MDS 4710/9710 Series

(Including: MDS 4710A/C/M and MDS 9710A/C/M/T)

400 MHz and 900 MHz Remote Data Transceivers

MDS 05-3305A01, Rev. D
JUNE 2008

GE MDS
industrial wireless networks

Installation & Operation Guide

QUICK START GUIDE

Below are the basic steps for installing the transceiver. See “INSTALLATION” on Page 5 of this guide for detailed instructions.

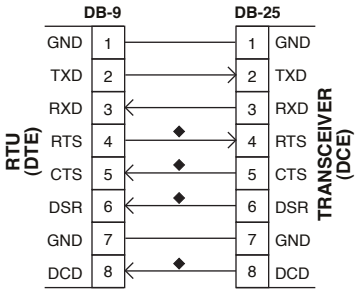
1. Install and connect the antenna system to the radio

- Use good quality, low loss coaxial cable. Keep the feedline as short as possible.
- Preset directional antennas in the direction of desired transmission.

2. Connect the data equipment to the radio’s INTERFACE connector

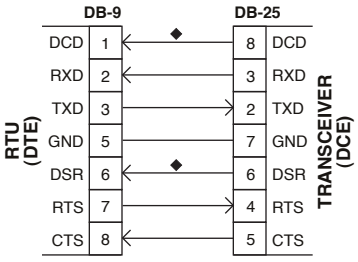
- Use a DB-25 Male connector to connect to the radio. Connections for typical systems are shown below.
- Connect only the required pins. Do not use a straight-through RS-232 cable with all pins wired.
- Verify the data equipment is configured as DTE. (By default, the radio is configured as DCE.)

DB-25 to DB-25 Example



◆ As required for application

DB-9 to DB-25 Example



◆ As required for application

3. Apply DC power to the radio (10.5–16 Vdc @ 2.5 A minimum)

- Observe proper polarity. The red wire is the positive lead; the black is negative.

4. Set the radio’s basic configuration with a Hand-Held Terminal (HHT)

- Set the transmit frequency (**TX xxx.xxxx**).
- Set the receive frequency (**RX xxx.xxxx**).
- Set the baud rate/data interface parameters as follows. Use the **BAUD xxxxx abc** command, where **xxxxx** equals the data speed (110–38400 bps) and **abc** equals the communication parameters as follows:
  a = Data bits (7 or 8)
  b = Parity (N for None, O for Odd, E for Even
  c = Stop bits (1 or 2)
  (Example: **BAUD 9600 8N1**)

  NOTE: 7N1, 8E2 and 8O2 are invalid parameters and are not supported by the transceiver.

5. Verify proper operation by observing the LED display

- Refer to Table 7 on Page 13 for a description of the status LEDs.
- Refine directional antenna headings for maximum receive signal strength using the **RSSI** command.

TABLE OF CONTENTS

Copyright Notice

Revision Notice

While every reasonable effort has been made to ensure the accuracy of this manual, product improvements may result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact our Customer Service Team using the information at the back of this guide. In addition, manual updates can often be found on the GE MDS Web site at www.microwavedata.com.

ISO 9001 Registration

GE MDS adheres to this internationally accepted quality system standard.

MDS Quality Policy Statement

We, the employees of GE MDS, LLC, are committed to achieving total customer satisfaction in everything we do.

Total Customer Satisfaction in:

- Conception, design, manufacture and marketing of our products.
- Services and support we provide to our internal and external customers.

Total Customer Satisfaction Achieved Through:

- Processes that are well documented and minimize variations.
- Partnering with suppliers who are committed to providing quality and service.
- Measuring our performance against customer expectations and industry leaders.
- Commitment to continuous improvement and employee involvement.

Antenna Installation Warning

1. All antenna installation and servicing is to be performed by **qualified technical personnel** only. When servicing the antenna, or working at distances closer than those listed below, *ensure the transmitter has been disabled*.

   Output is measured at the antenna terminal of the transmitter. The antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures to provide the minimum separation distances described in this filing for satisfying RF exposure compliance requirements. When applicable, RF exposure compliance may need to be addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of §1.1307(b)(3).

RF Exposure

Separation distances required for FCC RF Exposure compliance

2. Typically, the antenna connected to the transmitter is a directional (high gain) antenna, fixed-mounted on the side or top of a building, or on a tower. Depending upon the application and the gain of the antenna, the total composite power could exceed 200 watts EIRP. The antenna location should be such that only qualified technical personnel can access it, and that under normal operating conditions no other person can touch the antenna or approach within **3.05 meters** of the antenna.

