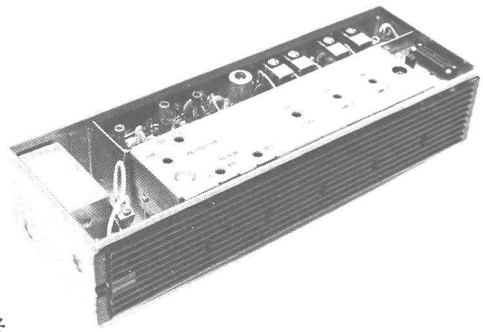
MOBILE RADIO

MASTR® Progress Line

132—174 MHz, 35-WATT TRANSMITTER MODELS 4ET85A10-21 & 4ET85A30-41

Maintenance Manual LBI 3939G
DATAFILE FOLDER DF3144 **********



SPECIFICATIONS *

FCC Filing Designation	**ET-85-A**
Frequency Range	132—174 MHz
Power Output	35 watts (132—162 MHz) 30 watts (162—174 MHz)
Crystal Multiplication Factor	12
Frequency Stability	±.0002% (-30°C to +60°C)
Spurious and Harmonic Radiation	At least 85 dB below rated power output
Modulation	Adjustable from 0 to ±5 kHz 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 Hz per EIA standards. Post limiter filter per FCC and EIA.
Distortion	Less than 3%
Deviation Symmetry	0.5 kHz maximum
Maximum Frequency Spacing	0.4%
Duty Capability	Continuous

ET-85-A

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

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ILLUSTRATIONS

WARNING

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

DESCRIPTION

Transmitter Type ET-85-A is a crystal controlled, frequency modulated transmitter designed for one-, two- or four-frequency operation in the 132-174 megahertz band. The transmitter consists of the following assemblies:

- Transistorized Exciter Board
  - Audio, modulator, amplifier and multiplier stages.
- Integrated Circuit Oscillator Module (ICOM)
  - Oscillator and buffer stages
- Transistorized PA Assembly
  - Multiplier, amplifiers, driver, power amplifier, power detector, low-pass filter and antenna switch or relay.
- Optional Channel Guard Board
  - Encoder and tone network

CIRCUIT ANALYSIS

The transmitter uses a total of 16 transistors to provide a minimum power output of 35 watts in the 132 to 162 MHz range, and 30 watts in the 162 to 174 MHz range. The frequency of the plug-in ICOM modules ranges from approximately 11 to 14.5 megahertz, and the ICOM frequency is multiplied 12 times.

A centralized metering jack (J102) is provided for use with GE Test Set Models 4EX3A10 (Rev. A or later) or 4EX8K11. The test set meters the amplifiers, multipliers, driver and PA stage, as well as the relative power output, reflected power and PA supply voltages. The metering jack also provides access to receiver audio, microphone and push-to-talk leads.

All input leads to the transmitter are individually filtered by the 20-pin feed-through by-pass connector J101. Supply voltage, metering and control functions for the exciter board are connected from the PA assembly to jacks J1 through J18 on the exciter board.

EXCITER

ICOM MODULE

ICOM module Model 4EG25A11 consists of a crystal-controlled Colpitts oscillator, a voltage regulator, a Channel Guard tone modulator and a buffer output stage. The entire module (including crystal) is enclosed in a dust-proof aluminum can, with the ICOM frequency and the transmitter operating frequency printed on the top. Access to the oscillator trimmer is obtained by prying off the plastic GE decal on the top of the can.

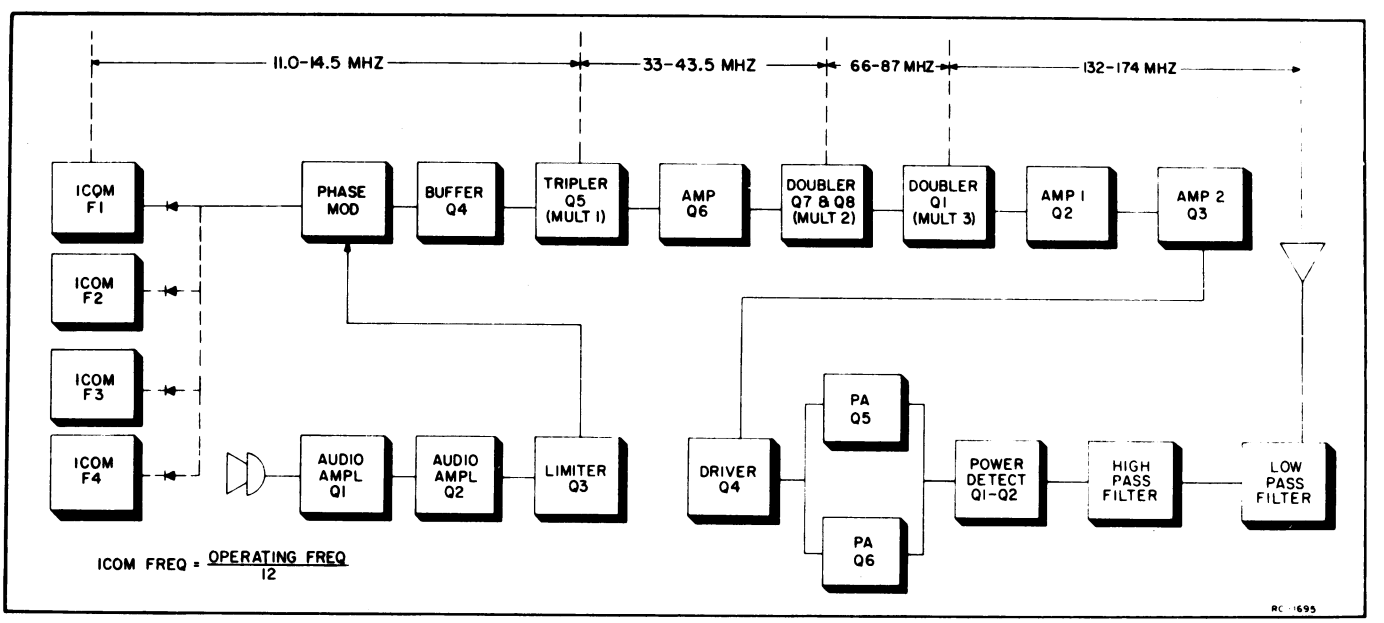


Figure 1 - Transmitter Block Diagram

The oscillator frequency is temperature-compensated at both ends of the temperature range to provide instant frequency compensation, with a frequency stability of ±.0002%.

In single-frequency transmitters, a keying jumper (from R38 on the exciter board) connects the ICOM to ground. Keying the transmitter applies +10 Volts to the ICOM, turning it on. With the ICOM operating, diode CR1 is forward biased and the oscillator output is applied to the modulator stage.

In multi-frequency transmitters, up to three additional ICOM modules can be plugged into the exciter board. The single-frequency keying jumper is removed, and the proper frequency is selected by switching the ICOM keying lead to ground by means of a frequency selector switch on the control unit.

CAUTION

All ICOM modules are individually compensated at the factory, and cannot be repaired in the field. Any attempt to remove the ICOM cover will void the warranty.

For radios equipped with Channel Guard, tone from the encoder-decoder board (on the receiver) is applied to the ICOM through Channel Guard Mod Adjust R25. The oscillator output is frequency modulated by the Channel Guard tone.

NOTE

If Channel Guard decode only is desired, disconnect the CHAN GD. TONE HI lead from J8 of the transmitter exciter board.

AUDIO AMPLIFIERS AND LIMITER

The audio section of the transmitter consists of direct-coupled feedback amplifiers Q1, Q2 and Q3. Q3 also acts as a limiter at high audio input levels. Audio from the microphone is coupled through an input network (C2 and R1) to the audio stages. The input network, in conjunction with the feedback circuit, provides the audio gain and a 6-dB/octave pre-emphasis.

The output of limiter Q3 is connected through Modulation Adjust potentiometer R8 to a de-emphasis network for 6-dB/octave de-emphasis and post limiter roll-off. The network consists of C7, C8, C9, R15, R16 and R17. Modulation adjust R8 determines the maximum signal level applied to the modulator circuit, and is normally set for ±4.5 kHz (narrow band).

PHASE MODULATOR

The phase modulator uses varactor CV1 (a voltage-variable capacitor) in a R-L-C network that includes R20 and L1. An audio signal applied to the modulator through L1 varies the capacitance of CV1, resulting in a phase modulated output. The modulator output is coupled through C13 to the base of buffer Q4.

BUFFER, AMPLIFIER AND MULTIPLIERS

Buffer stage Q4 isolates the modulator from the loading effects of the tripler stage, and provides some amplification. The output is direct-coupled to the base of Q5.

Q5 operates as a tripler (MULT-1) with the collector tank (T1) tuned to three times the ICOM frequency. The tripler is metered at J102 through R36. Following the tripler is amplifier Q6. This stage is metered at J102 through R35. The output of Q6 is capacitive-coupled from T1 to T3, and then to the base of Q7 and Q8.

Q7 and Q8 operate as a class C, push-push doubler (MULT-2) with the collector tank (T4) tuned to six times the ICOM frequency. The doubler stage is metered at J102 through R34.

PA ASSEMBLY

MULTIPLIER

The exciter output is capacitive-coupled to A102-L1 and then to the base of 2nd doubler A102-Q1. This stage operates as a common emitter doubler (MULT-3), and is metered at J102 through R1. The 2nd doubler output is coupled through a series-tuned circuit (tuned to 12 times the crystal frequency) to the base of amplifier Q2.

