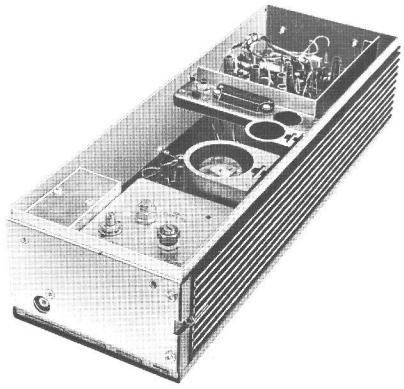
communications

MASTR Progress Line

66-88 MC, 30-WATT TRANSMITTER MODELS 4ET56A10-21 & 4ET56B10-15



SPECIFICATIONS *

FCC Filing Designation

ET-56-A(Narrow Band)
ET-56-B (Wide Band)

Frequency Range	66-88 MC
Power Output	
Mobile Power Supply	30 watts minimum (20% duty cycle)
Station Power Supply	30 watts minimum (continuous duty)
Crystal Multiplication Factor	12
Frequency Stability	±.0005% (-30°C to +60°C)
Spurious and Harmonic Radiation	At least 85 db below rated power output
Modulation	Adjustable from 0 to ±5 KC (Narrow Band) and 0 to ±15 KC (Wide Band) 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%
Deviation Symmetry	
Narrow Band	0.5 KC maximum
Wide Band	1.5 KC maximum
Tubes and Transistors	30-Watt Transmitter with no Options: 2 tubes 6 transistors 4 diodes
Maximum Frequency Spacing	0.4%
Duty Cycle	
Mobile	20% Transmit (one minute transmit, four minutes off)
Station	Continuous

Jul 31-73

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

ET-56-A & B

GENERAL ELECTRIC

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ILLUSTRATIONS

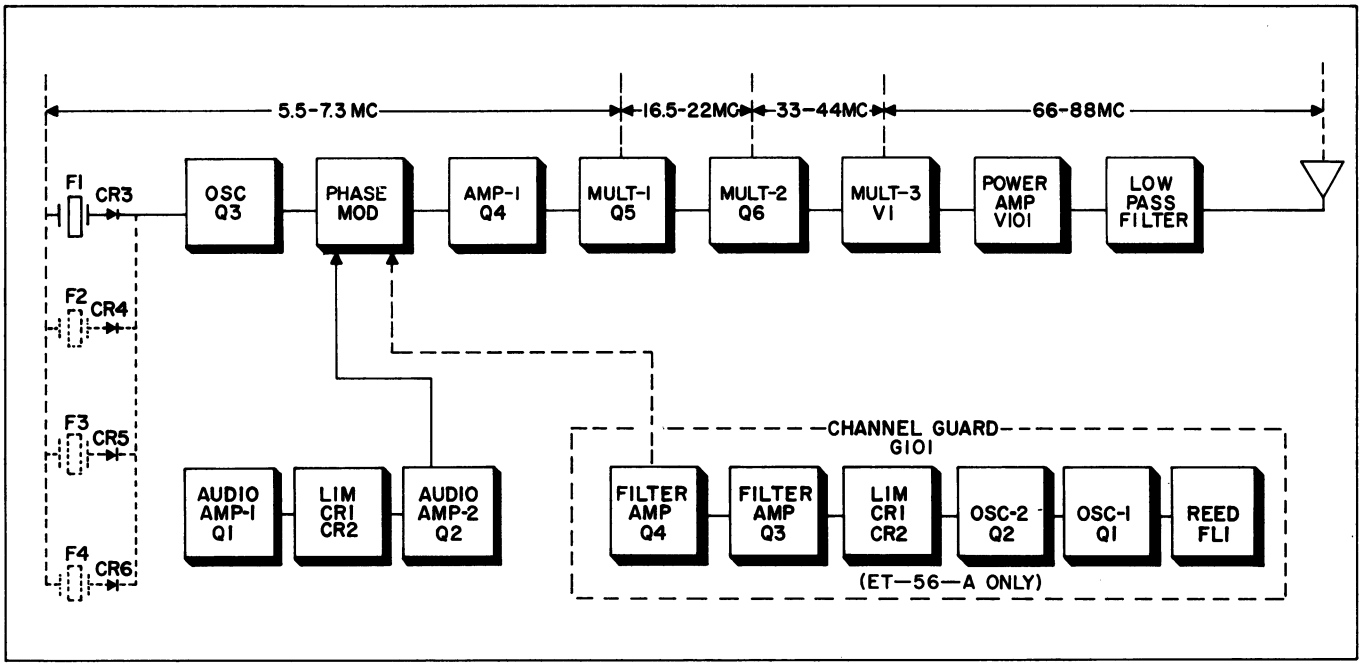
WARNING

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 Progress Line FM Transmitter Types ET-56-A and B are crystal-controlled, phase-modulated transmitters designed for one-, two-, or four-frequency operation within the 66-88 megacycle band. The transmitter consists of the following modules:

- Transistorized Exciter Board, with audio, oscillator, modulator, amplifier and multiplier stages,
- Tubed multiplier and power amplifier stages,
- Optional transistorized Channel Guard (ET-56-A only).



(RC-1191A)

Figure 1 - Transmitter Block Diagram

All input leads to the transmitter are individually filtered by the 20-pin feed-through by-pass connector J101. The output passes through a four-section, low-pass filter that features good shielding between sections and Teflon® capacitors for fail free operation with an open or shorted antenna.

CIRCUIT ANALYSIS

Six silicon transistors and only two tubes are used in the transmitter. When used with the mobile or station power supplies, the transmitter has a minimum power output of 30 watts. The frequency of the crystals used ranges from 5.5 to 7.3 megacycles, and the crystal frequency is multiplied 12 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 receiver 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 B+

Pin 5 - +450 volts PA B+

Pin 8 - -45 volts bias

Pin 14 - +10 volts for Channel Guard option (ET-56-A only).

Pin 15 - -20 volts for exciter board.

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 C41. The oscillator output is coupled directly 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 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. R48 and C74 provides RF de-coupling.

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 R14 to a combined post-limiter filter and de-emphasis network. This network consists of R17, R18, R19, C5, C8, C9 and C49. The output of the filter and de-emphasis network is applied directly to the phase modulator.

PHASE MODULATOR

The phase modulator is a varactor (voltage-variable capacitor) CV-1, 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 CV-1, resulting in a phase modulated output. The output of the modulator is coupled through blocking capacitor C51 to the base of the first amplifier. For Channel Guard and Wide Band transmitters, a second modulator stage (L2 and CV-2) is cascaded with the first modulator. The output of the Channel Guard encoder is fed through CHANNEL GUARD MOD ADJUST R20 to the modulator stages. The voice audio is also applied to both modulator stages.

AMPLIFIERS AND MULTIPLIERS

The first amplifier (Q4) isolates the modulator from the loading effects of the first multiplier and provides amplification. The output is DC-coupled to the first multiplier. Metering resistor R41 permits the MULT-1 stage to be metered at centralized metering jack J102-10.

Following Q4 are two inductively coupled Class C, common-emitter multiplier stages (Q5 and Q6). Q5 is a tripler, with collector tank L3 tuned to three times the crystal frequency.

Q6 operates as a doubler stage, with collector tank T1 tuned to six times the crystal frequency. Resistor R43 is for metering the MULT-2 stage at J102-2.

MULT-3

The output of the transistorized Exciter is coupled by a short length of RF cable to the grid tank (L12/L13) of beam pentode V1. This stage operates as a doubler with the plate tank tuned to 12 times the crystal frequency.

The grid of V1 is metered through metering resistors R1 and R2 at J102-4. The combination of R1, R2 and R3 drops the bias voltage to approximately -11 volts to protect V1 against loss of drive. Plate voltage is supplied through R7 and L1/L2.

When measuring grid current to V1, there will be a residual reading of approximately 0.16 volts without any drive. This is caused by the presence of fixed bias voltage to the grid of the tube.

POWER AMPLIFIER

The output of the MULT-3 stage is coupled to the grid of the compactron beam power amplifier (V101) through L5/L6, and is metered at J102-6 and J102-14 by measuring voltage drop across R10. Bias voltage (-45 volts) is applied to the PA grid through R9 and L7/L8. There is no residual reading on the PA.

