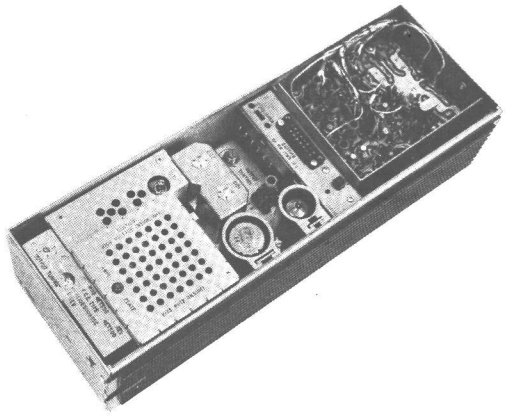
communications

MASTR Progress Line

406-470 MC, 35 & 60-WATT TRANSMITTER MODELS 4ET59D10-21 & 4ET60D10-21

Maintenance Manual LBI-3778
DF-3126



SPECIFICATIONS *

	ET-59-D	ET-60-D
FCC Filing Designation:		
Frequency Range:	406-420 & 450-470 MC	406-420 & 450-470 MC
Power Output:	35 watts minimum (20 watts minimum in 6-volt systems)	60 watts minimum
Crystal Multiplication Factor:	36	36
Frequency Stability:	0.0005% (-30°C to +60°C)	
Modulation:	Adjustable from 0 to +15 KC swing with instantaneous modulation limiting.	
Audio Frequency Characteristics:	Within +1 db to -3 db of a 6 db/octave pre-emphasis from 300 to 3000 cps 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.

ET-59-D & ET-60-D

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

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 Prgoress Line FM Transmitters Types ET-59-D and ET-60-D are crystal-controlled, phase-modulated transmitters designed for one-, two-, or four-frequency operation within the 406-420 and 450-470 megacycle bands. 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 Board.

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.

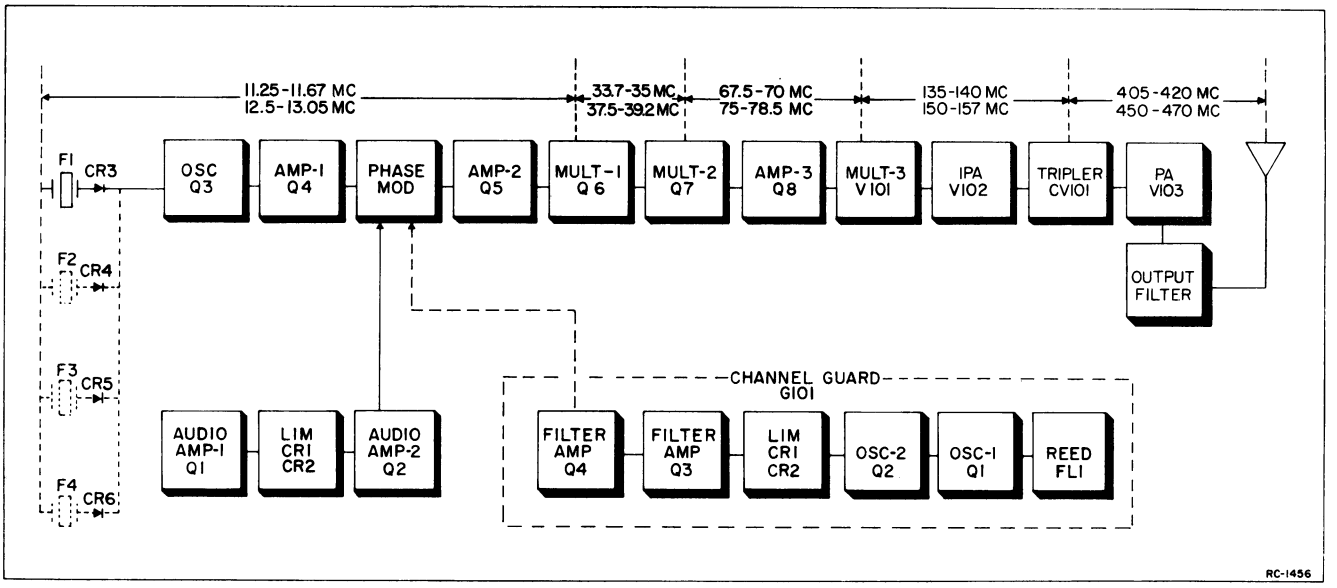


Figure 1 - Transmitter Block Diagram

CIRCUIT ANALYSIS

Eight silicon transistors and only three tubes are used in the transmitters. The frequency of the crystals used ranges from 11.25 to 11.67 and 12.5 to 13.05 megacycles, 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 - PA B+

Pin 8 - -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 different 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 ±.0005% 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 frequency is applied to the base of oscillator Q3. Feedback for the oscillator is developed across C34/C35. 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/C9. 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/L2. 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/L4 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 45-470 megacycle 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 (Z101/Z102) of beam pentode 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, L102/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 L102/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 C118/C119 to a passive tripler stage. The tripler consists of three tuned stages (C115 & L107/L108, C121 & L110/L111, and C122 & L112/L113) which are coupled together through the common impedance of varactor CV101.

The IPA output is 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 L127/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), L119/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 FL101/FL102 consisting of two inductively coupled helical resonators. C1/C2 and C3/C4 are the output tuning capacitors. L5/L6, C5 and C6 form an additional low-pass filter section. The RF output is fed through J103 to the antenna changeover 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 ENCODER (G101)

The Channel Guard Encoder is assembled on a printed wiring board that mounts on the underside of the MASTR transmitter. The encoder is supplied by a regulated -10 volts and a regulated -20 volts. The 10-volt supply is applied to Q1 and Q2 continuously (even in the STANDBY position), and the 20 volts is applied to Q3 and Q4 only when the transmitter is keyed.

Transistors Q1 and Q2 with reed FL1 are the tone oscillator portion of the circuit. The reed is resonant at the desired tone frequency. Clipping diodes CR1 and CR2 shape the output of the oscillator circuit into a square wave, which is coupled through the Channel Guard TONE ADJUST (R12) to the base of Q3. R12 will not require adjustment unless the Channel Guard tone frequency is changed. Then R12 must be set to the new reed frequency.

Q3 and Q4 form a two-section low-pass filter that removes the distortion in the square wave and produces a sine wave output. The square wave oscillator output is a constant amplitude, which makes the encoder less sensitive to shock and vibration. The encoder tone is fed to the tone modulator on the Exciter Board through Channel Guard MOD ADJ R34.

The channel can be monitored by moving the CHANNEL GUARD-OFF switch on the Control Unit to the OFF position (or by removing the microphone or handset from the optional hang-up bracket).

NOTE

If the Two-Way Radio is mounted vertically or at an angle of over 45°, rotate the encoder reed 90° in its mounting bracket so that the label with the G-E Part Number is facing the rear of the Two-Way Radio. See Figure 3 for location of the encoder reed.

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.
3. Slide cover back and lift off.

To service the transmitter from to 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.