AMPLIFIERS, DRIVER AND PA

Following the doubler are two common-emitter, series-tuned RF amplifier stages, Q2 and Q3. Q2 base voltage is metered at J102 through metering network CR1, R3 and R8. Q3 is metered at J102 through metering network CR2, R5 and R8.

Driver Q4 follows the two amplifier stages. Collector current for Q4 is metered across metering resistor R105 at J102 (DRIVER Ic). The reading is taken on the 1-volt scale (10 amperes full scale) with the GE Test Set in Position F. The driver output is coupled through a series-tuned circuit to base-balancing inductor L16, and then to the base of Q5 and Q6.

Q5 and Q6 operate as parallel-connected, common-emitter power amplifiers. Collector current for Q5 and Q6 is metered across metering resistor R102 at J102 (PA Ic). The reading is taken on the one volt scale (10 amperes full scale) with the GE Test Set in Position G, and with the HIGH SENSITIVITY button pressed.

Thermistor RT1 is mounted on the PA board between Q4 and Q5. The thermistor, in conjunction with a control circuit on the power regulator board, protects the PA stages against excessively high temperatures. If the temperature of the PA heat sink starts to rise excessively, RT1 activates the temperature control circuit, which reduces the supply voltage to the PA board. The control circuit keeps the supply voltage reduced until the temperature returns to normal.

The PA output is coupled through a series tuned circuit to power detector assembly A103.

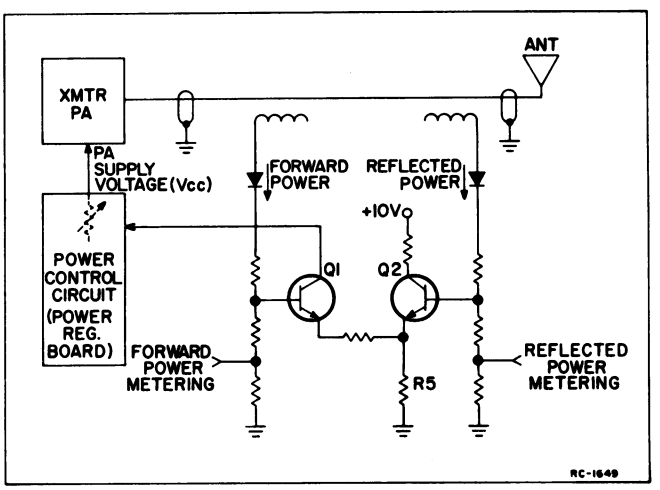


Figure 2 - Power Detector Circuit

POWER DETECTOR

Power detector A103 consists of the detector circuitry enclosed in a shielded casting, and a differential amplifier mounted on a printed wiring board. The detector circuit samples both the forward and reflected power on the antenna line, and applies the outputs to the bases of differential amplifier transistors Q1 and Q2. The output of the differential amplifier is proportional to the net power output (forward power minus reflected power). The differential amplifier is connected to a control circuit on the power regulator board which controls the supply voltage applied to the transmitter PA board (see Figure 2).

With normal power output into a 50-ohm load, Q1 conducts and Q2 is turned off. This keeps the power control circuit on the power regulator board turned off. A drop in power output reduces the drive to Q1, which activates the power control circuit and reduces the supply voltage to the transmitter (Vcc).

An increase in the VSWR increases the input to the base of Q2, causing Q2 to start conducting. This causes Q1 to conduct less due to the emitter bias developed by Q2 across R5. Q1 conducting less activates the power control circuit on the power regulator board, reducing the Vcc.

The output of the power detector is coupled through high-pass filter FL102 and through antenna changeover relay K101 or Solid State Antenna Switch A104/A105 to low-pass filter FL101. The output of FL101 is applied to the antenna.

SOLID STATE ANTENNA SWITCH

The Solid State Antenna Switch automatically provides antenna changeover for transmitter and receiver operation. During the receive mode of operation, the switch isolates the transmitter from the antenna. Application of RF from the transmitter causes the switch to operate, connecting the antenna to the transmitter and isolating the receiver. A continuous external bias voltage (+10 volts) is applied to the switch to prevent spurious antenna power from operating the switch during the receive mode.

When the transmitter is off, signals picked up by the antenna are connected to the receiver through Low Pass Filter FL101 and the filter network in the antenna switch. A parallel LC circuit (collector to base capacitance of Q1 and L2/L3) which is resonant near the receiver frequency provides isolation from transmitter loading.

When the transmitter is keyed and the peak RF voltage exceeds the +10 volt bias voltage, Q1 conducts. This connects RF voltage from the transmitter through Low Pass Filter FL101 to the antenna. Q2 and CR1 are biased on during transmit to isolate the receiver from the transmitter output. While Q2 is conducting, its collector is near ground potential. This places L4/L5 in parallel with C5/C6 forming a parallel resonant circuit near the transmitter frequency to isolate the receiver. CR1 provides additional isolation.

CHANNEL GUARD ENCODER OPTION

Channel Guard Encoder Model 4EH18A10 is a fully transistorized encoder for use with Royal Professional combinations in encode only applications, or where different encode and decode tones are desired. The tone frequencies are controlled by plug-in

tone networks that are made with precision components for excellent stability and reliability. The tone frequencies range from 71.9 to 203.5 Hz.

The encoder board and tone network mount on the underside on the transmitter chassis. Power, ground and tone output connections are made to transmitter exciter board A101 by means of a cable (19B216186-G1).

The encoder tone is provided by selective oscillators Q1 and Q2, which oscillate continuously at a frequency determined by the tone network (FL1). Negative feedback, applied through the tone network to the base of Q1, prevents any gain in the stage except at the desired encode frequency. The oscillator output is applied to the base of emitter-follower Q3.

Thermistor-resistor combination R1 and RT1 provides temperature compensation for the oscillator output. Limiter diodes CR1 and CR2 keep the tone amplitude constant.

The output of emitter-follower Q3 is applied to the ICOM module on the transmitter exciter board through Channel Guard MOD ADJUST R25. Instructions for setting R25 are contained in the Modulation Adjustment section of the Transmitter Alignment Procedure.

In encode-decode applications, the channel can be monitored before transmitting a message by moving the ON-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 Channel Guard decode only is desired, disconnect the CHAN GD. TONE HI lead from J8 of the transmitter exciter board.

CARRIER CONTROL TIMER

The Carrier Control Timer option shuts off the transmitter on each transmission after a one-minute timing cycle, and alerts the operator that the transmitter is off by means of an alarm tone in the speaker. The transmitter can be turned on again by releasing and rekeying the push-to-talk switch on the microphone.

The timing cycle (transmitter keyed time) is normally set at the factory for a duration of one minute. An optional potentiometer is available that permits the timing cycle to be adjusted from 15 seconds to 5 minutes. Complete instructions for the Carrier Control Timer are contained in Maintenance Manual LBI-4138.

MAINTENANCE

DISASSEMBLY

To service the transmitter from the top (Fig. 3):

1. Pull locking handle down and pull radio about one inch out of mounting frame.

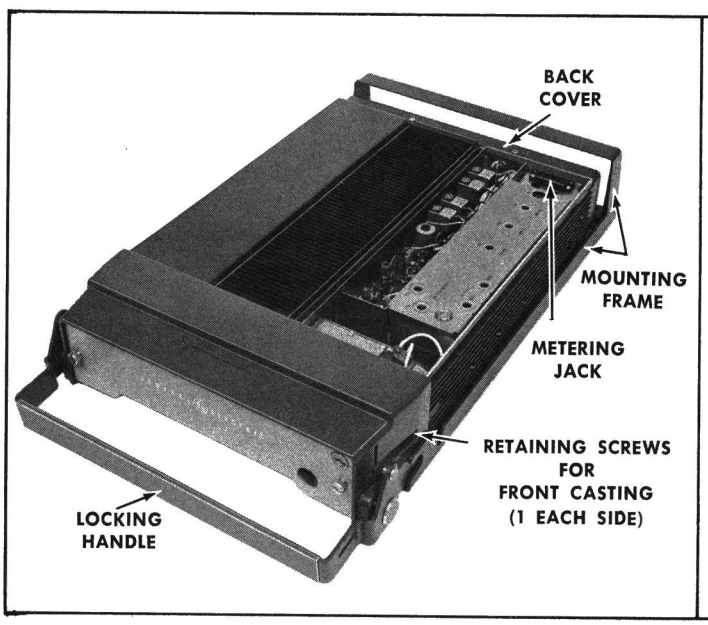


Figure 3 - Top Cover Removed

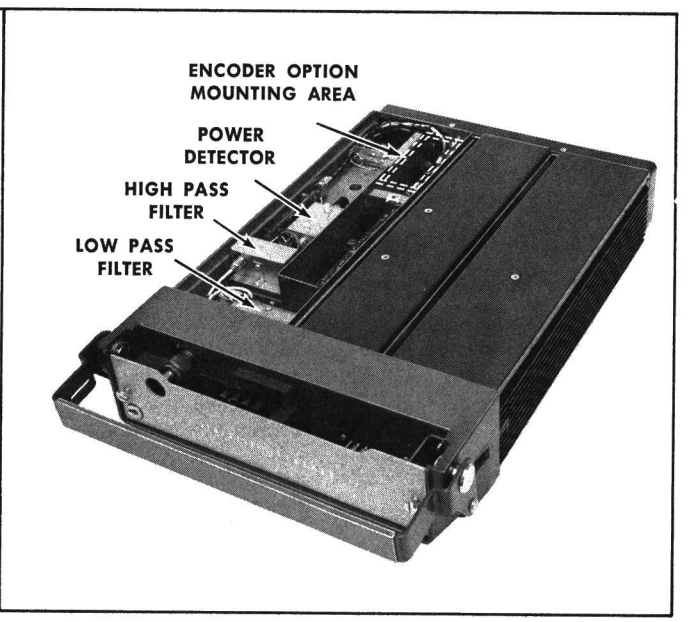


Figure 4 - Bottom Cover Removed

2. Pry up cover at rear of transmitter.

3. Slide cover back and lift off.

To service the transmitter from the bottom (Fig. 4):

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.

