MOBILE RADIO

RANGR 16 PLUS™

SYNTHESIZED MOBILE COMMUNICATIONS

MAINTENANCE MANUAL

LBI-31725

INCLUDES

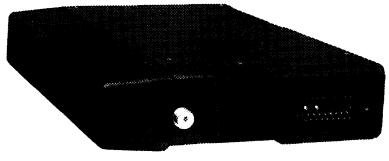
SERVICE SECTION LBI-31829

BOARD ASSEMBLIES LBI-31828

800 MHz

TWO-WAY FM

MOBILE RADIO



10/35 WATT

MOBILE RADIO

GENERAL ELECTRIC

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ILLUSTRATIONS

FCC FILING NUMBER AXA9HHTR-153-A2 10W
AXA9HHTR-154-A2 35W

WARNING

Although the highest DC voltage in Mobile Two-Way Radio equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

SYSTEM SPECIFICATIONS

FREQUENCY RANGE	806-825 MHz and 851-870 MHz for Tx 851-870 MHz for RX
BATTERY DRAIN (Maximum)	
Receive	
Squelched	1.0 Amperes at 13.6 Volts
Unsquelched	2.5 Amperes at 13.6 Volts
Transmit	
35 Watts	15 Amperes at 13.6 Volts
10 Watts	9 Amperes at 13.6 Volts
FREQUENCY STABILITY	0.0002%
TEMPERATURE RANGE	-30°C (-22°F) to +60°C (140°F)
DUTY CYCLE	100% Receive, 20% Transmit (EIA)
DIMENSION, LESS ACCESSORIES (H × W × D)	67 mm × 240 mm × 339 mm (2.6 × 9.5 × 13.5 inches)
WEIGHT, LESS ACCESSORIES	4.3 kg (9.5 pounds)

TRANSMITTER

CONDUCTED SPURIOUS	-70 dB
MODULATION	±4.5 kHz
AUDIO SENSITIVITY	55 to 110 millivolts
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -4.5 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 2% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.3 kHz maximum
MAXIMUM FREQUENCY SEPARATION	64 MHz
MICROPHONE LOAD IMPEDANCE	600 ohms
POWER ADJUST RANGE	100% to 50% of rated power
RF OUTPUT IMPEDANCE	50 ohms
FM NOISE	-45 dB
CARRIER ATTACK TIME	20 milliseconds
AUDIO ATTACK TIME	20 milliseconds
CHANNEL GUARD TX TONE DISTORTION	<5%

RECEIVER

AUDIO OUTPUT (to 4.0 ohm speaker)	10 Watts with less than 3% distortion
SENSITIVITY 12 dB SINAD (EIA Method)	0.35 μV
SELECTIVITY EIA Two-Signal Method (25 kHz channel spacing)	-75 dB
SPURIOUS RESPONSE	-75 dB
INTERMODULATION	-75 dB
MODULATION ACCEPTANCE	±7.0 kHz
MAXIMUM FREQUENCY SEPARATION	19 MHz
FREQUENCY RESPONSE	Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
RF INPUT IMPEDANCE	50 ohms
HUM/NOISE RATIO UNSQUELCHED SQUELCHED	 -45 dB -65 dB
RECEIVER RECOVERY TIME	200 milliseconds
RECEIVER ATTACK TIME	150 milliseconds
CHANNEL SPACING	25 kHz

* These specifications are intended primarily for use during service. Refer to the appropriate Specifications Sheet for the complete specifications.

PRODUCTION CHANGES

Changes to equipment that improves performance or simplifies circuits are identified by a Revision Letter which is stamped on the model number label. The revision stamped on the label includes all previous revisions. Refer to the parts list for a description of parts affected by these revisions.

Rev. A -19C851571P1, P2, P3, P4

A 10 pf capacitor (19A700219P26) was added from TR501-B (on Receiver Board) to ground. This change prevents receiver 1st IF (82.2 MHz) parasitic oscillations.

Rev. B - 19C851571P1, P2, P3, P4

Software was changed to 19A149268G7 (version 5.2) and a 100K resistor (B19/5RDAA01162) was added from IC617-57 to +5V analog on the System Control Board. This change corrected squelch and timig problems.

Rev. C - 19C851571P1, P2, P3, P4

A 5 pF capacitor (B19/5CAAD00800) and a 7 pF capacitor (B19/5CAAD00977) were added in seies from TR501-B to ground on the Receiver Board. The change prevents receiver 1st IF (82.2 MHz) parasitic oscillations (supersedes Rev. A change).