Plate current is metered from J102-1 to J102-9 across metering resistor R101. Plate voltage is supplied through L101, and the PA plate tank is shunt-tuned by capacitor C110. R13 and R14 are the screen grid dropping resistors.

WARNING

The meter leads are at plate potential (high B+) when metering the PA plate at J102-1 and J102-9.

Placing the TUNE-OPERATE switch (S102) in the OPERATE position applies 300 volts to A143/A144-J3 and -J7. The 300 volts appearing on each side of R12 effectively shorts the resistor out of the circuit, and R13 and R14 are in series for normal operation of V101. When S102 is in the TUNE position, the screen voltage is applied to J3 only. Now, dropping resistors R12, R13 and R14 are in series to reduce the screen voltage. This reduces the plate dissipation of V101 while tuning the power amplifier stage. Feedback through capacitor C115 and C122 neutralizes the stage.

Antenna coupling is achieved by varying the coupling between L108 and L113. C111 tunes the antenna circuit.

The RF output from the antenna coil is fed to low-pass filter FL104/FL105. This filter has a low insertion loss and a harmonic attenuation of at least -50 db through all harmonics. The filter output is fed to the antenna changeover relay located on the front of the system frame.

CHANNEL GUARD TRANSMITTER (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 control (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, producing a sine wave output. The square wave oscillator output has a constant amplitude, making 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 CG-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 Drawing and Part Number is facing the rear of the Two-Way Radio. See Figure 3 for location of the endoder 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 the bottom—

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

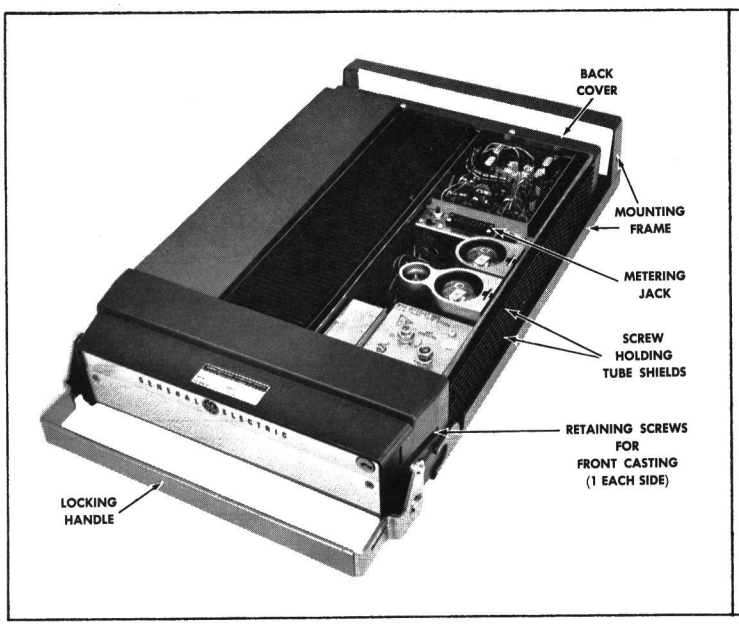


Figure 2 - Top Cover Removed

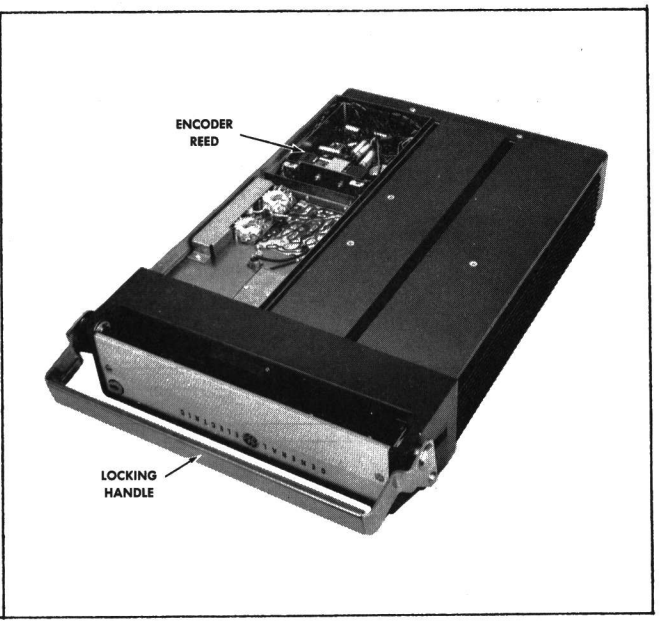


Figure 3 - Bottom Cover Removed

NOTE

To replace tubes, loosen screws holding tube shields and slide shields 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-through connector at the back of the transmitter, and slide the unit out of the system frame.

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R14) 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 4EX3A1

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 1.0-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 (R14) for a 4.5-kilocycle swing (13.5 KC for Wide Band) 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 (R20) for 0.75-KC tone deviation. Then repeak L1/L2 and L3/L4 as shown in Step 1 of Transmitter Alignment Procedure. Reset tone deviation to 0.75 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 multi-frequency units. Next, apply a 1.0 volt signal at 1000 cps and set MOD ADJUST (R14) for 3.75-KC deviation (4.5-KC minus 0.75-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:

$$P_i = \frac{\text{Plate Voltage X Plate Current Indication}}{4.67}$$

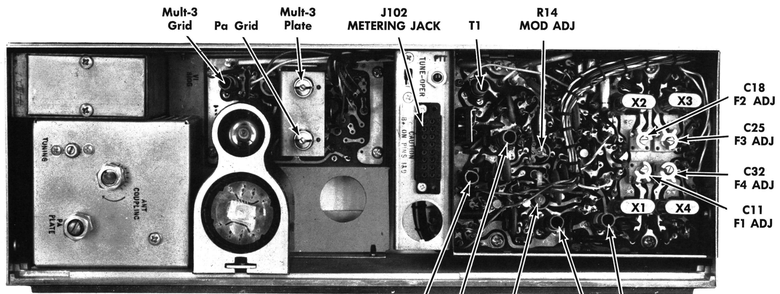
where:

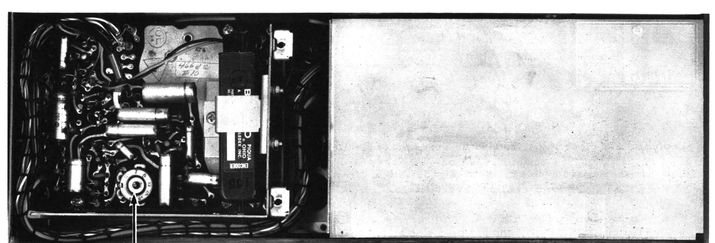
P_i is the power input in watts.

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).

4.67 is the value of the plate current metering resistor in ohms.





TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. General Electric Centralized Metering Test Set Model 4EX3A10, Station Meter Switching Panel, or a 20,000 ohms-per-volt Multimeter with a 1-volt scale.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place crystal (operating frequency ÷ 12) in crystal socket XY1.
2. Set crystal trimmer C11 to mid-capacity. If multi-frequency transmitter, set all trimmers to mid-capacity and tune transmitter on channel with the highest frequency (except for Step 7).
3. Place the TUNE-OPERATE switch (S102) in the TUNE position.
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 for Steps 6 through 14.
5. For a large change in frequency or a badly misaligned transmitter, set the slugs in all slug-tuned coils in the center of the coil form. All slugs will then tune clockwise, except MULT-3 PLATE and PA GRID slugs which tune counterclockwise.
6. All adjustments are made with the transmitter keyed.

