADJUST R34. Instructions for setting R34 are contained in the Modulation Adjustment section of the Transmitter Alignment Procedure.

The channel can be monitored before transmitting a message by moving the CG-OFF switch on the Control Unit to the OFF position, or by removing the microphone or handset from the operational hang-up bracket.

## MAINTENANCE

### DISASSEMBLY

To service the transmitter from the top--

1. Pull locking handle down and pull radio about one inch out of mounting frame.
2. Pry up cover at rear of transmitter.

To service the transmitter from the bottom--

1. Pull locking handle down and pull radio out of mounting frame.
2. Remove the two screws in bottom cover, and pry up at back of transmitter.
3. Slide cover back and lift off.

To remove transmitter from system frame--

1. Loosen the two retaining screws in the front casting (see Figure 2) and pull casting away from the system frame.
2. Remove the four screws in the back cover.
3. Remove the two screws holding the transmitter at each end of the system frame.
4. Disconnect the antenna jack in front of the transmitter and the 20-pin feed-thru connector at the back of the transmitter, and slide the unit out of the system frame.

### TUBE REPLACEMENT

#### WARNING

Before replacing tubes, remove all power from the unit so that the transmitter cannot be keyed. In mobile units, disconnect power plug P504. In stations, turn off the main line switch and discharge filter capacitors.

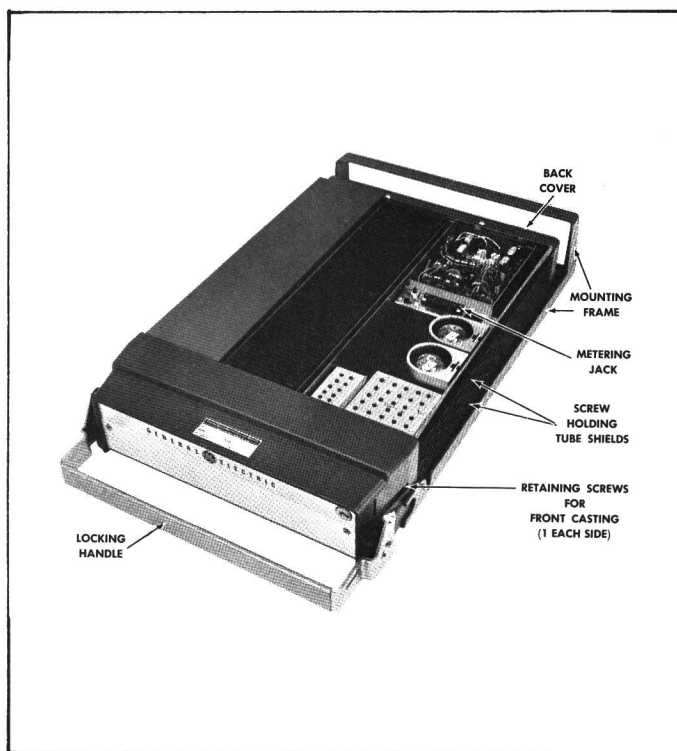


Figure 2 - Top Cover Removed

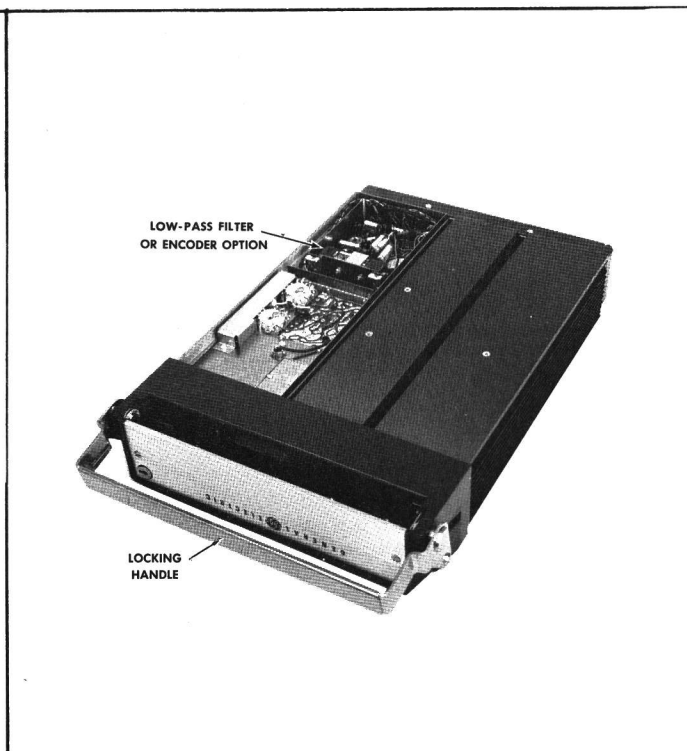


Figure 3 - Bottom Cover Removed

To replace 3rd Multiplier and IPA Tubes  
(V101 & V102)

Loosen the two screws holding tube shield to heatsink, and pull off tube shield. Then carefully work the tube out of its socket.

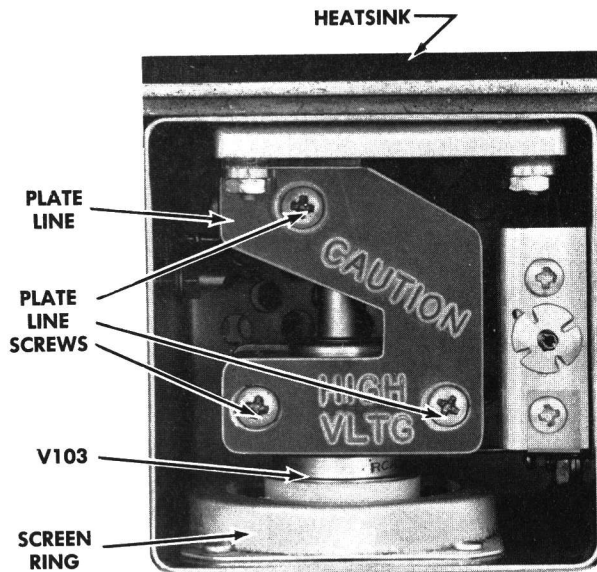


Figure 4 - PA Plate Box With Cover Removed

To replace Power Amplifier V103:

1. Make sure that all power is removed from the unit.

2. Remove the top cover on the AMPL PLATE box (Fig. 4). Allow the transmitter to cool if necessary.
3. Remove the three Phillips-head screws in the plate line, starting with the two screws nearest tube socket. Lift off the top section of the plate line. Next slide the bottom section toward the AMPL PLATE tuning adjustment and lift it out of the AMPL PLATE box.
4. Carefully work the tube out of its socket.
5. Use a screwdriver to bend the screen ring contacts out toward the center of the tube socket so that all contacts will touch the base of the tube.

**CAUTION**

Extreme care should be taken during PA tube replacement to avoid damaging the screen ring contacts.

6. Replace the tube by hand, making sure that it is fully seated in the socket and that all screen ring contacts are touching the tube.
7. Replace the plate lines, tightening the screw nearest the heatsink first. Then replace the top cover of AMPL PLATE box.
8. Realign the transmitter.

# ADDENDUM TO LBI-4430 AND LBI-4432

(470-512 MHz TRANSMITTER MODELS 4ET59G30-41, 4ET60G30-41, 4ET59H30-41 and 4ET60H30-41)

The following revision letter changes have been made to improve transmitter performance. The revision stamped on the assemblies includes all previous revisions.

## REV. A - CHASSIS AND RF ASSEMBLY 19E500865G3

To optimize tuning range of C104. Deleted C107, 748916P7, and added C108, 748916P4.

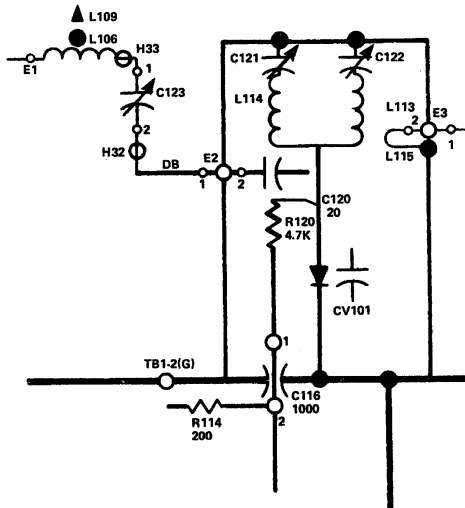
## REV. B - To insure proper tuning.

Deleted C115, 19B209372P1, and L108, 19B205615P1. Changed C120 from 5496218P8 to 5496218P46 and C123 from 5496218P7 to 5491271P6. Added L106, 19B205615P4.

## REV. A - CHASSIS AND RF ASSEMBLY 19E500865G4

To insure proper tuning. Deleted C115, 19B209372P1. Changed C120 from 5496218P8 to 5496218P46, C123 from 5496218P7 to 5491271P6, and L109 from 19B205615P3 to 19B205615P5.

Schematic Diagram Changed To:



## Alignment Procedure Change:

8.	E (MULT-4)	Pin 5	C104 & C123	Maximum	Tune IPA GRID (C104) for maximum meter reading. Then tune C123 for maximum meter reading (not required unless changing frequency).
9.	E (MULT-4)	Pin 5	C121 & C122	See Procedure	Tune C121 clockwise until meter reading drops abruptly. Then turn C122 clockwise for a change in meter reading. This step is not required unless changing frequency.
10.	F PA GRID	Pin 14 (+) Pin 6 (-)	AMPL GRID (C130 & C123, C121 & C122)	See Procedure	Tune AMPL GRID for maximum meter reading. Then retune C123, C121, C122 and AMPL GRID in that order until no further increase in meter reading is noted.  <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">NOTE</p> <p>If no reading is found, switch to test selector position "G" and alternately tune C123, C121, C122 and C130 for a peak in the reading at position "G". Then proceed with Step 10.</p> </div>

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R12) was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing overmodulation while preserving intelligibility.

TEST EQUIPMENT

- 1. An audio oscillator
- 2. A frequency modulation monitor
- 3. An output meter or a VTVM
- 4. GE Test Set Model 4EX3A10

PROCEDURE

- 1. Connect the audio oscillator and the meter across audio input terminals J5 (Green-Hi) and J6 (Black-Lo) on GE Test Set or across J1 (Mike High) and J2 (Mike Low) on the Exciter Board.
- 2. Apply a 0.75-volt signal at 1000 Hz to Test Set or across J1 and J2 on Exciter Board.
- 3. For transmitters without Channel Guard, set the MOD ADJUST (R12) for a 13 kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
- 4. For transmitters with Channel Guard, set the Channel Guard MOD ADJUST (R34) for 1.5 kHz tone deviation. Then repeak L1/L2 and L3/L4 as shown in Step 1 of Transmitter Alignment Procedure. Reset tone deviation to 1.5 kHz deviation. Remove the tone to the transmitter by unplugging leads to J7 and J8 on Exciter Board, or by switching to a non-Channel Guard frequency in multifrequency units. Next, apply a 1.0 volt signal at 1000 Hz and set MOD ADJUST (R12) for 11.5 kHz deviation (13 kHz minus 1.5 kHz tone deviation).
- 5. For multifrequency transmitters, set the deviation as described in Steps 3 or 4 on the channel producing the largest amount of deviation.

