MOBILE RADIO

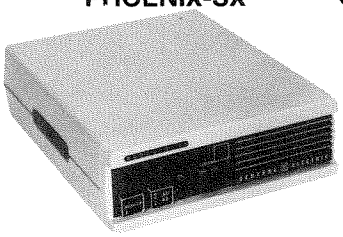
PHOENIX™-SX

WIDE BAND-SYNTHESIZED

MAINTENANCE MANUAL LBI31272B

403-512 MHz, 25 WATT MOBILE COMBINATION

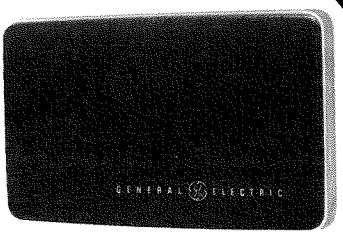
PHOENIX-SX



403-512 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!

SYSTEM SPECIFICATIONS*

FCC IDENTIFICATION NUMBER	TR-128-B ±5 PPM (470-512 MHz) TR-128-B2 ±2 PPM (470-512 MHz) TR-104-C ±5 PPM (403-470 MHz) TR-104-C2 ±2 PPM (403-470 MHz)
FREQUENCY RANGE	403-512 MHz
CHANNEL GUARD	33 EIA Tones, 83 Digital Codes
FREQUENCY STABILITY	±0.0005%
TEMPERATURE RANGE	-30°C (-22°F) To +60°C (140°F)
DUTY CYCLE	20% Transmit, 100% Receive
BATTERY DRAIN (With Display)	
Receiver	
Squelched	0.55 amperes
Unsquelched	0.95 amperes
Transmitter	6.5 Amperes @ 13.8 Volts
Channel Memory (Radio "Off")	135 milliamperes
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 (4.6 pounds)

TRANSMITTER*

POWER OUTPUT	25 Watts (22 Watts 470-512 MHz)
CONDUCTED SPURIOUS AND HARMONIC EMISSION	-70 dB
MODULATION	5.0 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 3000 Hz per EIA standards. Post limiter filter per FCC and EIA.
AUDIO DISTORTION	Less than 2% (1000 Hz) Less than 5% (300 to 3000 Hz)
DEVIATION SYMMETRY	0.3 kHz maximum
RF OUTPUT IMPEDANCE	50 ohms
FREQUENCY SEPARATION	20 MHz (18 MHz 403-440 & 470-512 MHz)
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 22 watts

RECEIVER*

AUDIO OUTPUT (to 4.0 ohms speaker)	3 Watts; (less than 5% distortion
SENSITIVITY	
12 dB SINAD	0.25 uV
20 dB Quieting Method	0.3 uV
ADJACENT CHANNEL SELECTIVITY EIA Two-Signal Method	-70 dB @ ±25 kHz
ALTERNATE CHANNEL SELECTIVITY EIA Two-Signal Method	-70 dB @ ±25 kHz
SPURIOUS RESPONSE	-80 dB
INTERMODULATION (12 dB SINAD)	-68 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	403-440 MHz 17 MHz; 440-470 MHz 20 MHz; 470-512 MHz 17 MHz
IMAGE REJECTION	-90 dB
RECEIVER RECOVERY TIME	100 milliseconds @ 8 dB SINAD
RECEIVER RESPONSE TIME	
Tone CG	$\left(\leq \frac{25000}{CG\ FREQ}\right)$
Digital CG	Less than 250 milliseconds
RECEIVER ATTACK TIME	90 milliseconds @ 8 dB SINAD
HUM AND NOISE	
Squelched	-80 dB
Unsquelched	-45 dB
CG BANDWIDTH	>1%, <2% of marked frequency

* 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** 440-470 MHz	**U** 440-470 MHz	**2** 25 kHz	**W** Wide Band	**25** 25-Watts	**B** 2 Tx 2 Rx	**A** ±2.5 PPM
	R 403-440 MHz	**R** 403-440 MHz				**T** 16 Tx 16 Rx	**B** ±5 PPM
	W 470-512 MHz	**W** 470-512 MHz				**P** 16 Tx 16 Rx Dual Priority Scan	