Rev. D - 19C851571P1, P2,

The folowing capacitors were changed or added on th 35 watt TX PA to improve operating efficiency at 806 MHz:

Changed:

C24 changed to B19/5CAAH00022
C25 changed to B19/5CAAH00022
C34 changed to B19/5CAAH00022
C35 changed to B19/5CAAH00022

Added:

C95 part number B19/5CMAB00987
C96 part number B19/5CMAB00987
CV1 part number B19/5CVAC00070
CV2 part number B19/5CVAC00070

Rev. E - 19C851571P1, P2

Rev. D - 19C851571P3, P4

Changed IC605 software to 19A149268G8 to incorporate 14-bit ID.

Rev. F - 19C851571P1, P2

Rev. E - 19C851571P3, P4

Added jumper to system Board to allow CPU clock frequency to be shifted.

Rev. F - 19C851571P3, P4

Rev. G - 19C851571P1, P2

To make compatible with the S700 Control Unit, the Front Mount Digital Radio, and to improve operation. Changed IC605 from 19A149268G8 (27256 PROM) to 19A149268G9 (27C512 PROM). Also, cut the printed wire going to IC605-1 and then added a jumper wire between IC605-1 and IC601-28 on the solder side of the printed wire board.

PROCEDURE

1. Remove radio top cover.

2. Remove radio System Board.

3. Cut run on solder side of printed wire board at IC605-1.

4. On the solder side of the printed wire board, solder a jumper wire between IC605-1 and IC601-28.

5. Remove IC605 (old PROM 19A149268G8) and reprogram with new 19A149268G9 software and replace IC605 in socket.

6. Mark new revision letter on radio frame beside combination nomenclature.

   REV.G -19C851571P1
   REV.F -19C851571P3

DESCRIPTION

General Electric synthesized RANGR 16 PLUS™ mobile radio combinations are completely solid state utilizing microcomputer technology and integrated circuits to provide high-quality, high-reliability radios.
The mobile radio is equipped with:

- Microcomputer Controlled Frequency Synthesizer
- 2 ppm frequency stability
- 9600 baud generator/detector
- Custom audio chip
- Serial control head Interface

Optional radio locks are available, however, the radio is not tamperproof.

The cover can be removed in the locked or unlocked position.

The radio set is housed in a weather-resistant case only 6.7 centimeters high. The radio is secured to the vehicle by a bottom mounting plate. When unlocked, the radio may be pulled out of the mounting plate or the top cover removed for servicing.