To remove transmitter from system frame:

1. Loosen the two retaining screws in the front casting (see Figure 3) 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 plug and receiver plug 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.

PA TRANSISTOR REPLACEMENT

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

To replace the PA transistors (Q2 through Q6):

1. Unsolder one lead at a time with a 50-Watt soldering iron. Hold the lead away from the printed circuit pattern with a scribe until the solder cools.

2. Turn the transmitter over and remove the Phillips-head screws holding the power detector and high-pass filter to the transmitter heatsink.

3. Hold the body of the transistor to prevent it from turning. Next, remove the transistor hold-down nut and springwasher through the hole in the heatsink with an 11/32-inch nut-driver. Lift out the transistor, and remove the old solder from the printed circuit board.

4. Trim the new transistor leads (if required) to approximately 3/8-inch lengths. Cut the collector lead at a 45° angle for future identification (see Fig. 5). The letter "C" on the top of the transistor indicates the collector.

5. Apply a coating of silicone grease around the transistor mounting surface, and place the transistor in the mounting hold. Align the leads as shown in the Outline Diagram. Then hold the body of the transistor and replace the holding-down nut and springwasher, using moderate torque (7 to 9-inch-pounds maximum).

6. Make sure that the transistor leads are formed as shown in Figure 6 so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.

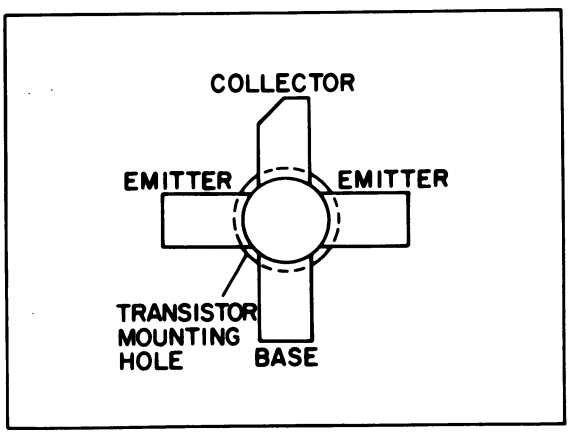


Figure 5 - Lead Identification

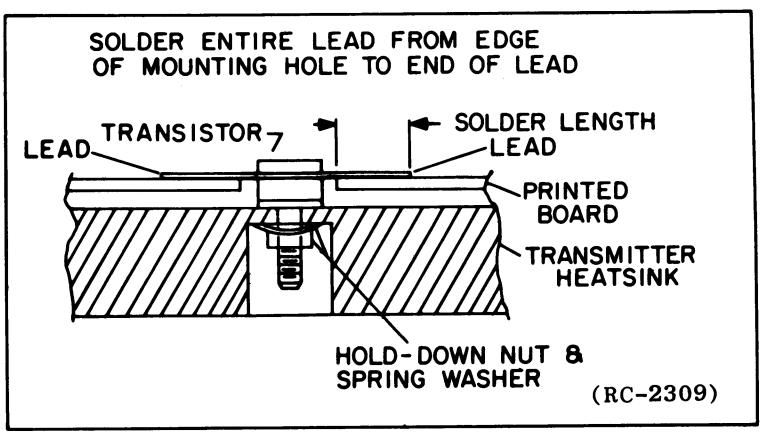


Figure 6 - Lead Forming

7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor.

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R8) 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 (GE Model 4EX6A10)
2. A frequency modulation monitor
3. An output meter of a VTVM
4. GE Test Set Models 4EX3A10 or 4EX8K10

PROCEDURE

1. Connect the audio oscillator and the meter across audio input terminals J5 (Green-Hi) and J6 (Black-Lo) on GE Test Set or across J1 (Mike High) and J2 (Mike Low) on the Exciter Board.
2. Apply a 0.75-volt signal at 1000 Hz to Test Set or across J1 and J2 on Exciter Board.
3. For transmitters without Channel Guard, set the MOD ADJUST (R8) for a 4.5-kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
4. For transmitters with Channel Guard, set the Channel Guard MOD ADJUST (R25) for 0.75 kHz tone deviation. Remove the tone to the transmitter by unplugging leads to J8 and J9 on Exciter Board, or by switching to a non-Channel Guard frequency in multifrequency units. Next, apply a 0.75-volt signal at 1000 Hz and set MOD ADJUST (R8) for a 2.75 kHz deviation (4.5 kHz minus 0.75 kHz tone deviation).
5. For multi-frequency transmitters, set the deviation as described in Steps 3 and 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 supply voltage and PA current, and using the following formula:

P_i = PA voltage x PA current

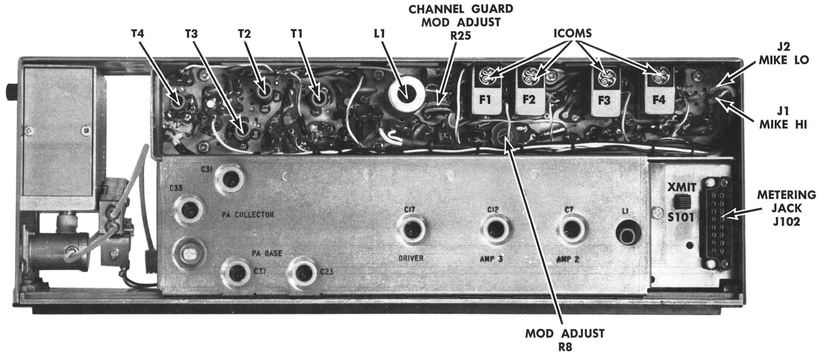
Where:

P_i is the power input in watts,

PA voltage is measured with the GE Test Set in Position G on the 15 volt scale, and the polarity switch in (-) position.

PA current is measured with the Test Set in Position G in the Test 1 position, and with the HIGH SENSITIVITY button pressed (10 amperes full scale).

Example: P_i = 12.5 volts x 5.5 amperes = 68.75 watts



REDUCED BATTERY DRAIN

Most Royal Professional transmitters will deliver more than rated power output. Operating at more than rated output may cause the battery drain to increase beyond the rated value. In installations where it is desirable to operate at rated battery drain while maintaining or exceeding rated power output, make the following adjustments:

1. With the Test Set in Position G, press the HIGH SENSITIVITY button and check the PA current (10 amperes full scale). If the reading exceeds 4.6 amperes, turn C37 clockwise until the meter reads 4.6 amperes.
2. Re-adjust C17, C23, C31 and C33 for maximum power output.
3. Repeat steps 1 and 2 until maximum power output is obtained with 4.6 amperes of PA current.

TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Set Model 4EX3A10 (Revision A or later), or Model 4EX8K11.
2. A 50-ohm wattmeter connected to J103.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place ICOM (s) in proper socket (ICOM frequency = operating frequency ÷ 12). Do not adjust ICOM trimmer.
2. Set the channel selector switch to the F1 position.
3. Turn the slugs in the Exciter coils L1, T1, T2, T3, T4 and PA coil L1 to the bottom of the coil. (In 132—150.8 MHz transmitters, preset the slugs in T1 and T2 to the center of the coil). Next, turn mica compression capacitors C7, C12, C17, C23, C31, C33 and C37 (on PA Board) all the way to the right (clockwise). Then set each capacitor two turns counterclockwise.
4. Connect the GE Test Set to Receiver Metering Jack J442 and check for +10 volts at Position J. If reading is not 10 volts, refer to the Power Regulator Outline Diagram and set R21 for +10 volts.
5. Connect GE Test Set to Metering Jack J102. Set the test polarity to + and set the range to the Test 1 (or 1-volt position for 4EX8K11).
6. All adjustments are made with the transmitter keyed. Unkey the transmitter between steps to avoid unnecessary heating.