PA POWER INPUT

For FCC Purposes, the PA power input can be determined by measuring the PA Plate voltage and the plate current indication, and using the following formula:

ET-59-H  $P_1 = \frac{\text{Plate Voltage} \times \text{Plate Current Indication}}{3.5}$

ET-60-H  $P_1 = \frac{\text{Plate Voltage} \times \text{Plate Current Indication}}{2.59}$

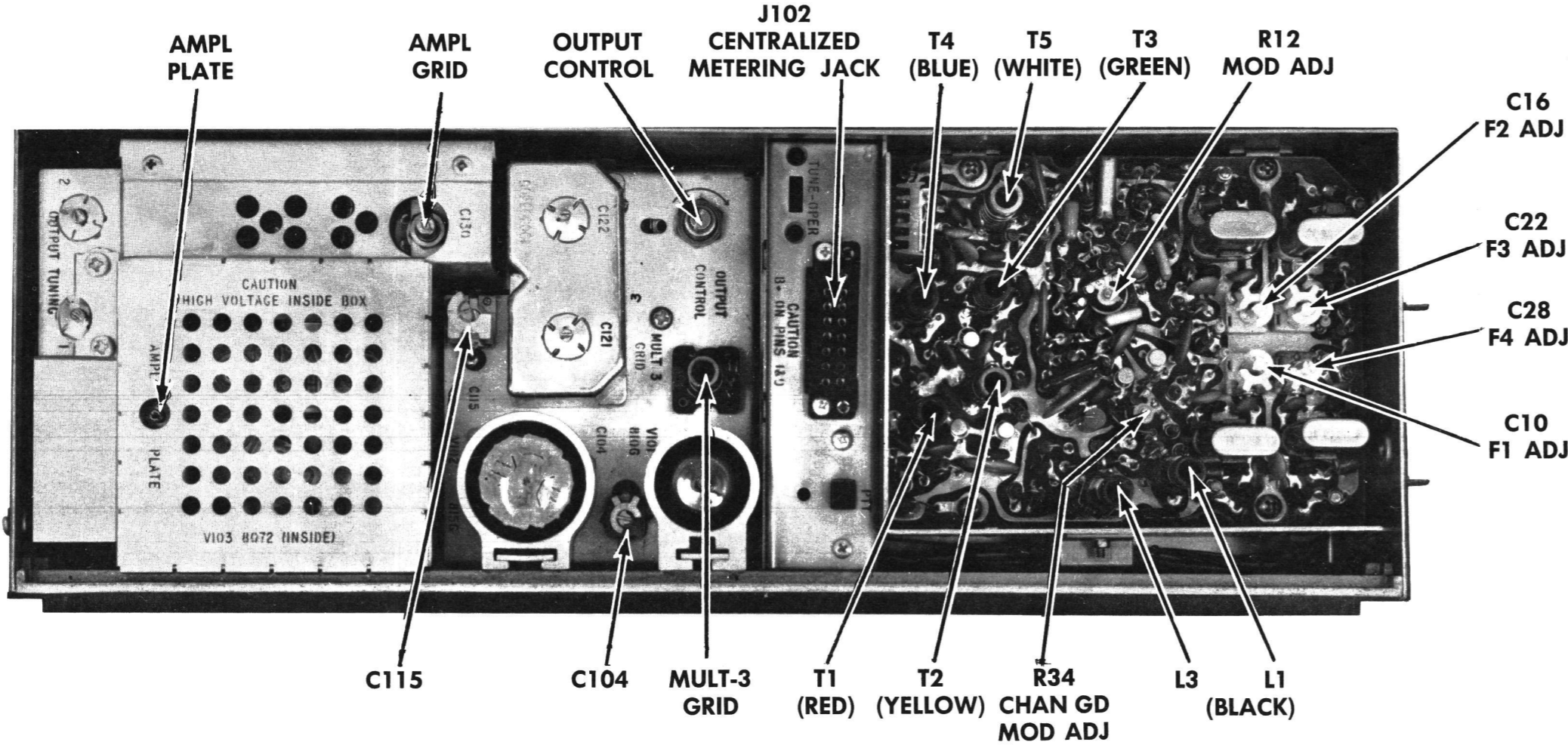
Where:

P<sub>1</sub> is the power input in watts.

Plate voltage is measured with GE Test Set in position G, using the 1000-volt scale (or measured from J102-1 to -16 with multimeter).

Plate current indication is measured with GE Test Set in Position G, using the TEST 1 scale (or measured from J102-1 to -9 with multimeter).

3.5 or 2.59 is the value of the plate current metering resistor in ohms.



TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

- 1. General Electric Test Set Models 4EX3A10 (TM11 or TM12), 4EX8K11, Station Test Meter Panel, or a 20,000 ohms-per-volt Multimeter with a 1-volt scale.

PRELIMINARY CHECKS AND ADJUSTMENTS

- 1. Place crystal (operating frequency ÷ 36) in crystal XY1.
- 2. For a badly mis-aligned transmitter or a large change in frequency, set crystal trimmer C10 to mid-capacity. If multifrequency transmitter, set all trimmers to mid-capacity and tune transmitter on channel with the lowest frequency (except for Steps 15 and 16.)
- 3. Turn OUTPUT CONTROL (R124) fully counterclockwise. This limits PA dissipation during initial tune-up.
- 4. Connect Test Set Model 4EX3A10 to the Transmitter Centralized Metering Jack J102. If using Multimeter, connect the positive lead to J102-16 (Ground), except where indicated.
- 5. For a large change in frequency or a badly misaligned transmitter, set the slugs in the Exciter coils at the bottom of the coil form, and the slug of Z102 (MULT-3 GRID) at the top of the coil form. Tune AMPL PLATE counterclockwise until the stud is even with the top of the case. Then turn C121, C122 and OUTPUT TUNING -1 and -2 fully counterclockwise.
- 6. All adjustments are made with the transmitter keyed.

ALIGNMENT PROCEDURE

STEP	METERING POSITION		TUNING CONTROL	TYPICAL METER READING	PROCEDURE
	4EX3A10	Multimeter - at J102			
EXCITER BOARD					
1.	A (MULT-1)	Pin 10	L1 (and L3 with Channel Guard)	0.8 V (0.5 V Minimum)	Tuning the modulator is a critical adjustment. Carefully tune L1 for maximum meter reading. For transmitters with Channel Guard, alternately tune L1/L2 and L3/L4 for maximum meter reading.
2.	A (MULT-1)	Pin 10	T1	See Procedure)	Tune T1 for a small peak in meter reading (not required unless changing frequency).
3.	B (MULT-2)	Pin 2	T2, T1 and T3	0.65 V (0.5 V Minimum)	Tune T2 and then T1 for maximum meter reading. Then tune T3 for minimum meter reading (not required unless changing frequency).
4.	C (AMPL-3)	Pin 3	T4, T3 and T5	0.60 V (0.5 V Minimum)	Tune T4 and then T3 for a maximum meter reading. Then tune T5 for minimum meter reading (not required unless changing frequency).
MULT-3, IPA AND POWER AMPLIFIER					
5.	D (MULT-3)	Pin 4	MULT-3 GRID (Z102)	0.6 V (0.5 V Minimum)	Tune MULT-3 GRID for maximum meter reading.
6.	C (AMPL-3)	Pin 3	T4	Maximum	Retune T4 for maximum meter reading.
7.	D (MULT-3)	Pin 4	MULT-3 GRID (Z102)	Maximum	Retune MULT-3 Grid for maximum meter reading.
8.	E (MULT-4)	Pin 5	C104 & C115	Maximum	Tune IPA GRID (C104) for maximum meter reading. Then tune C115 for maximum meter reading (not required unless changing frequency).
9.	E (MULT-4)	Pin 5	C121 & C122	See Procedure	Tune C121 clockwise until meter reading drops abruptly. Then turn C122 clockwise for a change in meter reading. This step is not required unless changing frequency.
10.	F PA GRID	Pin 14 (+) Pin 6 (-)	AMPL GRID (C130) & C115, C121 & C122	See Procedure	Tune AMPL GRID for maximum meter reading. Then retune C115, C121, C122 and AMPL GRID in that order until no further increase in meter reading is noted. <div><div>NOTE</div><div>If no reading is found, switch to test selector position "G" and alternately tune C115, C121, C122 and C130 for a peak in the reading at position "G". Then proceed with Step 10.</div></div>
11.	G PA Plate	WARNING High B+ on Pins 1 & 9 Pin 1 (+) Pin 9 (-)		Minimum	Tune AMPL PLATE for a dip in meter reading (not required unless changing frequency).
		AMPL PLATE			
12.	H REL PWR OUT	Pin 11	OUTPUT TUNING -1 & -2 and AMPL PLATE	Maximum	Alternately tune OUTPUT TUNING -1 and -2 and AMPL PLATE in that order for maximum meter reading.
13.	G PA PLATE	Pin 1 (+) Pin 9 (-)	OUTPUT CONTROL (R124)	See Procedure (See Note 1)	Adjust OUTPUT CONTROL for a meter reading of 0.64 volt (0.6 volt for continuous duty stations.
14.					Repeat Steps 12, 13 and 10 in that order.

STEP	METERING POSITION		TUNING CONTROL	TYPICAL METER READING	PROCEDURE
	4EX3A10	Multimeter - at J102			
FOR MULTI-FREQUENCY UNITS ONLY					
15.	F PA GRID	Pin 14 (+) Pin 6 (-)	AMPL GRID (C130)	See Procedure	After completing Steps 1 thru 14 using the lowest channel frequency, alternately switch from the highest to the lowest frequency and tune AMPL GRID for equal meter readings.
16.	H REL PWR OUT	Pin 11	OUTPUT TUNING-1 and AMPL PLATE	See Procedure	Alternately switch from the highest to the lowest frequency and tune OUTPUT TUNING-1 and AMPL PLATE for equal meter readings.
FREQUENCY ADJUSTMENT					
17.					With no modulation, adjust crystal trimmers C10, C16, C22 or C28 as required. Next, refer to the MODULATION ADJUSTMENT.

REDUCED POWER OPERATION

NOTE 1 - In some services, FCC regulations do not permit the use of full rated power input to the PA Plate circuit. In such cases:

- 1. In station applications, make sure that the power transformer taps are set for the PA Plate voltage shown in the Maintenance Manual for Power Supply Type EP-38-A.
- 2. In mobile applications, make sure that the transformer taps are set as shown in the Maintenance Manual for the 4EP37A10, 4EP37B10, 4EP37C10 or 4EP37D10.
- 3. Adjust the OUTPUT CONTROL for the meter reading shown in the following chart.