STEP	METERING POSITION 4EX3A10	METERING POSITION Multimeter - at J102	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
			EXCITER BOARD		
1.	A (MULT-1)	Pin 10	L1 (and L2 with Channel Guard)	0.6 v (0.4 v Minimum)	Tuning the modulator is a critical adjustment. Carefully tune L1 for maximum meter reading. For Channel Guard or Wide Band transmitters alternately tune L1 and L2 for maximum meter reading.
2.	A (MULT-1)	Pin 10	L3	See procedure	Tune L3 for a small peak in meter reading (not required unless changing frequency).
3.	B (MULT-2)	Pin 2	L4 and L3	0.65 v (0.4 v Minimum)	Tune L4 and then L3 for maximum meter reading. Then tune T1 for minimum meter reading (not required unless changing frequency). NOTE: Misalignment of this coil may result in the remainder of the transmitter being tuned off frequency. Always start with the slug in the center of the coil form (at maximum inductance) and tune for the first peak.
			MULT-3 AND POWER AMPLIFIER		
4.	D (MULT-3)	Pin 4	MULT-3 GRID and T1 (on Exciter)	0.55 v (0.4 v Minimum)	Alternately tune MULT-3 GRID and T1 (on Exciter) for maximum meter reading. Then tune MULT-3 PLATE for slight change in meter reading (not required unless changing frequency).
5.	F (PA GRID)	Pin 14 (+) and Pin 6 (-)	PA GRID and MULT-3 PLATE	0.45 v (0.4 v Minimum)	Alternately tune PA GRID and MULT-3 PLATE for maximum meter reading.
6.					Rotate ANT COUPLING fully counterclockwise.
7.	G (PA PLATE)	WARNING High B-plus on Pins 1 and 9.		Minimum	For single-frequency transmitters, carefully tune PA PLATE for minimum meter reading.
		Pin 1 (+) and Pin 9 (-)	PA PLATE		For multi-frequency transmitters, switch to the lowest frequency and adjust PA PLATE for minimum meter reading.
8.					Place S102 in the OPERATE position.
9.	G (PA PLATE)	Pin 1 (+) and Pin 9 (-)	ANT COUPLING	See procedure	Rotate ANT COUPLING clockwise until meter reading rises slightly. In multi-frequency transmitters, switch back to the highest frequency before tuning ANT COUPLING.
10.	G (PA PLATE)	Pin 1 (+) and Pin 9 (-)	ANT TUNING	Maximum	Adjust ANT TUNING for maximum meter reading.
11.	G (PA PLATE)	Pin 1 (+) and Pin 9 (-)	ANT COUPLING	0.7 v	Adjust ANT COUPLING for metering reading of 0.7 volts.
12.	F (PA GRID)	Pin 14 (+) and Pin 6 (-)	PA GRID	Maximum	Readjust PA GRID for maximum meter reading.
			FREQUENCY ADJUSTMENTS		
13.			C11 (C18, C25 and C32 in multi-frequency units)		With no modulation, adjust crystal trimmer C11 (on Exciter) for proper oscillator frequency. In multi-frequency units, adjust C18, C25 and C32 as required. Next, refer to the MODULATION ADJUSTMENT. NOTE: For proper frequency control of the transmitter, it is recommended that all frequency adjustments be made when the equipment is at a temperature of approximately 75°F. In no case should frequency adjustments be made when the equipment is outside the temperature range of 50° to 90°F.

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:
   G-E Model 4EX6A10 or
   Heath #IG-72
4. Deviation Meter (with a .75 KC scale) similar to:
   Measurements #140
   Lampkin #205A
5. Multimeter similar to:

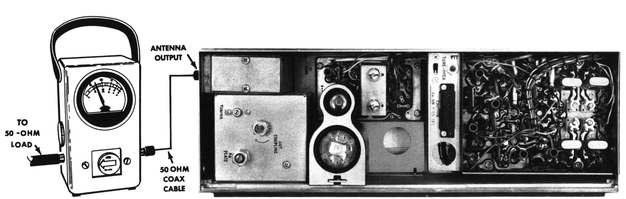
   G-E METERING TEST SET MODEL 4EX3A10 or
   Triplett #631 or
   20,000 ohms-per-volt voltmeter

STEP 1

POWER MEASUREMENT

TEST PROCEDURE

1. Connect transmitter output to wattmeter as shown below:



2. Key transmitter and check wattmeter for minimum reading of 30 watts.

SERVICE CHECK

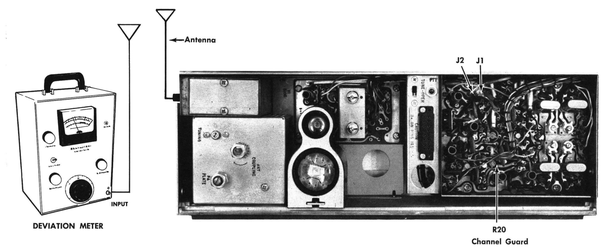
Refer to Service Hints on Transmitter Troubleshooting Procedure.

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 or Transmitter Exciter Board.

3. Key transmitter and check for 0.75-KC deviation. If reading is low or high, adjust Channel Guard MOD ADJUST (R20) for a reading of 0.75 KC.

NOTES:

The Channel Guard MOD ADJUST (R20) may be adjusted for deviations up to 0.80 KC for tone frequencies from 71.9 cps to 82.5 cps, and deviations up to 1.0 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

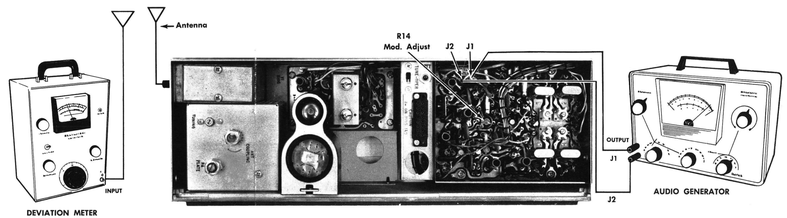
If the 0.75-KC deviation is not obtainable when adjusting R20, replace the Tone Transmitter reed.

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 1.0 VOLTS RMS and frequency to 1 KC.
4. Key the transmitter and adjust Deviation Meter to carrier frequency.
5. Deviation reading should be ±4.5 KC (±13.5 KC wide band).
6. Adjust "Modulation Adjust Control" R14 until deviation reads 4.5 KC (13.5 KC 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.

DEVIATION METER

NOTES: --MASTR transmitters are adjusted for 4.5 KC (13.5 KC wide band) deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 KC (15 KC wide band) under the worst conditions of frequency, voltage and temperature.

If the deviation reading plus (+) and minus (-) differs by more than 0.5 KC (1.5 KC 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 KC (10 KC wide band). Voltage should be LESS than 90 millivolts.

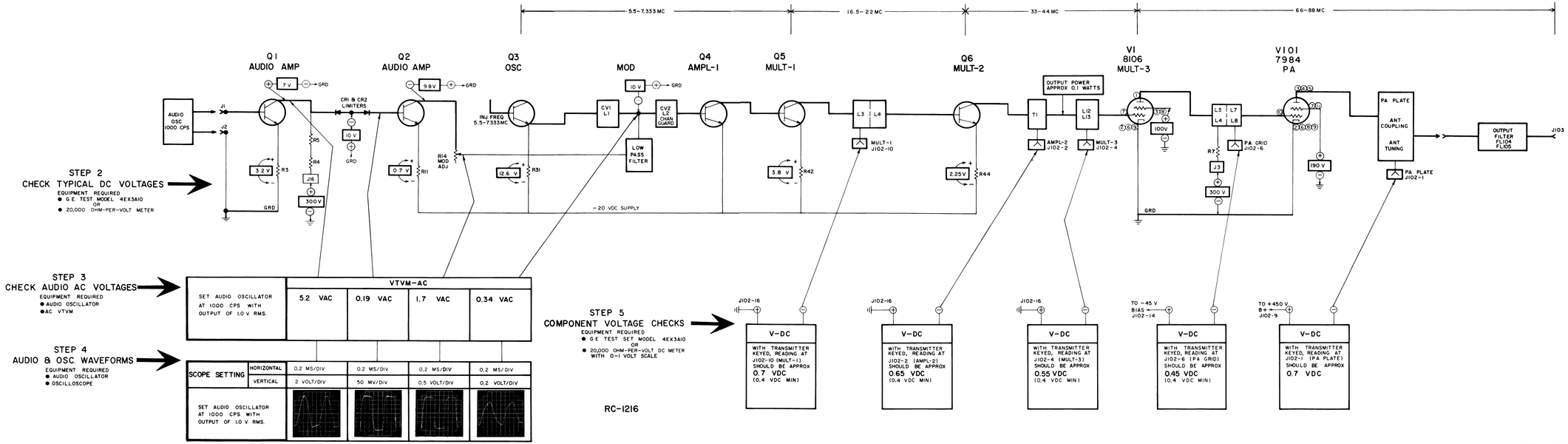
METER

STEP 1 — QUICK CHECKS

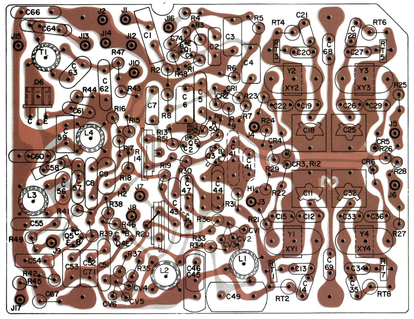
CHECK VOLTAGES AT CENTRALIZED METERING JACK J102 Multimeter - pin numbers GE Test Set - A thru G positions						
POWER OUTPUT	Pins 10 & 16 A	Pins 2 & 16 B	Pins 4 & 16 D	Pins 6 & 14 F	Pins 1 & 9 G	PROBABLE DEFECT
Low	0.7 v	0.65 v	0.6 v	0.4 v	0.7 v	Weak 7984
0	0.7 v	0.65 v	0.6 v	0	0	Open 7984
Low	0.7 v	0.65 v	0.6 v	Low or neg.	--	Weak 8106
0	0.7 v	0.65 v	0.15 v	0	0.4 v	8106 Fil. open
0	0.7 v	0.65 v	0.15 v	0	0	Open Fil. Fuse
0	0.7 v	0 or over 1.0 v	0.15 v	0	0.4 v	Defective Q6
0	Over 1.0 v	0	0.15 v	0	0.4 v	Shorted Q5 or Open Q4
0	0	0	0.15 v	0	0.4 v	Defective Q3 or Modulator (See note A)

