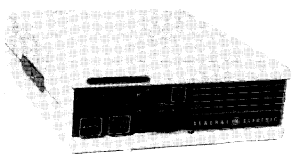
MOBILE RADIO

PHOENIX™-S

SYNTHESIZED — NARROW BAND
MAINTENANCE MANUAL LBI31188A

450-470 MHz, 25-WATT MOBILE COMBINATION

PHOENIX-S



450-470 MHz
MOBILE RADIO

MICROPHONE

TWO-WAY FM
MOBILE
COMBINATIONS

EXTERNAL
SPEAKER
(OPTIONAL)

GENERAL ELECTRIC

TABLE OF CONTENTS

CAUTION

Although the highest DC voltage in this mobile equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal 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!

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*

U.S.A.

SYSTEM SPECIFICATIONS*

FCC IDENTIFICATION NUMBER	TR-104-B
FREQUENCY RANGE	450-470 MHz
BATTERY DRAIN	
Receiver - W/Display	
Squelched	0.55 amperes
Unsquelched	0.95 amperes
Transmitter	6.5 Amperes @ 13.6 Volts
Channel Memory (Radio "Off")	135 milliamperes
FREQUENCY STABILITY	±0.0005%
TEMPERATURE RANGE	-30°C (-22°F) To +60°C (140°F)
DUTY CYCLE	20% Transmit, 100% Receive
DIMENSIONS, LESS ACCESSORIES (H X W X D)	65 MM X 190 MM X 240 MM (2.55 X 7.5 X 9.4 inches)
WEIGHT, LESS ACCESSORIES	2.07 kg (4.5 pounds)

TRANSMITTER

POWER OUTPUT	25 Watts
CONDUCTED SPURIOUS AND HARMONIC EMISSION	-70 dB
MODULATION	±4.5 kHz (±3.75 kHz voice modulation and 0.75 kHz CG modulation)
AUDIO SENSITIVITY	50 to 100 Millivolts at J911-4 20 to 50 Millivolts at J911-5
AUDIO FREQUENCY CHARACTERISTICS	Within +1 dB to -3 dB of a 6 dB per octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA.
AUDIO DISTORTION	2%
DEVIATION SYMMETRY	0.1 kHz maximum
RF OUTPUT IMPEDANCE	50 ohms
FREQUENCY SEPARATION	12.0 MHz (with center tuning)
CARRIER ATTACK TIME	30 milliseconds
AUDIO ATTACK TIME	30 milliseconds
CHANNEL GUARD TONE DISTORTION	5%
FM NOISE	-50 dB
MIC INPUT IMPEDANCE	Low
POWER ADJUST RANGE	15 to 25 Watts