	XMTR TYPE	MEASURED PLATE VOLTAGE	METER READING
For 60-Watt Input	ET-59-H	275 to 305 VDC (see Note 2)	0.7 VDC
For 120-Watt Input	ET-60-H	460 to 510 VDC (see Note 3)	0.7 VDC MAX.

NOTE 2 - If the plate voltage is not within the 275 to 305-volt limit, find the OUTPUT CONTROL setting by dividing 210 by the measured plate voltage.

Meter reading in volts =  $\frac{210}{\text{Measured Plate Voltage}}$

NOTE 3 - If the Plate Voltage is not within the 460 to 510-volt limit, find the OUTPUT CONTROL setting by dividing 311 by the measured plate voltage.

Meter reading in volts =  $\frac{311}{\text{Measured Plate Voltage}}$

ALIGNMENT PROCEDURE

470—512 MHz, 30 & 60-WATT MASTR TRANSMITTER MODELS 4ET59H30-41 & MODELS 4ET60H30-41

## TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating--but not properly. Problems encountered could be low power output, low B plus, tone and voice deviation, defective audio sensitivity and modulator adjust control set too high. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once a defect is pin-pointed, refer to the "Service Check" and the additional corrective measures included in the Transmitter Troubleshooting Procedure. Before starting with the Transmitter Test Procedures, be sure the transmitter is tuned and aligned to the proper operating frequency.

### TEST EQUIPMENT REQUIRED

for test hookup as shown:

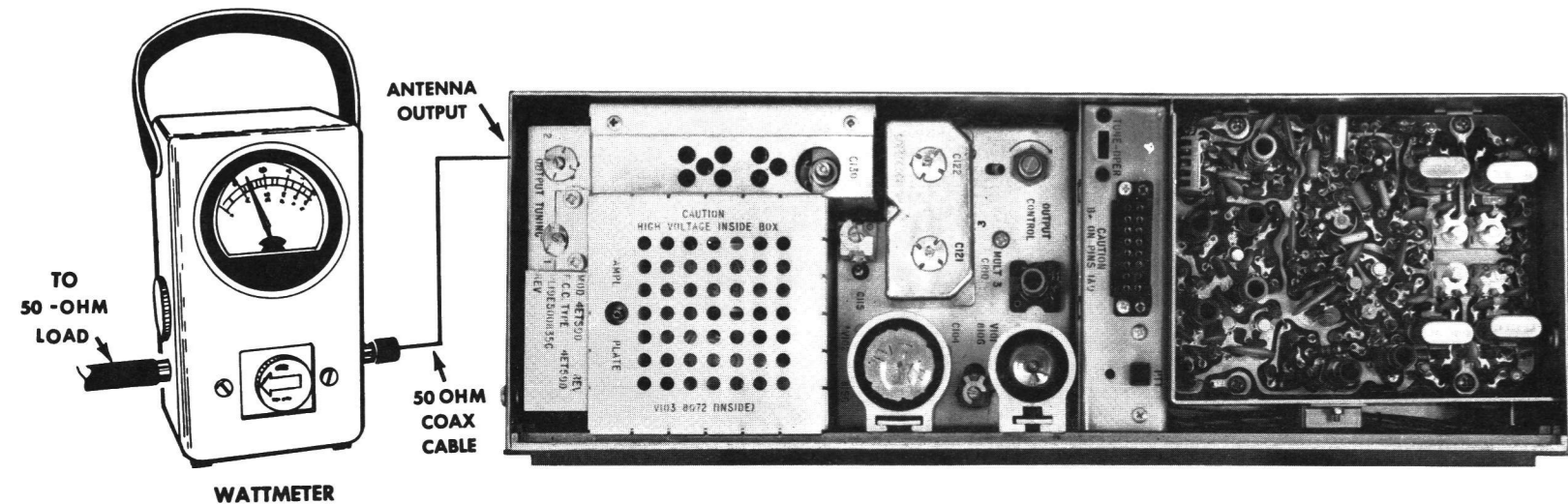
1. Wattmeter similar to: Bird #43
2. VTVM similar to: Triplett #850
3. Audio Generator similar to: GE Model 4EX6A10 or Heath #1G-72
4. Deviation Meter similar to: Measurements #140
5. Multimeter similar to: GE METERING TEST SET MODEL 4EX3A10, 4EX8K11, Triplett #631 or 20,000 ohms-per-volt voltmeter

### STEP 1

## POWER MEASUREMENT

### TEST PROCEDURE

1. Connect transmitter output to wattmeter as shown below, using a low-loss coaxial cable between the antenna jack and wattmeter. RG-303/U is recommended for accurate power output readings.



2. Key transmitter and check wattmeter for minimum reading as shown in power output chart on Transmitter Schematic Diagram.

### SERVICE CHECK

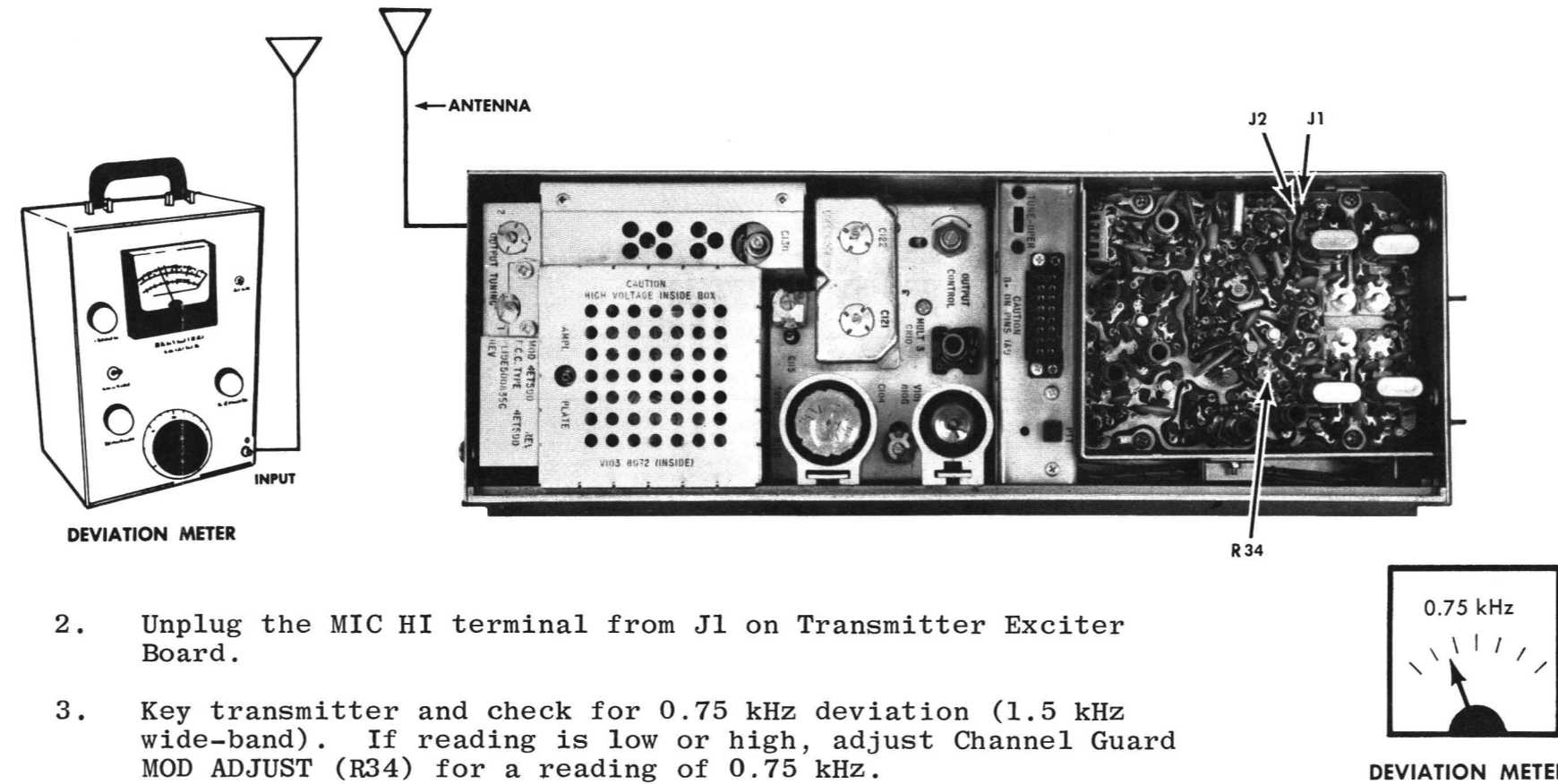
Refer to Service Hints on Transmitter Troubleshooting Procedure.

### STEP 2

## TONE DEVIATION WITH CHANNEL GUARD

### TEST PROCEDURE

1. Setup Deviation Meter and monitor output of transmitter as shown below:



2. Unplug the MIC HI terminal from J1 on Transmitter Exciter Board.
3. Key transmitter and check for 0.75 kHz deviation (1.5 kHz wide-band). If reading is low or high, adjust Channel Guard MOD ADJUST (R34) for a reading of 0.75 kHz.

### NOTES:

The Channel Guard MOD ADJUST (R34) may be adjusted for deviations up to 2.4 kHz for tone frequencies from 71.9 Hz to 82.5 Hz, and deviations up to 3.0 kHz for all tone frequencies above 82.5 Hz.

1. On units supplied with Channel Guard, the Phase Modulator Tuning should be peaked carefully to insure proper performance. (Refer to Steps 1 and 2 in the Transmitter Alignment Chart).
2. The Tone Deviation Test Procedures should be repeated everytime the Tone Frequency is changed.

### SERVICE CHECK

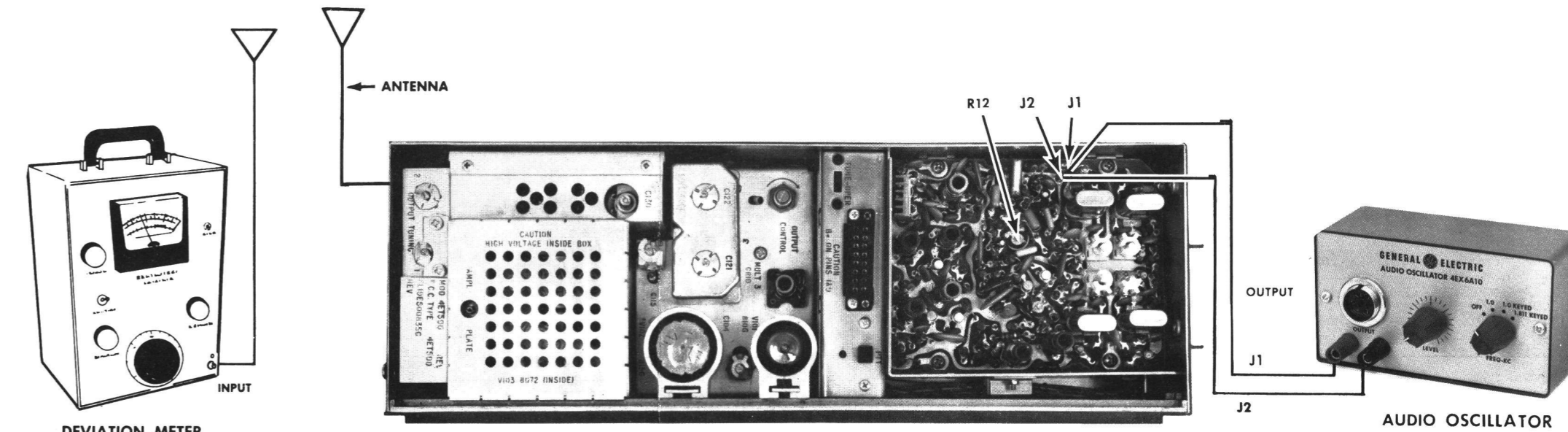
If the 0.75 kHz (1.5 kHz wide-band) deviation is not obtainable when adjusting R34, replace the encoder tone network.