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

1. -20 volt DC supply at J102-12-16.
2. Measure 12.6 VDC across Q3 emitter resistor R31, then:
   - (a) Remove crystal - a slight variation in R31 voltage reading indicates Q3 stage operating properly.
   - (b) If no voltage is measured, check keying leads, CR3-CR6, Q3.
   - (c) With crystal removed, short Q4 base to emitter. A voltage reading above 1.0 volt indicates Q4 and Q5 are operating properly. Defect may be in Modulator.
   - (d) If modulator is defective, check voltage variable diodes CV1 and CV2.



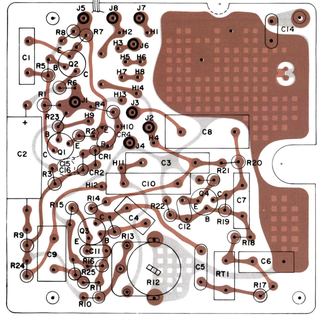
EXCITER



(19C303548, Sh. 1, Rev. 2)
(19C303548, Sh. 2, Rev. 2)

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

TO CHANNEL GUARD REED



CHANNEL GUARD GIOI

(19C303456, Sh. 1, Rev. 3)
(19C303456, Sh. 2, Rev. 3)

OUTLINE DIAGRAM

66 — 88 MC, 30-WATT TRANSMITTER
MODELS 4ET56A10-21 & 4ET56B10-15

EXCITER READINGS TAKEN TO CHASSIS GROUND

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	6.4K	6.8K	200K	12K	65K	22K
Q2	8.5K	5K	70K	13K	10K	10K
Q3	10K	5.5K	20K	2.9K	100	100
Q4	6.5K	3.1K	80K	8K	14.2K	2.5K
Q5	7K	3.8K	4.2K	2.5K	170Ω	170Ω
Q6	6.7K	3.3K	6.5K	3.1K	70	70

EXCITER READINGS TAKEN TO -20V LINE (J5 BLUE)

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	13K	12K	220K	45K	3.1K	6.5K
Q2	1.2K	1.2K	65K	4.7K	16K	22K
Q3	2.0K	2K	6.2K	5.5K	3.3K	6.6K
Q4	0	0	3.3K	3.4K	10K	4.1K
Q5	340	390	10K	4.1K	3.4K	6.5K
Q6	60	120	0	0	3K	6.6K

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

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

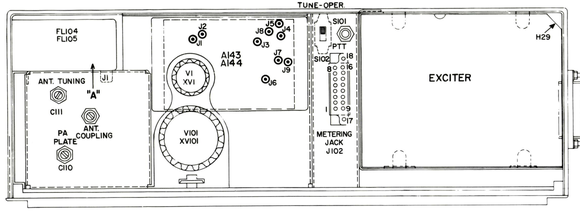
CHANNEL GUARD READINGS MEASURED TO CHASSIS GROUND

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	∞	∞	∞	∞	∞	∞
Q2	∞	∞	∞	∞	∞	∞
Q3	4.9K	2.7K	30K	9.5K	7.5K	8.4K
Q4	4.9K	2.7K	24K	6K	2.6K	2.5K

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

TRANSISTOR	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q1	200	200	14K	9K	25K	2.7K
Q2	1.3K	1.3K	6.3K	3.4K	8.7K	1.5K
Q3	∞	∞	∞	∞	∞	∞
Q4	∞	∞	∞	∞	∞	∞

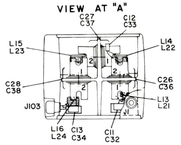
TOP VIEW



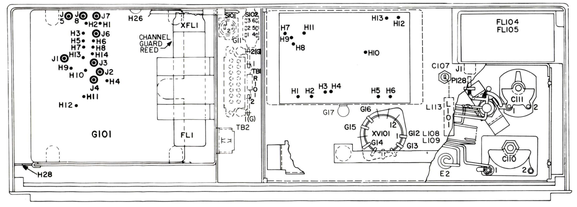
READINGS AT J101 TAKEN TO CHASSIS GROUND

PIN	−	+
1	0	0
2	∞	∞
3	2.2Ω	2.2Ω
4	530K	530K
5	∞	∞
6	∞	∞
7	∞	∞
8	70K	70K
9	∞	∞
10	∞	∞
11	∞	∞
12	30K	16K
13	∞	∞
14	∞	∞
15	6.5K	3.1K
16	∞ 30K	∞ 16K
17	∞ 30K	∞ 16K
18	∞ 30K	∞ 16K
19	0	0
20	∞	∞

VIEW AT "A"



BOTTOM VIEW

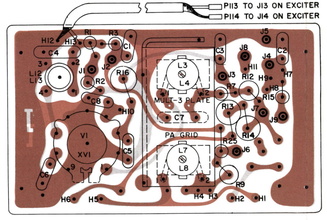


READINGS FROM TUBE SOCKET PINS TO CHASSIS GROUND

PIN	1	2	3	4	5	6	7	8	9	10	11	12
XVI	530K	0	630K 2.2Ω	0	0	0	15K	630K	0			
XVIOI	0	0	∞	∞	∞	0	530K	0	0	75K	530K	2.2Ω

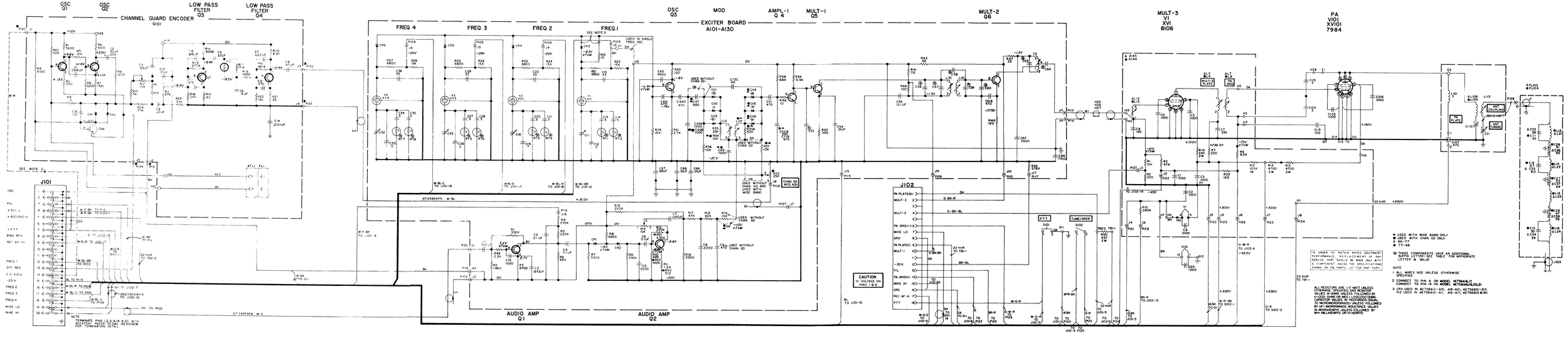
(19B620744, Rev. 9)

PI13 TO JI5 ON EXCITER
PI14 TO JI4 ON EXCITER



A143 - A144

(19B204613, Sh. 1, Rev. 1)
(19B204613, Sh. 2, Rev. 1)