TRANSMITTER ALIGNMENT PROCEDURE

STEP	METER POSITION	TUNING CONTROL	METER READING	PROCEDURE
			EXCITER BOARD	
1.	A Mult.-1	L1 & T1	See Procedure	Carefully tune L1 for maximum meter reading. In 150.8—174 MHz transmitters, tune T1 for a small change in meter reading. In 132—150.8 MHz transmitters, tune T1 clockwise for first indication.
2.	B Amp-1	T1 & T2	See Procedure	Tune T1 for maximum meter reading. In 150.8—174 MHz transmitters, tune T2 for a dip in meter reading. In 132—150.8 MHz transmitters, tune T2 clockwise for the 1st dip in meter reading.
3.	C Mult.-2	T3, T2 & T4	See Procedure	Adjust T3 for maximum meter reading. Re-adjust T2 for maximum meter reading. Then adjust T4 for minimum meter reading.
			POWER AMPLIFIER	
4.	D Mult.-3	L1 (PA) & T4	Maximum	Adjust L1 for maximum meter reading. Then re-adjust T4 and L1 for maximum meter reading.
5.	E Amp-2&3	C7	Maximum	Increase the capacity (clockwise) of C7 to the first indication. Then tune this response for maximum meter reading.
6.	E	C12	Maximum	Adjust C12 clockwise for maximum meter reading.
7.	F Driver Ic	C17	Maximum	Adjust C17 for maximum meter reading.
8.	G PA Ic	C23 & C37	5 Amps	With the HIGH SENSITIVITY button on the GE Test Set pressed, turn C23 counterclockwise for maximum meter reading. Do not exceed a meter reading of 5 Amperes (10 Amperes full scale). If necessary, turn C37 clockwise to keep maximum reading of C23 at 5 Amperes.
9.	G	C12 & C17	Maximum	With the HIGH SENSITIVITY Button pressed, adjust C12 and C17 for maximum meter reading.
10.	G	C23 & C37	See Procedure	If the meter reading exceeds 5 Amperes after adjusting C12 and C17, repeat Step 8.
11.	I Rel. Power Output	C31 & C33	See Procedure	Adjust C31 for maximum RF power output (this may be fully clockwise), and then turn C31 slightly counterclockwise from maximum. Next, turn C33 clockwise for maximum meter reading, and then turn C33 slightly clockwise from maximum meter reading. Repeat these adjustments until maximum power output is obtained. NOTE Meter Position "I" indicates relative power output. Either the test meter (in Position "I") or Wattmeter may be used to tune for maximum power output.
12.	G	C23 & C37	4.6 Amps	With the HIGH SENSITIVITY button pressed, check for a meter reading of 5 Amperes. If reading exceeds 5 Amperes, repeat Step 8 to get meter reading as close as possible to 5 Amperes. If the reading is less than 5 Amperes, adjust both C23 and C37 for maximum meter reading.

FREQUENCY ADJUSTMENT

First, check the transmitter frequency to determine if any adjustment is required. The frequency should be checked with a frequency meter of counter having an accuracy of 0.4 part-per-million (PPM), and with the ICOM module at 80°F (±4°F) or 26.5°C (±2°C) when possible. The ICOM temperature can be determined by taping a mercury thermometer to the side of the ICOM.

If an adjustment is required, use one of the following procedures:

If the ICOM is stabilized at 80°F, pry off the GE emblem and adjust the ICOM trimmer for correct transmitter operating frequency.

If the ICOM is not stabilized at 80°F, pry off the GE emblem and check for a color dot on the top of the can. This color dot indicates which correction curve to use in setting the unit on frequency (see Figure 7). Next, tape a thermometer to the ICOM and check the temperature when the thermometer is stabilized. Then proceed as shown in the following example:

1. Assume that the ICOM is marked with a green color dot and the temperature reading is 50°F. At that temperature, the green curve shown a correction factor of approximately +1.5 PPM. (At 132 MHz, 1 PPM is 132 Hz. At 174 MHz, 1 PPM is 174 Hz.)
2. With a transmitter operating frequency of 150 MHz, adjust the ICOM trimmer for a reading of +225 Hz (+1.5 x 150) higher than the licensed operating frequency.
3. If a negative correction factor is obtained (at temperatures above 80°F), adjust the ICOM trimmer for the indicated PPM lower than the operating frequency.

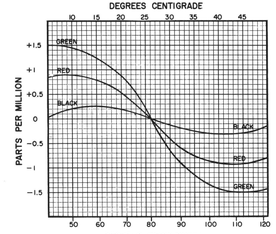


Figure 7 - ICOM Frequency Correction Curve

ALIGNMENT PROCEDURE

132—174 MHZ, 35-WATT TRANSMITTER
MODELS 4ET85A10-21

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:
   - GE Model 4EX6A10 or
   - Heath # 1G-72
4. Deviation Meter (with a .75 kHz scale) similar to:
   - Measurements # 140
   - Lampkin # 205A
5. Multimeter similar to:

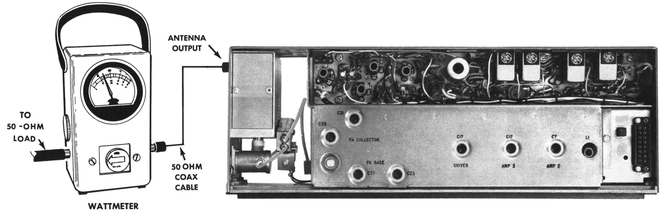
   GE TEST SET MODEL 4EX3A10,
   MODEL 4EX8K11 or
   20,000 ohms-per-volt voltmeter

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 35 watts (132-162 MHz), or 30 watts (162-174 MHz).

SERVICE CHECK

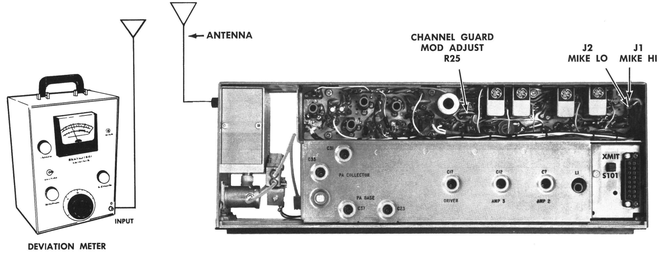
Refer to Service Hints on Transmitter Troubleshooting Procedure.

STEP 2

TONE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

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



2. Unplug the MIC HI terminal from J1 on Transmitter Exciter Board.
3. Key transmitter and check for 0.75-kHz deviation. If reading is low or high, adjust Channel Guard MOD ADJUST (R25) or a reading of 0.75-kHz.

NOTES: --The Channel Guard MOD ADJUST (R25) may be adjusted for deviations up to 1.0 kHz maximum for all tone frequencies.

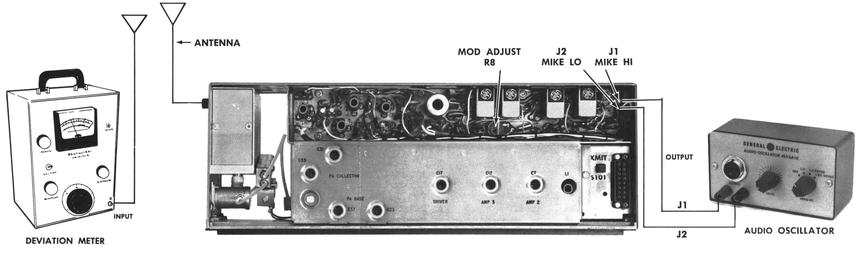
1. On units supplied with Channel Guard, the Phase Modulator Tuning should be peaked carefully to insure proper performance. (Refer to Steps 1 in the Transmitter Alignment Chart).
2. The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

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:

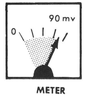


3. Set the generator output to 1.0 VOLTS RMS and frequency to 1 kHz.
4. Key the transmitter and adjust Deviation Meter to carrier frequency.
5. Deviation reading should be ±4.5 kHz.
6. Adjust Modulation Adjust Control R8 until deviation reads 4.5 kHz on plus (+) or minus (-) deviation, whichever is greater. This adjustment should be made with the correct level of tone applied on Channel Guard transmitters.

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

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

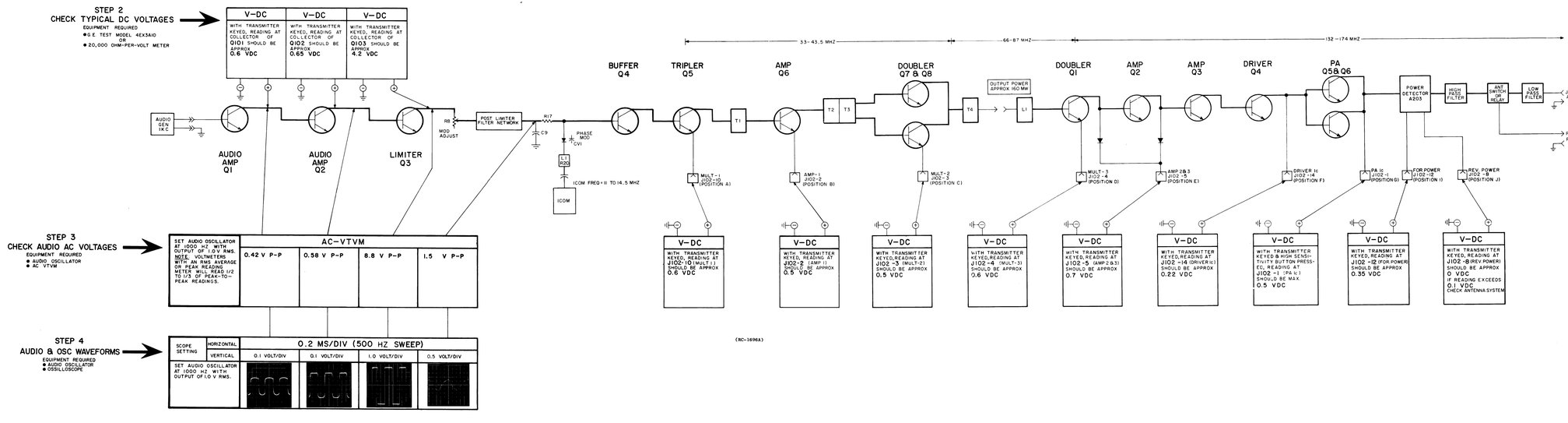
1. Recheck Step 1 as shown in the Transmitter Alignment Chart.
2. Check Audio Sensitivity by reducing generator output until deviation falls to 3.0 kHz. Voltage should be LESS than 100 millivolts.



