CHAPTER 4.0 RADIO SET AND ACCESSORIES

4.1 System Description

The Guardian Radio set consists of the following components:

- Transceiver Module
- Control/Display Module
- Antenna
- Battery

Accessories: Contact Datron Guardian representative.

4.1.1 Portable Radio

The Guardian Portable is a handheld, battery operated transceiver capable of providing secure and non-secure communications over a 136-174 MHz Radio Frequency (RF) range. The portable radio includes a Liquid Crystal Display (LCD), Dual-Tone Multiple-Frequency (DTMF) keypad, emergency push button, speaker/microphone, multi-function side connector, three programmable function side keys, 16-position channel select rotary knob, On/Off/Volume rotary knob, three-position programmable toggle switch, antenna connector, battery connector and a Light Emitting Diode (LED) Status Indicator. The Guardian Portable features adjustable power output ranging from 0.1 up to 5 watts. The Guardian portable radio operational modes include:

a. Clear Analog Voice FM, 12.5 and 25 kilo-hertz (kHz)
b. DES Continuously Variable Slope Delta (CVSD) Modulation Voice, 25 kHz, 12 kilobits per second (kbps)
c. Project 25 Clear Digital Voice 12.5 kHz
d. DTMF Overdial

4.1.2 Antennas

There are four antennas that can be used with the Guardian Radio. The antenna are connected to the radio by a Sub-Miniature series A (SMA) connector.

4.1.2.1 Standard Broadband Antenna

The Guardian standard antenna is a helical antenna designed to cover the entire 136-174 MHz frequency range, with a nominal impedance of 50 ohms.

4.1.2.2 Low-Band Narrowband Antenna

A helical antenna designed for the 136-150 MHz frequency range, with a nominal impedance of 50 ohms.

4.1.2.3 Mid-Band Narrowband Antenna

A helical antenna designed for the 150-162 MHz frequency range, with a nominal impedance of 50 ohms.

4.1.2.4 High-Band Narrowband Antenna

A helical antenna designed for the 162-174 MHz frequency range, with a nominal impedance of 50 ohms.

4.1.3 Battery

4.1.3.1 NiCAD Rechargeable Battery

A rechargeable NiCAD battery is the standard power source for the radio. The battery is a self-contained unit connected to the back of the radio by a reliable snap-lock mechanism. The battery has a capacity of 1,800 milliAmpere Hours (mAH) and at room temperature can provide over eight (8) hours of battery life at the five (5) Watt (W) transmit power level with an 90:5:5 Standby:Receive:Transmit (Stby:Rx:Tx) duty cycle.

4.1.3.2 NiMH Rechargeable Battery

A rechargeable NiMH battery is an optional power source for the radio. The battery is a self-contained unit connected to the back of the radio by a reliable snap-lock mechanism. The battery has a capacity of 4,000 milliAmpere Hours (mAH) and at room temperature can provide over ten (10) hours of battery life at the five (5) Watt (W) transmit power level with an 90:5:5 Standby:Receive:Transmit (Stby:Rx:Tx) duty cycle.

LED	Indication
Red	High temperature exceeded
Flashing Red	Over-discharged battery
Flashing Yellow	Under-temperature battery
Yellow	Normal charge
Green	Charge successfully completed
Flashing Red/Green	Charge error

Note: The battery "fuel gauge" is not operable while the battery is charging. It will refresh approximately 30 seconds after the radio is removed from the charger.

4.1.4 Guardian PC Programmer

The G25AXR010 Guardian Programming Kit is a Windows 95/98/NT-compatible software program capable of loading or modifying programming information into the radio from a PC. It includes software, a detailed user's guide, and an RS-232 compatible programming/cloning cable. The cable connects the PC serial port to the radio side connector. See the Guardian G25AXK001 Programming Manual for a complete description of PC Programmer operation. The PC Programmer is capable of programming the following parameters:

BANK

- Bank Tag
- Special Channels
  - Priority Channels 1 & 2
  - Emergency Channel
  - Home Channel
- Zones/Available Zones

ZONE

- Zone Tag
- Scan List
- Channels/Available Channels

CHANNEL

- Channel Tag
- Channel Type
- Bandwidth
- Receive Only Option
- Options
  - Scanlist
  - Talkaround
  - Locked
- Encryption
  - Enable
  - Key
- Transmit Power
  - High and Low RF Power Levels
- Receive and Transmit Parameters
  - Operating Frequencies
  - P25 NAC (Digital)
  - Talkgroup (Digital)
  - Squelch Mode/Value (Analog)
- Shadow Channels

GLOBAL

- User (Configuration Name)
- User ID P25
- Keys and Switches
  - Auxiliary Switch (1-3) Function
  - Toggle Switch Function
  - Emergency Button Function
- Programming Access
  - Programming Enable
  - Programming Password
- Scan
  - Revert Mode
  - Scan Delay
  - Scan Reply
  - Monitor Time
- Transmit
  - Transmit Inhibit/Override
  - Transmit Timeout
- Emergency
  - Alert Mode
  - Duration Timer
  - Repeat Timer

KEY

- Key Tag
- Key ID
- Key Data

4.1.5 Cloning Cable

The Guardian G25AXG004 Programming/Cloning Cable is used to transfer programming information (excluding crypto keys and global parameters) from one radio to another radio. The cable connects to the radio side connector on both the sending (source) and receiving (target) radios. Each cable end is labeled accordingly ("Source" and "Target") for ease of use.

4.1.6 Side Connector Assembly

An audio adapter assembly that allows several different audio accessories to be connected to the side connector.

4.2 Controls, Indicators, and Connectors

Consult the Guardian G25APK001 Operator Manual for detailed user operating instructions.

4.2.1 Controls

The radio controls consist of a 16-position channel rotary knob, an On/Off/Volume rotary knob, a three-position toggle switch, three programmable function side keys, an emergency push button, a PTT switch, and a 16 button keypad.

4.2.1.1 On/Off/Volume Rotary Knob

The On/Off/Volume knob located on the top of the radio is a 16-position rotary switch. The first position is "Off", the second position is "On With Speaker Off" (mute), the remaining positions are used for increasing volume levels.

4.2.1.2 16 Channel Rotary Knob

The Channel Select knob, located on top of the radio, is used to rapidly switch between sixteen (16) pre-selected channels.

4.2.1.3 Three Position Toggle Switch

The three-position toggle switch, located on top of the radio can be programmed using the PC Programmer for Zone Select, transmit Encryption enabled/disabled, Scan on/priority/off, High/Low Power, Talkaround on/ off, Monitor (squelch adjust) on/off, and Disabled.

4.2.1.4 Push-To-Talk (PTT) Switch

The PTT switch is located on the left side of the radio.

4.2.1.5 Three Programmable-Function Side Keys

Three programmable side keys are located on the left side of the radio, two above and one below the PTT switch. These keys can be programmed using the PC Programmer for the following functions:

- Backlight dim/bright/off, (future use)
- Encryption on/off,
- Scan List add/delete,
- Keypad Disable, (future use)
- Monitor on/off,
- Scan on/priority/off,
- Signal Strength Meter on/ off,
- Talkaround on/off,
- Home Channel,
- Audible Tones on/off, (future use)
- Next Zone, (future use)
- Open Microphone, (future use)
- Previous Channel, (future use) and
- Disabled.

4.2.1.6 Emergency Key

The Emergency push button can be programmed for Emergency operation or Key Zeroize operation. When programmed for emergency operation, the Emergency push button is activated by the operator for emergency calling. Once activated, the emergency condition remains active until it is cleared by a different means, such as turning off the radio. When the emergency mode is activated, an emergency message is broadcast over the Emergency channel. There are two programmable audio (full alert and silent) and display (alert and silent) modes. When in Alert mode, EMERGENCY flashes on the radio display and an audio tone is sounded. When in the Silent mode, there is no audio tone and no LED indication. When programmed for Key Zeroize operation the emergency push-button can be used to instantly "panic zeroize" all encryption keys contained in the radio.

4.2.1.7 16 Key DTMF pad

The radio includes a 16-button conductive rubber keypad with positive feedback on the front panel. The keypad provides adjustable backlighting for nighttime viewing. The 16 keys are divided into two sections. The function of each of the four keys on the first row is indicated on the bottom line of the display. The remaining four rows of three keys each correspond to a standard 12 button DTMF (telephone) keypad.

4.2.2 Indicators

4.2.2.1 Liquid Crystal Display (LCD)

The radio contains a full graphics 80 x 32 pixel LCD that uses characters and graphics to provide the operator with radio operating information. The display provides backlighting for nighttime operation.

4.2.2.2 LED Status Indicator

Operating status is visually indicated by a three-color LED. The LED is viewable from both the top and front of the radio and provides radio status as follows:

LED	Indication
RED	Transmitting.
GREEN	Receiving/Busy Channel indicator
Flashing GREEN	Receiving Encrypted transmission
ORANGE	Emergency/Low Battery

4.2.2.3 Audible Tones

The radio has several audible tones that are activated by states of operation or by radio faults. These tones are described in Appendix C.