### STEP 3

## VOICE DEVIATION AND SYMMETRY

### TEST PROCEDURE

1. Unplug the High and Low Mike leads from the Exciter Board Jacks J1 and J2.
2. Connect test equipment to transmitter as shown below:

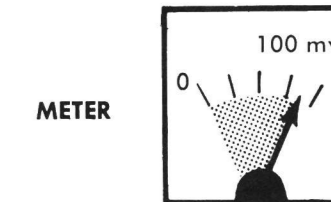
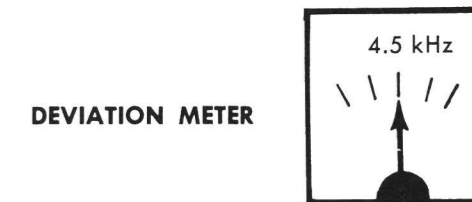


3. Set the generator output to 0.75 VOLTS RMS and frequency to 1 kHz.
4. Key the transmitter and adjust Deviation Meter to carrier frequency.
5. Deviation reading should be  $\pm 4.5$  kHz ( $\pm 13$  kHz wide-band).
6. Adjust "Modulation Adjust Control" R12 until deviation reads 4.5 kHz (13 kHz wide-band) on plus (+) or minus (-) deviation, whichever is greater. This adjustment should be made with the correct level of tone applied on Channel Guard transmitters.

**NOTES:** --MASTR transmitters are adjusted for 4.5 kHz (13 kHz wide-band) deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5 kHz (15 kHz wide-band) under the worst conditions of frequency, voltage and temperature.

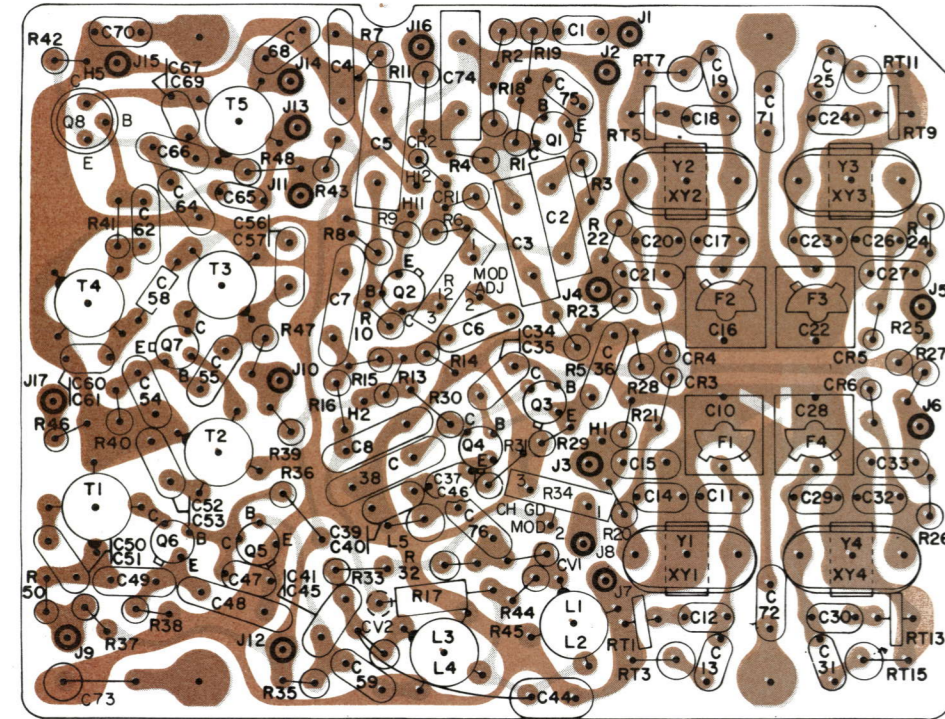
If the deviation reading plus (+) and minus (-) differs by more than 0.5 kHz (1.5 kHz wide-band), check the following:

1. Recheck Step 1 as shown in the Transmitter Alignment Chart.
2. Check Audio Sensitivity by reducing generator output until deviation falls to 3.3 kHz (10 kHz wide-band). Voltage should be LESS than 100 millivolts.





EXCITER  
A102,A104,A106,A108,A110,A112



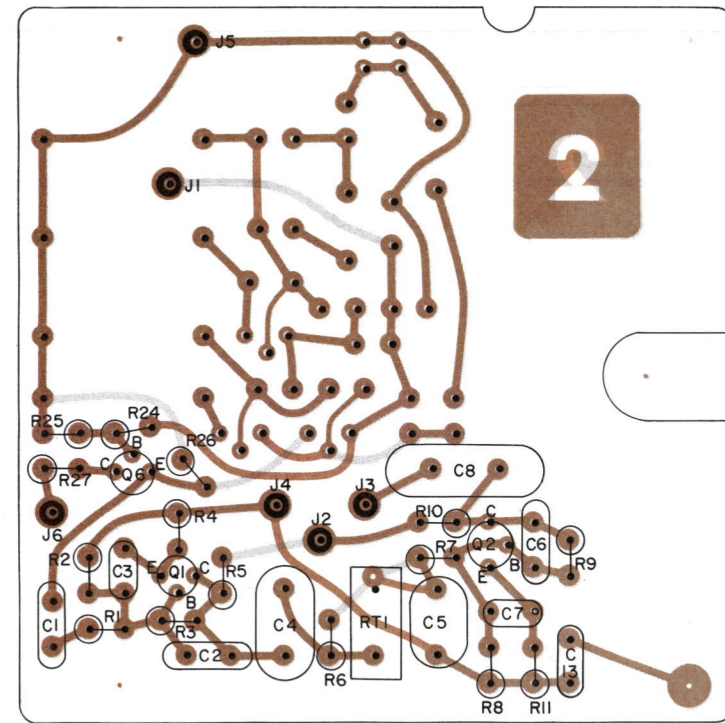
EXCITER READINGS TAKEN TO CHASSIS GROUND

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	6.5K	6.8K	240K 12K
Q2	6.2K	4K	70K 10K
Q3	9K	2.7K	9K 2.7K
Q4	7K	5K	9K 2.7K
Q5	5K	2.7K	70K 6.8K
Q6	4K	3.2K	3.7K 2.3K
Q7	5.2K	2.9K	5K 2.7K
Q8	5K	2.7K	5K 2.7K

EXCITER READINGS TAKEN TO 20 VOLT LINE, J15 BLUE LEAD

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	1.1K	14K	240K 30K
Q2	1K	1K	70K 4.3K
Q3	2.6K	2.5K	10K 5.5K
Q4	1.5K	1.5K	2.6K 2.5K
Q5	0	0	70K 3.2K
Q6	340	350	8K 3.8K
Q7	60	180	0
Q8	27	27	47

(19C303483, Sh. 1, Rev. 7)  
(19C303483, Sh. 2, Rev. 7)



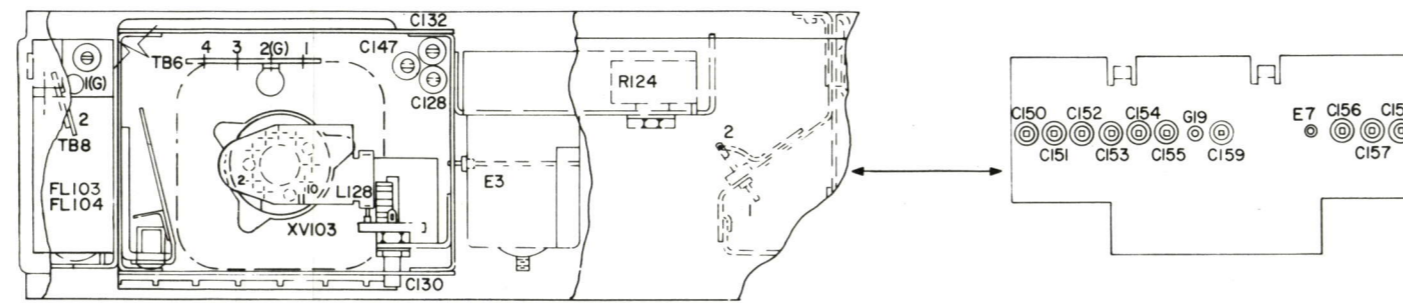
LOW-PASS FILTER  
G101

(19C311800, Sh. 1, Rev. 2)  
(19C311800, Sh. 2, Rev. 2)