STEP 1 - QUICK CHECKS

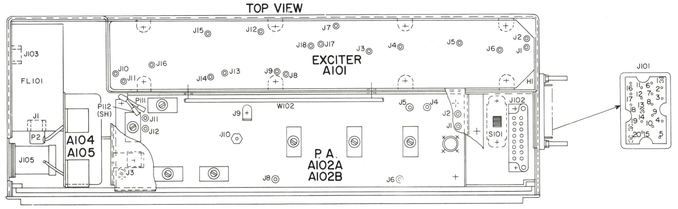
Meter Position	Probable Defective Stage		
	High Meter Reading	Low Meter Reading	Zero Meter Reading
A (MULT-1)	Q4 or Q5	Q4 or open L1	10-volt regulator, ICOM, CV1, or Q4, Q5
B AMP	Q6, T2	Q6, T1	T1, Q6, T2
C (MULT-2)	Q7, Q8, T4	Q7, Q8, T3	Q7, Q8, T3, T4
D (MULT-3)	A102-Q1	Keyed 12.5 volts, T4 A102-Q1	Keyed 12.5 volts, A102-Q1
E (AMP 2/3)	Q4	Q2, Q3, or protective circuits activated*	Keyed 12.5 volts, short circuit protector, A102-Q1
F (DRIVER Ic)	Top Voltage limiter	Q4, or protective circuits activated*	Keyed 12.5 volts, short circuit protector Q4
G (PA Ic)	Mis-aligned PA. Check Alignment Procedure	Q5 or Q6, or protective circuits activated*	Keyed 12.5 volts, short circuit protector, Q5 or Q6
I (Forward Power)	High power output. Check Alignment Procedure	Mis-aligned PA	NO POWER OUTPUT
J (Reflected)	High VSWR- check antenna system and relay	LOW VSWR (Normal)	

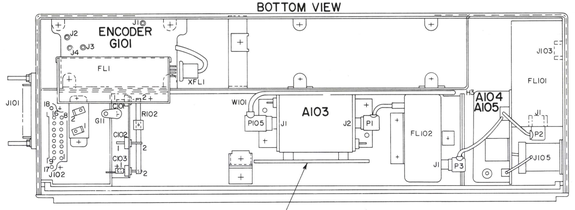
*Refer to the power regulator Troubleshooting Procedure for check of protective circuits.

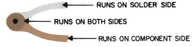


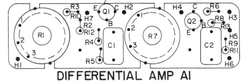
TROUBLESHOOTING PROCEDURE

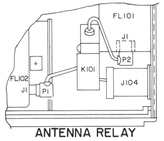
132—174 MHZ, 35-WATT TRANSMITTER
MODELS 4ET85A10-21





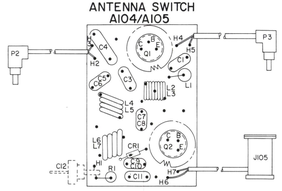






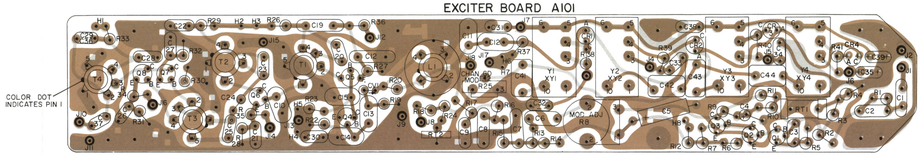
OUTLINE DIAGRAM

132—174 MHZ, 35-WATT TRANSMITTER
MODELS 4ET85A10-21



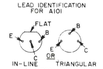
(19B621234, Rev. 5)

MODEL NO.	FREQ RANGE MHZ	NO. OF FREQ	CHAN GUARD	ANT RELAY	ANT SWITCH
4ET85A10	132-150.8	1		X	
4ET85A11	150.8-174	1		X	
4ET85A14	132-150.8	MULTI-F		X	
4ET85A15	150.8-174	MULTI-F		X	
4ET85A16	132-150.8	1	X	X	
4ET85A17	150.8-174	1	X	X	
4ET85A20	132-150.8	MULTI-F	X	X	
4ET85A21	150.8-174	MULTI-F	X	X	
4ET85A30	132-150.8	1			X
4ET85A31	150-8-174	1			X
4ET85A34	132-150.8	MULTI-F			X
4ET85A35	150.8-174	MULTI-F			X
4ET85A36	132-150.8	1	X		X
4ET85A37	150.8-174	1	X		X
4ET85A40	132-150.8	MULTI-F	X		X
4ET85A41	150.8-174	MULTI-F	X		X

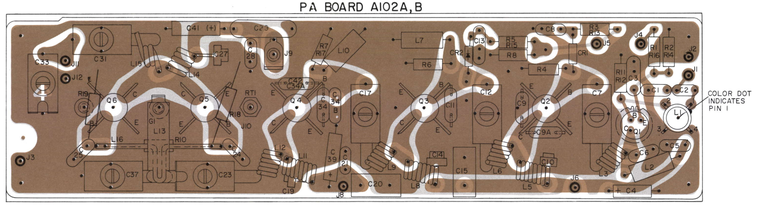


(19D602939, Sh. 1, Rev. 1)
(19D602939, Sh. 2, Rev. 1)

LEAD IDENTIFICATION FOR A101



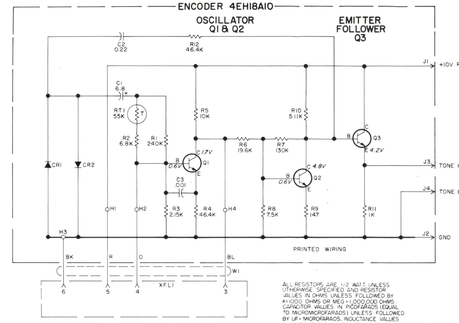
NOTE LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



(19C311397, Sh. 1, Rev. 4)
(19C311397, Sh. 2, Rev. 4)

CHANNEL GUARD ENCODER MODEL 4EH18A10

SCHEMATIC DIAGRAM



ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED. RESISTANCE VALUES IN OHMS OR MEGOHMS FOLLOWED BY K=1000 OHMS OR M=1,000,000 OHMS. CAPACITOR VALUES IN MICROFARADS EQUAL TO MICROMICROFARADS UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS

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

THIS ELEM DIAG APPLIES TO:

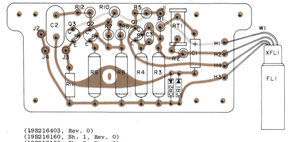
MODEL NO.	REV LETTER
4EH18A10	

VOLTAGE READINGS

READINGS MEASURED FROM TRANSISTOR PIN TO GROUND WITH A 20,000 OHM-PER-VOLT METER.

(19C311817, Rev. 1)

OUTLINE DIAGRAM



(19B216403, Rev. 0)
(19B216160, Sh. 1, Rev. 0)
(19B216160, Sh. 2, Rev. 0)

SCHEMATIC DIAGRAM

132—174 MHZ, 35-WATT TRANSMITTER
MODELS 4ET85A10-21

PARTS LIST

LBI-30190

130-174 MHz TRANSMITTER

MODELS MIRAGE/A10-21 ANTENNA RELAY
MODELS MIRAGE/A10-41 ANTENNA SWITCH

SYMBOL	GE PART NO.	DESCRIPTION
A101		EXCITER BOARD ASSEMBLY 19D402932
		G1 = FREQUENCY HIGH SPLIT G2 = MULTI-FREQUENCY-HIGH SPLIT G3 = FREQUENCY-LOW SPLIT CHANNEL GUARD G4 = MULTI-FREQUENCY-LOW SPLIT G5 = FREQUENCY-HIGH SPLIT CHANNEL GUARD G6 = MULTI-FREQUENCY-HIGH SPLIT CHANNEL GUARD G7 = FREQUENCY-LOW SPLIT CHANNEL GUARD G8 = MULTI-FREQUENCY-LOW SPLIT CHANNEL GUARD
		* * * * * * * * * CAPACITORS * * * * * * * * *
C1	19A116080P1	Polyester: 0.01 µf 10%, 50 VDC.
C2	7481350P111	Ceramic disc: 1500 pf 10%, 500 VDCW; sin to EMC Type J2 Discap.
C3	6944617P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C4	5496328P99	Tantalum: 3.3 µf ±20%, 15 VDCW; sin to Sprague Type 150D.
C5	5496287P10	Tantalum: 22 µf ±20%, 15 VDCW; sin to Sprague Type 150D.
C6	19A116080P5	Polyester: 0.047 µf ±20%, 50 VDC.
C7 thru C9	7481350P111	Ceramic disc: 1500 pf ±10%, 500 VDCW; sin to EMC Type J2.
C10	5493366P49K	Mica: 68 pf ±20%, 100 VDCW; sin to Electro Motive Type DM-15.
C11	5493366P150J	Mica: 150 pf ±5%, 100 VDCW; sin to Electro Motive Type DM-15.
C12	5493366P150K	Mica: 150 pf ±10%, 100 VDCW; sin to Electro Motive Type DM-15.
C13 and C14	7486103P135	Silver mica: 220 pf ±10%, 500 VDCW; sin to Electro Motive Type DM-20.
C15	7486103P117	Silver mica: 39 pf ±10%, 500 VDCW; sin to Electro Motive Type DM-20.
C16*	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap. Added by REV A. Deleted by REV E.
C17 and C18	5494481P129	Ceramic disc: 3900 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C19	5496319P249	Ceramic disc: 27 pf ±5%, 500 VDCW; temp coef -90 PPM.
C21	19A116055P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C22*	7486103P127	Silver mica: 100 pf ±10%, 500 VDCW; sin to Electro Motive Type DM-15.
		In REV A and earlier:
	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C23*	5496319P250	Ceramic disc: 30 pf ±5%, 500 VDCW; temp coef -90 PPM.
		In REV A and earlier:
	5496319P249	Ceramic disc: 27 pf ±5%, 500 VDCW; temp coef -90 PPM.
C24	19A116055P18	Mica: 1000 pf ±5%, 500 VDCW; sin to Electro Motive Type DM-30.
C25	19A116055P19	Phenolic: 0.36 pf 25%, 500 VDCW.
C26	5496319P249	Ceramic disc: 27 pf ±5%, 500 VDCW; temp coef -90 PPM.
C28 thru C29	19A116055P18	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.