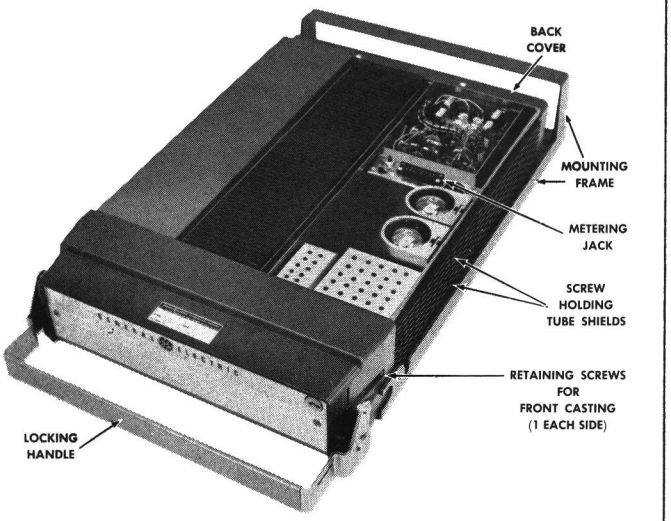


Figure 2 - Top Cover Removed

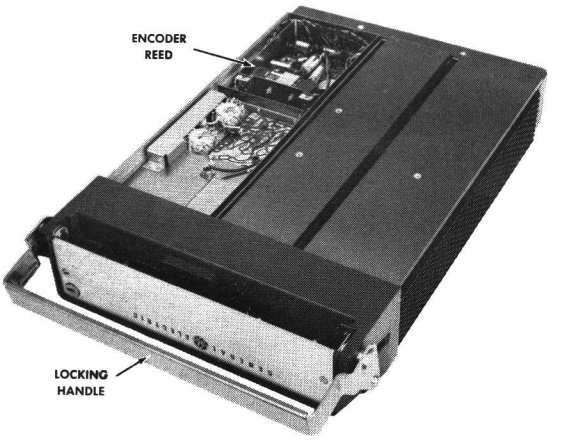


Figure 3 - Bottom Cover Removed

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.

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.

To replace Power Amplifier V103:

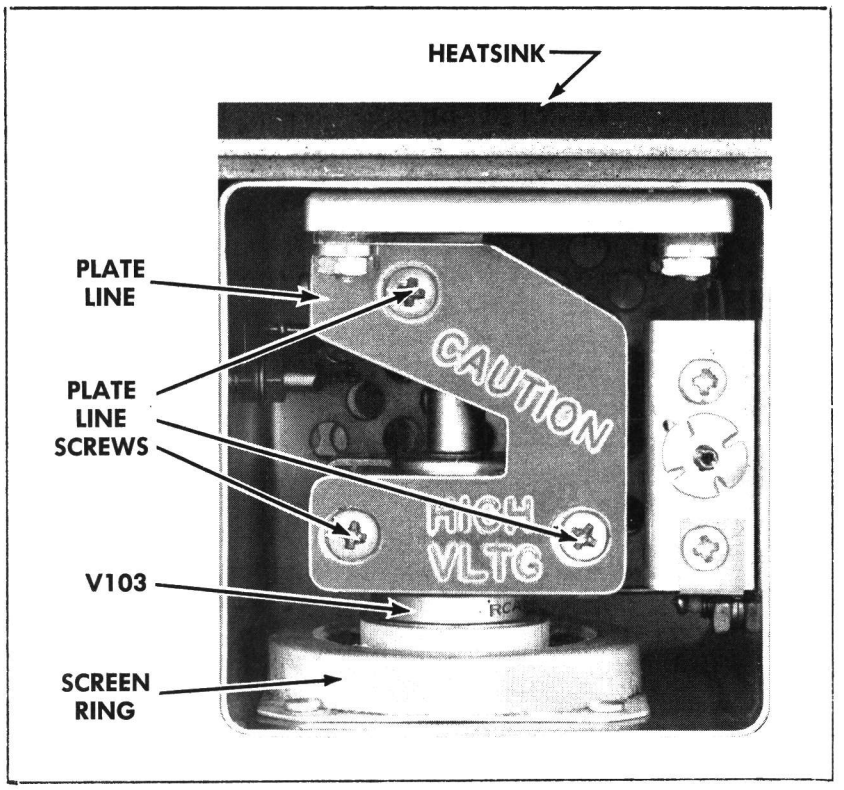


Figure 4 - PA Plate Box With Cover Removed

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 heat-sink first. Then replace the top cover of AMPL PLATE box.

8. Realign the transmitter.

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. G-E 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 G-E Test Set or across J1 (Mike High) and J2 (Mike Low) on the Exciter Board.
2. Apply a 0.75-volt signal at 1000 cps 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 kilocycle 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 KC tone deviation. Then repeak L1/L2 and L3/L4 as shown in Step 1 of Transmitter Alignment Procedure. Reset tone deviation to 1.5 KC 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 cps and set MOD ADJUST (R12) for 11.5 KC deviation (13 KC minus 1.5 KC 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-D: $P_i = \frac{\text{Plate Voltage x Plate Current Indication}}{3.5}$

ET-60-D: $P_i = \frac{\text{Plate Voltage x Plate Current Indication}}{2.59}$

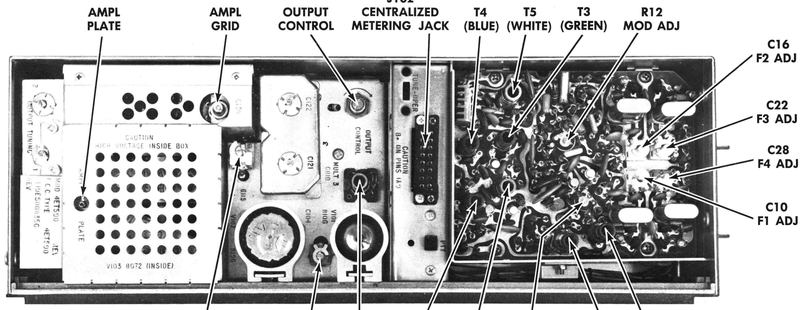
Where:

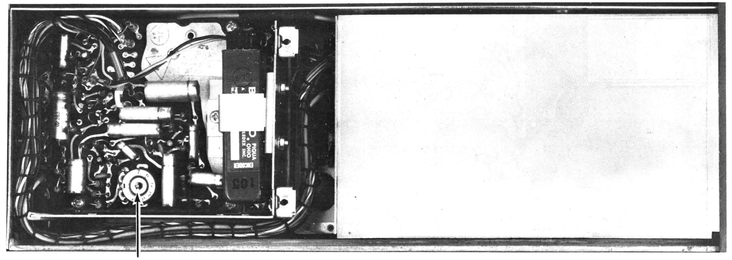
P_i is the power input in watts.

Plate voltage is measured with G-E 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 G-E 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 Model 4EX3A10 (T311 or T312), 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 socket XY1.
2. Set crystal trimmer C10 to mid-capacity. If multi-frequency 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.
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 Z101/Z102 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 4EX3A10	METERING POSITION Multimeter - at J102	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
			EXCITER BOARD		
1.	A (MULT-1)	Pin 10	L1/L2 (and L3/L4 with Channel Guard)	0.7 v (0.5 v Minimum)	Tuning the modulator is a critical adjustment. Carefully tune L1/L2 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	0.65 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 (Z101/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 (Z101/Z102)	Maximum	Retune MULT-3 Grid for maximum meter reading.
8.	E (MULT-4)	Pin 5	IPA GRID (C104) & C115	Maximum	Tune IPA GRID 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) & C113, 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.
11.	G PA PLATE	WARNING High B+ on Pins 1 & 9 Pin 1 (+) Pin 9 (-)	AMPL PLATE	Minimum	Tune AMPL PLATE for a dip in meter reading (not required unless changing frequency).
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 0.7 volt (0.6 volt for continuous duty stations).
14.					Repeat Steps 12, 13 and 10 in that order
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.

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 Model 4EP28A10.
2. In mobile applications, make sure that the transformer taps are set as shown in the Maintenance Manual for the 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-D	275 to 305 VDC (see Note 2)	0.7 VDC
For 120-Watt Input	ET-60-D	460 to 510 VDC (see Note 3)	0.64

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 = $\frac{311}{\text{Measured Plate Voltage}}$

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
   Jones #711N
2. VTVM similar to:
   Triplett #850
   Heath #1M-21
3. Audio Generator similar to:
   Heath #1G-72
4. Deviation Meter similar to:
   Measurements #140
   Lampkin #205A
5. Multimeter similar to:

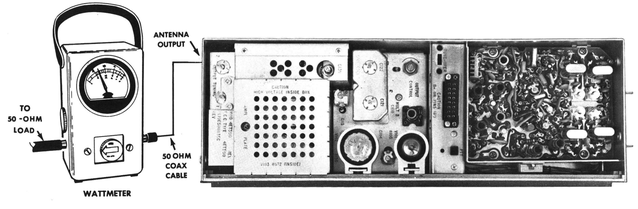
G-E METERING TEST SET MODEL 4EX3A10 or
Triplett #631 or
20,000 ohms-per-volt voltmeter

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

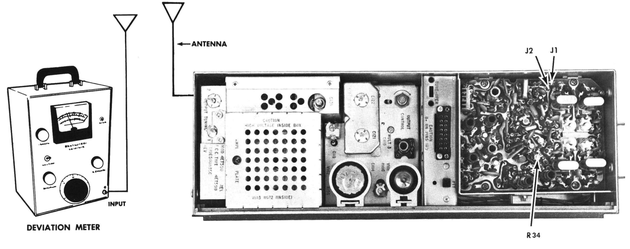
Refer to Service Hints on Transmitter Troubleshooting Procedure.