RECEIVER

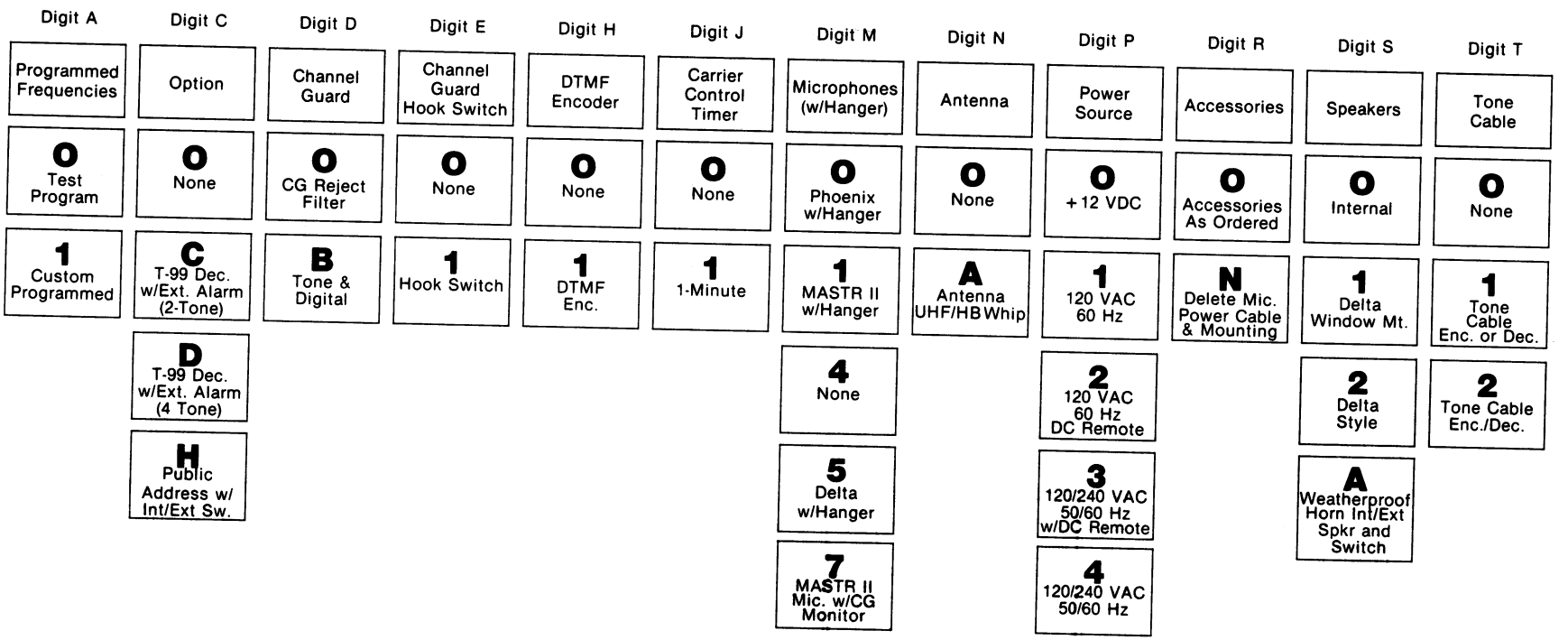
AUDIO OUTPUT (to 4.0 ohms speaker)	3 Watts (less than 5% distortion
SENSITIVITY	
12 dB SINAD	0.20 uV
20 dB Quieting Method	0.28 uV
ADJACENT CHANNEL SELECTIVITY	
EIA Two-Signal Method	-75 dB @ ±25 kHz
SPURIOUS REJECTION	-90 dB
INTERMODULATION (12 dB SINAD)	-72 dB
MODULATION ACCEPTANCE	±7.0 kHz
SQUELCH SENSITIVITY	<8 dB SINAD <10 dB SINAD W/Digital Channel Guard
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
FREQUENCY SEPARATION	
With Center Tuning	2.0 MHz
1 dB degradation	3.0 MHz
IMAGE REJECTION	-90 dB
RECEIVER RECOVERY TIME	100 milliseconds @ 8 dB SINAD
RECEIVER RESPONSE TIME	
Tone CG	$\left(\leq \frac{2500}{\text{CG FREQ}} \right)$ ms
Digital CG	Less than 330 milliseconds
RECEIVER ATTACK TIME	90 milliseconds @ 8 db SINAD
HUM AND NOISE	
Squelched	-80 dB
Unsquelched	-50 dB
CG BANDWIDTH	>1%, <2% of marked frequency
CHANNEL SPACING	25 kHz

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

COMBINATION NOMENCLATURE

Digits 1&2	Digit 3	Digit 4	Digit 5	Digit 6	Digits 7&8	Digit 9	Digit 10
Product Code	Transmit Frequency Range	Receive Frequency Range	Channel Spacing	Type	RF Power Output	Freq. Capacity	Oscillator Stability
N5	**U** 450-470 MHz	**U** 450-470 MHz	**2** 25 KHz	**N** Narrow Band	**25** 25-Watts	**A** 1 Tx 1 Rx	**B** ±5 PPM
						B 2 Tx 2 Rx	
						T 16 Tx 16 Rx	

STRUCTURED OPTIONS



DESCRIPTION

The General Electric synthesized narrowband Phoenix-S mobile radios are completely solid state utilizing state-of-the-art microcomputer technology and integrated circuits (IC's) to provide high-quality, high reliability performance radios. The 450-470 MHz Phoenix-S provides 25 watts RF output power with allowable channel spacing (frequency spread between channels) of 5.5 MHz transmit with no degradation and 2 MHz receive with no degradation or up to 3.0 MHz receive with 1 dB degradation. The Phoenix-S radio is provided with a capacity of 1, 2, or 16 channels.