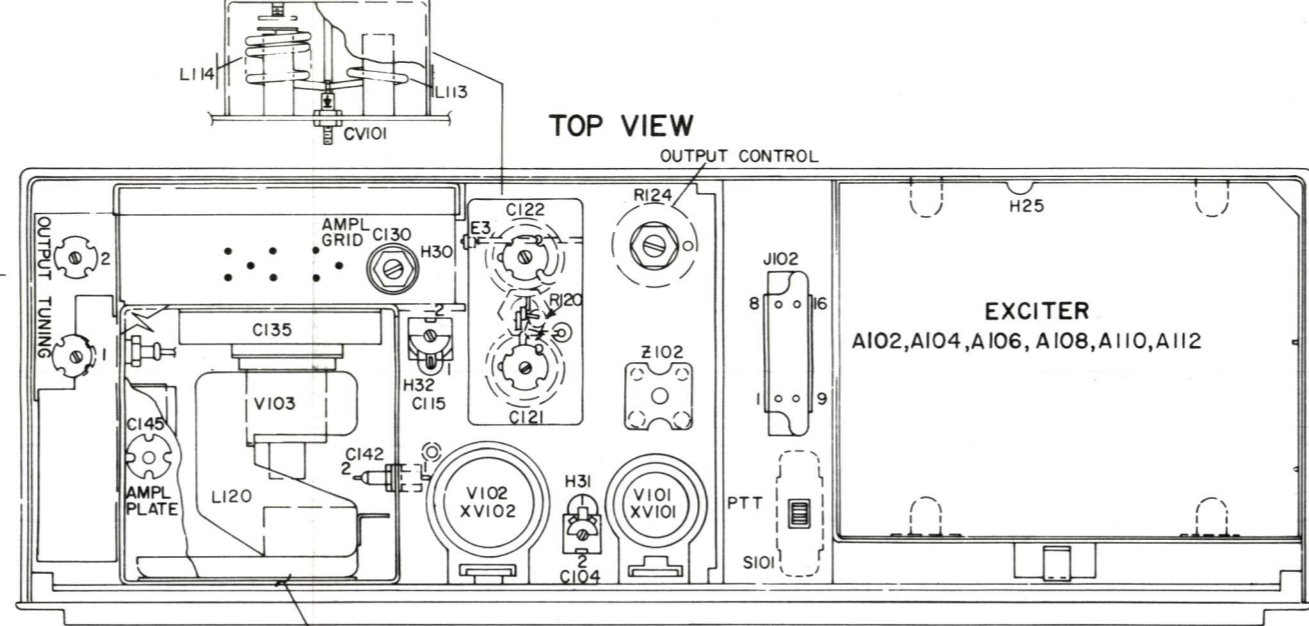
OUTLINE DIAGRAM

470—512 MHz, 30 & 60-WATT TRANSMITTER  
MODELS 4ET59H30-41 & 4ET60H30-41

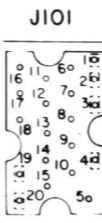
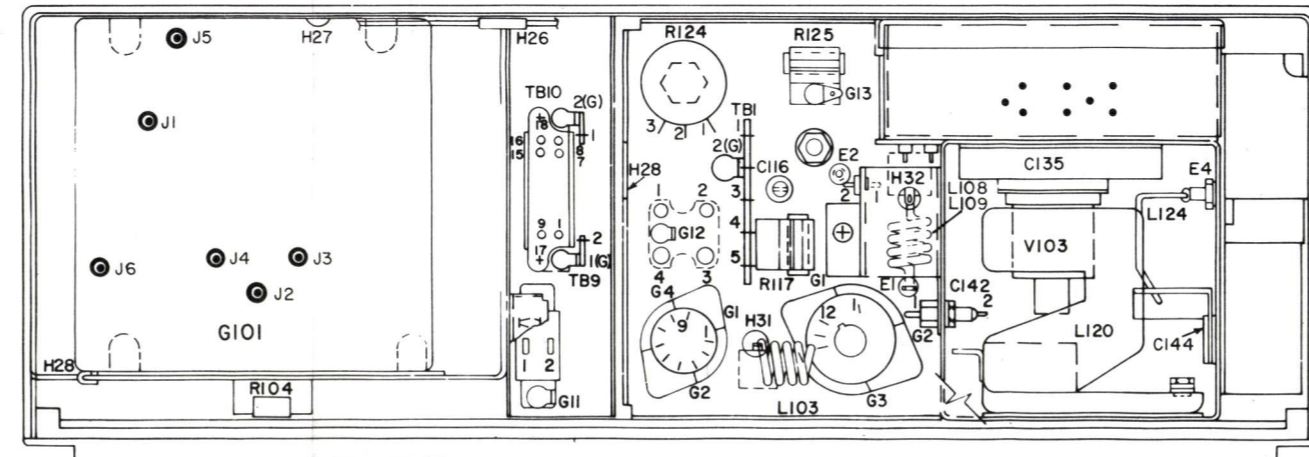
SIDE VIEW



TOP VIEW



BOTTOM VIEW



RESISTANCE READINGS

ALL READINGS ARE TYPICAL READINGS MEASURED WITH A 20,000 OHM-PER-VOLT METER AND J101 DISCONNECTED. + OR - SIGNS SHOW METER LEAD GROUNDING. OUTPUT CONTROL FULLY COUNTER-CLOCKWISE AND ALL TUBES IN THEIR SOCKETS.

FOR READINGS OF: USE SCALE:  
1-100Ω X 1  
100-1KΩ X 10  
1K-50KΩ X 1,000  
50K-∞Ω X 100,000

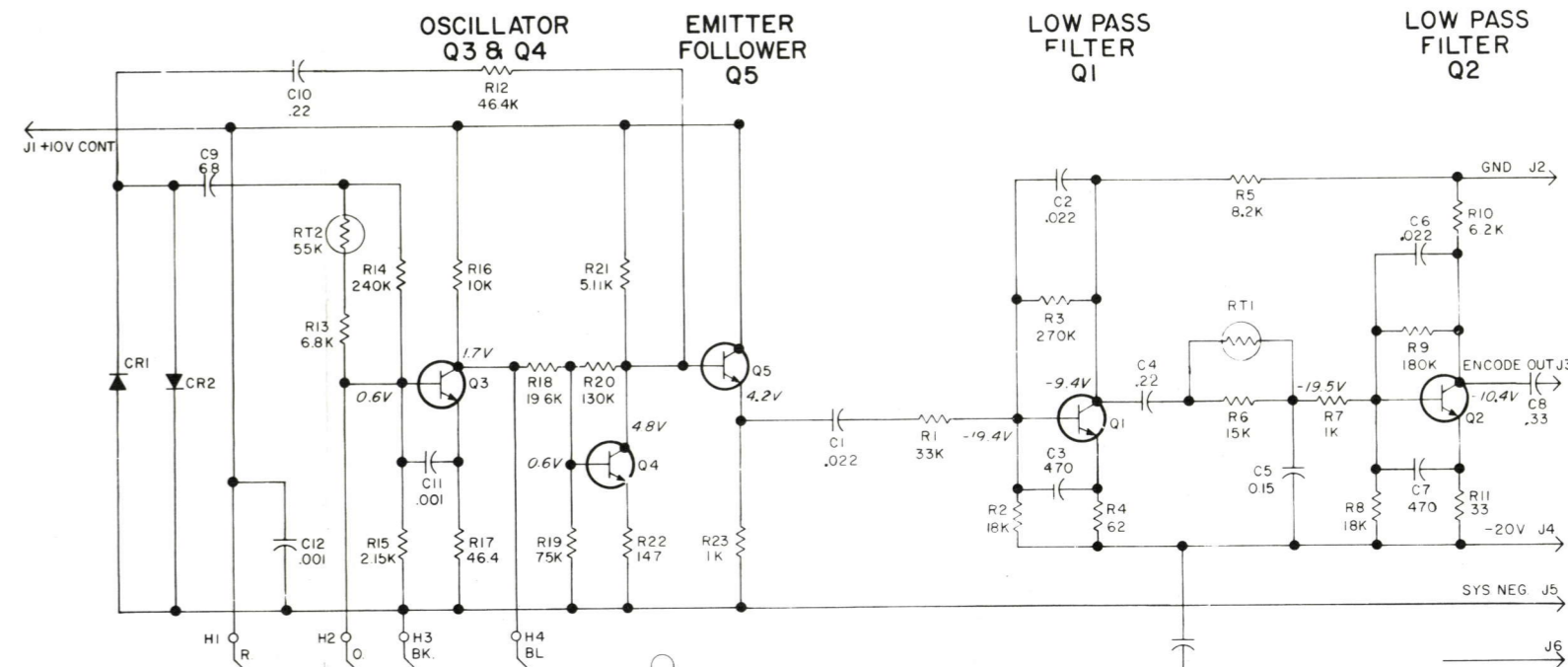
READINGS TAKEN FROM TUBE SOCKET PINS TO CHASSIS GROUND

PIN	1	2	3	4	5	6	7	8	9	10	11	12
XV101	20K	0	46K	1Ω	0	0	32K	46K	0	55K	24K	0
XV102	1Ω	0	19K	19K	19K	0	24K	0	0	0	0	0
XV103	0	∞	2K/6K	0	0	1Ω	12.5K	2K/6K	0	∞	2K/6K	0

\* READING DEPENDS ON METER POLARITY.

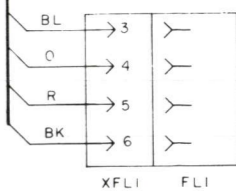
CHANNEL GUARD ENCODER MODEL 4EH17A10

SCHEMATIC DIAGRAM



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.

(19D402941, Rev. 2)



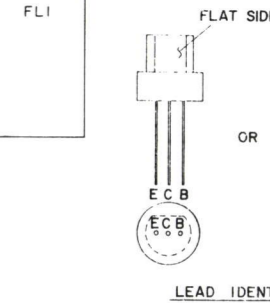
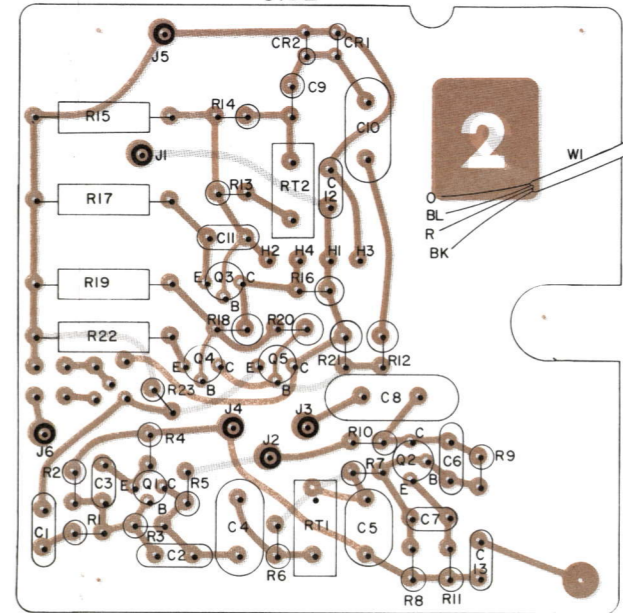
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROFARADS UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

REVISION LTR BLOCK

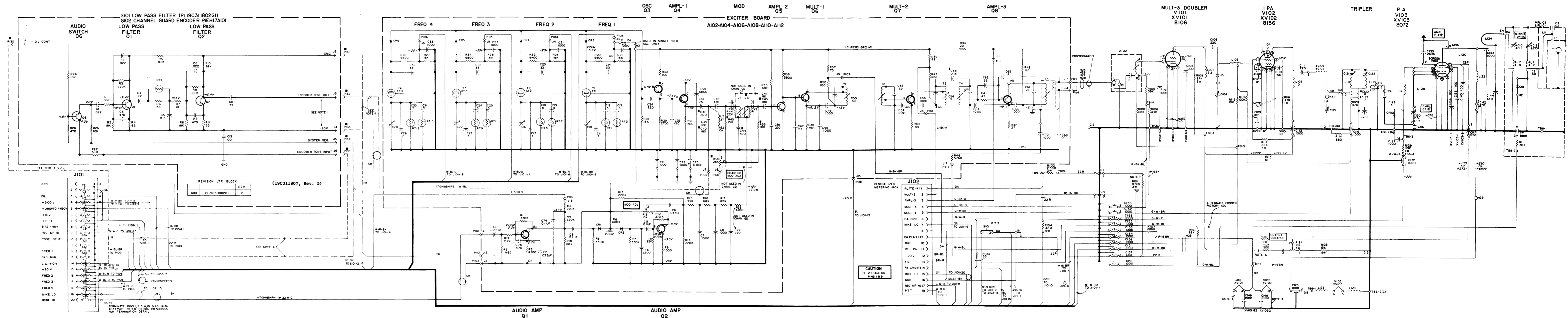
REV	REV
G102	4EH17A10

OUTLINE DIAGRAM

ENCODER  
MODEL 4EH17A10  
G102



(19C311861, Rev. 3)  
(19C311800, Sh. 1, Rev. 2)  
(19C311800, Sh. 2, Rev. 2)