SYMBOL	GE PART NO.	DESCRIPTION
C29*	5496319P234	Ceramic disc: 3.0 pf ±0.35 pf, 500 VDCW, temp coef -90 PPM.
		In REV C and earlier:
	5496319P236	Ceramic disc: 5.0 pf ±0.35 pf, 500 VDCW, temp coef -90 PPM.
C30	19A116053P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C31 thru C34	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C35	5496319P230	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -90 PPM.
C37	19A116050P49	Ceramic disc: 6 pf ±5, 500 VDCW, temp coef -80 PPM.
C38	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C39 thru C42	19A116050P47	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -150 PPM.
C43	19A116050P43	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -150 PPM.
C44 thru C46	19A116050P39	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -150 PPM.
C47	19A116050P35	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -150 PPM.
C48	19A116050P31	Ceramic disc: 10 pf ±5%, 500 VDCW, temp coef -150 PPM.
C49	19A116050P27	Ceramic disc: 6.8 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C50	19A116050P25	Ceramic disc: 5.6 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C51	19A116050P23	Ceramic disc: 4.7 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C52	19A116050P21	Ceramic disc: 3.9 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C53	19A116050P19	Ceramic disc: 3.3 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C54	19A116050P17	Ceramic disc: 2.7 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C55	19A116050P15	Ceramic disc: 2.2 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C56	19A116050P13	Ceramic disc: 1.8 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C57	19A116050P11	Ceramic disc: 1.5 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C58	19A116050P9	Ceramic disc: 1.2 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C59	19A116050P7	Ceramic disc: 1.0 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C60	19A116050P5	Ceramic disc: 0.8 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C61 thru C63	19A116050P3	Ceramic disc: 0.5 pf ±0.25 pf, 500 VDCW, temp coef -150 PPM.
C64		Not used.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
CR1 thru CR4	5082-2800	Silicon.
CR5	4036-5300	Varactor, silicon: 33 pf ±10% at 4 VDC; sin to Pacific Semiconductor Variap Type V-536.
		* * * * * * * * * JACKS AND RECEPTACLES * * * * * * * * *
J1 thru J18	4033513P4	Contact, electrical: sin to Bead Chain LS3-3.
		* * * * * * * * * INDUCTORS * * * * * * * * *
L1	19D403909G20	Coil. Includes tuning slug 540179HP2.
		* * * * * * * * * TRANSISTORS * * * * * * * * *
Q1 thru Q3	19A115488P1	Silicon, NPN.
		* * * * * * * * * TRANSFORMERS * * * * * * * * *
Q4	19A115330P1	Silicon, NPN.
Q5 and Q6*	19A115328P1	Silicon, NPN.
Q7* and Q8*	19A116012P1	Silicon, NPN.
		In REV B and earlier:
	19A116050P1	Silicon, NPN.
		* * * * * * * * * RESISTORS * * * * * * * * *
R1	3R7P2042	Composition: 0.30 megohm ±5%, 1/2 w.
R2	3R7P0563X	Composition: 5600 ohms ±10%, 1/2 w.
R3 and R4	3R7P1053J	Composition: 10,000 ohms ±5%, 1/2 w.
R5	3R7P0473X	Composition: 47,000 ohms ±10%, 1/2 w.
R6	3R7P0563X	Composition: 5600 ohms ±10%, 1/2 w.
R7	3R7P0933X	Composition: 39,000 ohms ±10%, 1/2 w.
R8	19B800331M99	Variable, carbon film: approx 75 to 10,000 ohms ±20%, 0.5 w; sin to CTS Type X-201.
R9 and R10	3R7P0473J	Composition: 47,000 ohms ±5%, 1/2 w.
R11	3R7P0563J	Composition: 5.6 megohm ±5%, 1/2 w.
R12	3R7P0470X	Composition: 47 ohms ±10%, 1/2 w.
R13	3R7P0623J	Composition: 62,000 ohms ±5%, 1/2 w.
R14	3R7P0513J	Composition: 51,000 ohms ±5%, 1/2 w.
R15	3R7P0393J	Composition: 39,000 ohms ±5%, 1/2 w.
R16	3R7P0473J	Composition: 47,000 ohms ±5%, 1/2 w.
R17	3R7P0563X	Composition: 56,000 ohms ±10%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
R18	3R7P0943J	Composition: 2400 ohms ±5%, 1/2 w.
R19	3R7P0103X	Composition: 10,000 ohms ±10%, 1/2 w.
R20	3R7P0323X	Composition: 32,000 ohms ±10%, 1/2 w.
R22	3R7P0333X	Composition: 33,000 ohms ±10%, 1/2 w.
R23	3R7P1513X	Composition: 1500 ohms ±10%, 1/2 w.
R24	3R7P0513J	Composition: 5100 ohms ±5%, 1/2 w.
R25	19B800350P107	Variable, carbon film: approx 75 to 25,000 ohms ±10%, 0.25 w; sin to CTS Type X-301.
R26	3R7P0990X	Composition: 99 ohms ±10%, 1/2 w.
R27	3R7P0012J	Composition: 200 ohms ±5%, 1/2 w.
R28	3R7P0101X	Composition: 100 ohms ±10%, 1/2 w.
R29	3R7P0220X	Composition: 22 ohms ±10%, 1/2 w.
R30	3R7P0100X	Composition: 10 ohms ±10%, 1/2 w.
R31 thru R33	3R7P0560X	Composition: 56 ohms ±10%, 1/2 w.
R34	3R7P0473X	Composition: 47,000 ohms ±10%, 1/2 w.
R35*	3R7P0273X	Composition: 27,000 ohms ±10%, 1/2 w.
		In REV A and earlier:
	3R7P0473X	Composition: 47,000 ohms ±10%, 1/2 w.
R36	3R7P0933X	Composition: 93,000 ohms ±10%, 1/2 w.
R37	3R7P0153X	Composition: 15,000 ohms ±10%, 1/2 w.
R38 thru R41	3R7P0273X	Composition: 2700 ohms ±10%, 1/2 w.
R71	5496328P40	Thermistor: 10,000 ohms ±10%, color code red/white; sin to Gilbar Type TED-8.
R72	19C300064P8	Disc: 3500 ohms ±10%; sin to GE 4D.
T1	19D403909G23	Coil. Includes tuning slug 540179HP2.
T2	19D403909G21	Coil. Includes tuning slug 540179HP2.
T3	19D403909G23	Coil. Includes tuning slug 540179HP2.
T4	19D403909G24	Coil. Includes tuning slug 540179HP2.
		* * * * * * * * * OSCILLATOR * * * * * * * * *
Y1 thru Y4	4E02SA11	When recording, specify ICOM Frequency, ICOM Frequency + operating frequency + 12, or Integrated Circuit Oscillator Module (ICOM).
	19D419070P1	Cap, decorative.
		* * * * * * * * * SOCKETS * * * * * * * * *
XY1 thru XY4	19B216043G1	Socket.
A103		POWER AMPLIFIER 19D419070G1 150-174 MHz A103B1 19D419069G32 (Part of 19D419316G1)
A103A		
A103B		
C1	19A116050P421	Ceramic disc: 36 pf ±5, 500 VDCW, temp coef -150 PPM.
C2	19A116050P81	Ceramic disc: 9.0 pf ±10%, 500 VDCW, temp coef -150 PPM.
C3	7488103P135	Silver mica: 220 pf ±10%, 500 VDCW; sin to Electro Motive Type DM-20.
C4	5496287P14	Tantalum: 15 µf ±20%, 20 VDCW; sin to Sprague Type 150D.
C5	19A116053P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.