STRUCTURED OPTIONS

Digit A	Digit C	Digit D	Digit E	Digit H	Digit J	Digit M	Digit N	Digit P	Digit R	Digit S	Digit T
Programmed Frequencies	Option	Channel Guard	Channel Guard Hook Switch	DTMF Encoder	Carrier Control Timer	Microphones (w/Hanger)	Antenna	Power Source	Accessories	Speakers	Tone Cable
0 Test Program	**0** None	**0** CG Reject Filter	**0** None	**0** None	**0** None	**0** Phoenix	**0** None	**0** +12 VDC	**0** As Ordered	**0** Internal	**0** None
1 Customer Programmed	**D** T-99 Dec. 4-Tone (w/Ext. Alarm)	**B** Tone & Digital	**1** Hook Switch	**1** DTMF Enc.	**1** 1-Minute	**1** MASTR II	**A** Antenna	**1** 120 VAC 60 Hz	**1** Radio Only Less Micro-phone Power Cable & Mtng. Hdwe.	**1** Delta Window Mt.	**1** Tone Cable Enc. or Dec.
	H Public Address w/ Int/Ext. Sw.					**4** None		**2** 120 VAC 60 Hz DC Remote		**2** Delta Style	**2** Tone Cable Enc./Dec.
	C Type 99 2-Tone (w/Ext. Alarm Switch)					**5** Delta		**3** 120/240 VAC 50/60 Hz w/DC Remote		**A** Weatherproof Horn Int/Ext Spkr and Switch	
						7 MASTR II Mic. w/CG Monitor		**4** 120/240 VAC 50/60 HZ			

LBI31272

DESCRIPTION

The General Electric wideband-synthesized PHOENIX-SX mobile radios are completely solid state utilizing microcomputer technology and integrated circuits (IC's) to provide high-quality, high reliability performance radios. The PHOENIX-SX provides 25 watts (440-470 MHz) or 22 watts (403-440 & 470-512 MHz) RF output power. Frequency separation of 20 MHz across the 440-470 MHz frequency band and 17 MHz across the 403-440 and 470-512 MHz frequency band is provided.

The radio contains a transmitter/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
- 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 audio 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, 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 behind 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, mode A/B switch, 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 the channel number being illuminated.

The radio is designed for operation only in 12 Volt, negative ground vehicles. Appropriate required voltages within the radio are supplied by internal regulators.

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.

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 on the synthesizer/interconnect board using the General Electric Universal 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 manually on a per channnel basis through J802.

NOTE

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

A PROM label located on the top cover inside the radio describes the radio's personality. This information provides the serviceman and 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 instructions are provided in the maintenance manual for the programmer.

SYNTHESIZER/INTERCONNECT BOARD

The synthesizer/interconnect board consists of a microcomputer, electrically eraseable PROM (EE PROM), a frequency synthesizer IC, 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 filter 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

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.

Mode A/B Switch

In a 16 channel radio there are two banks, A & 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 number 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 45 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 from 300 Hz to 3000 Hz.

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.

When using the AC supply, reduce the transmit power (if necessary) so that maximum current draw does not exceed 6.0 amperes. Adjust POWER CONTROL accordingly.

DUAL PRIORITY SCAN (DPS) OPTIONAL

A Scan/Display board located behind the radio front panel provides control and display circuits to select up to 16 channels for scanning. Two priority levels may be activated by front panel control allowing the user to select a main priority channel which is selected any time a signal is present. A second level priority channel is selected each time a signal is present, pre-empted only by priority Channel 1. All other channels selected for scanning are pre-empted by both priority channels. DPS is available only in 16 channel radios. With DPS an external speaker is used.

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 a unique front cap for the PHOENIX-SX 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. With DTMF Encoder an external speaker is used.

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

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