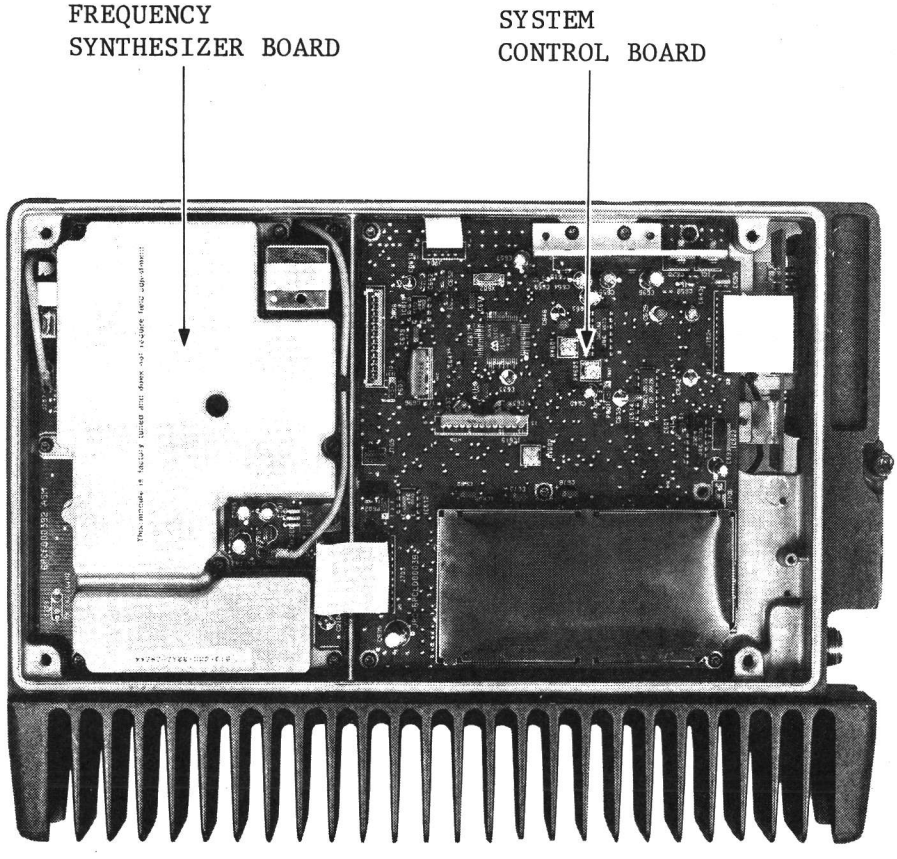
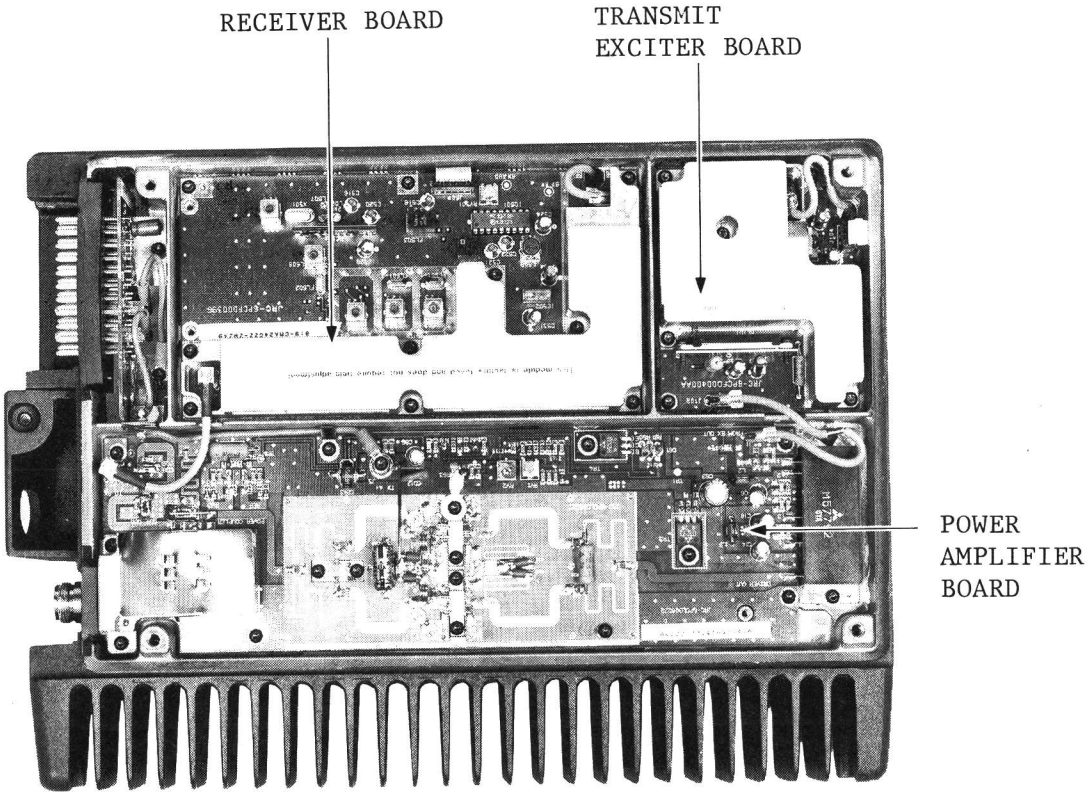
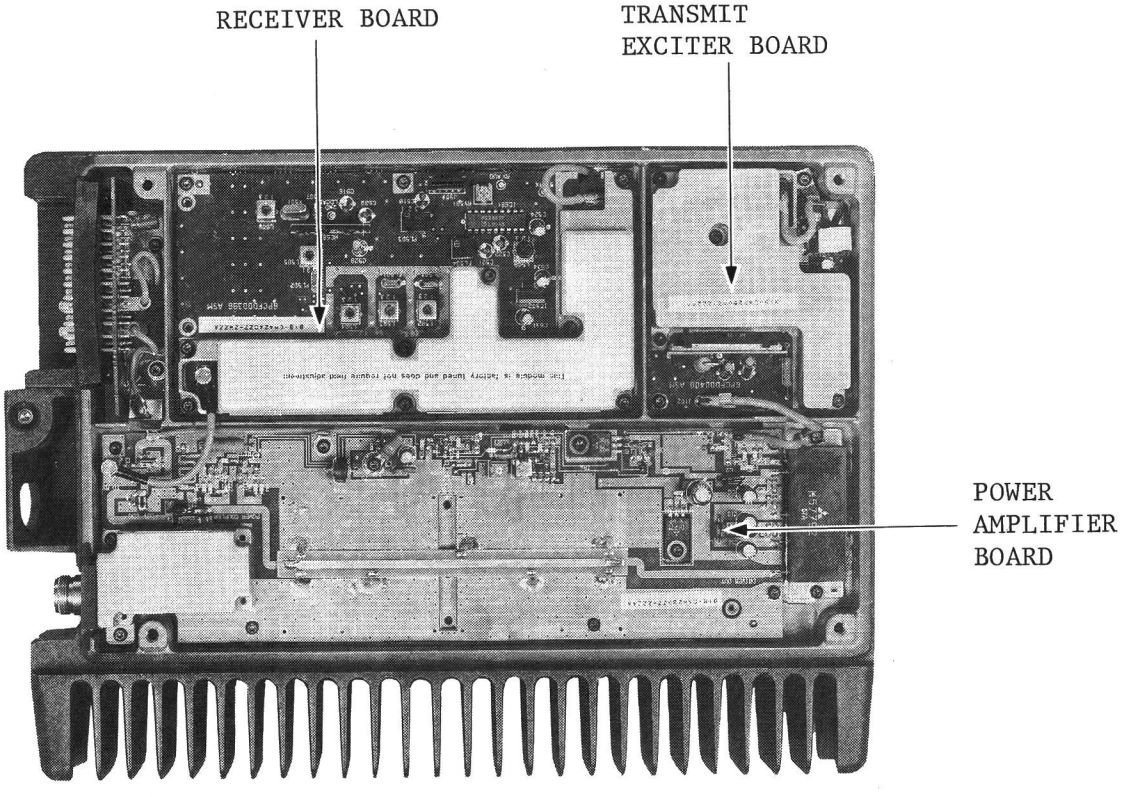