SYMBOL	GE PART NO.	DESCRIPTION
C6	19A116050P47K1	Ceramic disc: 47 pf ±10%, 500 VDCW, temp coef -150 PPM.
C7	19A050400P102	Feedthru: 4 to 35 pf, 400 VDCW.
C8	19A116053P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C9 thru C11	19A116053P681	Ceramic disc: 39 pf ±10%, 500 VDCW, temp coef -150 PPM.
C12 thru C14	5493393P107	Ceramic, stand off: 1000 pf +100% -0%, 500 VDCW; sin to Allen-Bradley Type SSSD.
		In 19D415192G5 chassis thru REV J. In 19D415192G506 or REV K and later:
	7484398P4	Silver mica: 500 pf ±10%, 500 VDCW; sin to Underwood Type J-1-GP.
C15	19A116080P9	Polyester: 0.22 µf ±20%, 50 VDC.
C17	19B209469P163	Variable, mica: 7 to 50 pf, 400 VDCW.
C19*	5493393P107	Ceramic, stand off: 1000 pf +100% -0%, 500 VDCW; sin to Allen-Bradley Type SSSD.
		In 19D415192G5 chassis thru REV J. In 19D415192G506 or REV K and later:
	7484398P4	Silver mica: 500 pf ±10%, 500 VDCW; sin to Underwood Type J-1-GP.
C20	19A116080P49	Polyester: 0.22 µf ±20%, 50 VDC.
C21	19A116055P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C23*	19B209469P304	Variable, mica: 16 to 90 pf, 400 VDCW.
		In 19D415192G5 of REV A and earlier; In 19D415192G506 of REV B and earlier:
	19B209469P303	Variable, mica: 7 to 50 pf, 400 VDCW.
C24 and C25	19A116050P502	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -150 PPM.
C27*	5493393P107	Ceramic, stand off: 1000 pf +100% -0%, 500 VDCW; sin to Allen-Bradley Type SSSD.
		In 19D415192G5 earlier than REV A; In 19D415192G506 of REV A and earlier:
	7484398P4	Silver mica: 500 pf ±10%, 500 VDCW; sin to Underwood Type J-1-GP.
C28	19A116055P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sin to EMC Type JF Discap.
C29	19A116050P10	Polyester: 0.33 µf ±20%, 50 VDC.
C31	19B209469P105	Variable, mica: 34 to 110 pf, 400 VDCW.
C33	19B209469P90	Variable, mica: 37 to 140 pf, 400 VDCW.
C34 and C34A	19A116050P47K2	Ceramic disc: 47 pf ±10%, 500 VDCW, temp coef -150 PPM.
C34B	19A116050P47K3	Ceramic disc: 47 pf ±10%, 500 VDCW, temp coef -150 PPM. Added to 19D419069G32 by REV A.
C35	19A116050P103	Variable, mica: 7 to 50 pf, 400 VDCW.
C36	5496287P14	Tantalum: 15 µf ±20%, 20 VDCW; sin to Sprague Type 150D.
C41	5496287P14	Tantalum: 15 µf ±20%, 20 VDCW; sin to Sprague Type 150D.
C42	19A116050P483K1	Ceramic disc: 83 pf ±10%, 500 VDCW, temp coef -150 PPM.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
CR1 and CR2	19A115230P51	Silicon.

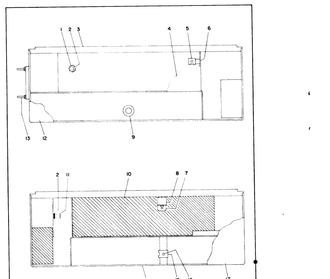
SYMBOL	GE PART NO.	DESCRIPTION
J1 thru J4	4033513P4	* * * * * * * * * JACKS AND RECEPTACLES * * * * * * * * * Contact, electrical: sin to Bead Chain LS3-3.
J5	4033513P4	Contact, electrical: sin to Bead Chain LS3-3.
J9	4033384P2	Contact, electrical: sin to Alco 3-1315.
J10		(Part of MT1).
J11 and J12	4033513P4	Contact, electrical: sin to Bead Chain LS3-3.
L1	19D403909G21	* * * * * * * * * INDUCTORS * * * * * * * * * Coil. Includes tuning slug 540179HP2.
L2	7488079P33	Choke, RF: 1 µh ±10%, 0.18 ohms DC res max; sin to Jeffers 4413-2K.
L3	19B216375P1	Coil.
L5	19B216375P2	Coil.
L6	19B216375P1	Coil.
L7	7488079P8	Choke, RF: 3.30 µh ±10%, 1.00 ohms DC res max; sin to Jeffers 4421-12K.
L8	19B216375P3	Coil.
L9	19B216375P1	Coil.
L10	7488079P43	Choke, RF: 10.0 µh ±10%, 0.30 ohms DC res max; sin to Jeffers 4433-6K.
L11	19B216375P3	Coil.
L12	19B216375P1	Coil.
L13	7488079P61	Choke, RF: 10 µh ±10%, 3 ohms DC res max; sin to Jeffers 4414-12K.
L14	19B216375P3	Coil.
L15	19B216375P4	Coil.
L16	19A128364P1	Coil.
Q1	19A116016P1	* * * * * * * * * TRANSISTORS * * * * * * * * * Silicon, NPN.
Q2	19A116029P1	Silicon, NPN.
Q3	19A116028P1	Silicon, NPN.
Q4	19A116028P4	Silicon, NPN.
Q5 and Q6	19A116028P5	Silicon, NPN.
CR1 and CR2	19A115230P51	* * * * * * * * * RECTIFIERS * * * * * * * * * Silicon.
J1 and J2	7104841P16	* * * * * * * * * JACKS AND RECEPTACLES * * * * * * * * * Jack, phono type: coaxial.
K1	3E77P01J	* * * * * * * * * RELAYS * * * * * * * * * Composition: 91 ohms ±5%, 1/2 w.
A104 and A106		ANTENNA SWITCH 19C317078G1 150-174 MHz 19C317078G2 130-150 MHz (Part of 19D419316G1)
		* * * * * * * * * CAPACITORS * * * * * * * * *
C1	19C301466P233	Ceramic disc: 0.01 pf ±5%, 2KV VDCW; temp coef -80 PPM.
C2	5494481P113	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sin to EMC Type JF Discap.
C4	19A116050P23	Ceramic disc: 2700 pf ±10%, 1000 VDCW; sin to EMC Type JF Discap.
C5	19C300468P213	Ceramic disc: 13 pf ±5%, 500 VDCW; temp coef -80 PPM.
C6	19C300468P214	Ceramic disc: 15 pf ±5%, 500 VDCW; temp coef -80 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
MT1	19A123944G1	* * * * * * * * * THERMISTORS * * * * * * * * * Thermistor assembly: included (2)0) 4033513P14 electrical contact.
A103		POWER DETECTOR 19D419069G1 (Part of 19D419316G1)
A1		CONNECTOR BOARD 19D416049G1
		* * * * * * * * * CAPACITORS * * * * * * * * *
C1 thru C3	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
		* * * * * * * * * TRANSISTORS * * * * * * * * *
Q1 thru Q3	19A115133P1	Silicon, NPN; sim to Type 2N3713.
		* * * * * * * * * RESISTORS * * * * * * * * *
R1	19A115481P2	Variable, wirewound: 5000 ohms ±20%, 3 w; sin to CTS Series 113.
R2	3R315P153J	Composition: 1300 ohms ±5%, 1/4 w.
R3	3R315P151J	Composition: 150 ohms ±5%, 1/4 w.
R4	3R315P302J	Composition: 3000 ohms ±5%, 1/4 w.
R5	3R315P221J	Composition: 220 ohms ±5%, 1/4 w.
R6	3R315P221K	Composition: 220 ohms ±10%, 1/4 w.
R7	19A115481P3	Variable, wirewound: 5000 ohms ±20%, 3 w; sin to CTS Series 115.
R8	3R315P152J	Composition: 1500 ohms ±5%, 1/4 w.
R9	3R315P151J	Composition: 150 ohms ±5%, 1/4 w.
		* * * * * * * * * CAPACITORS * * * * * * * * *
C1	5493392P107	Ceramic, feed-thru: 1000 pf +100%-0%, 500 VDCW; sin to Allen Bradley Type FASC.
C2	5496319P41	Ceramic disc: 10 pf ±5%, 500 VDCW, temp coef 0 PPM.
C3	5496319P41	Ceramic disc: 10 pf ±5%, 500 VDCW, temp coef 0 PPM.
C4	5493393P7	Ceramic, feed-thru: 1000 pf +100%-0%, 500 VDCW; sin to Allen Bradley Type FASC.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
P2 and P3	5491686P64	RF, 50 ohms: Includes 12 inch cable (19B209044P18).
		* * * * * * * * * TRANSISTORS * * * * * * * * *
Q1* and Q2*	19A116179P1	Silicon, NPN. Deleted in 19D413140G3 by REV C.
Q3* and Q4*	19A116179P2	Silicon, NPN. Added to 19D413140G3 by REV C.
		* * * * * * * * * RESISTORS * * * * * * * * *
R1	3R77P483K	Composition: 6800 ohms ±10%, 1/2 w.
		CHASSIS AND PA ASSEMBLY 19D413140G2 150-156.9 MHz REV A 19D413140G3 157-162 MHz REV B 19D413140G4 150.8-174 MHz REV C
		* * * * * * * * * CAPACITORS * * * * * * * * *
C101 thru C103	5493392P7	Ceramic, feed-thru: 1000 pf +100%-0%, 500 VDCW; sin to Allen Bradley Type FASC.
C105	5496367P14	Tantalum: 15 µf ±20%, 20 VDCW; sin to Sprague Type 150D.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
CR101	4037E23P5	Silicon.
		* * * * * * * * * FILTERS * * * * * * * * *
FL101	19D419077G1	Filter.
FL102	19B216336G1	Filter.