4.2.3 Connectors

4.2.3.1 Side Connector

The side connector is an 18-pin connector located on the right side of the radio. This connector is used for multiple functions, including PC Programming, keyfill, cloning, and audio accessory attachment. The pin names and functions are delineated in Chapter 9.

4.2.3.2 Antenna Connector

The antennas screw into an SMA female connector located on the top of the radio.

4.2.3.3 Battery Connector

The battery connects to a reliable, long-wearing, easily operated twist-lock connector mechanism located on the bottom of the radio.

4.3 Transceiver Characteristics

The radio frequency range is 136-174 MHz with channel spacing of 12.5 or 25 kHz, tunable in 5 kHz steps.

4.3.1 Transmitter Characteristics

4.3.1.1 Transmitter Output

The transmitter output consists of a single channel Frequency Modulated (FM) carrier using either conventional 12.5 or 25 kHz FM modulation, or 12.5 kHz Compatible 4-level FM (C4FM). The signal source is analog or digitized voice signals.

4.3.1.2 Transmit Squelch

Transmit squelch parameters are required to enable selective squelch communications options. These parameters are described below.

4.3.1.2.1 Analog Transmit Squelch

There are three types of analog transmit squelch:

- *None* - No squelch will be included with the analog transmit signal.
- *Continuous Tone-Controlled Squelch System (CTCSS)* - Sub-audible CTCSS squelch tones will be included with the analog transmit signal.
- *Digital Coded Squelch (DCS)* - DCS variables will be superimposed on the analog transmit signal.

4.3.1.2.2 Digital Transmit Squelch

There are four types of digital transmit squelch:

- *None* - No squelch will be included with the digital transmit signal.

- *Network Access Code (NAC)* - A digital NAC will be transmitted with the Project 25 digital transmit signal. This primary purpose of this code is to allow a user access to a repeater network.
- *Talk Group Identifier (TGID)* - A digital TGID will be transmitted with the Project 25 digital transmit signal. This primary purpose of this selective digital calling identification is to group users into functional teams.
- *Individual Call* - TGID is automatically set to 0000 (hex) and the User ID of the targeted radio is activated within the Project 25 digital transmit signal.

4.3.2 Receiver Characteristics

4.3.2.1 Receiver Performance

The receiver is capable of demodulating a single-channel FM carrier using either conventional 12.5 kHz FM, 25 kHz FM, C4FM, or Compatible Quadrature Phase Shift Keying (CQPSK) modulation. The receiver demodulates analog or digital voice and data signals. The radio circuitry can receive clear messages while operating in secure mode, and secure messages while in the clear mode if encryption is enabled.

4.3.2.2 Receive Squelch

4.3.2.2.1 Analog Receive Squelch

There are three types of analog receive squelch:

- *Carrier (Noise)* - Squelch is opened on any intelligible analog signal.
- *CTCSS* – Squelch is opened on any analog signal that has the correct CTCSS tone.
- *DCS* - Squelch is opened on any analog signal that has the correct DCS variable.

4.3.2.2.2 Digital Receive Squelch

There are four types of digital receive squelch:

- *Monitor* - Squelch is opened on any intelligible digital signal. The NAC and Talkgroup ID do not have to match.
- *Normal* - Squelch is opened on any digital signal that has the correct NAC.
- *Selective* - Squelch is opened on any digital signal that has the correct NAC and TGID.
- *Individual Call* - Squelch is opened on a digital signal that has a TGID of 0000 (hex) and has a User ID matching that of the receiving radio.

4.4 Communication Security

The radio is capable of secure communication by means of Type 3 software-based encryption, and is fully compatible with any radio using Project 25 DES encryption. When the radio is operating in the secure mode, the transmission of all tone squelch signals is disabled.

4.4.1 Algorithms

The radio is capable of Single-Bit Cipher Feedback (SBCF) DES (compatible with other manufacturers) 25 kHz channels.

4.4.2 Key-Fill

Key-fill is accomplished through the radio side connector using the PC Programmer. The PC Programming cable is used to load the keys. The radio can store up to 16 cryptographic encryption keys. The radio retains encryption keys until they are rewritten or zeroized.

4.4.3 Zeroization

The radio can immediately zeroize all encryption keys through the manual panic zeroize control. Panic zeroization can be accomplished by pressing and holding the top key on the side panel and then pressing the emergency button. The radio can also zeroize all encryption keys, or can selectively zeroize individual encryption keys, through the

programming menu. The emergency key can be programmed using the PC Programmer to panic zeroize all encryption keys.