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 1.5-KC deviation. If reading is low or high, adjust Channel Guard MOD ADJUST (R34) for a reading of 0.75 KC.

NOTES:

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

DEVIATION METER

NOTES:

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 every time the Tone Frequency is changed.

SERVICE CHECK

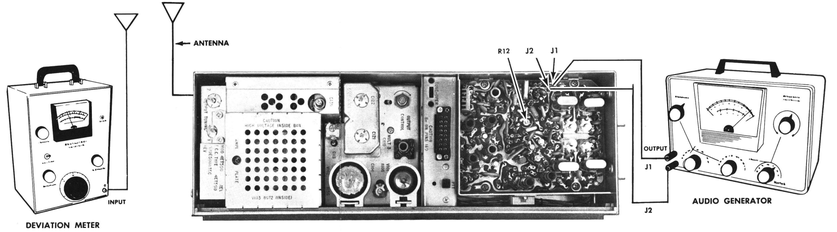
If the 1.5 KC deviation is not obtainable when adjusting R34, adjust R12 until 0.75 is obtained.

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 KC.
4. Key the transmitter and adjust Deviation Meter to carrier frequency.
5. Deviation reading should be ±13 KC.
6. Adjust "Modulation Adjust Control" R12 until deviation reads 13 KC on plus (+) or minus (-) deviation, whichever is greater. This adjustment should be made with the correct level of tone applied on Channel Guard transmitters.

DEVIATION METER

NOTES:

--MASTR transmitters are adjusted for 13 KC deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 15 KC under the worst conditions of frequency, voltage and temperature.

If the deviation reading plus (+) and minus (-) differs by more than 1.5 KC, 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 10 KC. Voltage should be LESS than 100 millivolts.

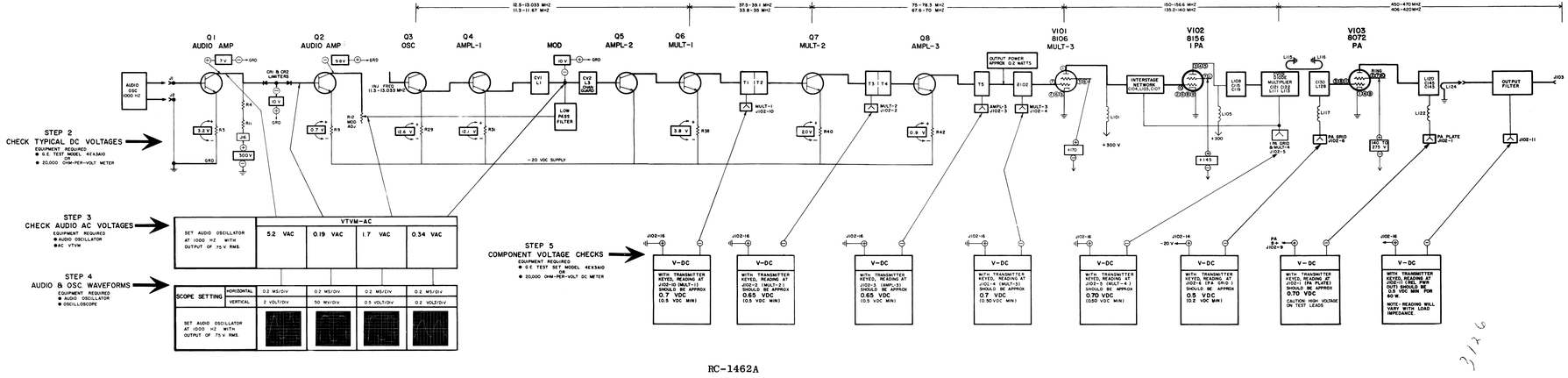
METER

STEP 1 - QUICK CHECKS

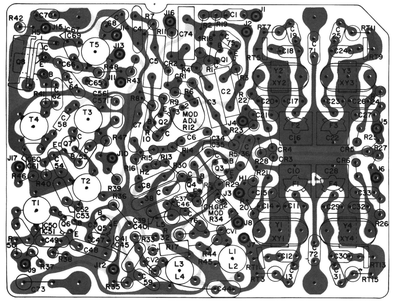
POWER OUTPUT	CHECK VOLTAGES AT CENTRALIZED METERING JACK J102 Multimeter = pin numbers GE Test Set = A-G positions							PROBABLE DEFECT
	Pins 10 & 16 A	Pins 2 & 16 B	Pins 3 & 16 C	Pins 4 & 16 D	Pins 5 & 16 E	Pins 6 & 14 F	Pins 1 & 9 G	
0	0	0	0	0.18 v	0.28 v	0	Low	Defective Q3-Q6 or Modulator (see Note A)
0	over 1.0 v	0	0	0.18 v	0.28 v	0	Low	Shorted Q5 or open Q6
0	0.70 v	0 or over 1.0 v	0	0.18 v	0.28 v	0	Low	Defective Q7
0	0.70 v	0.65 v	0 or over 1.0 v	0.18 v	0.28 v	0	Low	Defective Q8
0	0.70 v	0.65 v	low	0.18 v	0.28 v	0	Low	Open filament on 8106, open coax
0	0.70 v	0.65 v	0.7 v	0.75 v	0.28 v	0	Low	Open filament on 8156
0	0.70 v	0.65 v	0.7 v	0.75 v	0.75 v	0	0	Open filament on 8072
0	0.70 v	0.65 v	0.7 v	0.75 v	0.5 v	0	0	If no peak at position "E" when tuning C115, bad multiplier diode
0	0.72 v	0.65 v	0.7 v	0.75 v	0.75 v	high	Very Low or 0	Bad R123/R126, bad R124, shorted 8072 screen
Low	0.72 v	0.65 v	0.7 v	0.75 v	0.75 v	Low	0.70 v	Weak 8156 or 8072
Erratic	0.72 v	0.65 v	0.7 v	0.75 v	0.75 v	Very high	0.70 v	Check contacts on screen by-pass ring

NOTE A --- Localize trouble by checking: --

1. -20 volt DC supply at J102-12-16.
2. Measure 12.1 VDC across Q4 emitter resistor R31 (1500 ohms), then:
   - (a) Remove crystal - a slight variation in R31 voltage reading indicates Q3 and Q4 stages operating properly.
   - (b) If no voltage is measured, check keying leads CR3-CR6, Q3, Q4.
   - (c) With crystal removed, short Q5 base to emitter. A voltage reading above 1.0 volt indicates Q5 and Q6 are operating properly. Defect may be in Modulator.
   - (d) If modulator is defective, check voltage variable diodes CV1 and CV2.