MODEL NO.	REV.	MODEL NO.	REV.	FREQ. RANGE	NO. OF FREQ.	CHAN. GD.
4ET56B10	A	4ET56B10	D	66-77 MC	1	
4ET56B-1	A	4ET56B11	D	72-88 MC	2	
4ET56B-2	A	4ET56B12	D	66-77 MC	2	
4ET56B-3	A	4ET56B13	D	66-77 MC	4	
4ET56B-4	A	4ET56B13	G	66-77 MC	4	X
4ET56B-5	A	4ET56B13	H	66-77 MC	4	X
		4ET56B13	H	72-88 MC	4	X
		4ET56B13	J	72-88 MC	4	X
		4ET56B20	H	66-77 MC	4	X
		4ET56B20	H	72-88 MC	4	X
		4ET56B21	H	72-88 MC	4	X

COMPONENT NUMBER	66-77 MC	77-88 MC
R1	1.43K	1.43K
R2	1.96K	1.96K
R3	1.33K	1.33K
R4	1.87	1.87
R5	1.33K	1.33K
R6	1.87	1.87
R7	1.33K	1.33K
C53	1.125	1.125
C54	1.390	1.215
C57	1.27	1.19
C58	1.27	1.19
C60	1.390	1.215
C61	1.27	1.19
C62	1.27	1.19
C64	1.72	1.34

RT-THRU-HTR REF J5-C

(198620714, Rev. 23)

- ● USED WITH WIDE BAND ONLY
- ▲ USED WITH CHAN GD ONLY
- ■ SEE NOTE 1
- ◆ 77-88

◆ THESE COMPONENTS HAVE AN ADDITIONAL SUFFIX LETTER-SEE TABLE FOR APPROPRIATE LETTER & VALUE

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

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

NOTE:
1. ALL WIRES N22 UNLESS OTHERWISE SPECIFIED.
2. CONNECT TO PIN 6 ON MODEL 4ET56A9,J1,2,3.
   CONNECT TO PIN 14 ON MODEL 4ET56A8,9,20,21
3. CR3 USED IN 4ET56A1-A/5, A/8-A21, 4ET56B0-B/9, R/2 USED IN 4ET56A10-A/C, A/6-A/7, 4ET56B0 & B/L

SCHEMATIC DIAGRAM

66 — 88 MC, 30-WATT TRANSMITTER
MODELS 4ET56A10-21 & 4ET56B10-15

PARTS LIST

LBI-3522A

66-68 MC TRANSMITTER
MODELS 4ET56A10 - 4ET56A31
MODELS 4ET56B10 - 4ET56B15

4ET56A10-15 (PL-19ZB03868-G03-60) (STANDARD) KEY D
4ET56A16-21 (PL-19ZB03868-G01-66) (CHANNEL GUARD) KEY H
4ET56B10-15 (PL-19ZB03868-G01-66) KEY A

SYMBOL	G-E PART NO.	DESCRIPTION
		EXCITER BOARD ASSEMBLY
A104, 105		4104, 105 19D402285-G4, 5 (4ET56A10, 11
A106, 110		4106, 110 19D402285-G6, 7 (4ET56A12, 13)
A114, 115		4114, 115 19D402285-G8, 14, 15 (4ET56A14, 15)
A119, 120		4119, 120 19D402285-G19, 20 (4ET56A16, 17)
A124, 125		4124, 125 19D402285-G24, 25 (4ET56A18, 19)
A129, 130		4129, 130 19D402285-G29, 30 (4ET56A20, 21)
A154, 155		4154, 155 19D402285-G34, 35 (4ET56B10, 11)
A159, 160		4159, 160 19D402285-G39, 40 (4ET56B12, 13)
A164, 165		4164, 165 19D402285-G44, 45 (4ET56B14, 15)
		- - - - - - - - CAPACITORS - - - - - - - -
C1	19B209243-P3	Polyester: .022 µf ±20%, 40 VDC; sim to Amperex C280AA/PZZE.
C2*	19B209243-P4	Polyester: .033 µf ±20%, 40 VDC.
		In Models 4ET56A10-15 Rev B and earlier: In Models 4ET56A16-21 Rev D and earlier:
	19B209243-P3	Polyester: .022 µf ±20%, 40 VDC.
C3*	19B209243-P13	Polyester: 0.1 µf ±20%, 250 VDC.
		In Models 4ET56A10-15 Rev C and earlier: In Models 4ET56A16-21 Rev E and earlier:
	19LA115414-P13	Polyester: 0.1 µf ±20%, 200 VDC.
C4	19B209243-P7	Polyester: 0.1 µf ±20%, 40 VDC.
C5	7491395-P114	Ceramic disc: .0022 µf ±10%, 500 VDCW.
C6	19B209243-P7	Polyester: 0.1 µf ±20%, 40 VDC.
C7	19B209243-P5	Polyester: .047 µf ±20%, 40 VDC.
C8	7491395-P114	Ceramic disc: .0022 µf ±10%, 500 VDCW.
C9	5493366-P470K	Silver mica: 470 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C11	5491271-P106	Variable, subminiature: approx 1.98-12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C12	5496219-P5	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C13 and C14	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C15	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C18	5491271-P106	Variable, subminiature: approx 1.98-12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C19	5496219-P5	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C20 and C21	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C22	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C25	5491271-P106	Variable, subminiature: approx 1.98-12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C26	5496219-P5	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C27 and C28	19C300685-P93	Ceramic disc: 5 pf ±0.1 pf, 500 VDCW, temp coef 0 PPM.
C29	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C32	5491271-P106	Variable, subminiature: approx 1.98-12.4 pf, 750 v peak; sim to EF Johnson 189-6-5.
C33	5496219-P5	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C34 and C35	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
C36	5496219-P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C41D	5490008-P143	Silver mica: 470 pf ±10%, 300 VDCW; sim to Electro Motive Type DM-15.
C43	5494481-P131	Ceramic disc: .006 pf ±10%, 500 VDCW; sim to RMC Type JF Discap.
C44D	5496372-P66	Ceramic disc: 470 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C45B	5493367-P1500K	Mica: .0015 µf ±10%, 100 VDCW; sim to Electro Motive Type DM-20.
C46B	5493367-P1000K	Mica: .001 µf ±10%, 100 VDCW; sim to Electro Motive Type DM-20.
C47	5496372-P174	Ceramic disc: 680 pf ±5%, 500 VDCW, temp coef -3300 PPM.
C49	5493367-P1000J	Silver mica: .001 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-20.
C51	5496372-P66	Ceramic disc: 470 pf ±5%, 500 VDCW, temp coef -2200 PPM.
C52B	5493366-P390K	Silver mica: 390 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C53D	5493366-P120K	Silver mica: 120 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C53E	5493366-P100K	Silver mica: 100 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C54	19B209243-P1	Polyester: .01 pf ±20%, 40 VDCW.
C55	7491827-P5	Ceramic disc: 0.1 pf +80% -30%, 50 VDCW; sim to RMC Discap 36C12.
C56C	5493366-P390J	Silver mica: 390 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C56D	5493366-P270J	Silver mica: 270 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C57D	5496219-P949	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -1500 PPM.
C57E	5496219-P753	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C58D	5496219-P3	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C58E	7770468-P33	Ceramic: 2 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C59C	5493366-P390J	Silver mica: 390 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C59D	5493366-P270J	Silver mica: 270 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C60D	5496219-P949	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -1500 PPM.
C60E	5496219-P753	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C61B	5494481-P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C62	5494481-P129	Ceramic disc: .004 pf ±10%, 500 VDCW; sim to RMC Type JF Discap.
C63D	5493366-P27J	Silver mica: 27 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C63E	5493366-P22J	Silver mica: 22 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C64D	5496219-P758	Ceramic disc: 62 pf ±5%, 500 VDCW, temp coef -750 PPM.
C64E	5496219-P718	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -750 PPM.
C66	5494481-P129	Ceramic disc: .004 pf ±10%, 500 VDCW; sim to RMC Type JF Discap.
C67	5496267-P18	Tantalum: 6.8 pf ±20%, 35 VDCW; sim to Sprague Type 150D.
C68 and C69	7491827-P2	Ceramic disc: .01 pf +80% -30%, 50 VDCW; sim to Sprague 18C180.
C71B	5493366-P470K	Mica: 470 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C73C	5493366-P68J	Mica: 68 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C74	5494481-P111	Ceramic disc: .001 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115331-P1	Silicon.
CR3* thru CR6*	19A115603-P1	Silicon.
		In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev E and earlier:
	19A115348-P1	Silicon.
CV1* and CV2*	5495769-P8	Silicon, capacitive.
		In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev E and earlier:
	5495769-P13	Silicon, capacitive.
CV3* thru CV6*	5495769-P8	Silicon, capacitive. Added in Models 4ET56A10-15 by Rev D: Added in Models 4ET56A16-21 by Rev F.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1D	PL-19C303946-G4	Coil. Includes tuning slug 5491798-P2.
L2D	PL-19C303946-G4	Coil. Includes tuning slug 5491798-P2.
L3C	PL-19BD20650-G2	Coil. Includes tuning slug 5491798-P4.
L4C	PL-19BD20650-G6	Coil. Includes tuning slug 5491798-P4.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
Q3 and Q4	19A115330-P1	Silicon, NPN.
Q5 and Q6*	19A115328-P1	Silicon, NPN.
		In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev E and earlier:
	19A115329-P1	Silicon, NPN.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3877-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R2	3877-P105K	Composition: 1 megohm ±10%, 1/2 w.
R3*	3877-P472K	Composition: 4700 ohms ±10%, 1/2 w.
		In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev E and earlier:
	3877-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R4	3877-P274K	Composition: 0.27 megohm ±10%, 1/2 w.
R5	3877-P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R6	3877-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R7	3877-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R8	3877-P684K	Composition: 0.68 megohm ±10%, 1/2 w.
R9	3877-P334K	Composition: 0.33 megohm ±10%, 1/2 w.
R10	3877-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R11	3877-P122K	Composition: 1200 ohms ±10%, 1/2 w.
R13	3877-P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R14*	19B209358-P106	Variable, carbon film: approx 75-10,000 ohms ±30%, 0.25 w; sim to CTS Type U-301.
	19B201969-P6	In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev E and earlier: Variable, carbon film: .01 megohm ±30%, 0.1 w; sim to Centralab Series 4.
R15 and R16	3877-P224K	Composition: 0.22 megohm ±10%, 1/2 w.
R17	3877-P473K	Composition: 47,000 ohms ±10%, 1/2 w.
R18	3877-P623K	Composition: 62,000 ohms ±10%, 1/2 w.
R19	3877-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R20*	19B209358-P107	Variable, carbon film: approx 75-25,000 ohms ±30%, 0.25 w; sim to CTS Type U-301.
	19B201969-P7	In Models 4ET56A16-21 of Rev C, D, and E: In Models 4ET56A16-21 of Rev B and earlier: Variable, carbon film: 25000 ohms ±30%, 0.1 w; sim to Centralab Series 4.
	19B201969-P6	In Models 4ET56A10-15 of Rev C and earlier: In Models 4ET56A16-21 of Rev B and earlier: Variable, carbon film: .01 megohm ±30%, 0.1 w; sim to Centralab Series 4.