(19B621407, Rev. 2)

- USED WITH 470-494 MHz UNITS ONLY
- ▲ USED WITH 494-512 MHz UNITS ONLY
- USED WITH CHAN. GD. UNITS ONLY

## NOTES

1. RI01 USED IN 4ET59H MODELS ONLY. RI01 IS REPLACED WITH DA WIRE ON 4ET60H MODELS.
2. ALL 22R WIRES ARE 44036700P3.
3. BEND TERMINAL BACK DOWN AGAINST SOCKET SADDLE, AND PRESS IT TIGHTLY AGAINST SADDLE WHILE SOLDERING.
4. PART OF CABLE (H82024002).
5. ALL WIRES N22 EXCEPT AS OTHERWISE SHOWN.
6. RI23 USED IN 4ET60H MODELS ONLY. RI23 IS REPLACED WITH RI24 ON 4ET59H MODELS.
7. CONNECTED TO PIN 6 ON MODELS 36 & 37.
8. CONNECTED TO PIN 14 ON MODELS 36, 39, 40 & 41.

50W NO.	PARTS LIST	LETTER
1	PL19C31802G1	
2	PL19C31802G1	
3	PL19C31802G1	
4	PL19C31802G1	
5	PL19C31802G1	
6	PL19C31802G1	
7	PL19C31802G1	
8	PL19C31802G1	
9	PL19C31802G1	
10	PL19C31802G1	
11	PL19C31802G1	
12	PL19C31802G1	
13	PL19C31802G1	
14	PL19C31802G1	
15	PL19C31802G1	
16	PL19C31802G1	
17	PL19C31802G1	
18	PL19C31802G1	
19	PL19C31802G1	
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41	PL19C31802G1	
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43	PL19C31802G1	
44	PL19C31802G1	
45	PL19C31802G1	
46	PL19C31802G1	
47	PL19C31802G1	
48	PL19C31802G1	
49	PL19C31802G1	
50	PL19C31802G1	

MODEL NO.	FREQ. RANGE	NO. OF FREQ.	CHAN. ID.
4ET59H30	470-494	1	
4ET59H31	470-494	1	
4ET59H32	470-494	1	
4ET59H33	470-494	1	
4ET59H34	470-494	1	
4ET59H35	470-494	1	
4ET59H36	470-494	1	
4ET59H37	470-494	1	
4ET59H38	470-494	1	
4ET59H39	470-494	1	
4ET59H40	470-494	1	
4ET59H41	470-494	1	
4ET59H42	470-494	1	
4ET59H43	470-494	1	
4ET59H44	470-494	1	
4ET59H45	470-494	1	
4ET59H46	470-494	1	
4ET59H47	470-494	1	
4ET59H48	470-494	1	
4ET59H49	470-494	1	
4ET59H50	470-494	1	
4ET59H51	470-494	1	
4ET59H52	470-494	1	
4ET59H53	470-494	1	
4ET59H54	470-494	1	
4ET59H55	470-494	1	
4ET59H56	470-494	1	
4ET59H57	470-494	1	
4ET59H58	470-494	1	
4ET59H59	470-494	1	
4ET59H60	470-494	1	
4ET59H61	470-494	1	
4ET59H62	470-494	1	
4ET59H63	470-494	1	
4ET59H64	470-494	1	
4ET59H65	470-494	1	
4ET59H66	470-494	1	
4ET59H67	470-494	1	
4ET59H68	470-494	1	
4ET59H69	470-494	1	
4ET59H70	470-494	1	
4ET59H71	470-494	1	
4ET59H72	470-494	1	
4ET59H73	470-494	1	
4ET59H74	470-494	1	
4ET59H75	470-494	1	
4ET59H76	470-494	1	
4ET59H77	470-494	1	
4ET59H78	470-494	1	
4ET59H79	470-494	1	
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4ET59H82	470-494	1	
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4ET59H86	470-494	1	
4ET59H87	470-494	1	
4ET59H88	470-494	1	
4ET59H89	470-494	1	
4ET59H90	470-494	1	
4ET59H91	470-494	1	
4ET59H92	470-494	1	
4ET59H93	470-494	1	
4ET59H94	470-494	1	
4ET59H95	470-494	1	
4ET59H96	470-494	1	
4ET59H97	470-494	1	
4ET59H98	470-494	1	
4ET59H99	470-494	1	
4ET59H00	470-494	1	

## SCHEMATIC DIAGRAM

470-512 MHz, 30 & 60-WATT MASTR  
TRANSMITTER MODELS 4ET59H30-41 &  
MODELS 4ET60H30-41

PARTS LIST		
LBI-4431		
470-512 Mhz TRANSMITTER MODELS 4ET95H30-41 MODELS 4ET90H30-41		
SYMBOL	GE PART NO.	DESCRIPTION
A102, A104, A106, A108, A110, A112		EXCITER BOARD A102 19D402308G2 1 FREQ A104 19D402308G4 2 FREQ A106 19D402308G6 3 FREQ A108 19D402308G8 1 FREQ CHANNEL GUARD A110 19D402308G10 2 FREQ CHANNEL GUARD A112 19D402308G12 4 FREQ CHANNEL GUARD
C1	19A116080P3	Polyester: .022 pf ±20%, 50 VDCW.
C2	19A116080P4	Polyester: .033 pf ±20%, 50 VDCW.
C3	19A116080P7	Polyester: 0.1 pf ±20%, 50 VDCW.
C4	7491395P114	Ceramic disc: 2200 pf ±10%, 500 VDCW; sim to RMC Type JF.
C5	19A116080P7	Polyester: 0.1 pf ±20%, 50 VDCW.
C6	19A116080P5	Polyester: .047 pf ±20%, 50 VDCW.
C7	7491395P111	Ceramic disc: 1500 pf ±10%, 500 VDCW; sim to RMC Type JF.
C8	5493367P100K	Mica: 1000 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-20.
C10	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C11	5496219P7	Ceramic disc: 7.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C12 and C13	19C300685P93	Ceramic disc: 5 pf ±2%, 500 VDCW, temp coef 0 PPM.
C14	5496219P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C15	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C16	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C17	5496219P7	Ceramic disc: 7.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C18 and C19	19C300685P93	Ceramic disc: 5 pf ±2%, 500 VDCW, temp coef 0 PPM.
C20	5496219P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C21	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C22	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C23	5496219P7	Ceramic disc: 7.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C24 and C25	19C300685P93	Ceramic disc: 5 pf ±2%, 500 VDCW, temp coef 0 PPM.
C26	5496219P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C27	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C28	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C29	5496219P7	Ceramic disc: 7.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C30 and C31	19C300685P93	Ceramic disc: 5 pf ±2%, 500 VDCW, temp coef 0 PPM.
C32	5496219P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C33	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C34	5496372P50	Ceramic disc: 220 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C36	5496219P467	Ceramic disc: 150 pf ±5%, 500 VDCW, temp coef -220 PPM.
C37	5496372P327	Ceramic disc: 75 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C38	5494481P131	Ceramic disc: 6800 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C39	5496372P145	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -3300 PPM.
C40	5496372P345	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C41	5493366P180K	Mica: 180 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C44	5493366P470J	Mica: 470 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C45	5496372P245	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -2200 PPM.
C46	5496372P347	Ceramic disc: 200 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C47	5496219P749	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -750 PPM.
C48	5494481P129	Ceramic disc: 3900 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C49	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C50	5496219P253	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -80 PPM.
C52	5496219P253	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -80 PPM.
C54 and C55	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C56	5496219P440	Ceramic disc: 9.0 pf ±0.25 pf, 500 VDCW, temp coef -220 PPM.
C58	5491601P35	Phenolic: 0.15 pf ±10%, 500 VDCW.
C59	5493366P220K	Mica: 220 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C60	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C61	5496219P244	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -80 PPM.
C62	5496219P51	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C64	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C65	5496219P35	Ceramic disc: 4.0 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C66	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C67	5496219P247	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -80 PPM.
C68	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C70 thru C72	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C73	5496267P18	Tantalum: 6.8 pf ±20%, 35 VDCW; sim to Sprague Type 150D.
C74	19A115414P13	Polyester: 0.1 pf ±20%, 200 VDCW.
C75	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C76	5493366P470K	Mica: 470 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C77	5493366P270K	Mica: 270 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
CR1 and CR2	19A115250P1	Silicon.