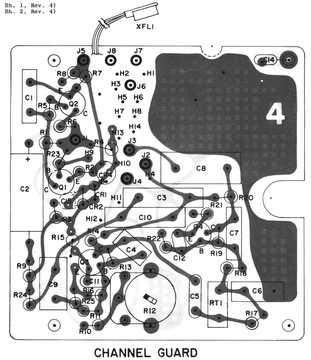


EXCITER
A101-A112



(19C303483, Sh. 1, Rev. 4)
(19C303483, Sh. 2, Rev. 4)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE



CHANNEL GUARD
G101

(19C303456, Sh. 1, Rev. 4)
(19C303456, Sh. 2, Rev. 4)

EXCITER READINGS TAKEN TO CHASSIS GROUND

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	6.5K	0.8K	240K	12K	50K	20K
Q2	6.2K	4K	70K	11K	9.8K	10K
Q3	9K	2.7K	9K	2.7K	100	100
Q4	7K	5K	9K	2.7K	100	100
Q5	5K	2.7K	70K	6.8K	3.7K	2.3K
Q6	4K	2.2K	3.7K	2.2K	175	175
Q7	5.2K	2.2K	5K	2.7K	465	465
Q8	5K	2.7K	5K	2.7K	67	67

EXCITER READINGS TAKEN TO 20 VOLT LINE (J15 BLUE LEAD)

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	11K	1M	240K	30K	60K	35K
Q2	1K	1K	70K	4.3K	1MA	18K
Q3	2.6K	2.5K	10K	5.5K	2.7K	5.1K
Q4	1.5K	1.5K	2.5K	2.5K	2.7K	5.1K
Q5	0	0	70K	3.7K	8.2K	3.8K
Q6	340	300	8K	3.8K	3K	5.1K
Q7	60	180	0	0	2.3K	5.5K
Q8	27	27	47	47	2.6K	5K

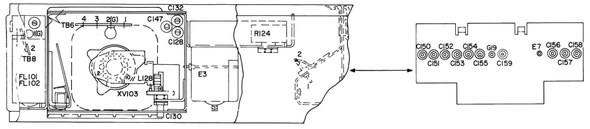
CHANNEL GUARD READINGS MEASURED TO CHASSIS GROUND

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	+	−	+	−	+	−
Q1	○○	○○	○○	○○	○○	○○
Q2	○○	○○	○○	○○	○○	○○
Q3	2.7K	4.9K	9.5K	30K	8.4K	7.5K
Q4	2.7K	4.9K	5K	2K4	2.5K	2.5K

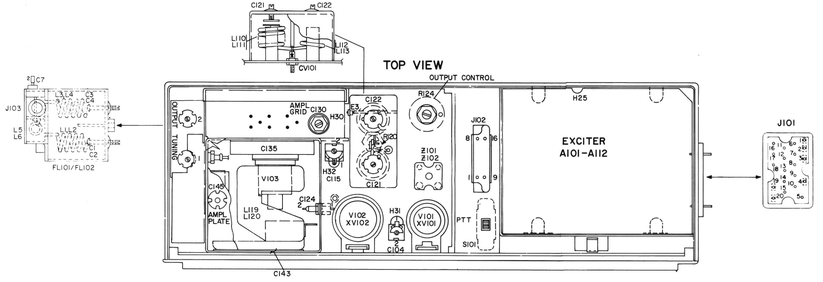
CHANNEL GUARD READINGS MEASURED TO −10 VOLT LINE (J5 ORANGE LEAD)

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	+	−	+	−	+	−
Q1	200	200	9K	1MA	2.7K	25K
Q2	1.3K	1.3K	2.5K	6.3K	15K	8.7K
Q3	○○	○○	○○	○○	○○	○○
Q4	○○	○○	○○	○○	○○	○○

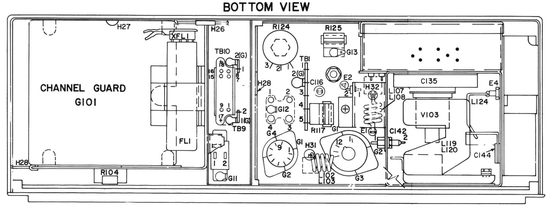
SIDE VIEW



TOP VIEW



BOTTOM VIEW



(19B620790, Rev. 4)

READINGS AT J101 TAKEN TO CHASSIS GROUND.

PIN	−	+
1	0	0
2	○○	○○
3	1Ω	1Ω
4	19K	19K
5	○○	○○
6	○○	○○
7	○○	○○
8	50K	50K
9	○○	○○
10	○○	○○
11	○○	○○
* 12		
13	○○	○○
14	○○	○○
15	5.5K	2.5K
* 16	○○/30K	○○/15K
* 17	○○/30K	○○/15K
* 18	○○/30K	○○/15K
19	0	0
20	○○	○○

* 1ST READING FOR SINGLE FREQ.
2ND READING FOR MULTI-FREQ.

RESISTANCE READINGS

ALL READINGS ARE TYPICAL READINGS MEASURED WITH A 20,000 OHM-PER-VOLT METER AND J101 DISCONNECTED. + OR − SIGNS SHOW METER LEAD GROUNDED. 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			
XV102	1Ω	0	19K	19K	19K	0	24K	0	0	55K	24K	0
XV103	0	○○	2K/6K *	0	0	1Ω	12.5K	2K/6K *	0	○○	2K/6K *	

* READING DEPENDS ON METER POLARITY.

OUTLINE DIAGRAM

406 — 470 MHZ, 35 & 60-WATT TRANSMITTER
MODELS 4ET59D10-21 & 4ET60D10-21

(19B620781, Rev. 7)

READING ARE TYPICAL VOLTAGES MEASURED TO GROUND WITH A 20,000 OHM-PER-VOLT METER, WITH THE TRANSMITTER KEYED, AND WITH TUNE-OPERATE SWITCH IN THE OPERATE POSITION. PA PLATE VOLTAGES WILL VARY AS SHOWN IN THE FOLLOWING CHART DUE TO THE DIFFERENT POWER SUPPLIES USED AND THE LOADING LIMITATIONS OF DIFFERENT SERVICES.

PA PLATE VOLTAGE		PA INPUT	RATED OUTPUT	APPLICATION	POWER SUPPLY USED
ET-59-D	ET-60-D				
290 VDC		60 WATTS	20 WATTS	P.A. EXCITER OR CLASS A, C B STATION OR MOBILE	4EP37A10 4EP38A10
380 VDC		70 WATTS	20 WATTS	6-VOLT MOBILE	4EP37C10
435 VDC		90 WATTS	35 WATTS	12-VOLT MOBILE	4EP37B10
				28-VOLT MOBILE	4EP37D10
	485 VDC	120 WATTS	40 WATTS	STATION	4EP38A10
	660 VDC	180 WATTS	70 WATTS	MOBILE	4EP37A10
		150 WATTS	60 WATTS	STATION	4EP38A10

READINGS ON Q1 AND Q2 ON CHANNEL GUARD ENCODER WERE MEASURED IN A NEGATIVE GROUND SYSTEM. FOR POSITIVE GROUND SYSTEMS, MEASURE Q1 AND Q2 READINGS TO J5 (SYSTEM NEGATIVE) ON ENCODER BOARD.

● USED WITH 405-420MC UNITS ONLY.
▲ USED WITH 450-470MC UNITS ONLY.
■ USED WITH CHAN. GD. UNITS ONLY.

NOTES

1. R101 USED IN 4ET59D MODELS ONLY. R101 IS REPLACED WITH DA WIRE ON 4ET60D MODELS.
2. ALL 22R WIRES ARE A4036780P3.
3. BEND TERMINAL BACK DOWN AGAINST SOCKET SADDLE, AND PRESS IT TIGHTLY AGAINST SADDLE WHILE SOLDERING.
4. CONNECT TO PIN 6 ON MODELS 16 & 17
   CONNECT TO PIN 14 ON MODELS 18, 19, 20 & 21.
5. ALL WIRES N22 EXCEPT AS OTHERWISE SHOWN.
6. R123 USED IN 4ET60D MODELS ONLY, R123 IS REPLACED WITH R126 ON 4ET59D MODELS.