SYMBOL	G-E PART NO	DESCRIPTION
R21	3877-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R22	3877-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R23	3877-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R24	3877-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R25	3877-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R26	3877-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R27	3877-P682K	Composition: 6800 ohms ±10%, 1/2 w.
R28 and R29	3877-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R30	3877-P101K	Composition: 100 ohms ±10%, 1/2 w.
R31A	3877-P272K	Composition: 2700 ohms ±5%, 1/2 w.
R33D	3877-P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R34C	3877-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R35B	3877-P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R36 and R37	3877-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
J1 thru J10	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J12 thru J17	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
R38	3877-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R39	3877-P393K	Composition: 3900 ohms ±10%, 1/2 w.
R41	3877-P750J	Composition: 75 ohms ±5%, 1/2 w.
R42	3877-P391K	Composition: 390 ohms ±10%, 1/2 w.
R43	3877-P360J	Composition: 36 ohms ±5%, 1/2 w.
R44	3877-P121K	Composition: 120 ohms ±10%, 1/2 w.
R45	5493548-P474	Deposited carbon: 0.576 megohm ±1%, 1/2 w; sim to Texas Instrument Type CDL/ZRR.
R46	3877-P100K	Composition: 10 ohms ±10%, 1/2 w.
R47	3877-P330K	Composition: 33 ohms ±10%, 1/2 w.
R48	3877-P222K	Composition: 2200 ohms ±10%, 1/2 w.
R49	3877-P101K	Composition: 100 ohms ±10%, 1/2 w.
R50	3877-P511J	Composition: 510 ohms ±5%, 1/2 w.
R51*	3877-P434J	Composition: 0.43 megohm ±5%, 1/2 w.
	3877-P356J	In Models 4ET56B10-15 earlier than Rev A: In Models 4ET56A16-21 of Rev D and earlier: Composition: 0.36 megohm ±5%, 1/2 w.
R52*	3877-P104K	Composition: 0.1 megohm ±10%, 1/2 w.
	3877-P823K	In Models 4ET56B10-15 earlier than Rev A: Composition: 82,000 ohms ±10%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - - -
RT1C	19B209284-P11	Disc: 187 ohms res nominal at 25°C, color code brown.
RT2C	19B209284-P4	Rod: 53,000 ohms res nominal at 25°C, color code yellow.
RT3C	19B209284-P11	Disc: 187 ohms res nominal at 25°C, color code brown.
RT4C	19B209284-P4	Rod: 53,000 ohms res nominal at 25°C, color code yellow.
RT5C	19B209284-P11	Disc: 187 ohms res nominal at 25°C, color code brown.
RT6C	19B209284-P4	Rod: 53,000 ohms res nominal at 25°C, color code yellow.
RT7C	19B209284-P11	Disc: 187 ohms res nominal at 25°C, color code brown.
RT8C	19B209284-P4	Rod: 53,000 ohms res nominal at 25°C, color code yellow.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1*	PL-19B205262-G2	Coil. Includes tuning slug 5491798-P4. Deleted in Models 4ET56A10-15 by Rev D: Deleted in Models 4ET56A16-21 by Rev F.
		In Models 4ET56A10-15 earlier than Rev A: In Models 4ET56A16-21 of Rev D and earlier:
	PL-19B204651-G1	Coil. Includes tuning slug 5491798-P4.
T2*	PL-19B205262-G1	Coil. Includes tuning slug 5491798-P4. Added in Models 4ET56A10-15 by Rev D: Added in Models 4ET56A16-21 by Rev F.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - SOCKETS - - - - - - - - -
XY1 thru XY4		Refer to Mechanical Parts (RC-1210).
		- - - - - - - - - CRYSTALS - - - - - - - - -
		When reordering give G-E Part No. and specify exact freq needed.
		Crystal freq = (OF ÷ 12).
Y1 thru Y4	19B206175-P4	Quartz: freq range 5500 to 6417 KC, temp range -30°C to +85°C. (66-77 MC).
Y1 thru Y4	19B206175-P5	Quartz: freq range 6416 to 7334 KC, temp range -30°C to +85°C. (77-88 MC).
		BOARD ASSEMBLY PL-19B204927-G1
XY1	7480470-P2	Tube, mica-filled phen: 8 pins rated at 1 amp.
		BOARD ASSEMBLY PL-19B204931-G2 (Used in PL-19C303434-G4, 5)
J1 thru J10	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J12 thru J17	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		POWER AMPLIFIER BOARD ASSEMBLY
A143 and A144	A143 19C303543-G4 A144 19C303542-G6	(4ET56A10, 12, 14, 16, 18, 20) (4ET56B10, 12, 14) (4ET56A11, 13, 15, 17, 19, 21) (4ET56B11, 13, 15)
		- - - - - - - - - CAPACITORS - - - - - - - - -
C105 and C106	5494481-P11	Ceramic disc: .001 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C107	7485975-P17	Ceramic, feed-thru: 470 pf ±20%, 750 VDCW; sim to Erie Style 327.
C110	5491498-P3	Variable: approx 2.8-50 pf, 1700 v peak.
C111	19B209123-P1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -1500 PPM.
C115	5492304-P8	Ceramic disc: .3 pf ±0.25 pf, 2000 VDCW, temp coef +0 1130 PPM.
C122	5492304-P8	Ceramic disc: .3 pf ±0.25 pf, 2000 VDCW, temp coef +0 1130 PPM.
C124	5494481-P11	Ceramic disc: .001 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - - FILTERS - - - - - - - - -
FL1		Bead, governor: coil - 600 ohms ±10%, standard 7-pin tube socket mounting.
	3R161-P719	71.9 cps
	3R161-P770	77.0 cps
	3R161-P825	82.5 cps
	3R161-P948	94.8 cps
	3R161-P1000	100.0 cps
	3R161-P1035	103.5 cps
	3R161-P1072	107.2 cps
	3R161-P1109	110.9 cps
	3R161-P1147	114.7 cps
	3R161-P1188	118.8 cps
	3R161-P1230	123.0 cps
	3R161-P1273	127.3 cps
	3R161-P1318	131.8 cps
	3R161-P1365	136.5 cps
	3R161-P1413	141.3 cps
	3R161-P1465	146.5 cps
	3R161-P1514	151.4 cps
	3R161-P1567	156.7 cps
	3R161-P1622	162.2 cps
	3R161-P1679	167.9 cps
	3R161-P1738	173.8 cps
	3R161-P1799	179.9 cps
	3R161-P1862	186.2 cps
	3R161-P1928	192.8 cps
	3R161-P2035	203.5 cps
FL104 and FL105		LOW PASS FILTER ASSEMBLY
	FL104 19D402233-G4	(4ET56A11, 13, 15, 17, 19, 21) (4ET56B11, 13, 15)
	FL105 19D402233-G6	(4ET56A10, 12, 14, 16, 18, 20) (4ET56B10, 12, 14)
		The low pass filter is factory tuned. If it is found to be defective it is recommended that the entire filter assembly be replaced to maintain rated power output and spurious attenuation.