SYMBOL	GE PART NO.	DESCRIPTION
CR3 thru CR6	19A115603P1	Silicon.
CV1	5495766P8	Silicon, capacitive.
J1 thru J17	4033513P4	----- JACKS AND RECEPTACLES ----- Contact, electrical; sim to Bead Chain L93-3.
L1	19B204526G2	----- INDUCTORS ----- Coil. Includes tuning slug 5491798P2.
L3	19B204526G4	Coil. Includes tuning slug 5491798P2.
L5	7488079P48	Choke, RF: 27.0 pf ±10%, 1.40 ohms DC res max; sim to Jeffers 4422-9K.
Q1 and Q2	19A115123P1	----- TRANSISTORS ----- Silicon, NPN; sim to Type 2N2712.
Q3 thru Q5	19A115330P1	Silicon, NPN.
Q6 and Q7	19A115328P1	Silicon, NPN.
Q8	19A115329P1	Silicon, NPN.
R1	3R77P334K	----- RESISTORS ----- Composition: 0.33 megohms ±10%, 1/2 w.
R2	3R77P105K	Composition: 1 megohm ±10%, 1/2 w.
R3	3R77P472K	Composition: 4700 ohms ±10%, 1/2 w.
R4	3R77P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R5	3R77P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R6	3R77P684K	Composition: 0.68 megohm ±10%, 1/2 w.
R7	3R77P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R8	3R77P823K	Composition: 82,000 ohms ±10%, 1/2 w.
R9	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R10 and R11	3R77P224K	Composition: 0.27 megohm ±10%, 1/2 w.
R12	19B209358P106	Variable, carbon film: approx 75 to 10,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R13 and R14	3R77P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R15	19B204531G1	Coil. Includes tuning slug 5491798P4.
R16	3R77P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R17	3R77P823K	Composition: 82,000 ohms ±10%, 1/2 w.
R18	3R77P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R19	3R77P222K	Composition: 2200 ohms ±10%, 1/2 w.
R20	3R77P682K	Composition: 6800 ohms ±10%, 1/2 w.
R21	3R77P153K	Composition: 15,000 ohms ±10, 1/2 w.
R22	3R77P682K	Composition: 6800 ohms ±10%, 1/2 w.
R23	3R77P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R24	3R77P682K	Composition: 6800 ohms ±10%, 1/2 w.
R25	3R77P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R26	3R77P682K	Composition: 6800 ohms ±10%, 1/2 w.
R27 and R28	3R77P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R29	3R77P272K	Composition: 2700 ohms ±10%, 1/2 w.
R30	3R77P101K	Composition: 100 ohms ±10%, 1/2 w.
R31	3R77P152K	Composition: 1500 ohms ±10%, 1/2 w.
R32 and R33	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
R34	19B209358P107	Variable, carbon film: approx 75 to 25,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R35	3R77P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R36	3R77P392K	Composition: 3900 ohms ±10%, 1/2 w.
R37	3R77P750J	Composition: 75 ohms ±5%, 1/2 w.
R38	3R77P391K	Composition: 390 ohms ±10%, 1/2 w.
R39	3R77P620J	Composition: 62 ohms ±5%, 1/2 w.
R40	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R41	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R42	3R77P270K	Composition: 27 ohms ±10%, 1/2 w.
R43	3R77P200J	Composition: 20 ohms ±5%, 1/2 w.
R44	3R77P223K	Composition: 22,000 ohms ±10%, 1/2 w.
R45	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w.
R46	19A116278P474	Metal film: 0.576 megohm ±2%, 1/2 w.
R47	3R77P391K	Composition: 390 ohms ±10%, 1/2 w.
R48	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R50	3R77P101K	Composition: 100 ohms ±10%, 1/2 w.
R53	3R152P472K	Composition: 4700 ohms ±10%, 1/4 w.
RT1	19B209284P6	----- THERMISTORS ----- Thermistor, disc: 198 ohms DC res max, ±5%, color code blue; sim to GE3D2116.
RT3	19B209284P2	Thermistor, rod: 6850 ohms DC res min, ±5%, color code red; sim to GE1R1537.
RT5	19B209284P2	Thermistor, disc: 198 ohms DC res max, ±5%, color code blue; sim to GE3D2116.
RT7	19B209284P2	Thermistor, rod: 6850 ohms DC res min, ±5%, color code red; sim to GE1R1537.
RT9	19B209284P6	Thermistor, disc: 198 ohms DC res max, ±5%, color code blue; sim to GE3D2116.
RT11	19B209284P2	Thermistor, rod: 6850 ohms DC res min, ±5%, color code red; sim to GE1R1537.
RT13	19B209284P6	Thermistor, disc: 198 ohms DC res max, ±5%, color code blue; sim to GE3D2116.
RT15	19B209284P2	Thermistor, rod: 6850 ohms DC res min, ±5%, color code red; sim to GE1R1537.
T1	19B204534G1	----- TRANSFORMERS ----- Coil. Includes tuning slug 5491798P4.
T2	19B204531G1	Coil. Includes tuning slug 5491798P4.
T3	19B204535G1	Coil. Includes tuning slug 5491798P4.
T4	19B204535G2	Coil. Includes tuning slug 5491798P4.
T5	19B204537G1	Coil. Includes tuning slug 5491798P4.
XY1 thru XY4	19B216043G1	----- SOCKETS ----- Socket: 6 contacts.
Y1 thru Y4	19B206175P7	----- CRYSTALS ----- When reordering give GE Part Number and specify exact freq needed. Crystal frequency = (OF ± 36). Quart: freq range 12,500 to 14,500 KHz, temp range -30°C to +85°C.
Y1	5494481P12	----- CAPACITORS ----- Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.

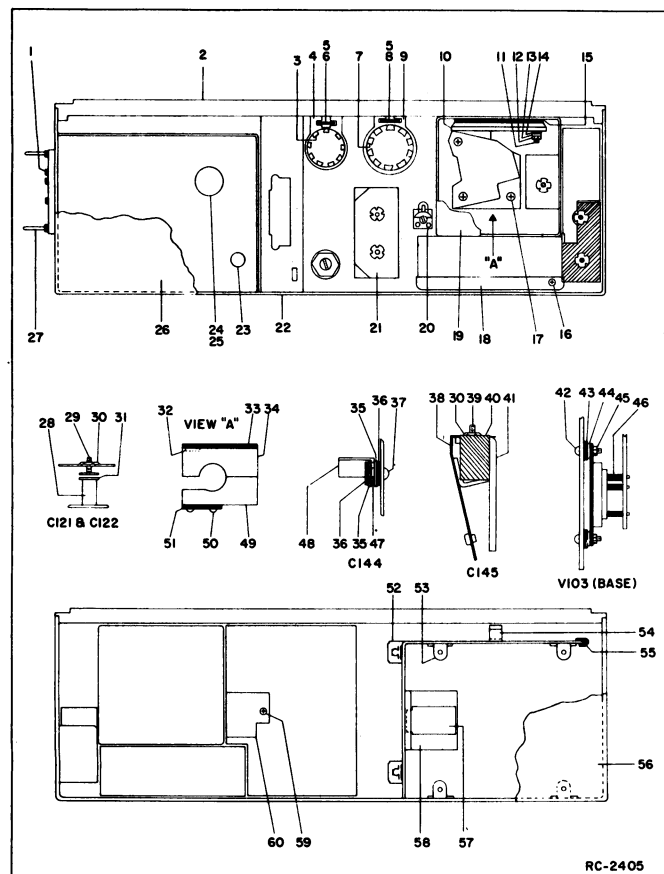
SYMBOL	GE PART NO.	DESCRIPTION
C104	5491271P6	Variable: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C105	5494481P12	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C106	19B209204P1	Ceramic disc: 220 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C107	7489162P7	Silver mica: 12 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C108	7489162P4	Silver mica: 8 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C109	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C110	7489162P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C111	19B209204P1	Ceramic disc: 220 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C113	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C115	19B209372P1	Variable: approx 2.3 to 24.3 pf; sim to EF Johnson Type V 193-0008-013.
C116	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C120	5496218P8	Ceramic disc: 8.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C121 and C122		Refer to Mechanical Parts (RC-2405), items 28 thru 31.
C123	5496218P7	Ceramic disc: 7.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C126	7489162P1	Silver mica: 5 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C127	5494481P12	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C128	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C130	5490272P17	Variable: 2 to 7.83 pf, 1250 v peak; sim to Johnson Type M.
C132	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C135	19B209369P1	Mica: 2500 pf ±20%, 400 VDCW; sim to EF Johnson 124-113-18.
C136	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C138	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C140	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C142	7485975P17	Ceramic, feed-thru: 470 pf ±20%, 750 VDCW; sim to Erie Style 327.
C143		Refer to Mechanical Parts (RC-2405), items 10, and 15.
C144		Refer to Mechanical Parts (RC-2405), items 37, 47 and 48.
C145		Refer to Mechanical Parts (RC-2405), items 30, 38, 39, 40 and 41.
C147	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C148 and C149	5494481P12	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C150 thru C156	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
C157	19B209282P1	Ceramic, feed-thru: 680 pf ±20%, 1000 VDCW; sim to Sprague Type 544C.
C158 and C159	5493392P7	Ceramic, feed-thru: 1000 pf ±100% -0%, 500 VDCW; sim to Allen-Bradley Type FASC.
CR101	4037822P1	Silicon.
CV101	19A115809P1	Silicon, capacitive.

SYMBOL	GE PART NO.	DESCRIPTION
E1	19B200535P3	----- TERMINALS ----- Feed-thru: sim to Sealectro ST-1500SL-C3.
E2	4029309P1	Feed-thru: sim to Sealectro FT-SM-27.
E3	4036032P5	Feed-thru: sim to Sealectro FT-SM-10.
E7	4034512P2	Feed-thru: sim to Sealectro FT-SM-22-TUR.
FL103	19C303559G3	470-494 Mhz.
FL104	19C303559G4	494-512 Mhz.
GI01		----- BANDPASS FILTER ----- LOW PASS FILTER 19C311802G1
C1	19A116080P103	----- CAPACITORS ----- Polyester: 0.022 pf ±20%, 50 VDCW.
C2	19A116080P3	Polyester: 0.022 pf ±20%, 50 VDCW.
C3	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C4	19A116080P9	Polyester: 0.22 pf ±20%, 50 VDCW.
C5	19A116080P8	Polyester: 0.15 pf ±20%, 50 VDCW.
C6	19A116080P3	Polyester: .022 pf ±20%, 50 VDCW.
C7	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C8	19B209243P14	Polyester: 0.33 pf ±20%, 250 VDCW.
C13	5494481P111	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
J1 thru J6	4033513P4	----- JACKS AND RECEPTACLES ----- Contact, electrical; sim to Bead Chain L93-3.
Q1 and Q2	19A115123P1	----- TRANSISTORS ----- Silicon, NPN; sim to Type 2N2712.
Q6	19A115123P1	Silicon, NPN; sim to Type 2N2712.
R1	3R77P333K	----- RESISTORS ----- Composition: 33,000 ohms ±10%, 1/2 w.
R2	3R77P183K	Composition: 18,000 ohms ±10%, 1/2 w.
R3	3R77P274K	Composition: 0.27 megohm ±10%, 1/2 w.
R4	3R77P620J	Composition: 62 ohms ±5%, 1/2 w.
R5	3R77P822K	Composition: 8200 ohms ±10%, 1/2 w.
R6	3R77P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R7	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R8	3R77P183K	Composition: 18,000 ohms ±10%, 1/2 w.
R9	3R77P184K	Composition: 0.18 megohm ±10%, 1/2 w.
R10	3R77P622J	Composition: 6200 ohms ±5%, 1/2 w.
R11	3R77P330K	Composition: 33 ohms ±10%, 1/2 w.
R12	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R13	3R77P473K	Composition: 47,000 ohms ±10%, 1/2 w.
R14	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R17	3R77P512K	Composition: 5100 ohms ±10%, 1/2 w.
RT1	5490828P30	----- THERMISTORS ----- Rod: 0.33 megohm ±10% res, 1 w max; sim to Global Type 783H-3.

SYMBOL	GE PART NO.	DESCRIPTION
J101	19C303426G1	----- JACKS AND RECEPTACLES ----- Connector: 20 pin contacts.
J102	19B205689G1	Connector: 18 electrical contacts.
L101	7488079P35	Choke, RF: 2.2 pf ±10%, 0.5 ohm DC res max; sim to Jeffers 4412-9K.
L103	19A122524G1	Coil.
L105	7488079P33	Choke, RF: 1 pf ±10%, 0.15 ohm DC res max; sim to Jeffers 4412-9K.