The radio contains a transmit/receiver board, synthesizer/interconnect board, and a recessed front panel which houses the internal speaker and identifies the controls and indicators. Its small size makes it ideal for front mounting in conventional vehicles. The standard combinations are equipped with:

- Microcomputer controlled frequency synthesizer
- Channel Guard Tone/Code Reject Filter
- One, two or 16 channels
- Seven Segment Channel Display
- .0005% Frequency Stability

Software options include:

- Carrier Control Timer
- Tone and Digital Channel Guard

The radio consists of an effective heat-dissipating, aluminum die cast "H" frame on which two circuit boards are mounted. The transmitter/receiver board is mounted on the bottom of the "H" frame and includes the exciter, power amplifier, and receiver circuitry. The synthesizer/interconnect board (mounted on top of the "H" frame) contains all interconnections, microcomputer, frequency synthesizer, transmitter audio processor, microphone preamplifier, and Channel Guard circuitry. All external connectors, controls and indicators are mounted directly on the two boards for reliability and ease of disassembly.

In radios equipped with 16 channels or more, a separate display board is provided for mounting the channel select pushbutton and the display and CAS indicators.

The boards plug into each other, eliminating the need for interconnecting wires. The only wires used in the radio are the plug-in leads for the internal speaker. The top and bottom covers enclose the "H" frame and provide optimum protection for the radio. The internal speaker mounts inside the front panel.

The front control panel is made of highly durable ABS plastic with rounded corners and recessed controls to meet passenger safety requirements. The panel provides access to four standard operator controls: channel selector switch, a mode A/B switch (multi-frequency radios), a momentary MONITOR pushbutton (fixed squelch and Channel Guard monitor), and a rotary, edge-mounted Volume ON-OFF control. A red Transmit indicator LED (Light Emitting Diode) and yellow Channel Busy indicator are provided. Power On is indicated by a green LED located next to the transmit indicator or channel number indicator.

All supply voltages used in the radio is provided by the vehicle battery. The radio is designed for operation only in 12 Volt, negative ground vehicle systems.

The radio is of modular construction. Both major modules and tuning adjustments are easily accessible. Loosening the two screws in the rear of the top cover provides access to the synthesizer/interconnect board. Loosening the two screws in the rear of the bottom cover provides access to the transmitter/receiver board.

A PROM label located on the top cover inside the radio describes the radio's personality. This information provides the service man with a quick reference to the operating characteristics of the radio.

Information identified on the PROM label includes the PROM Kit number, the radio serial number, all transmit and receive channel numbers and frequencies, Channel Guard, tones/codes, and carrier control timer information for each channel. This information is provided for both operating modes A and B.

If the personality of the radio is changed (EE PROM reprogrammed) all information relating to the radio's new personality should be recorded either on the old label, if space is available, or on a new label. The part number of the PROM label is 19C850828P1 and may be ordered from General Electric Service Parts.

PROGRAMMING

The EE PROM allows the radio to be reprogrammed as needed to adapt to changing system requirements. RF frequencies, Channel Guard tones and digital codes, and the CCT function can be reprogrammed. The EE PROM is reprogrammed through the radio functional connectors J910 and J911 using the General Electric

Universal Radio Programmer Model TG2310. This programmer allows all information to be loaded simultaneously.

Alternatively, the General Electric Single Channel Programmer Model EX22A10 may be used which allows the user to reprogram the radio on a per channnel basis.

NOTE

When programming RF frequencies in the 450-470 MHz band, remember that all frequencies used must be divisible by 12.5 kHz.

Programming instructions are provided in the related maintenance manual for the programmer.

SYNTHESIZER/INTERCONNECT

The frequency synthesizer consists of a microcomputer, electrically erasable PROM (EE PROM), a frequency synthesizer, IC5, a common transmit/receive VCO, and associated circuitry. The frequency synthesizer under control of the microcomputer, generates all transmit and receive RF frequencies.

The EE PROM 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 EE PROM and provides the correct walsh bits to the Channel Guard board to generate the correct Channel Guard tone or digital code on a per channel basis. Standard tones from 67 Hz to 210.7 Hz and digital codes from 023 (Hex) to 526 (Hex) are available.

CHANNEL SELECTION

In multi-frequency radios, channel selection is accomplished through the use of two switches: the channel select switch (^) and the MODE A/B switch. The channel select switch automatically advances the selected channels, while depressed. The MODE A/B switch selects one of two banks, A or B, of up to 8 channels accessed by the channel select switch.

In a 16 channel radio there are two banks, A and B, of eight channels each. By operating the MODE A/B pushbutton switch the user can select two independent transmit and receive frequencies per channel displayed, providing the radio with up to 16 independent transmit and receive frequencies. The selected channel (1-8) is displayed. Mode A/B is indicated by the decimal point on the channel display. It is on for mode B and off for mode A.