SYMBOL	GE PART NO.	DESCRIPTION
C7	19C300465P316	Ceramic disc: 16 pf ±5%, 500 VDCW; temp coef -150 PPM.
C8	19C300465P319	Ceramic disc: 20 pf ±5%, 500 VDCW; temp coef -150 PPM.
C9	19C300465P312	Ceramic disc: 13 pf ±5%, 500 VDCW; temp coef -80 PPM.
C10	19C300465P314	Ceramic disc: 15 pf ±5%, 500 VDCW; temp coef -80 PPM.
C11	5494481P113	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sin to EMC Type JF Discap.
C13	5493393P10	Ceramic, feed-thru: 470 pf ±20%, 500 VDCW; sin to Allen Bradley Type FASC.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
CR1	19A115230P1	Silicon.
		* * * * * * * * * INDUCTORS * * * * * * * * *
L1	7488079P10	Coil, RF: 3.30 µh ±10%, 0.13 ohms DC res max; sin to Jeffers 4431-1K.
L2*	19B216005P2	Coil.
		In REV B and earlier:
	19B216005P14	Coil.
L3	19B216005P13	Coil.
L4	19B216005P8	Coil.
L5	19B216005P7	Coil.
L6	19B216005P6	Coil.
L7	19B216005P1	Coil.
		* * * * * * * * * JACKS AND RECEPTACLES * * * * * * * * *
J105	19B216415G1	Connector. Includes the following:
	7104841P6	Jack, phono: Micro-fitted phenolic or ceramic, 300 VRMS max operating; sim to Cinch 16E1305K.
	19A131436P1	Cap.
	19A117228P1	Hood.
		* * * * * * * * * PLUGS * * * * * * * * *
P1	19A116080P1	RF, 50 ohms: Female BNC; specify case, mounting .50 sqg at 12 VDC; sim to Snaksplce Type SS-12.
		* * * * * * * * * TRANSISTORS * * * * * * * * *
Q1* and Q2*	19A116179P1	Silicon, NPN. Deleted in 19D413140G3 by REV C.
Q3* and Q4*	19A116179P2	Silicon, NPN. Added to 19D413140G3 by REV C.
		* * * * * * * * * RESISTORS * * * * * * * * *
R1	3R77P483K	Composition: 6800 ohms ±10%, 1/2 w.
		CHASSIS AND PA ASSEMBLY 19D413140G2 150-156.9 MHz REV A 19D413140G3 157-162 MHz REV B 19D413140G4 150.8-174 MHz REV C
		* * * * * * * * * CAPACITORS * * * * * * * * *
C101 thru C103	5493392P7	Ceramic, feed-thru: 1000 pf +100%-0%, 500 VDCW; sin to Allen Bradley Type FASC.
C105	5496367P14	Tantalum: 15 µf ±20%, 20 VDCW; sin to Sprague Type 150D.
		* * * * * * * * * DIODES AND RECTIFIERS * * * * * * * * *
CR101	4037E23P5	Silicon.
		* * * * * * * * * FILTERS * * * * * * * * *
FL101	19D419077G1	Filter.
FL102	19B216336G1	Filter.

SYMBOL	GE PART NO.	DESCRIPTION
		* * * * * * * * * JACKS AND RECEPTACLES * * * * * * * * *
J101	19C303439G1	Connector: 20 pin contacts.
J102	19B209548G1	Connector: 19 pin contacts.
J104		(Part of E101).
		* * * * * * * * * RELAYS * * * * * * * * *
K101	19B203631G1	Relay assembly. Includes P1, P2 and J104.
		* * * * * * * * * PLUGS * * * * * * * * *
P105		(Part of W101).
P106	4028946P1	Contact, electrical: sin to AMP 41854.
P108	4028946P1	Contact, electrical: sin to AMP 41854.
P109	19B209315P1	Terminal, solderless.
P110	4028946P6	Contact, electrical: sin to AMP 13060-0.
P111 and P113		(Part of W101).
P112		Bracket, flathead: No. 8 x 1/2. (Secures bottom cover).
P113 thru P115		(Part of W102).
P116	19C303439G5	Mobile bottom cover.
	19C303439G7	Station bottom cover.

SYMBOL	GE PART NO.	DESCRIPTION
P119 and P121	4028946P2	Contact, electrical: sin to Amp 42827-2.
P122	4028946P1	Contact, electrical: sin to AMP 41854.
P123 and P124	4028946P2	Contact, electrical: sin to Amp 42827-2.
P125	4028946P1	Contact, electrical: sin to AMP 41854.
P126 and P127	4028946P2	Contact, electrical: sin to Amp 42827-2.
P128 thru P130		(Part of W102).
P131	4028946P1	Contact, electrical: sin to AMP 41854.
P132 and P133	4028946P2	Contact, electrical: sin to Amp 42827-2.
P134 thru P136		(Part of W103).
		* * * * * * * * * RECEPTACLES * * * * * * * * *
XP101	19A115077P1	Socket.
		* * * * * * * * * PLUGS * * * * * * * * *
P102	19A115077P2	Screwmount: 0.1 ohm ±5, 3 w; sim to IRC Type BWH.
P103	4031932P3	Push: SPST, normally open, momentary contact .50 amp at 12 VDC; sim to Snaksplce Type SS-12.
		* * * * * * * * * CABLES * * * * * * * * *
W101		CABLE ASSEMBLY 19A116040G2
		* * * * * * * * * PLUGS * * * * * * * * *
	P105 5491686P56	RF Cable assembly: approx 12 inches long with plug welded on one end.
	P111 4028946P2	Contact, electrical: sin to Amp 42827-2.
	P112 4028946P1	Contact, electrical: sin to AMP 41854.
W102		CABLE ASSEMBLY 19B216429G1
		* * * * * * * * * PLUGS * * * * * * * * *
	P113 4028946P2	Contact, electrical: sin to Amp 42827-2.
	P114 4028946P1	Contact, electrical: sin to AMP 41854.
	P115 4028946P2	Contact, electrical: sin to Amp 42827-2.
	P116 4028946P1	Contact, electrical: sin to AMP 41854.
		MECHANICAL PARTS (REF. MC-7098)
1	403543P91	Heat sink. (Used with Q1 on A103A, 102B).
2	4036555P1	Insulator, disc: nylon. (Used with Q1 on A103A, 4103B; Q1 and Q2 on A104, A105).
3	19C311781P1	Heat sink.



PRODUCTION CHANGES

Changes to the equipment to improve performance or to simplify circuits are identified by a change letter or number assigned 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 - Exciter Board A101 (19D402932G1 thru G8)
To improve spurious rejection. Added C16.

REV. B - Exciter Board A101 (19D402932G1 thru G8)
To improve spurious rejection. Changed C32, C33, R35 and tap on T2. Deleted C16.

REV. C - Exciter Board A101 (19D402932G1 thru G8)
To incorporate different transistors. Changed Q7 and Q8.

REV. A - Chassis and PA Assembly (19D413140G1)
To improve stability in 132-150.8 MHz PA boards (A102). Added R18 and R19.

Chassis and PA Assembly (19D413140G4)

REV. A - To improve impedance matching. Added C34B.

REV. A - Chassis and PA Assembly (19D413140G3)

REV. B - Chassis and PA Assembly (19D413140G4)
To incorporate different capacitors. Changed C10, C16, C39 and C57.

REV. B - Chassis and PA Assembly (19D413140G3)
To incorporate different transistors. Changed Q3, C32, R35 and tap on T2. Deleted C16.

REV. C - Antenna Switch 19C317078G2
To incorporate different transistors. Changed Q1, Q2 and L2.

REV. D - Exciter Board A101 (19D402932G101, 2, 3, 4) to improve tuning. Changed C57.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

LBI-3938C

CHANNEL GUARD ENCODER
MODEL 4EH18A10
19B216161G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C2	19B209243P15	Polyester: 0.22 µf ±20%, 250 VDCW.
C3	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR1 and CR2	5494922P1	Silicon.
		- - - - - - - - - - TONE NETWORKS - - - - - - - - - -
FL1	19B205280	Tone Detector. (Check group numbers for desired frequency).
	G1	71.9 Hz
	G2	77.0 Hz
	G3	82.5 Hz
	G4	88.5 Hz
	G5	94.8 Hz
	G6	100.0 Hz
	G7	103.5 Hz
	G8	107.2 Hz
	G9	110.9 Hz
	G10	114.8 Hz
	G11	118.8 Hz
	G12	123.0 Hz
	G13	127.3 Hz
	G14	131.8 Hz
	G15	136.5 Hz
	G16	141.3 Hz
	G17	146.2 Hz
	G18	151.4 Hz
	G19	156.7 Hz
	G20	162.2 Hz
	G21	167.9 Hz
	G22	173.8 Hz
	G23	179.9 Hz
	G24	186.2 Hz
	G25	192.8 Hz
	G26	203.5 Hz
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J1 thru J4	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1 thru Q3	19A115362P1	Silicon, NPN; sim to Type 2N2925.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77P244J	Composition: .24 megohm ±5%, 1/2 w.
R2	3R77P682J	Composition: 6800 ohms ±5%, 1/2 w.
R3	19A116278P233	Metal film: 2150 ohms ±2%, 1/2 w.
R4	19A116278P65	Metal film: 46.4 ohms ±2%, 1/2 w.
R5	19A116278P301	Metal film: 10,000 ohms ±2%, 1/2 w.
R6	19A116278P329	Metal film: 19,600 ohms ±2%, 1/2 w.
R7	19A116278P412	Metal film: 0.13 megohm ±2%, 1/2 w.
R8	19A116278P285	Metal film: 7500 ohms ±2%, 1/2 w.
R9	19A116278P117	Metal film: 147 ohms ±2%, 1/2 w.
R10	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R11	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R12	19A116278P365	Metal film: 46,400 ohms ±2%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - THERMISTORS - - - - - - - -
RT1	5490828P36	Thermistor: 55,000 ohms ±10%, color code black/red; sim to Globar Type 723-B.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	19A121920G3	Cable assembly. Includes socket (XFL1), approx 4.25 inches long.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XFL1		(Part of W1).
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B216186G1	Cable assembly. (Connects to J1 thru J4).
	4029840P2	Contact, electrical: sim to Amp 42827-2. (Connects to J1, J3, J4).
	4029840P1	Contact, electrical: sim to AMP 41854. (Connects to J2).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES