MOBILE RADIO

M-PD

VOICE GUARD™

SCAN WITH DES
DIGITAL SPEECH ENCRYPTION

MAINTENANCE MANUAL LBI-31915

TABLE OF CONTENTS

403-512 MHz
PERSONAL
TWO-WAY FM RADIO

GENERAL ELECTRIC

TABLE OF CONTENTS

SPECIFICATIONS

SYSTEM		
Frequency Stability	5 PPM	2.5 PPM
Frequency Range	FCC Identification Number	
403 MHz to 440 MHz	AXA9MZTR-146-2A5	AXA9MZTR-146-2A25
440 MHz to 470 MHz	AXA9MZTR-146-B5	AXA9MZTR-146-B25
470 MHz to 512 MHz	AXA9MZTR-146-C5	AXA9MZTR-146-C25
Dimensions (H X W X D) (with standard capacity battery pack)	182.88 mm X 69.08 mm X 48.26 mm	
Weight (with standard capacity battery pack)	28 ounces	
Operable Temperature Range	-30°C to +60°C	
TRANSMIT		
RF Power Output	0.4 to 4 Watts	
Spurious Emissions	-37 dBm	
Maximum Deviation	5 KHz	
FM Hum & Noise (EIA)	-40 dB	
Audio Distortion (60% MOD)	3%	
Frequency Stability (-30°C to +60°C)	5 PPM	2.5 PPM
RF Load Impedance	50 ohms	
Microphone Sensitivity (EIA 60% MOD)	Less than 90 dB SPL	
Audio Frequency Response	Within +1 and -3 dB of a 6 dB/octave pre-emphasis from 300 Hz to 3000 Hz.	

RECEIVE

Sensitivity (12 dB SINAD)	-116 dBm
Spurious Emissions	-57 dBm
Spurious Response Rejection	72 dB (Minimum)
Intermod Distortion Rejection	70 dB (Minimum)
Adjacent Channel Selectivity	70 dB (25 KHz)
Squelch Sensitivity Adjustable	6 dB SINAD (Minimum)
Distortion (EIA 0.5 Watt)	5% (Maximum)
Audio Frequency Response	Within +1 and -3 dB of a 6 dB/octave de-emphasis from 300 Hz to 3000 Hz.

CRYPTOGRAPHIC

DES 64-bit output feed back mode

No bit error extension

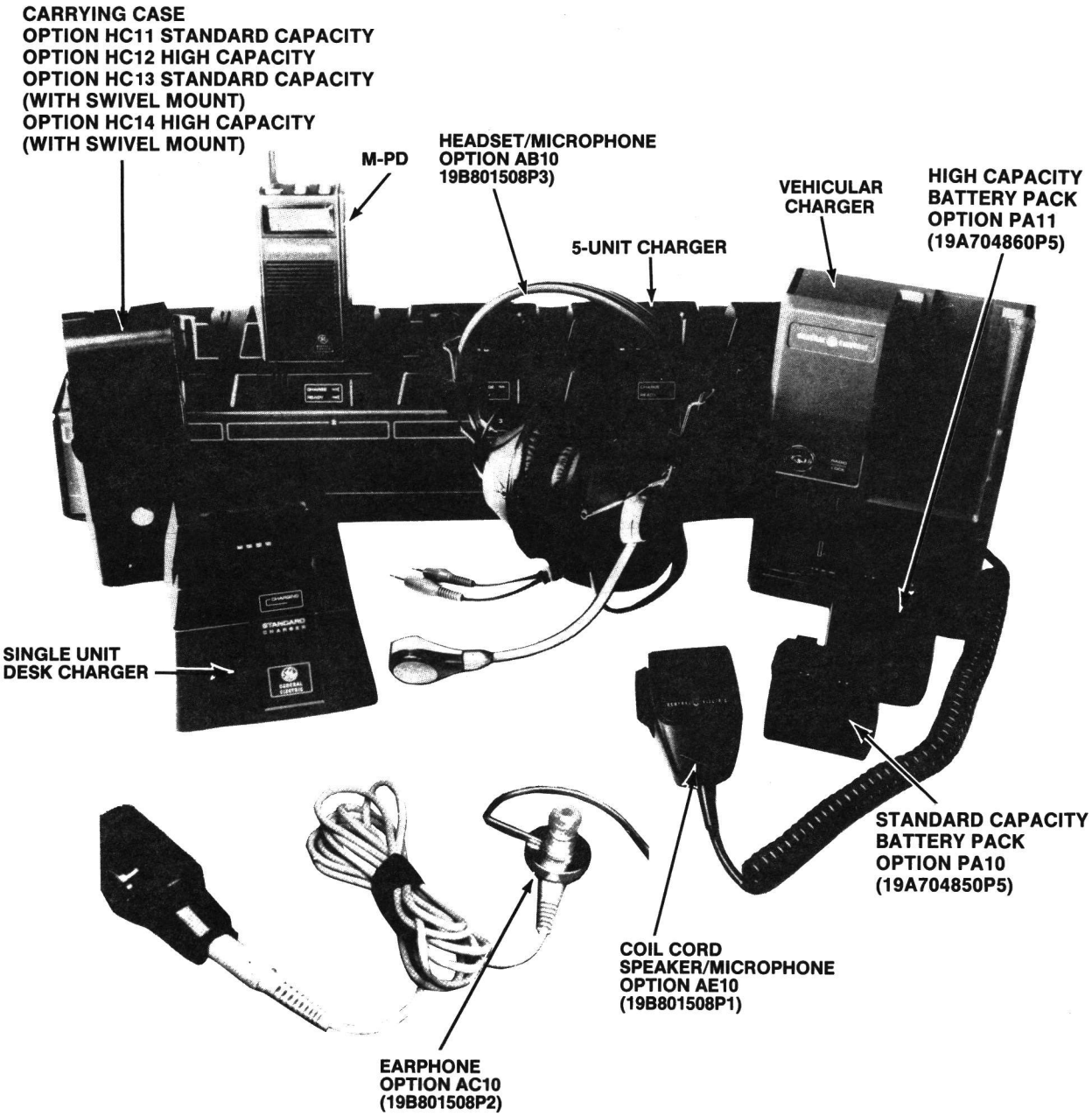
Assured acquisition at 12 dB SINAD (SINAD measured in CLEAR mode)

Recurring sync assures late entry and re-entry performance

Encrypted mode range is equal to CLEAR mode range.

Key Permutations (User selected using a Key Variable Loader) DES	7.2×10^{16}
Speech Digitalization	9600 baud sub-band coding
Key Storage	30 second power interruption allowed.
Signaling	Continuous digital signaling in encrypted mode. Up to 255 outside addresses (OA's) available (one per channel). Any 1 of 255 OA's can be used on each of the 48 channels.

OPTIONS AND ACCESSORIES



COMBINATION NOMENCLATURE

Digits 1&2	Digit 3	Digit 4	Digit 5	Digit 6
Product Code	Frequency Range	Controller	Stability	Power Source
PV	P 403-423 MHz	E 4 Button DES Algorithm	2 2.5 PPM	N Nicad Standard Capacity
	R 410-430 MHz		5 5 PPM	M Nicad High Capacity
	S 420-440 MHz			X NO Battery
	T 440-460 MHz			
	U 450-470 MHz			
	V 470-488 MHz			
	W 482-500 MHz			
	X 494-512 MHz			

DESCRIPTION

General Electric's M-PD **VOICE GUARD** (VG) four button SCAN Personal Radio is a high-quality, high-performance, synthesized, two-way, FM communications unit for use in public services where private voice communications is required. **VOICE GUARD** capability provides digital speech encryption/decryption with full features and full range performance using the Data Encryption Standard (DES) algorithm. The algorithm offers the user a high level of voice security by virtue of the extremely large number of available cryptographic keys. Cryptographic keys are user loadable using General Electric's Key Loader, Model V4025. The DES algorithm provides 7.2×10^{16} possible cryptographic keys.

The M-PD VOICE GUARD SCAN Personal Radio with provides the following features:

- **High Level Security:** Uses the government approved DES algorithm for speech encryption.

- **Encrypted Range Equal to CLEAR Range:** No operational compromise in coverage when in the encrypted mode.

- **Field Programmable through UDC:** Without opening the radio, the radio personality is programmed into the radio through the UDC by interfacing with any IBM/XT or truly compatible personal computer.

  Also, without opening the radio, the cryptographic key is loaded into the radio through the UDC by interfacing with the General Electric Key Loader.

- **Eight Character Alphanumeric Liquid Crystal Display:** This display indicates the condition of the radio. It shows: channel designation, **PRIVATE** mode, signaling on/off, transmit, volume level, battery condition, channel busy, high/low power output, scan on/off and priority 1 & 2. The display can be illuminated for nighttime operation.

- **48 Channel Capability:** The LCD display can use any 8 alphanumeric characters to designate each of the 48 possible channels. Channel control can originate from either the up/down channel ramping buttons or the "Home" channel button.

- **Programmable Multi-Tone Channel Guard (CTCSS) Encode/Decode:** Channel Guard tone frequencies within the range of 67 Hz to 210.7 Hz, including all of the standard EIA frequencies, may be programmed. Different encode/decode and encode only frequencies as well as with/without Channel Guard options are also programmable into the radio.

  The same channel is used with and without Channel Guard By programming two different radio channels with the same frequency information but only one with Channel Guard capability.

- **Programmable Multi-Code Digital Channel Guard Encode/Decode:** Similar capability as with Tone Channel Guard is available.

- **Programmable Carrier Control Timer:** Personality information includes an optional period of transmit time from 5 to 300 seconds after which the unit will automatically unkey and provide an alerting tone. This feature is reinitiated on every PTT and the alert tone is removed upon release of the PTT.

- **Minimum Volume Level:** Personality information includes a minimum volume level below which the radio controls cease to reduce the volume.

- **Squelch Tail Elimination:** Squelch and audio circuits are designed so that annoying squelch pops which may occur at the end of received messages are minimized on non Channel Guard channels and eliminated on Channel Guard channels. This system is compatible with existing GE systems.

- **Programmable Squelch:** The noise squelch opening threshold can be programmed for each channel using the "reconfigure" feature of the programming software.

- **Channel Busy Lock Out:** Personality information includes the capability to prevent the transmit circuit from operating on a channel where carrier activity is present. The "channel Busy" indicator BSY is active during this time.

- **Automatic Power Levels:** High (HI) or Low (LO) power levels for each channel can be programmed into the radio personality such that the level is automatically selected. Other levels can be obtained using "reconfigure".

- **Home Channel Feature:** A "home" channel can be programmed into the radio which is selected by pressing the HOME button. This allows a user to quickly reach a reference channel.

- **Surveillance Feature:** In addition to the ability to program the display lighting on or off for each channel, the side-tone beep, related to the operation of a radio control, is capable of being enabled or disabled on each channel, independently.

- **Simple Remote Control Capability:** By connection through the UDC (Universal Devices Connector) a simple speaker/microphone can be operated which can also control PTT and the volume level (HI and LO).

- **Push Button Controls:** All control functions on the radio, except for the power ON/OFF switch, are operated through push button controls located on the top, side and front of the radio.

- **Two-Tone Sequential Decode:** Selective calling decode is enabled or disabled on each individual channel. Three simultaneous unique decodes are available for each channel to allow large systems the capability for individual and group calls.

  Compatibility with Channel Guard, Digital Channel Guard, GE-STAR and Dual Priority SCAN are maintained. Choices of various audible alerting signals are available when programming the radio.

- **Programmable Dual-Priority SCAN:** The radio can be programmed to SCAN any number of selected channels including two priority channels. The radio reverts to the priority level channels should any activity occur on those channels. There are two levels of priority. The first priority channel takes precedence over the second priority channel and the second priority channel takes precedence over other scanned channels. Channels to be scanned may be fixed by programming or may be front panel selectable.

- **High/Low Power Selection:** Programmed into the personality of the radio and automatically selected when a specific channel is selected.

Physically this radio consists of a rugged all metal housing designed to MIL-810D specifications and consisting of a front and a rear cover plus a Standard Capacity or High Capacity battery pack. The front cover assembly contains an LCD circuit board with various display and indicating circuits and a VOICE GUARD module. The VOICE GUARD module consists of an Analog board and a Digital board which plug together.

The rear cover assembly contains an RF circuit board specially shielded with a zinc alloy and consisting of the transmit/receive circuits with a frequency synthesizer controlled by a microprocessor located on the VOICE GUARD Digital board.

The VOICE GUARD module is interconnected with flexible circuits to the LCD board, front panel switches and the UDC in the front cover of the radio. The front cover then plugs into the rear cover (RF section). Refer to the Interconnection Diagram.

Radio Assembly

Transmit Circuit:

The transmit circuit is made of four major circuits as follows:

1. Wideband Hybrid Exciter: Amplifies the signal from the frequency synthesizer with about 21 dB gain.

2. Wideband Power Amplifier: Amplifies the output signal of the exciter (13 dB to 18 dB) to the desired output level for transmission.

3. Wideband Power Control Hybrid IC: Can reduce the transmit output level by 10 dB.

4. Output Low Pass Filter (LPF): Consists of a three stage LPF to eliminate harmonics.

The transmit circuit completely covers the band within the split with no adjustments except for the RF power control voltage from the VOICE GUARD module.

Receive Circuit:

The receive circuit consists of three major circuits as follows:

1. Front End Circuit: Consists of a single stage pre-amplifier with about 12 dB gain along with input and output band pass filters.

2. First Mixer and IF Circuit: A special Double Balanced Mixer (DBM) to provide a 45 MHz first IF, which is passed through a Band Pass Filter (BPF) and an IF amplifier to obtain the desired first IF signal level.

3. Second IF (455 KHz): Consists of one IC and one BPF. The IC contains the second mixer, the second IF amplifier and the FM detector. The second IF provides audio for the VOICE GUARD module.

Frequency Synthesizer:

The frequency synthesizer is made up of three major modules as follows:

1. Voltage Controlled Oscillator (VCO) Module: The UHF band frequency synthesizer has two VCO's one for transmitting and one for receiving. The transmit circuit is modulated at both the transmit VCO and the VCTCXO.

2. Voltage Controlled Temperature Compensated Oscillator (VCTCXO) Module: The VCTCXO is a temperature compensated crystal oscillator to provide a 13.2 MHz reference frequency and has modulation capability.

3. Phase Lock Loop (PLL): Consists of a frequency divider and a low current drain CMOS IC for phase comparison.

VOICE GUARD Module:

The VOICE GUARD module consists of two circuit boards as follows:

1. Analog Board: This board commands all functions and operations of the radio by providing CLEAR and PRIVATE mode switching, audio processing through the CAC IC circuit for both the transmit circuit and the receive circuits, and various operating supply voltages for circuits within the VOICE GUARD module and in the RF section.

2. Digital Board: This board provides Digital VOICE GUARD encryption/decryption, system control through an 80C31 microprocessor and an intelligent I/O device 63C05 microprocessor controlled by the 80C31. This board also provides various supply voltages for the VOICE GUARD module and the radio RF section.

LCD Circuit:

The Liquid Crystal Display (LCD) circuit consists of an LCD driver circuit for the display. This board also interconnects the VOICE GUARD module to the internal speaker/microphone, the front panel keys and the UDC through flexible circuits.

DATA ENCRYPTION STANDARD

The Data Encryption Standard (DES) is a public domain encryption system that is described in the U.S. Department of Commerce, National Bureau of Standards publication FIPS PUB 46; titled DATA ENCRYPTION STANDARD. This system was developed to be used in commercial applications of communications equipment within the United States.

The U.S Government has, by Executive Order, in federal standard FED-STD-1027 mandated that all Federal government radio (and other telecommunications) systems that are equipped with private voice communications equipment, shall employ the DES algorithm. Furthermore, such equipment shall carry the endorsement of the National Security Agency (NSA) in the form of a USGEID number which shall appear on each approved piece of equipment. These numbers are issued after completion of an endorsement process for each model of equipment to be offered for sale to any U.S. Government agency. Non-Federal government agencies are not required to have equipment possessing USGEID numbers

This Federal Standard specifies the minimum general security requirements that are to be satisfied in implementing the Data Encryption Standard (DES) algorithm in a telecommunications environment.

Endorsed personal handheld radios have, but are not limited to, the following general characteristics:

- Mounted in tamper-resistant boxes.
- If tampered with, the cryptographic keys contained therein will be destroyed.
- Provide malfunction alarms.
- No single electrical component failure shall permit transmission in the CLEAR when the PRIVATE mode has been selected.

The DES algorithm employs a sixty four bit cryptographic key (code). This electronic key is used for encryption/decryption of any digitized voice data transmitted or received in a communication system and prevents unauthorized monitoring of voice communications. Fifty six bits of the sixty four bit key are used for encryption. The remaining eight bits are parity bits. This results in 7.2×10^{16} unique cryptographic keys being available for the user. The security of a DES equipped system is achieved as the result of the extremely large number of available keys and the key is the only unknown element in a DES equipped system. It has been estimated that an exhaustive search of the available DES keys, employing a high speed computer, would require many tens of years to determine the correct key used in a communication system at any given time. A **Key Loader** is used by the system security officer to program the cryptographic key into the M-PD VOICE GUARD SCAN Personal radio.

The cryptographic Key Loader is a small handheld calculator type keyboard display unit that permits easy and secure user entry, storage and transfer of the electronic keyword (key). It simply connects through a

cable to the Universal Device Connector (UDC) located on the side of the radio. Turning the radio OFF, with the radio slide OFF/ON switch located on the side of the battery pack, then back ON and performing the procedures for the Key Loader allows the cryptographic key(s) to be transferred to the VOICE GUARD module (Refer to Key Loader Operator's Manual LBI-31541).

DUAL PRIORITY SCAN

The following features are available when Dual Priority SCAN is implemented in the M-PD VOICE GUARD SCAN radio software.

- Channels are scanned every 50 milliseconds. A list of the scanned channels is maintained by software. Channels can be added or deleted from the SCAN list if the ADD/ DELETE option is available on the keypad. A fixed SCAN LIST option is also programmable from the PC programmer.

- The Priority 1 channel will be scanned every 250 milliseconds and the Priority 2 channel will be scanned every second. Channel Guard decode will normally be disabled when the radio is in SCAN mode. SCAN with Channel Guard is available but the SCAN rate is slower.

- Once a channel frequency is loaded and the synthesizer LOCK DETECT is made, accounting for about 10 milliseconds, the carrier detection has to be made within the next 40 milliseconds.

- If squelch is detected in the window on any given channel (non-Priority) then the Priority 1 channel is scanned every 250 milliseconds and the Priority 2 channel is scanned every second. On the Priority channels, carrier will be detected using fast squelch. Active channels can be deleted from the SCAN LIST when SCAN is operational, by pressing the **DEL** key.

- If fast squelch is detected on a priority 2 channel, then the Priority 1 channel is scanned every 250 milliseconds.

- If fast squelch is detected on the priority 1 channel, then all scans are stopped for the duration of carrier present on the priority channel.

- When CARRIER DETECT is lost on any channel after acquisition, the channel is dropped if the carrier is not reacquired within a programmable delay period up to 5 seconds. SCAN will resume after PTT within a programmable delay period up to 10 seconds.

SCAN Options

SCAN options are available for selection by the user during personality programming of the radio as follows:

- **Key Pad Programmable Priority Channels:** Here the priority 1 and 2 channels can be programmed from the front key pad and the top key pad. Channels can also be added and deleted from the SCAN LIST using the same method. If a channel is selected and the ADD key is pressed for a second time after the selected channel was already added to the SCAN LIST, the selected channel is moved up to Priority 2. Pressing the ADD key again moves the channel up to Priority 1. The Priority 1 or 2 flags are displayed as required.

- **Fixed Priority 1 Channel:** The Priority 1 channel can be fixed. If the Priority 1 channel is fixed, then the channel cannot be deleted from the SCAN LIST. The Priority of the channel cannot be changed. This option can be enabled in the personality.

- **Selected Channel as Priority 1 Channel:** If this option is enabled, the selected channel becomes the Priority 1 channel. The Priority 2 channel will still be key pad programmable.

- **Fixed SCAN LIST:** Here all the scannable channels will be fixed in personality RAM. The keys ADD and DEL will be inactive in this configuration. The Priority 1 and 2 channels, if desired, will also be fixed if this option is enabled.

- **SCAN With Channel Guard:** This option allows the use of Channel Guard during SCAN. Enabling this option will cause the SCAN rate of the Priority 1 channel to be reduced to 400 milliseconds from the normal 250 millisecond rate, if carrier is detected on any channel.

Displays During SCAN Operation

- If a carrier is detected on any channel during SCAN, the channel name will be displayed. When the channel is dropped, at the end of a transmission hang delay time, the previously selected channel name is redisplayed.

- If a carrier is detected on any of the priority channels the channel name and the priority of the channel will be displayed.

- If the **SCAN, ADD** or **DEL** buttons on the key pad are operated when the SCAN option is disabled, the message **SCAN DIS** will be displayed for two seconds.

- If the fixed Priority 1 channel option is enabled, then attempting to move any channel to Priority 1 from the key pad will cause **FIXED P1** to be displayed for two seconds.

- If the fixed Priority 1 option is enabled, attempting to delete a Priority 1 channel from the key pad will cause the display to read **FIXED P1** for two seconds.

- If the fixed SCAN LIST option is displayed, then attempting to add or delete channels from the key pad will cause the display to read **FIXD LST** for two seconds.

Combinations of SCAN Options

SCAN Option	Combinations of Other SCAN Options
SCAN disabled	None
SCAN enabled	All legal combinations
Fixed Priority 1	SCAN with Channel Guard Fixed SCAN list
Priority on selected channel	SCAN with Channel Guard
SCAN with Channel Guard	Fixed Priority 1 channel Fixed SCAN LIST Priority 1 on selected channel
Fixed SCAN LIST	SCAN with Channel Guard

OPERATION

The M-PD VOICE GUARD SCAN Personal Radio is delivered disassembled into three parts as follows:

1. M-PD Radio (Main Unit)
2. Antenna
3. Battery Pack

Assemble these parts into one unit according the following procedure and as shown in Figure 1 - M-PD VOICE GUARD SCAN Operating Controls and Accessories.

NOTE

Either the antenna or the RF test connector can be connected to the M-PD radio antenna jack, as desired. Certain UDC devices contain RF connectors which connect to the RF jack beside the UDC. These devices disconnect the antenna jack.

1. Screw the antenna (2) or the RF test connector (4) in the antenna jack. A clockwise turn will insert the antenna or RF test connector, while a counterclockwise turn will remove them.
2. Slide the battery pack along the bottom of the M-PD main unit from the arrow-marked direction, shown in Figure 1, until the battery pack locks into place.

Operating Procedure (refer to Figure 1)

To Receive A Message:

1. Slide the **ON/OFF** switch on the side of the battery pack to **ON** position to turn on the radio.
2. Press the **VOL ▲** (Up) or **VOL ▼** (Down) button and listen for the desired level of the beep.
3. Press the **CHAN ▲** (Up) or **CHAN ▼** (Down) button to select the desired channel.
4. Press both **VOL ▲** (Up) and **VOL ▼** (Down) buttons simultaneously to disable squelch. Then press either the **VOL ▲** (Up) or the **VOL ▼** (Down) button to set the volume to the desired listening level. Releasing either the **VOL ▲** (Up) or the **VOL ▼** (Down) or both resets the squelch after approximately two seconds.
5. Enable/Disable Channel Guard by pressing both **CHANNEL** buttons simultaneously. If Channel Guard is enabled, the **SIG** flag is displayed.
6. Your radio is now ready to receive **CLEAR** or **PRIVATE** messages. The procedure is the same.

Transmitting a CLEAR Message:
(Not Encrypted)

1. Turn the radio on, set the audio level, and select the desired channel as described under TO RECEIVE A MESSAGE.

NOTE

If a **"P_"** is displayed as the left most characters of the LCD display, press the **PVT** button for 1/2 second. The **"P_"** will go out and the radio will be in the **CLEAR** mode.

2. Verify that the **BSY** indicator is **out**, i.e.; no other transmissions on the selected channel in progress. **NEVER** interrupt another transmission.
3. While holding the radio so that the antenna is vertical, press the PTT bar and speak directly into the grill or across the face of an external microphone. Speak in a normal tone and level of voice. The **TX** indicator will be on while the PTT switch is pressed. Release the PTT bar as soon as you stop talking. Messages cannot be received when the PTT bar is pressed.