NOTE

The mode A/B switch may be used to provide mobile-to-mobile communications through an intermediate repeater (repeated path) or direct mobile-to-mobile communications. For example: Channel 1 mode A may be programmed for the repeater frequency (repeated path) while channel 1 mode B would be programmed for the mobile receive frequency (direct path). Judicious programming will allow selection of direct or repeated paths on desired channels.

TRANSMITTER

The transmitter consists of a fixed-tuned exciter, an audio processor, wideband power amplifier, and a solid state antenna switch. The audio processor is located on the synthesizer/interconnect board. The RF power output level is set internally to rated output power, typically 25 watts.

Frequency stability for both the transmitter and receiver is maintained by an electronic temperature compensation network.

RECEIVER

The dual conversion receiver consists of a front end section and two mixer/IF sections operating at 21.4 MHz and 455 kHz. The receiver also contains a squelch and audio section. The squelch circuit is contained within the 2nd Converter-FM detector IC. The audio section provides a 3-watt audio output into a 4-ohm load with less than 5% distortion.

AC POWER SUPPLY OPTION

To use the radio as a base station, an optional 120 Volt AC, 60 Hertz power supply is available. An eight foot cable connects the power supply to the radio. The cable length permits the power supply to be located away from the radio. A green Power On LED is located on the front panel of the power supply. In addition a 120/240 Volt AC, 50/60 Hz supply is also available where its use is dictated. DC remote control may be provided with either supply.

MICROPHONE

The standard mobile combinations use an electret microphone. The Phoenix microphone is housed in a sturdy case, and the extendable coiled cord plugs into a jack at the back of the radio. The microphone is secured to the radio by

means of a strain relief hook on the microphone cable. A microphone hanger is supplied with the microphone. Option microphones such as the MASTR II and MASTR Delta microphones may be used.

HOOKSWITCH OPTION

In Channel Guard applications, a microphone hookswitch may be supplied with the radio. The Channel Guard is disabled when the microphone is removed from the hookswitch.

EXTERNAL SPEAKER (OPTIONAL)

A five-inch speaker, contained in a LEXAN® housing, provides an audio output of 3 watts. The nominal speaker impedance is 3.2 ohms. The speaker leads are connected to pins 3 and 7 of Systems Plug P910. A weatherproof horn type speaker is available also. When the External Speaker is used, refer to the installation instructions and interconnection diagram for jumper modifications.

UNIVERSAL TONE CABLE

A universal tone cable equipped with a 9-pin Winchester connector is required when an external tone encoder or decoder is used. The tone cable interconnects the tone encoder/decoder with the radio and also may be used with the public address option. Refer to the installation diagrams in the option manual for jumper modifications. A second cable is required when both encode and decode functions are used.

DTMF ENCODER

The DTMF encoder option provides an unique front cap for the Phoenix radio which houses the DTMF touch tone pad assembly. The external encoder is connected to the radio via a tone cable terminating at HL75-HL79 on the synthesizer/interconnect board. A second cable interconnects the touch pad to the synthesizer/interconnect board. Refer to the Installation Diagram for details.

OPERATION

Complete operating instructions for the Two-Way Radio are provided in a separate Operator's Manual. The basic procedures for receiving and transmitting messages is as follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by turning the ON-OFF Volume control to the right.
2. Select desired Mode by pressing the MODE A/B switch. Mode B indicated by illuminated decimal point.
3. Select the desired channel by pressing the channel increment "∧" switch.
4. Push in the MONITOR button to disable the squelch circuit and Channel Guard decoder. Adjust the volume control for a comfortable listening level and then release the MONITOR button for normal operation.

The radio is now ready to receive messages from other radios in the system.

TO TRANSMIT A MESSAGE

1. Turn the radio on as directed in the "To Receive A Message" section.
2. Select desired channel.
3. Press the PTT switch on the microphone and speak across the face of the microphone in a normal voice level. Release the PTT switch as soon as the message has been given. The red indicator light on the control panel will glow each time the microphone PTT switch is pressed, indicating that the transmitter is on the air. The receiver is muted when the transmitter is keyed.

MAINTENANCE

The use of microcomputer technology allows self diagnostic routines to be incorporated in software. The diagnostic routines are easy to run and provide a quick analysis of microcomputer and frequency synthesizer operation. The routines should always be run first when troubleshooting the radio.

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

- System Interconnections
- Mechanical Layout Diagrams
- Disassembly Procedures
- IC and Chip Component Replacement Procedures
- Self-Diagnostic Routines
- Transmitter and Receiver Alignment Procedures
- Troubleshooting Information