MODEL NO		REV	FREQ. RANGE	NO. OF FREQ	CHAN GD
35 WATT	60 WATT				
4ET59D10	4ET60D10	B	405-420MC	1	
4ET59D11	4ET60D11	B	450-470MC	1	
4ET59D12	4ET60D12	B	405-420MC	2	
4ET59D13	4ET60D13	B	450-470MC	2	
4ET59D14	4ET60D14	B	405-420MC	4	
4ET59D15	4ET60D15	B	450-470MC	4	
4ET59D16	4ET60D16	C	405-420MC	1	X
4ET59D17	4ET60D17	C	450-470MC	1	X
4ET59D18	4ET60D18	C	405-420MC	2	X
4ET59D19	4ET60D19	C	450-470MC	2	X
4ET59D20	4ET60D20	C	405-420MC	4	X
4ET59D21	4ET60D21	C	450-470MC	4	X

SCHEMATIC DIAGRAM

406 — 470 MHZ, 35 & 60-WATT MASTR TRANSMITTER MODELS 4ET59D10-21 & MODELS 4ET60D10-21

PARTS LIST

LBI-3776B

405-470 MHz TRANSMITTER

MODELS 4ET59D10-15 (19E500835 G10-15) STANDARD REV B
MODELS 4ET59D16-21 (19E500835 G16-21) CHANNEL GUARD REV C
MODELS 4ET60D10-15 (19E500835 G10-15) STANDARD REV B
MODELS 4ET60D16-21 (19E500835 G16-21) CHANNEL GUARD REV C

SYMBOL	G-E PART NO.	DESCRIPTION
A101 thru A112		EXCITER BOARD A101 19D402308-G1 4ET59D10, 4ET60D10 1 Freq A102 19D402308-G2 4ET59D11, 4ET60D11 1 Freq A103 19D402308-G3 4ET59D12, 4ET60D12 2 Freq A104 19D402308-G4 4ET59D13, 4ET60D13 2 Freq A105 19D402308-G5 4ET59D14, 4ET60D14 4 Freq A106 19D402308-G6 4ET59D15, 4ET60D15 4 Freq A107 19D402308-G7 4ET59D16, 4ET60D16 1 Freq A108 19D402308-G8 4ET59D17, 4ET60D17 1 Freq A109 19D402308-G9 4ET59D18, 4ET60D18 2 Freq A110 19D402308-G10 4ET59D19, 4ET60D19 2 Freq A111 19D402308-G11 4ET59D20, 4ET60D20 4 Freq A112 19D402308-G12 4ET59D21, 4ET60D21 4 Freq
		- - - - - - - - - - - CAPACITORS - - - - - - - - - - -
C1	5491189-P102	Polyester: .022 μf ±20%, 50 VDCW.
C2	19B209243-P4	Polyester: .033 μf ±20%, 50 VDCW.
C3	19B209243-P7	Polyester: 0.1 μf ±20%, 50 VDCW.
C4	7491395-P114	Ceramic disc: .0022 μf ±10%, 500 VDCW; sim to RMC Type JL.
C5	19B209243-P7	Polyester: 0.1 μf ±20%, 50 VDCW.
C6	19B209243-P5	Polyester: .047 μf ±20%, 50 VDCW.
C7*	7491395-P111	Ceramic disc: .0015 μf ±10%, 500 VDCW; sim to RMC Type JL. In Models 4ET59D10-15, 4ET60D10-15 Rev A and earlier: In Models 4ET59D16-21, 4ET60D16-21 Rev B and earlier:
	7491395-P114	Ceramic disc: .0022 μf ±10%, 500 VDCW; sim to RMC Type JL.
C8*	5493367-P1000K	Silver mica: .001 μf ±10%, 100 VDCW; sim to Electro Motive Type DM-20. Added in Models 4ET59D10-15, 4ET60D10-15 by Rev B.
C9*	5493367-P1500K	Silver mica: .0015 μf ±10%, 100 VDCW; sim to Electro Motive Type DM-20. Deleted in Models 4ET59D10-15, 4ET60D10-15 by Rev B.
C10	5491271-P106	Variable: approx 1.98 to 12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C11	5496219-P7	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C12 and C13	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C14	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C15	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C16	5491271-P106	Variable: approx 1.98 to 12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C17	5496219-P7	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C18 and C19	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C20	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C21	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C22	5491271-P106	Variable: approx 1.98 to 12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C23	5496219-P7	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C24 and C25	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	G-E PART NO	DESCRIPTION
C26	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C27	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C28	5491271-P106	Variable: approx 1.98 to 12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C29	5496219-P7	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C30 and C31	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C32	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C33	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C34	5496372-P50	Ceramic disc: 220 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C35	5496372-P54	Ceramic disc: 270 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C36	5496219-P467	Ceramic disc: 150 pf ±5%, 500 VDCW, temp coef -220 PPM.
C37	5496372-P327	Ceramic disc: 75 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C38	5494481-P131	Ceramic disc: .0068 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C39	5496372-P145	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -3300 PPM.
C40	5496372-P345	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C41	5493366-P180K	Silver mica: 180 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C44	5493366-P470J	Silver mica: 470 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C45	5496372-P45	Ceramic disc: 180 pf ±10%, 500 VDCW, temp coef -2200 PPM.
C46	5496372-P347	Ceramic disc: 200 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C47	5496219-P749	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -750 PPM.
C48	5494481-P129	Ceramic disc: .0039 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C49	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C50	5496219-P253	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -80 PPM.
C51	5496219-P257	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -80 PPM.
C52	5496219-P253	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -80 PPM.
C53	5496219-P257	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -80 PPM.
C54 and C55	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C56	5496219-P440	Ceramic disc: 9 pf ±0.25 pf, 500 VDCW, temp coef -220 PPM.
C57	5496219-P343	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -150 PPM.
C58	5491601-P35	Phenolic: 0.15 pf ±10%, 500 VDCW; sim to Quality Components Type MC.
C59	5493366-P220K	Silver mica: 220 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C60	5496219-P241	Ceramic disc: 10 pf ±5%, 500 VDCW, temp coef -80 PPM.
C61	5496219-P244	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -80 PPM.
C62	5496219-P51	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef 0 PPM.
C64	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C65	5496219-P35	Ceramic disc: 4 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.

SYMBOL	G-E PART NO	DESCRIPTION
C66	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C67	5496219-P247	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -80 PPM.
C68	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C69	5496219-P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C70 thru C72	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C73	5496267-P18	Tantalum: 6.8 μf ±20%, 35 VDCW; sim to Sprague Type 150D.
C74	19A115414-P13	Polyester: 0.1 μf ±20%, 200 VDCW.
C75	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C76	5493366-P470K	Silver mica: 470 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C77*	5493366-P270K	Silver mica: 270 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15. Added in Models 4ET59D10-15, 4ET60D10-15 by Rev B.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A115331-P1	Silicon.
CR3 thru CR6	19A115348-P1	Silicon.
CV1 and CV2	5495769-P8	Varactor, silicon: 33 pf ±20% at 4 VDC; sim to Pacific Semiconductors Varicap Type V-595.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J17	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L1	19B204526-G2	Coil. Includes tuning slug 5491798-P2.
L2	19B204526-G1	Coil. Includes tuning slug 5491798-P2.
L3 R1	19B204526-G4 3R152-P333J	Coil. Includes tuning slug 5491798-P2. Composition: 33,000 ohms ±5%, 1/4 w.
L4 R1	19B204526-G3 3R152-P333J	Coil. Includes tuning slug 5491798-P2. Composition: 33,000 ohms ±5%, 1/4 w.
L5	7488079-P48	Choke, RF: 27 μh ±10%, 1.4 ohms DC res max; sim to Jeffers 4422-9.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 and Q2	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
Q3 thru Q5	19A115330-P1	Silicon, NPN.
Q6 and Q7	19A115328-P1	Silicon, NPN.
Q8	19A115329-P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	3R77-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R2	3R77-P105K	Composition: 1 megohm ±10%, 1/2 w.
R3	3R77-P472K	Composition: 4700 ohms ±10%, 1/2 w.
R4	3R77-P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R5	3R77-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R6	3R77-P684K	Composition: 0.68 megohm ±10%, 1/2 w.
R7	3R77-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R8	3R77-P823K	Composition: 82,000 ohms ±10%, 1/2 w.
R9	3R77-P102K	Composition: 1000 ohms ±10%, 1/2 w.
R10 and R11	3R77-P274K	Composition: 0.27 megohm ±10%, 1/2 w.