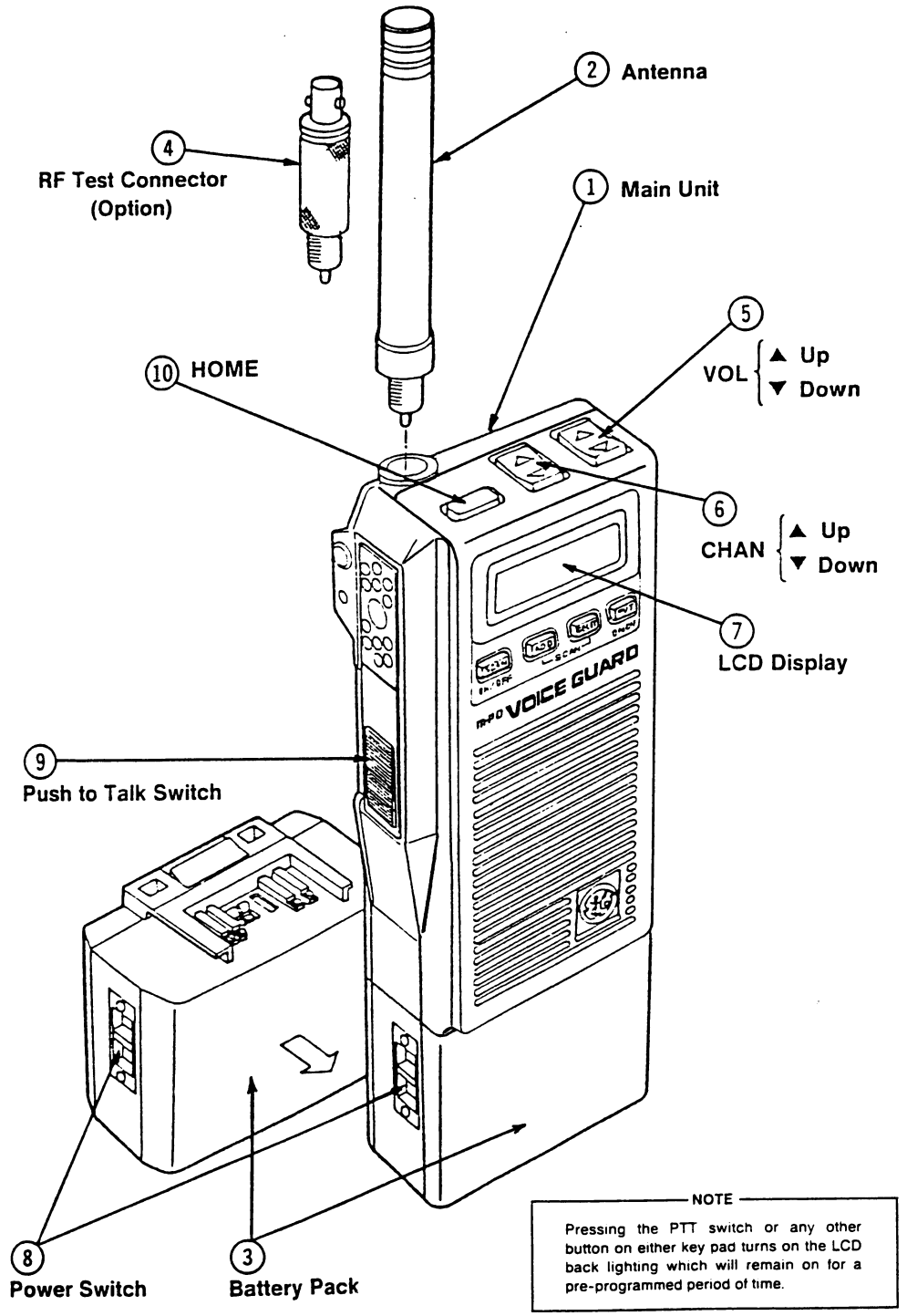


FIGURE 1 - M-PD VOICE GUARD SCAN OPERATING CONTROLS AND ACCESSORIES

4. A clear transmit alert tone will be heard each time the PTT is pressed if so programmed for **FS-1027** operation.

Sending A **PRIVATE** Message:
(Encrypted)

1. The cryptographic key must be loaded before you can transmit a PRIVATE message (refer to KEY LOADER FILL).

2. Turn the radio on, set the audio level, and select the desired channel as described under TO RECEIVE A MESSAGE.

3. Press the **PVT** button to see a **"P_"** displayed as the two left most characters of the LCD display indicating the **PRIVATE** transmit mode.

4. Verify that the **BSY** indicator is **out**, i.e.; no other transmissions on the selected channel are in progress. **NEVER** interrupt another transmission.

5. While holding the radio so that the antenna is vertical, press the PTT bar and speak directly into the grill or across the face of an external microphone. Speak in a normal tone and level of voice. The TX indicator will be on while the PTT switch is pressed. Release the PTT bar as soon as you stop talking. Messages cannot be received when the PTT bar is pressed.

Home Channel:

A **"home"** transmit/receive channel may be selected by pressing the **HOME** button. Messages will be sent and received on this channel until another channel is selected with the **CHAN ▲** (Up) or the CHAN **▼** (Down) button.

Key Loader Fill:

The cryptographic keys for the M-PD SCAN with VG radio are loaded using GE Key Loader, Model V4025. a special cable is supplied with this option to interface the Key Loader to the radio. Refer to the applicable Key Loader Operator's Manual (LBI-31541) for instructions on how to program the Key Loader.

Once the cryptographic keys are programmed into the Key Loader, the following procedures may be used to transfer the cryptographic keys to the M-PD radio.

1. Slide the **ON/OFF** switch to the **OFF** position.

2. Connect the M-PD VOICE GUARD Key Loader cable to the UDC Adapter connected to the UDC on the side of the radio. Connect the other end to the telephone type connector on the Key Loader.

3. Press the **PWR** switch on the Key Loader. After the Key Loader display reads **"MASTER MODE"**, press the **TRN** key. Now, select the key to be downloaded to the radio (refer to the Key Loader Operator's Manual LBI-31541).

4. Slide the radio power switch to the **ON** position. Ensure that the radio display reads **"KEY LOAD"**.

5. Press the **EXE** button on the Key Loader keypad to initiate the key transfer. The key loader display should read **"GOOD 1.x TRANSFER"**, where "x" is the selected key number.

6. Disconnect the Key Loader cable from the UDC. A tone will be heard from the speaker and the display will change back to the name of the selected channel.

Controls And Indicators

Pressing any push-button switch illuminates the LCD display for approximately two seconds.

Controls:

ON/OFF The **ON/OFF** slide switch located on the battery pack controls power from the battery pack to the radio. When turned on, an audible "click" will be heard and a light yellow square will show beneath the switch.

▲ VOL ▼ Sets receive audio to one of 32 different levels. Adjust the audio level by pressing the button in the desired direction **VOL ▲** (Up) or **VOL ▼** (Down) and listening for the desired level of beep. Holding the button in either position will ramp the volume up or down. Beeps will not occur if a message is being received.

The receiver may be unsquelched by simultaneously depressing both **VOL ▲** (Up) and **VOL ▼** (Down) buttons. The squelch will remain disabled as long as either VOL button is held. This permits the user to listen to the receiver noise to set the volume to the desired level.

▲ CHAN ▼ Selects the transmit/receive channel. Channels may be selected one step at a time (up to 48 channels) or progressively if either button is pressed continuously. (Stops at each end.).

On channels programmed with Channel Guard, the decode function may be enabled or disabled by simultaneously pressing both **CHAN ▲** (Up) and **CHAN ▼** (Down) buttons. The LCD display will indicate SIG if the CG decode is enabled. There will be no indication in the LCD display when the CG decode is disabled.