Figure 1 - Typical Module Layout (Top View)



35 W TYPE



10 W TYPE

Figure 2 - Typical Module Layout (Bottom View)

The basic radio consists of five printed wiring boards mounted in a cast aluminum frame. The five boards are the System Control board, the Frequency Synthesizer board, the Transmit Exciter board, the Power Amplifier board, and the Receiver board.

The radio is of double-layer construction with tuning adjustments easily accessible from the top of the radio.

The System Control board and the Frequency Synthesizer board are located on the top of the radio, while the Transmit Exciter board, the Power Amplifier board, and the Receiver board are located on the bottom.

Interconnections are provided by ribbon cable between the boards. A power bus connects A+ and A- from the front connector to the PA assembly.

Test points for the transmitter, receiver and system functions are provided for simplified alignment and troubleshooting.

SYNTHESIZER/INTERCONNECT

The synthesizer consists of a microcomputer, electrically-erasable PROM (EEPROM), a frequency synthesizer IC, transmit and receive VCO's and associated circuitry. The frequency synthesizer, under control of the microcomputer, generates all transmit and receive RF frequencies.

The EEPROM stores binary data for all RF frequencies, Channel Guard tones/digital codes, and the timing function of the carrier control timer (CCT). The microcomputer accesses the EEPROM and provides the correct WALSH bits for the Channel Guard circuitry to generate the Channel Guard tone or digital code, on a per-channel basis.

PROGRAMMING

The EEPROM allows the radio to be programmed or reprogrammed as needed to adapt to changing system requirements. RF frequencies, Groups, Systems, Channel Guard tones, and digital codes can be reprogrammed.

The EEPROM can be reprogrammed through the radio front connector using the General Electric Radio Programmer. This programmer allows all information to be loaded simultaneously.

NOTE

When programming, remember that all RF frequencies must be divisible by 12.5 kHz.

Programming instructions are provided in the respective Programmer Maintenance Manuals.

TRANSMITTER

The transmitter consists of the exciter, frequency synthesizer, transmit VCO, and a power amplifier (PA) assembly. The PA assembly consists of a PA board mounted along the side of the radio next to the heat sink assembly. The PA board also contains a solid-state antenna relay and a low-pass filter.

Audio, 9600 baud data, and Channel Guard circuitry for the transmitter is located on the System Control board.

RECEIVER

The receiver consists of the frequency synthesizer, RX VCO, injection amplifiers, front end, IF, and limiter detector. Audio, squelch and Channel Guard circuitry for the receiver is located on the System Control board.

SYSTEM CONTROL FUNCTION

A microprocessor on the System Control board controls the frequency synthesizer, TX on/off, decoding of 9600 baud data and CTCSS tones, generation of 9600 baud data and CTCSS tones, etc. The audio processor circuitry for the transmitter and the receiver are located on the System Control board. Squelch control circuitry, test points, and the digital voice guard control circuit are also located on the System Control board.

CONTROL UNITS

Control Units are available and may be used directly with RANGR 16 PLUS™ radio combinations.

Refer to the applicable Maintenance Manual for a detailed description of the Control Units used with the RANGR 16 PLUS™ radio combinations.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in the Operator's Manual for the Control Unit used.

MAINTENANCE

The use of microcomputer technology allows self-diagnostic maintenance routines to be incorporated in the microcomputer software. These routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation.

The maintenance section of this manual contains the diagnostic routines and other information required to service this radio. The maintenance section includes:

- System interconnections
- Mechanical layout
- Disassembly procedures
- Replacement of ICs, chip capacitors, and resistors
- Microcomputer self-diagnostics
- Alignment procedures for the transmitter and receiver
- Troubleshooting procedures and waveforms

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