SYMBOL	G-E PART NO	DESCRIPTION
R12	19B201969-P6	Variable, carbon film: .01 megohm ±20%, 0.1 w; sim to Centralab Series 4.
R13 and R14	3R77-P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R15*	3R77-P333K	Composition: 33,000 ohms ±10%, 1/2 w. In Models 4ET59D10-15, 4ET60D10-15 Rev A and earlier: In Models 4ET59D16-21, 4ET60D16-21 Rev B and earlier:
	3R77-P393K	Composition: 39,000 ohms ±10%, 1/2 w.
R16*	3R77-P683K	Composition: 68,000 ohms ±10%, 1/2 w. In Models 4ET59D10-15, 4ET60D10-15 Rev A and earlier: In Models 4ET60D16-21, 4ET59D16-21 Rev B and earlier:
	3R77-P433K	Composition: 43,000 ohms ±10%, 1/2 w.
R17*	3R77-P823K	Composition: 82,000 ohms ±10%, 1/2 w. In Models 4ET59D10-15, 4ET60D10-15 Rev A and earlier: In Models 4ET59D16-21, 4ET60D16-21 Rev B and earlier:
	3R77-P332K	Composition: 3300 ohms ±10%, 1/2 w.
R18	3R77-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R19	3R77-P222K	Composition: 2200 ohms ±10%, 1/2 w.
R20	3R77-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R21	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R22	3R77-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R23	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R24	3R77-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R25	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R26	3R77-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R27 and R28	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R29	3R77-P272K	Composition: 2700 ohms ±10%, 1/2 w.
R30	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R31	3R77-P152K	Composition: 1500 ohms ±10%, 1/2 w.
R32 and R33	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R34	19B201969-P7	Variable, carbon film: .025 megohm ±20%, 0.1 w; sim to Centralab Series 4.
R35	3R77-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R36	3R77-P392K	Composition: 3900 ohms ±10%, 1/2 w.
R37	3R77-P750J	Composition: 75 ohms ±5%, 1/2 w.
R38	3R77-P391K	Composition: 390 ohms ±10%, 1/2 w.
R39	3R77-P620J	Composition: 62 ohms ±5%, 1/2 w.
R40	3R77-P181K	Composition: 180 ohms ±10%, 1/2 w.
R41	3R77-P470K	Composition: 47 ohms ±10%, 1/2 w.
R42	3R77-P270K	Composition: 27 ohms ±10%, 1/2 w.
R43	3R77-P200J	Composition: 20 ohms ±5%, 1/2 w.
R44	3R77-P223K	Composition: 22,000 ohms ±10%, 1/2 w.
R45	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R46	5495948-P474	Deposited carbon: 0.576 megohm ±1%, 1/2 w; sim to Texas Instrument Type CD1/2MR.
R47	3R77-P391K	Composition: 390 ohms ±10%, 1/2 w.
R48	3R77-P470K	Composition: 47 ohms ±10%, 1/2 w.
R50	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R53*	3R152-P472K	Composition: 4700 ohms ±10%, 1/4 w. Added in Models 4ET59D10-15, 4ET60D10-15 by Rev B.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	19B209284-P6	Disc: 75 ohms, color code blue.
RT3	19B209284-P2	Rod: 2140 ohms, color code red.

SYMBOL	G-E PART NO	DESCRIPTION
RT5	19B209284-P6	Disc: 75 ohms, color code blue.
RT7	19B209284-P2	Rod: 2140 ohms, color code red.
RT9	19B209284-P6	Disc: 75 ohms, color code blue.
RT11	19B209284-P2	Rod: 2140 ohms, color code red.
RT13	19B209284-P6	Disc: 75 ohms, color code blue.
RT15	19B209284-P2	Rod: 2140 ohms, color code red.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T1	19B204534-G1	Coil. Includes tuning slug 5491798-P4.
T2	19B204531-G1	Coil. Includes tuning slug 5491798-P4.
T3	19B204535-G1	Coil. Includes tuning slug 5491798-P4.
T4	19B204535-G2	Coil. Includes tuning slug 5491798-P4.
T5	19B204537-G1	Coil. Includes tuning slug 5491798-P4.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XY1 thru XY4		Refer to Mechanical Parts (RC-1465).
		- - - - - - - - - - - CRYSTALS - - - - - - - - - - -
		When reordering give GE Part Number and specify exact frequency needed. Crystal frequency = (OF ÷ 36).
Y1 thru Y4	19B206175-P6	Quartz: freq range 11,000 to 12,566 KHz, temp range -30°C to +85°C. (406-120 MHz Transmitter).
Y1 thru Y4	19B206175-P7	Quartz: freq range 12,500 to 14,500 KHz, temp range -30°C to +85°C. (450-470 MHz Transmitter).
		- - - - - - - - - - - CAPACITORS - - - - - - - - - - -
C101	5494481-P12	Ceramic disc: .001 μf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C104	5491271-P6	Variable: approx 1.98-12.4 pf, 750 v peak; sim to EF Johnson 189-6.
C105	5494481-P12	Ceramic disc: .001 μf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C106	19B209204-P1	Ceramic disc: 220 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C107	7489162-P7	Silver mica: 12 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C108	7489162-P4	Silver mica: 8 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C109	7489162-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C110	7489162-P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C111	19B209204-P1	Ceramic disc: 220 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C113	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C115	19B209372-P1	Variable: approx 2.3 to 24.3 pf; sim to EF Johnson Type V 193-0008-010.
C116	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C118	7489162-P8	Silver mica: 15 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C119	7489162-P6	Silver mica: 10 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C121 and C122		Refer to Mechanical Parts (RC-1465).
C125	7489162-P2	Silver mica: 6 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C126	7489162-P1	Silver mica: 5 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C127	5494481-P12	Ceramic disc: .001 μf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C128	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.