HOME When pressed, selects a programmable **"home"** transmit/receive channel regardless of the channel selected by the CHAN switch.

SCAN When pressed, toggles the scan function on and off. When the scan function is turned on, the LCD display SCN flag flashes on and off. When the scan function is off, the SCN flag indicates that the selected channel is in the list of channels to be scanned. Complete absence of the SCN flag indicates scan is off and the selected channel is not in the list of channels to be scanned. When the unit is in scan, all buttons except **SCAN, PTT** and **HOME** are inactive.

ON/OFF

ADD When pressed, adds the selected channel to the scan list and turns on the display SCN flag. Pressing this key a second time makes the selected channel priority two and turns on the display **"2"** flag. Pressing this key a third time makes the selected channel priority one, if "Priority 1 Fixed" option is not enabled. The display **"1"** flag is turned on. No action is taken if this key is pressed additional times.

SCAN

DEL When pressed, deletes the selected channel from the scan list and turns off display SCN, **"1"** and **"2"** flags.

SCAN

PVT When pressed, the **PVT** switch toggles operation of the radio between the **CLEAR** and **PRIVATE** modes. When operating in the **PRIVATE** mode a **P_** is displayed on the left side of the LCD display. The first two characters of the previously displayed information will be overwritten. All transmissions are encrypted and no CLEAR warning tone is sounded. Both CLEAR and PRIVATE messages will be received.

KEY ZERO All cryptographic keys are zeroized by simultaneously pressing the **SCAN** button and the **PVT** button for at least two seconds.

Removing the battery pack for more then approximately one minute will zeroize the key.

Cryptographic keys are also immediately zeroized if the rear section (RF section) of the radios is removed.

Indicators:

The LCD display indicates channel name and/or number and various option modes, error or warning conditions. In addition, various indicators in the display are used to indicate status of operational modes of the radio or channels programmed.

BAT Low battery indicator - displayed whenever the battery pack voltage is low and the battery pack will soon need recharging.

BSY Channel busy indicator - displayed whenever the selected channel is being received or in use. This does not mean that audio will be heard because a tone option such as Channel Guard may prevent listening to undesired signals.

HI High power indicator - this symbol, when on, indicates the high RF power level has been selected. No indication for low RF power.

P_ Encrypted message indicator - indicates that any transmissions will be in the **PRIVATE** mode.

SCN Scan indicator - when this symbol is on, the selected channel is on the scan list. When this symbol is flashing on or off, the radio is in the scan mode.

SIG Signaling (Channel Guard) enable indicator - displayed whenever a signaling function is enabled. When enabled, only desired signals will be heard.

TX Transmit indicator - displayed whenever the transmitter push - to - talk (PTT) switch is pressed and the transmitter is enabled and operating normally.

1 Priority 1 indicator - during scan operation, this symbol is displayed when the channel selected is Priority 1.

2 Priority 2 indicator - during scan operation, this symbol is displayed when the channel selected is Priority 2.

Alert Tones

Carrier Control Timer (Optional):

This option unkeys the transmitter if the user exceeds the preprogrammed time for continuous transmission and produces a continuous repetitive beeping tone in the speaker until the PTT switch is released. Releasing the PTT switch resets the timer.

Clear Warning Tone (If programmed):

If the radio is in the CLEAR mode a CLEAR transmit alert tone will be heard each time the PTT switch is pressed.

Continuous Repetitive Warnings:

An audio alert tone will be heard from the speaker as a warning to the user that a failure associated with the selected channel, radio, or cryptographic hardware has occurred. A warning tone is sounded for each of the following conditions.

Radio/Channel Failure:

Indicates failure of the synthesizer to lock on frequency or incorrect channel data is detected. The alarm will sound as long as the transmitter is ON and operation is inhibited. The user may select another channel until the failure is corrected. If incorrect channel data is detected the display flashes a CHN ERR message along with the alarm. If the synthesizer fails to lock, the display flashes with the selected channel name.

Cryptographic Hardware Failure:

Upon power up, a repetitive beep and the display saying **DES ERR** indicates failure of the encryption circuit. The beep is also sounded and the display flashes **KEY ERR** if the radio is keyed while an invalid cryptographic key is present. A valid cryptographic key must be loaded into the VG unit before resuming normal operations.

RAM Fail:

Beeps on power up if personality RAM contains an error. The LCD will display **RAM FAIL**. May indicate failure of the RAM backup lithium battery.

Battery Low:

Repetitive beep and flashing channel display plus **BAT** indicator if you try to key after the battery voltage is below the programmed LOCKOUT TX voltage.

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