Antenna Gain vs. Recommended Safety Distance
(MDS 4710 Series)

	Antenna Gain (MDS 4710 Series)		
	0–5 dBi	**5–10 dBi**	**10–16.5 dBi**
Minimum RF Safety Distance	0.79 meter	1.41 meters	3.05 meters

Antenna Gain vs. Recommended Safety Distance
(MDS 9710 Series)

	Antenna Gain (MDS 9710 Series)		
	0–5 dBi	**5–10 dBi**	**10–18.65 dBi**
Minimum RF Safety Distance	0.53 meter	0.94 meter	2.6 meters

FCC Part 15 Notice

The MDS 4710 AND 9710 transceivers licensed under Part 15 of the FCC Rules. (MDS 4710, Part 90.210, 403–512 MHz; MDS 9710, Part 101.101, 928–960 MHz) Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This device is specifically designed to be used under Section 15.247 of the FCC Rules and Regulations. Any

unauthorized modification or changes to this device without the express approval of Microwave Data Systems may void the user's authority to operate this device. Furthermore, this device is intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device.

CSA/us Notice

This product is approved for use in Class 1, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication *NFPA 70*, otherwise known as the National Electrical Code.

The transceiver has been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) which also issues the US mark of approval (CSA/US). The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

CSA Conditions of Approval: The transceiver is not acceptable as a stand-alone unit for use in the hazardous locations described above. It must either be mounted within another piece of equipment which is certified for hazardous locations, or installed within guidelines, or conditions of approval, as set forth by the approving agencies. These conditions of approval are as follows:

- The transceiver must be mounted within a separate enclosure which is suitable for the intended application.
- The antenna feedline, DC power cable and interface cable must be routed through conduit in accordance with the National Electrical Code.
- Installation, operation and maintenance of the transceiver should be in accordance with the transceiver's installation manual, and the National Electrical Code.
- Tampering or replacement with non-factory components may adversely affect the safe use of the transceiver in hazardous locations, and may void the approval.
- A power connector with screw-type retaining screws as supplied by GE MDS must be used.

WARNING

EXPLOSION HAZARD!

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) for further information on hazardous locations and approved Division 2 wiring methods.

Distress Beacon Warning

In the U.S.A., the 406 to 406.1 MHz band is reserved for use by distress beacons. Since the radio described in this manual is capable of transmitting in this band, take precautions to prevent the radio from transmitting between 406 to 406.1 MHz in U.S. applications.

ESD Notice

To prevent malfunction or damage to this radio, which may be caused by Electrostatic Discharge (ESD), the radio should be properly grounded by connection to the ground stud on the rear panel. In addition, the installer or operator should follow proper ESD precautions, such as touching a grounded bare metal object to dissipate body charge, prior to adjusting front panel controls or connecting or disconnecting cables on the front or rear panels.

Environmental Information

The equipment that you purchased has required the extraction and use of natural resources for its production. Improper disposal may contaminate the environment and present a health risk due to hazardous substances contained within. To avoid dissemination of these substances into our environment, and to diminish the demand on natural resources, we encourage you to use the appropriate recycling systems for disposal. These systems will reuse or recycle most of the materials found in this equipment in a sound way. Please contact MDS or your supplier for more information on the proper disposal of this equipment.

1.0 GENERAL

1.1 Introduction

This guide presents installation and operating instructions for the MDS 4710A/9710A and the MDS 4710C/9710C Series (400/900 MHz) digital radio transceivers.

These transceivers (Figure 1) are data telemetry radios designed to operate in a point-to-multipoint environment, such as electric utility Supervisory Control and Data Acquisition (SCADA) and distribution automation, gas field automation, water and wastewater SCADA, and on-line transaction processing applications. They use microprocessor control and Digital Signal Processing (DSP) technology to provide highly reliable communications even under adverse conditions.

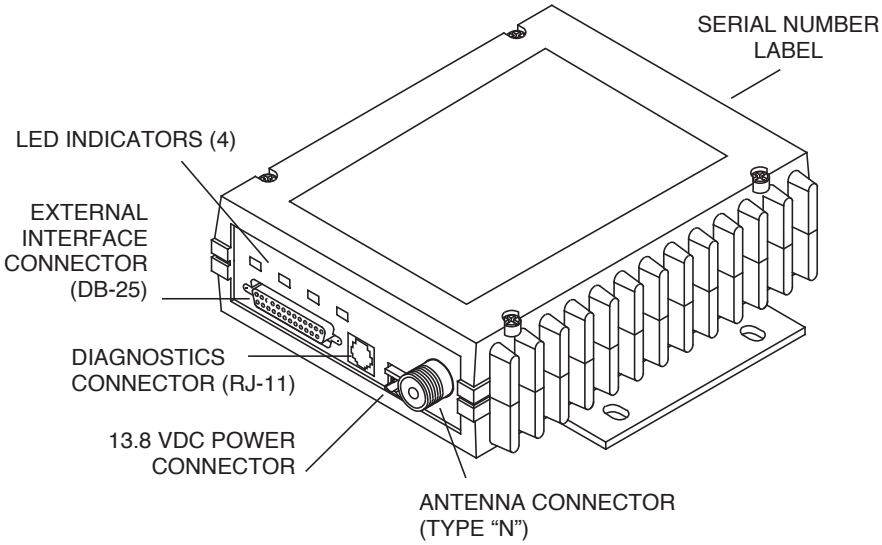


Figure 1. Transceiver Connectors and Indicators

Modulation and demodulation is accomplished using Digital Signal Processing (DSP). DSP adapts to differences between components from unit to unit, and ensures consistent and repeatable performance in ambient temperatures from –30 to +60 degrees Centigrade. The use of Digital Signal Processing eliminates the fluctuations and variations in modem operation that degrade operation of analog circuits.