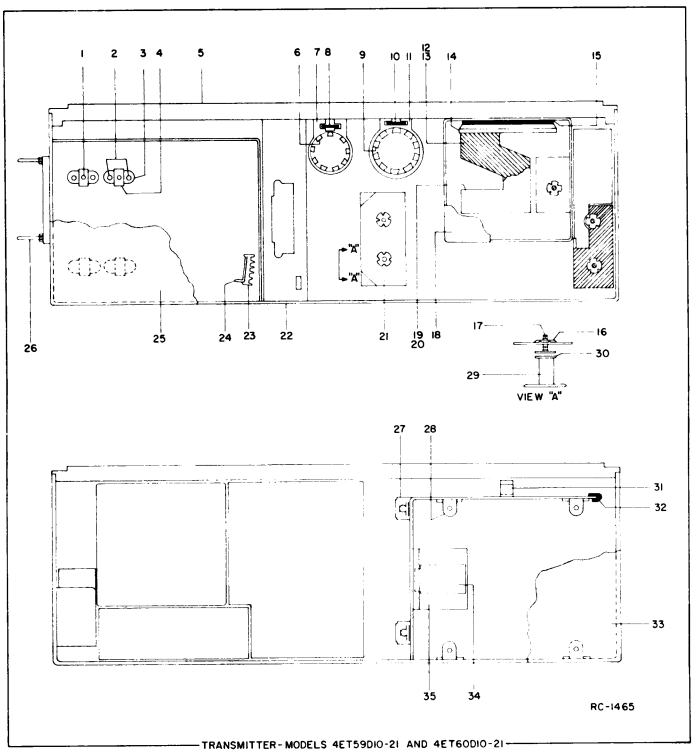
SYMBOL	G-E PART NO	DESCRIPTION
C130	5490272-P17	Variable: 2 to 7.83 pf, 1250 v peak; sim to Johnson Type M.
C132	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C135	19B209369-P1	Mica: 2650 pf ±20%, 400 VDCW; sim to EF Johnson 124-113-18.
C136	7489162-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C138	7489162-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C140	7489162-P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C142	7485975-P17	Ceramic, feed-thru: 470 pf ±20%, 750 VDCW; sim to Erie Style 327.
C143 thru C145		Refer to Mechanical Parts (RC-1465).
C147	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C148 and C149	5494481-P12	Ceramic disc: .001 μf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C150 thru C156	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C157	19B209282-P1	Ceramic, feed-thru: 680 pf ±20%, 1000 VDCW; sim to Sprague Type 544C.
C158	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C.
C159*	5493392-P7	Ceramic, feed-thru: .001 μf +100% -0%, 500 VDCW; sim to Allen-Bradley Type FA5C. Added by Rev A.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR101	4037822-P1	Silicon.
CV101	19A115809-P1	Silicon, capacitive.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1	19B200535-P3	Feed-thru: sim to Sealectro ST-1500SL-C3.
E2	4029309-P1	Feed-thru: sim to Sealectro FT-SM-27.
E3	4036032-P5	Feed-thru: sim to Sealectro FT-SM-10.
E7	4034512-P2	Feed-thru: sim to Sealectro FT-SM-22-TUR.
		- - - - - - - - - - - FILTERS - - - - - - - - - - -
		BANDPASS FILTER NOTE: The bandpass filters are factory tuned. If a filter component (except as shown below) is found to be defective, it is recommended that the entire filter assembly be replaced to maintain rated power output and spurious attenuation.
FL101	19C303559-G1	405-420 MHz.
FL02	19C303559-G2	450-470 MHz.
		- - - - - - - - - - OSCILLATORS - - - - - - - - - -
G101		TONE OSCILLATOR ENCODER 19C303466-G2 (Used in Models 4ET59D16-21, 4ET60D16-21)
		- - - - - - - - - - - CAPACITORS - - - - - - - - - - -
C1	19B209243-P6	Polyester: .068 μf ±20%, 50 VDCW.
C2	7489483-P17	Electrolytic: 50 μf +75% -10%, 25 VDCW; sim to Sprague 30D.
C3	19A115414-P116	Polyester: 0.33 μf ±10%, 100 VDCW.
C4	19B209243-P2	Polyester: .015 μf ±20%, 50 VDCW.
C5	19B209243-P17	Polyester: 0.22 μf ±20%, 250 VDCW.
C6	19B209243-P16	Polyester: 0.15 μf ±20%, 250 VDCW.
C7	19B209243-P3	Polyester: .022 μf ±20%, 50 VDCW.

SYMBOL	G-E PART NO	DESCRIPTION
C8	19A115414-P17	Polyester: 0.47 μf ±20%, 100 VDCW.
C9	19B209243-P17	Polyester: 0.22 μf ±20%, 250 VDCW.
C10	19A115414-P116	Polyester: 0.33 μf ±10%, 100 VDCW.
C11 and C12	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C14	5494481-P111	Ceramic disc: .001 μf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C16	5496219-P21	Ceramic disc: 100 pf ±10%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A115250-P1	Silicon.
CR4	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - - FILTERS - - - - - - - - - - -
FL1		Reed, governor: coil-600 ohms ±10%, standard 7-pin tube socket mounting.
	3R161-P719 -P770 -P825 -P885 -P948 -P1000 -P1035 -P1072 -P1109 -P1148 -P1188 -P1230 -P1273 -P1318 -P1365 -P1413 -P1462 -P1514 -P1567 -P1622 -P1679 -P1738 -P1799 -P1862 -P1928 -P2035	71.9 Hz 77.0 82.5 88.5 94.8 100.0 103.5 107.2 110.9 114.8 118.8 123.0 127.3 131.8 136.5 141.3 146.2 151.4 156.7 162.2 167.9 173.8 179.9 186.2 192.8 203.5
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J8	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
Q2 thru Q4	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R1	3R77-P562K	Composition: 5600 ohms ±10%, 1/2 w.
R2	3R77-P201J	Composition: 200 ohms ±5%, 1/2 w.
R3*	3R77-P103J	Composition: 10,000 ohms ±5%, 1/2 w. In Models earlier than Rev B:
	3R77-P682J	Composition: 6800 ohms ±5%, 1/2 w.
R4	3R77-P512J	Composition: 5100 ohms ±5%, 1/2 w.
R5	3R77-P123K	Composition: 12,000 ohms ±10%, 1/2 w.
R6	3R77-P512J	Composition: 5100 ohms ±5%, 1/2 w.
R7	3R77-P132J	Composition: 1300 ohms ±5%, 1/2 w.
R8	3R77-P622J	Composition: 6200 ohms ±5%, 1/2 w.
R9	3R77-P122K	Composition: 1200 ohms ±10%, 1/2 w.
R10	3R77-P302J	Composition: 3000 ohms ±5%, 1/2 w.
R11	3R77-P273K	Composition: 27,000 ohms ±10%, 1/2 w.
R12	7491365-P220	Variable, carbon film: .01 megohm ±10%, .08 w; sim to CTS Type UPE-70.
R13	3R77-P274K	Composition: 0.27 megohm ±10%, 1/2 w.
R14	3R77-P822K	Composition: 8200 ohms ±10%, 1/2 w.
R15	3R77-P620J	Composition: 62 ohms ±5%, 1/2 w.

SYMBOL	G-E PART NO	DESCRIPTION
R16	3R77-P243J	Composition: 24,000 ohms ±5%, 1/2 w.
R17	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R18	3R77-P102K	Composition: 1000 ohms ±10%, 1/2 w.
R19	3R77-P184K	Composition: 0.18 megohm ±10%, 1/2 w.
R20	3R77-P622J	Composition: 6200 ohms ±5%, 1/2 w.
R21	3R77-P330K	Composition: 33 ohms ±10%, 1/2 w.
R22	3R77-P183K	Composition: 18,000 ohms ±10%, 1/2 w.
R23	3R77-P623J	Composition: 62,000 ohms ±5%, 1/2 w.
R24	3R77-P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R25	3R77-P393K	Composition: 39,000 ohms ±10%, 1/2 w.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT1	5490828-P30	Rod: 0.33 megohm ±10%, 1 w max; sim to Globar Type 783H-3.
		- - - - - - - - - - - SOCKETS - - - - - - - - - - -
XFL1	19A121920-G1	Reed, phen: 7 pins; sim to Elco 04-710-02 (modified).
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J101	19C303426-G1	Connector: 20 pin contacts.
J102	19B205689-G1	Connector: 18 electrical contacts.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L101	7488079-P35	Choke, RF: 2.2 μh ±10%, 0.5 ohm DC res max; sim to Jeffers 4412-9.
L102	19A122524-G2	Coil.
L103	19A122524-G1	Coil.
L105	7488079-P33	Choke, RF: 1 μh ±10%, 0.15 ohm DC res max; sim to Jeffers 4412-5.
L107	19B205615-P2	Coil.
L108	19B205615-P1	Coil.
L110	19B205614-P2	Coil.
L111	19B205614-P1	Coil.
L112	19B205614-P4	Coil.
L113	19B205614-P3	Coil.
L115 and L116		Refer to Mechanical Parts (RCJ-1465).
L117	7772834-P7	Choke, RF: 0.2 μh ±10%, .034 ohm ±15% DC res, 320 to 520 MHz freq range; sim to Ohmite Z-460.
L119 and L120		Refer to Mechanical Parts (RC-1465).
L122	7772834-P7	Choke, RF: 0.2 μh ±10%, .034 ohm ±15% DC res, 320 to 520 MHz freq range; sim to Ohmite Z-460.
L124	19A121390-P1	Coil.
L125 and L126	19B205616-P1	Coil.
L127	19B204658-P3	Grid line.
L128	19B204658-P1	Grid line.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P101	4029840-P2	Contact, electrical: sim to AMP 42827-2.
P102	4029840-P1	Contact, electrical: sim to AMP 41854.
P103 thru P106	4029840-P2	Contact, electrical: sim to AMP 42827-2.
P107	4029840-P1	Contact, electrical: sim to AMP 41854.
P108 thru P113	4029840-P2	Contact, electrical: sim to AMP 42827-2.
P114	4029840-P1	Contact, electrical: sim to AMP 41854.