SYMBOL	G-E PART NO	DESCRIPTION
R12	3876-P104K	Composition: 0.1 megohm ±5%, 1 w.
R13 and R14	3879-P472K	Composition: 4700 ohms ±10%, 2 w.
R15	5495948-P444	Deposited carbon: 0.28 megohm ±1%, 1/2 w; sim to Texas Instrument Type CDL/ZRL.
R16*	3879-P243J	Composition: 24,000 ohms ±5%, 2 w. Added in Models 4ET56A10-15 by Rev B: Added in Models 4ET56A16-21 by Rev D,
R25	3877-P161J	Composition: 160 ohms ±5%, 1/2 w.
		- - - - - - - - - TUBES - - - - - - - - -
V1		Type 8106.
		- - - - - - - - - SOCKETS - - - - - - - - -
XV1	7480470-P2	Tube, mica-filled phen: 8 pins rated at 1 amp.
		BOARD ASSEMBLY PL-19B204931-G2 (Used in PL-19C303434-G4, 5)
J1 thru J10	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J11 thru J17	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1*	5494481-P111	Ceramic disc: .001 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap. Added in Models 4ET56A16-21 by Rev A,
C16*	5496219-P21	Ceramic disc: 100 pf ±10%, 500 VDCW, temp coef 0 PPM. Added in Models 4ET56A16-21 by Rev G.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1* and CR2*	19A115250-P1	Silicon. In Models 4ET56A16-21 earlier than Rev A:
	4036936-P1	Silicon.
CR3*	19A115250-P1	Silicon. Added by Rev G. In Models 4ET56A16-21 earlier than Rev A:
	4036936-P1	Silicon.
CR4	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
Q2 thru Q4	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - 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 P110	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P112 thru P117	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P120	4029840-P1	Contact, electrical; sim to Amp 41854.
P121	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P122 thru P127	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P128	4033513-P17	Contact, electrical: sim to Bead Chain R125-19.
P129 thru P132	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P133	4029840-P1	Contact, electrical; sim to Amp 41854.
P134 thru P137	4029840-P2	Contact, electrical; sim to Amp 42827-2.

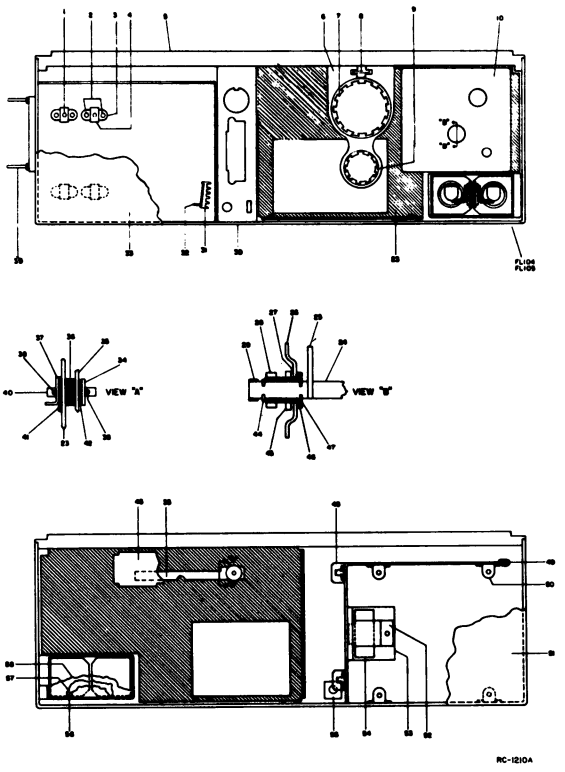
SYMBOL	G-E PART NO	DESCRIPTION
G101		- - - - - - - - - OSCILLATORS - - - - - - - - - TONE OSCILLATOR ENCODER ASSEMBLY PL-19C302460-G2 (Used in Models 4ET56A16-21)
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19B209243-P6	Polyester: .068 µf ±20%, 40 VDCW.
C2	7489483-P17	Electrolytic: 50 µf +75 -10%, 25 VDCW; sim to Sprague 30D.
C3	19A115414-P116	Polyester: 0.33 µf ±10%, 100 VDCW.
C4	19B209243-P2	Polyester: .015 µf ±20%, 40 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: .033 µf ±20%, 40 VDCW.
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%, 500 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
C14*	5494481-P111	Ceramic disc: .001 pf ±20%, 500 VDCW; sim to RMC Type JF Discap. Added in Models 4ET56A16-21 by Rev A,
C16*	5496219-P21	Ceramic disc: 100 pf ±10%, 500 VDCW, temp coef 0 PPM. Added in Models 4ET56A16-21 by Rev G.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1* and CR2*	19A115250-P1	Silicon. In Models 4ET56A16-21 earlier than Rev A:
	4036936-P1	Silicon.
CR3*	19A115250-P1	Silicon. Added by Rev G. In Models 4ET56A16-21 earlier than Rev A:
	4036936-P1	Silicon.
CR4	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115889-P1	Silicon, NPN; sim to Type 2N2712.
Q2 thru Q4	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
		- - - - - - - - - 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 P110	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P112 thru P117	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P120	4029840-P1	Contact, electrical; sim to Amp 41854.
P121	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P122 thru P127	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P128	4033513-P17	Contact, electrical: sim to Bead Chain R125-19.
P129 thru P132	4029840-P2	Contact, electrical; sim to Amp 42827-2.
P133	4029840-P1	Contact, electrical; sim to Amp 41854.
P134 thru P137	4029840-P2	Contact, electrical; sim to Amp 42827-2.