SYMBOL	GE PART NO.	DESCRIPTION
5	19A115332P1	Tap screw: No. 6-32 x 3/8. (Secures V101, V102 heat sinks).
6	19A122497P1	Support. (Used with V101).
7	7165167P9	Insert, tube shield: sim to Atlas Insert 106-332-21. (Used with V102).
8	19A122497P2	Support. (Used with V102).
9	19A122498P1	Heat sink. (Used with V102).
10	19C311166P2	Base line. (Part of C143).
11	N170P13010P	Cap screw: No. 6-32 x 5/8. (Used with Base line).
12	N210P13C13	Hex nut: No. 6-32. (Used with Base line).
13	19A115729P1	Flatwasher: No. 6. (Used with Base line).
14	19A115730P1	Bushing. (Used with Base line).
15	19A121350P1	Insulator. (Part of C143).
16	19B201074P205	Tap screw, Phillips Pozidriv: 4-40-5/16.
17	N80P15024C	Machine screw: No. 8-32 x 1-1/2. (Secures plate line).
18	19B204654P2	Cover.
19	19C303544P2	Cover. (Located over V103).
20	N539P108F22	Drive screw: No. 00 x 1/2. (Secures C115).
21	19C303405P2	Casting. (Consists C121, C122, and CV101).
22	19B204395G2	Chassis.
23	4036555P1	Insulator, washer: nylon. (Used with Q6 on A114-A120).
24	4034252P5	Can. (Used with T2 on A114-A120).
25	19A121688P4	Cap. (Used with T2 on A114-A120).
26	19C303396G1	Mobile Top Cover.
	19C303495G8	Station Top Cover. (Except Repeaters and VM).
	19C303673G3	Station Top Cover. (Repeaters and VM only).
27	19A121676P1	Guide pin: No. 4-40 thread. (Used with J101).
28	4036899P4	Insulator standoff: sim to Centralab 3BX3778C. (Part of C121 and C122).
29	4036765G4	Screw. (Part of C121 and C122).
30	7137968P8	Stop nut: thd size No. 6-32; sim to Palmut T032005. (Part of C121, C122, and C145).
31	4036765G2	Screw. (Part of C121 and C122).
32	7142162P84	Spacer: 3/8 dia.
33	19C317637P1	Plate. (Located on top of plate line item 34).
34	19D402783P3	Plate line. (Part of L120).
35	4032084P1	Washer, insulated. (Part of C144).
36	4031593P1	Washer. (Part of C144).
37	N80P9008C6	Machine screw: No. 4-40 x 1/2. (Part of C144).
38	19A12518G1	Spring. (Part of C145).
39	19A122709P1	Set screw: sim to N174P1314. (Part of C145).
40	19A122516P1	Slide. (Part of C145).
41	19A122526G1	Support. (Part of C145).
42	N80P9010C6	Machine screw: No. 4-40 x 5/16.
43	N401P8C13	Flatwasher: No. 8.
44	N404P11C6	Lockwasher: No. 4.
45	7141225P2	Hex nut: No. 4-40.
46	19A115177P1	Contact, electrical: female, cad plated bronze, accepts 0.93 pin; sim to Component Mfg Service Inc C-6. (Used with terminals 3, 8, and 11 on XV103).
47	4031594P1	Insulator. (Part of C144).
48	5491229P1	Support. (Part of C144).
49	19B219139P1	Plate line. (Part of L120).
50	19B201074P705	Tap screw, Phillips Pozidriv: No. 6-32 x 5/16. (Secures Hi Split plate to plate line item 49).

SYMBOL	GE PART NO.	DESCRIPTION
51	19B219136P1	Hi Split Plate. (Used in 494-512 MHz split).
52	4036921P1	Bracket, angle: sim to Tinnerman C17609-8A-67.
53	19B204366P1	Support.
54	4038930P1	Clip. (Mounts R104).
55	4029030P10	Rubber channel.
56	19C303396G3	Mobile Bottom Cover.
	19C303396G7	Station Bottom Cover.
57	19A121065P1	Support. (Used with Channel Guard).
58	19A121257G1	Angle. (Used with Channel Guard).
59	19B201074P304	Tap screw: Phillips Pozidriv: No. 6-32 x 1/4.
60	19A122562G1	Support. (Used with L108, L109).



PARTS LIST

LB1-3936E  
CHANNEL GUARD ENCODER G102  
4EH17A10 19C311802-G2  
REV A

SYMBOL	GE PART NO.	DESCRIPTION
C1*  C2  C3  C4  C5  C6  C7  C8  C9  C10  C11 thru C13	19A116080-P103	----- CAPACITORS ----- Polyester: 0.022 $\mu$ f $\pm$ 10%, 50 VDCW. Earlier than REV A:
	19B209243-P2	Polyester: 0.015 $\mu$ f $\pm$ 20%, 50 VDCW.
	19A116080-P3	Polyester: 0.022 $\mu$ f $\pm$ 20%, 50 VDCW.
	5494481-P107	Ceramic disc: 470 pf $\pm$ 20%, 1000 VDCW; sim to RMC Type JF Discap.
	19A116080-P9	Polyester: 0.22 $\mu$ f $\pm$ 20%, 50 VDCW.
	19A116080-P8	Polyester: 0.15 $\mu$ f $\pm$ 20%, 50 VDCW.
	19A116080-P3	Polyester: 0.022 $\mu$ f $\pm$ 20%, 50 VDCW.
	5494481-P107	Ceramic disc: 470 pf $\pm$ 20%, 1000 VDCW; sim to RMC Type JF Discap.
	19B209243-P14	Polyester: 0.33 $\mu$ f $\pm$ 20%, 250 VDCW.
	5496267-P1	Tantalum: 6.8 $\mu$ f $\pm$ 20%, 6 VDCW; sim to Sprague Type 150D.
CR1 and CR2	19A116080-P109	Polyester: 0.22 $\mu$ f $\pm$ 10%, 50 VDCW.
	5494481-P111	Ceramic disc: .001 $\mu$ f $\pm$ 20%, 1000 VDCW; sim to RMC Type JF Discap.
	19A115250-P1	----- DIODES AND RECTIFIERS ----- Silicon.
	FL1	----- TONE NETWORKS ----- TONE FREQUENCY NETWORK 19B205280
	19B205280-G1	71.9 Hz
	19B205280-G2	77.0 Hz
	19B205280-G3	82.5 Hz
	19B205280-G4	88.5 Hz
	19B205280-G5	94.9 Hz
	19B205280-G6	100.0 Hz
J1 thru J6	19B205280-G7	103.5 Hz
	19B205280-G8	107.2 Hz
	19B205280-G9	110.9 Hz
	19B205280-G10	114.8 Hz
	19B205280-G11	118.8 Hz
	19B205280-G12	123.0 Hz
	19B205280-G13	127.3 Hz
	19B205280-G14	131.8 Hz
	19B205280-G15	136.5 Hz
	19B205280-G16	141.3 Hz
Q1 and Q2  Q3 thru Q5	19B205280-G17	146.2 Hz
	19B205280-G18	151.4 Hz
	19B205280-G19	156.7 Hz
	19B205280-G20	162.2 Hz
	19B205280-G21	167.9 Hz
	19B205280-G22	173.8 Hz
	19B205280-G23	179.9 Hz
	19B205280-G24	186.2 Hz
	19B205280-G25	192.8 Hz
	19B205280-G26	203.5 Hz
R1	4033513-P4	----- JACKS AND RECEPTACLES ----- Contact, electrical; sim to Bead Chain L93-3.
	19A115123-P1	----- TRANSISTORS ----- Silicon, NPN; sim to Type 2N2712.
	19A115362-P1	Silicon, NPN; sim to Type 2N2925.
	3R77-P333K	----- RESISTORS ----- Composition: 33,000 ohms $\pm$ 10%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
R2	3R77-P183K	Composition: 18,000 ohms $\pm$ 10%, 1/2 w.
R3	3R77-P274K	Composition: 0.27 megohms $\pm$ 10%, 1/2 w.
R4	3R77-P620J	Composition: 62 ohms $\pm$ 5%, 1/2 w.
R5	3R77-P822K	Composition: 8200 ohms $\pm$ 10%, 1/2 w.
R6	3R77-P153K	Composition: 15,000 ohms $\pm$ 10%, 1/2 w.
R7	3R77-P102K	Composition: 1000 ohms $\pm$ 10%, 1/2 w.
R8	3R77-P183K	Composition: 18,000 ohms $\pm$ 10%, 1/2 w.
R9	3R77-P184K	Composition: 0.18 megohms $\pm$ 10%, 1/2 w.
R10	3R77-P622J	Composition: 6200 ohms $\pm$ 5%, 1/2 w.
R11	3R77-P330K	Composition: 33 ohms $\pm$ 10%, 1/2 w.
R12	5495948-P365	Deposited carbon: 46,400 ohms $\pm$ 1%, 1/2 w; sim to Texas Instrument CD1/2MM.
R13	3R77-P682J	Composition: 6800 ohms $\pm$ 5%, 1/2 w.
R14	3R77-P244J	Composition: 0.24 megohms $\pm$ 5%, 1/2 w.
R15	19A116278-P233	Metal film: 2150 ohms $\pm$ 2%, 1/2 w.
R16	19A116278-P301	Metal film: 10,000 ohms $\pm$ 2%, 1/2 w.
R17	19A116278-P65	Metal film: 46.4 ohms $\pm$ 2%, 1/2 w.
R18	19A116278-P329	Metal film: 19,600 ohms $\pm$ 2%, 1/2 w.
R19	19A116278-P285	Metal film: 7500 ohms $\pm$ 2%, 1/2 w.
R20	19A116278-P412	Metal film: 130,000 ohms $\pm$ 2%, 1/2 w.
R21	19A116278-P269	Metal film: 5110 ohms $\pm$ 2%, 1/2 w.
R22	19A116278-P117	Metal film: 147 ohms $\pm$ 2%, 1/2 w.
R23	3R77-P102K	Composition: 1000 ohms $\pm$ 10%, 1/2 w.
RT1	5490828-P30	----- THERMISTORS ----- Thermistor: 330,000 ohms $\pm$ 10%, color code black and gray; sim to Globar Type 783H-3.
RT2	5490828-P36	Thermistor: 55,000 ohms $\pm$ 10%, color code black and red; sim to Globar Type 723B.
W1		----- CABLES ----- (Part of XF11).
XF11	19A121920-G3	----- SOCKETS ----- Reed, mica-filled phen: 7 pins rated at 1 amp at 500 VRMS with 4-1/4 inches of cable.  ENCODER INSTALLATION KIT 19A127174-G1
P130 thru P135	N404P13C13	----- MISCELLANEOUS ----- Lockwasher, no. 6.
	N80P13005C13	Machine screw, no. 6-32 x 5/16.
	19B201074-P304	Tap screw, no. 6-32 x 1/4.
	N210P13C13	Nut, no. 6-32.
	19B205480-G2	Harness. Includes:
	4029840-P2	Contact, electrical; sim to Amp 42827-2.

\*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 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

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These instructions do not purport to cover all details or variations in equipment not 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.

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# **MAINTENANCE MANUAL**

**LBI-4432**

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MOBILE RADIO DEPARTMENT  
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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