SYMBOL	G-E PART NO	DESCRIPTION
P115 thru P117	4029840-P2	Contact, electrical: sim to AMP 42827-2.
P130 thru P132	4029840-P2	Contact, electrical: sim to AMP 42827-2.
P133	4029840-P1	Contact, electrical: sim to AMP 41854.
P134	4029840-P2	Contact, electrical: sim to AMP 42827-2.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19A115416-P1	Precision, wirewound: 0.91 ohm ±1%, 2 w; sim to Dale Type RS-2B.
R102	19A115416-P3	Precision, wirewound: 2.59 ohms ±1%, 2 w; sim to Dale Type RS-2B.
R103	3R77-P330J	Composition: 33 ohms ±5%, 1/2 w.
R104	5493035-P11	Wirewound: 40 ohms ±5%, 5 w; sim to Tru-Ohm Type X-60.
R105	3R77-P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R106	3R77-P431J	Composition: 430 ohms ±5%, 1/2 w.
R107	5495948-P444	Deposited carbon: 0.28 megohm ±1%, 1/2 w; sim to Texas Instrument Type CD1/2MR.
R108	3R77-P683J	Composition: 68,000 ohms ±5%, 1/2 w.
R109	3R79-P273K	Composition: 27,000 ohms ±10%, 2 w.
R112	3R77-P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R113	3R77-P104J	Composition: 0.1 megohm ±5%, 1/2 w.
R114	3R77-P681J	Composition: 680 ohms ±5%, 1/2 w.
R115	3R77-P510J	Composition: 51 ohms ±5%, 1/2 w.
R117	3R149-P223J	Composition: 22,000 ohms ±5%, 4 w.
R118	3R78-P473K	Composition: 47,000 ohms ±10%, 1 w.
R120	3R77-P473K	Composition: 47,000 ohms ±10%, 1/2 w.
R123	3R77-P152K	Composition: 1500 ohms ±10%, 1/2 w.
R124	19B209381-P1	Variable, composition: 10,000 ohms ±20%, 3 w; sim to Allen-Bradley Type K.
R125	3R149-P153K	Composition: 15,000 ohms ±10%, 4 w.
R126	3R79-P562K	Composition: 5600 ohms ±10%, 2 w.
R129	3R78-P391J	Composition: 390 ohms ±5%, 1 w.
R130*	3R77-P683K	Composition: 68,000 ohms ±10%, 1/2 w. Added by Rev A.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S101	4031922-P1	Pushbutton: SPST, normally open, 1/2 amp at 12 VDC; sim to Stackpole Type SS-15.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7775500-P9	Phen: 5 terminals.
TB6	7775500-P10	Phen: 4 terminals.
TB9	7487424-P1	Miniature, phen: 1 terminal.
TB10	7487424-P2	Miniature, phen: 1 terminal.
		- - - - - - - - - - - TUBES - - - - - - - - - - -
V101		Type 8106.
V102		Type 8156.
V103		Type 8072.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XV101	7480532-P8	Tube, phen: 9 pins; sim to Elco 04-903-84.
XV102	19C301007-P5	Tube, plastic: 12 pins: sim to Alcon Metal Products 371G.
XV103	19B209160-P1	Tube, plastic: 11 pins; sim to kF Johnson 124-311-100.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - TUNED CIRCUITS - - - - - - - - -
Z101	19B204543-G2	Coil. Includes tuning slug 5491798-P4.
C1	5496203-P468	Capacitor, ceramic disc: 510 pf ±5%, 500 VDCW, temp coef -5600 PPM.
Z102	19B204543-G1	Coil. Includes tuning slug 5491798-P4.
C1	5496203-P468	Capacitor, ceramic disc: 510 pf ±5%, 500 VDCW, temp coef -5600 PPM.
		MECHANICAL PARTS
		(SEE RC-1465)
1	19B200525-P9	Rivet. (Part of XY1-4 in A101-112).
2	19A115793-P1	Contact, electrical: sim to Malco 2700. (Part of XY1-4 in A101-112).
3	19C311172-P2	Socket. (Part of XY1-4 in A101-112).
4	4033089-P1	Clip. (Part of XY1-4 in A101-112).
5	19C311152-P1	Heat sink.
6	7165167-P5	Insert, tube shield: sim to Atlas Insert 106-332-5. (Used with V101).
7	19B204570-P3	Heat sink. (Used with V101).
8	19A122497-P1	Support. (Used with V101).
9	7165167-P9	Insert, tube shield: sim to Atlas Insert 106-332-21. (Used with V102).
10	19A122497-P2	Support. (Used with V102).
11	19A122498-P1	Heat sink. (Used with V102).
12	19C311164-P1	Line plate. (Used with L119 in Models 4ET59D11, 13, 15, 17, 19, 21, 4ET60D11, 13, 15, 17, 19, 21).
13	19C311164-P2	Line plate. (Used with L120 in Models 4ET59D10, 12, 14, 16, 18, 20, 4ET60D10, 12, 14, 16, 18, 20).
14	19C311166-P1	Base line. (Mounts L115, 116, 119, 120).
15	19A121350-P1	Insulator.
16	7117825-P1	Washer, spring tension: sim to Tinnerman C4578B-632-24.
17	4036765-G4	Screw. (Part of C121, 122).
18	19C303544-P2	Cover. (Used with V103).
19	19D402783-P2	Line plate. (Used with L115 in Models 4ET59D11, 13, 15, 17, 19, 21, 4ET60D11, 13, 15, 17, 19, 21).
20	19C311164-P3	Line plate. (Used with L116 in Models 4ET59D10, 12, 14, 16, 18, 20, 4ET60D10, 12, 14, 16, 18, 20).
21	19C303405-P2	Casting. (Part of C121, 122).
22	19B204395-G2	Chassis.
23	19B204393-P1	Heat sink. (Used with Q8 in A101-112).
24	19B204394-P1	Support. (Used with Q8 in A101-112).
25	19C303495-G8	Station Top Cover (except Repeaters and VM).
	19C303673-G3	Station Top Cover (Repeaters and VM only).
	19C303396-G1	Mobile Top cover.
26	19A121676-P1	Guide pin: 4-40 thread. (Used with J101).
27	4036921-P1	Bracket, angle: sim to Tinnerman C17609-8A-67.
28	19B204366-P1	Support.
29	4036899-P4	Insulator, standoff: sim to Centralab 3BX3778C. (Part of C121, 122).
30	4036765-G2	Screw. (Part of C121, 122).
31	4038930-P1	Clip. (Mounts R104).
32	4029030-P10	Rubber channel.
33	19C303495-G7	Station Bottom Cover.
	19C303396-G3	Mobile Bottom cover.
34	19A121065-P1	Support. (Used with FL1 in Models 4ET59D16-21, 4ET60D16-21).
35	19A121257-G1	Angle. (Used with FL1 in Models 4ET59D16-21, 4ET60D16-21).



TRANSMITTER - MODELS 4ET59D10-21 AND 4ET60D10-21

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 compensate for diode sensitivity variations in the relative power output metering circuit. Added C159 & R130.

REV. B - Models 4ET59D16-21, 4ET60D16-21

To reduce tone distortion. Changed R3 on Tone Oscillator Encoder G101.

REV. B - Models 4ET59D10-15, 4ET60D10-15

REV. C - Models 4ET59D16-21, 4ET60D16-21

To increase audio high frequency roll-off and reduce sideband radiation in adjacent channel. Changed C7, R15, R16 & R17 on A101-A112. Added C8, C77, R53 and deleted C9 on A101-A106.

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-3778

DF-3126

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