SYMBOL	G-E PART NO	DESCRIPTION
R17	3877-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R18	3877-P102K	Composition: 1000 ohms ±10%, 1/2 w.
R19	3877-P184K	Composition: 0.18 megohm ±10%, 1/2 w.
R20	3877-P622J	Composition: 6200 ohms ±5%, 1/2 w.
R21	3877-P330K	Composition: 33 ohms ±10%, 1/2 w.
R22	3877-P183K	Composition: 18,000 ohms ±10%, 1/2 w.
R23	3877-P623K	Composition: 62,000 ohms ±10%, 1/2 w.
R24	3877-P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R25	3877-P393K	Composition: 39,000 ohms ±10%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - - -
RT1	5490828-P30	Rod: 0.33 megohm ±10% res, 1 w max; sim to Global Type TK33B-3.
		- - - - - - - - - SOCKETS - - - - - - - - -
XFL1	PL-19A121920-G1	Bead, mica-filled phen: 7 pins rated at 1 amp at 500 VRMS with 4-1/2 inches of cable.
		BOARD ASSEMBLY PL-19B204542-G2
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1 thru J8	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J101	PL-19C303426-G1	Connector: 20 pin contacts.
J102	PL-19B203689-G1	Connector: 18 pin contacts.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L101	7772834-P4	Choke, RF: 7 µh, approx freq range 35 to 110 mc; sim to Chanlo 2-30.
L108	19B204926-P1	Coil.
L109	19B204926-P2	Coil.
L113	19A121381-P1	Coil.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3877-P562K	Composition: 5600 ohms ±10%, 1/2 w.
R2	3877-P201K	Composition: 200 ohms ±10%, 1/2 w.
R3*	3877-P103J	Composition: 10,000 ohms ±5%, 1/2 w. In Models 4ET56A16-21 of Rev G or earlier: Composition: 6800 ohms ±5%, 1/2 w.
R4*	3877-P512K	Composition: 5100 ohms ±10%, 1/2 w. In Models 4ET56A16-21 earlier than Rev A: Composition: 9100 ohms ±10%, 1/2 w.
R5	3877-P123K	Composition: 12,000 ohms ±10%, 1/2 w.
R6	3877-P512K	Composition: 5100 ohms ±10%, 1/2 w.
R7	3877-P132K	Composition: 1300 ohms ±10%, 1/2 w.
R8	3877-P622K	Composition: 6200 ohms ±10%, 1/2 w.
R9	3877-P122K	Composition: 1200 ohms ±10%, 1/2 w.
R10	3877-P302J	Composition: 3000 ohms ±5%, 1/2 w.
R11	3877-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	3877-P274K	Composition: 0.27 megohm ±10%, 1/2 w.
R14	3877-P822K	Composition: 8200 ohms ±10%, 1/2 w.
R15	3877-P620K	Composition: 62 ohms ±10%, 1/2 w.
R16	3877-P243K	Composition: 24,000 ohms ±10%, 1/2 w.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - RESISTORS - - - - - - - - -
R101	19A115416-P6	Precision, wirewound: 4.67 ohms ±1%, 2 w; sim to Dale Type RS-2B.

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S101	4031922-P1	Push: SPST, normally open, .50 amp at 12 VDC; sim to Stackpole Type SS-15.
S102	19B209040-P1	Slide: DPDT, 0.5 amp at 125 v; sim to Continental Wirt Type 126.
		- - - - - - - - TERMINAL BOARDS - - - - - - - -
TB1	7487424-P2	Miniature, phen: 1 terminal.
TB2	7487424-P1	Miniature, phen: 1 terminal.
		- - - - - - - - - - TUBES - - - - - - - - - -
V101		Type 7984.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XV101	19C301007-P5	Tube, plastic: 12 pins rated at 5 amps max; sim to Alcon Metal Products 371G bottom mount.
		MECHANICAL PARTS (SEE RC-1210)
1	19B200525-P9	Rivet. (Part of XY1-4).
2	19A115793-P1	Contact, electrical; sim to Malco 2700. (Part of XY1-4).
3	19C311172-P2	Crystal socket. (Part of XY1-4).
4	4033089-P1	Clip. (Part of XY1-4).
5	PL-19C303395-G3	Heat sink.
6	19B204702-P1	Tube heat sink. (Used with V1 and V101).
7	7165167-P7	Tube shield insert: approx 5-3/16 x 1-7/8 inches flat; sim to Atlas 106-332-18. (Used with V101).
8	19A121195-P2	Support. (Used with V101).
9	7165167-P5	Tube shield insert: approx 2-7/8 x 1-1/4 inches flat; sim to Atlas 106-332-5. (Used with V1).
10	PL-19B204490-G1	Can: approx 2 x 3-1/16 x 3-1/4 inches.
23	PL-19B204708-G1	Chassis: approx 7-3/4 x 4-1/2 inches.
24	19A121189-P2	Post: approx 2-3/8 x 1/4 inches dia.
25	N509P612C	Not Used.
26	19B205023-P1	Support: approx 1-3/8 x 1/2 x 1/16 inches thick.
27	7115130-P9	Lockwasher; sim to Shakeproof 1220-2.
28	4031531-P1	Locknut. No. 32.
29	4031527-P2	Collar: approx 1/8 x 5/16 inches.
30	PL-19B204395-G1	Chassis: approx 14-1/2 x 4-3/4 x 3-3/8 inches.
31	19B204393-P1	Not Used.
32	19B204394-P1	Not Used.
33	PL-19C303396-G1	Cover.
34	N402P39C13	Washer: approx 3/16 inch dia.
35	19C303666-P1	Line plate. (Used with V101).
36	19B204756-P1	Insulator, ceramic. (Part of post assembly).
37	19B204776-P1	Angle support. (Part of post assembly).
38	N509P608C13	Dowel pin, spring: approx 1/2 x 1/16 inch dia.
39	19A121676-P1	Pin guide: 4-40 thread, approx 5/8 inch pin. (Used with J101).
40	19A122724-P1	Post.
41	19A121547-P1	Plate. (Part of post assembly).
42	5493361-P6	Spring washer; sim to Shakeproof 3502-10-79.
43	19B204640-P1	Shield. (Used with V101 line plate).
44	N910P18C	Retaining ring: approx 1/32 x 5/16 inches dia.
45	7893938-P1	Nut. No. 32.
46	4031530-P1	Bearing: 3/8 - 32 threads.

SYMBOL	G-E PART NO	DESCRIPTION
47	4031532-P1	Cup washer: approx 1/2 inch dia.
48	4036921-P1	Mounting support, bottom cover: approx 7/8 x 5/8 x 1/32 inches dia; sim to Tinnerman C17609-8A-67.
49	4029030-P10	Rubber channel: approx 1-1/4 inches long.
50	19B204366-P1	Support: approx 11/16 x 3/8 x 1/16 inches thick.
51	PL-19C303396-G3	Cover: approx 14-3/8 x 4-3/4 x 5-16 inches thick.
52	19A121065-P1	Support: (Used with FL1 in Models 4ET56A16-21).
53	PL-19A121257-G1	Angle. (Used with FL1 in Models 4ET56A16-21).
54	4032591-P26	Not Used.
55	4036835-P3	Not Used.
56	19A121008-P1	Plate: approx 2-3/8 x 1-3/16 x 1/16 inches thick. (Used with FL104, 105).
57	19A121007-P1	Pad: approx 2-3/8 x 1-3/16 inches. (Used with FL104, 105).
58	19A121005-P1	Shield: approx 2-3/8 x 1-3/16 inches.



PRODUCTION CHANGES

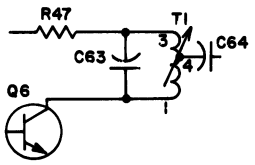
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter" which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - (Models 4ET56A16-21 only)
To reduce Channel Guard distortion, changed CR1, CR2, CR3 and R4 and added C14.

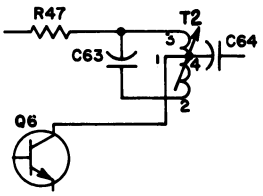
REV. A - (Models 4ET56A10-15 only)
REV. B - (Models 4ET56A16-21 only)
To improve stability of 2nd Multiplier, changed T1.

Elementary Diagram Changes:

Was



Changed To



REV. C - (Models 4ET56A16-21 only)
To reduce Channel Guard distortion. Changed R20 on Exciter Board Assembly.

REV. B - (Models 4ET56A10-15 only)
REV. D - (Models 4ET56A16-21 only)
To increase PA grid drive. Replaced R6 with R16 on PA Board Assembly.

REV. C - (Models 4ET56A10-15 only)
REV. E - (Models 4ET56A16-21 only)
To increase sensitivity of microphone input. Changed C2 and R3 on Exciter Board Assembly.

REV. D - (Models 4ET56A10-15 only)
REV. F - (Models 4ET56A16-21 only)
To incorporate improved semiconductor components into the Exciter Board Assembly. Changed C3, CR3-CR6, CV1 and CV2, Q6, R14 and R20; deleted T1; and added CV3-CV6, R12 and T2.

REV. G - (Models 4ET56A16-21 only)
To protect Channel Guard Encoder from RF fields. Added C16 and replaced CR3 with CR4 on Encoder Assembly (G101).

REV. H - (Models 4ET56A16-21 only)
To reduce tone distortion. Changed R3 on G101.

REV. A - (Models 4ET56B10-15 only)
To increase range of modulation control. Changed R51 and R52 on Exciter Board Assembly.

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 No.

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.

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PRINTED IN U.S.A.

DF-3123