The transceiver is designed for trouble-free operation with data equipment provided by other manufacturers, including Remote Terminal Units (RTUs), flow computers, lottery terminals, automatic teller machines, programmable logic controllers, and others.

NOTE: Some features are not available on all radios, based on the options purchased and the applicable regulatory constraints for the region in which the radio operates.

1.2 Applications

Point-to-Multipoint, Multiple Address Systems (MAS)

This is the most common application of the transceiver. It consists of a central master station and several associated remote units as shown in Figure 2. A MAS network provides communication between a central host computer and remote terminal units (RTUs) or other data collection devices. The operation of the radio system is transparent to the computer equipment.

Often, however, a radio system consists of many widely separated remote radios. A point-to-multipoint or SCADA (Supervisory Control and Data Acquisition) system might be a new installation for automatic, remote monitoring of gas wells, water tank levels, electric power distribution system control and measurement, etc.

The radio system can replace a network of remote monitors currently linked to a central location via leased telephone line. At the central office of such a system, there is usually a large mainframe computer and a way to switch between individual lines coming from each remote monitor. In this type of system, there is a modulator/demodulator (modem) at the main computer, and at each remote site, usually built into the remote monitor itself. Since the cost of leasing a dedicated-pair phone line is quite high, a desirable alternative is to replace the phone line with a radio path.

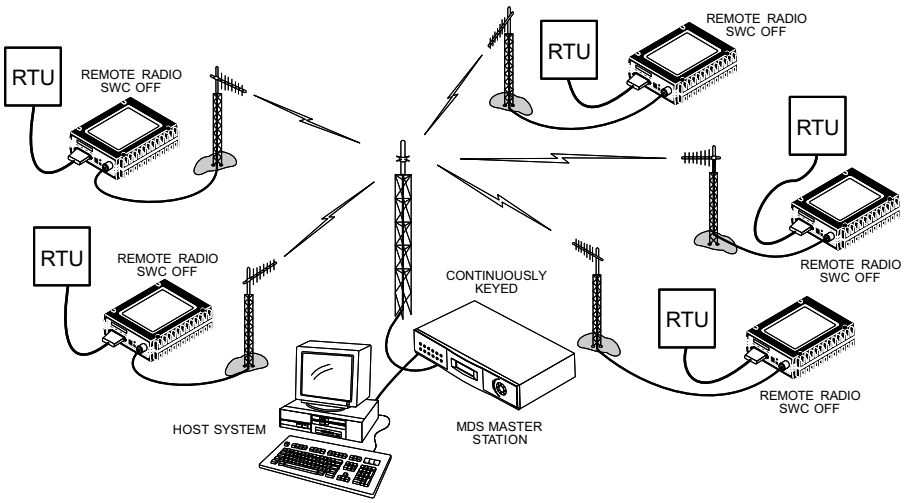


Figure 2. Typical MAS Point-to-Multipoint Network

Point-to-Point System

Where permitted, the transceiver can also be used in a point-to-point system. A point-to-point system consists of just two radios—one serving as a master and the other as a remote—as shown in Figure 3. It provides a simplex or half-duplex communication link for the transfer of data between two locations.

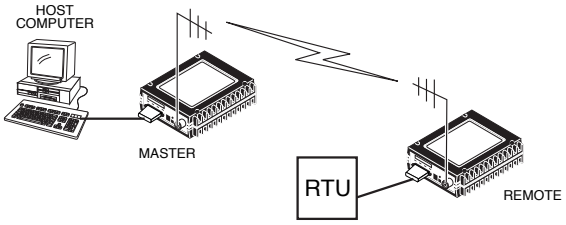


Figure 3. Typical Point-to-Point Link

Continuously-Keyed versus Switched-Carrier Operation

Continuously-Keyed operation means the master station transmitter is always keyed and an RF carrier is always present, even when there is no data to send. The master station is always simultaneously transmitting and continuously listening. Use different frequencies to transmit and receive. This is the method used in many MAS systems, as is shown in the typical system in Figure 2. This is network arrangement useful for high-speed polling applications.

NOTE: MDS 4710/9710 remotes do not support full-duplex operation.

Switched-Carrier operation is a half-duplex mode of operation where the master station transmitter is keyed to send data and unkeyed to receive.

Single-Frequency (Simplex) Operation

Single-frequency operation (also known as simplex) is a special case of switched-carrier operation. Single frequency operation is automatically selected whenever the transmit and receive frequencies are set to the same value. When used, single frequency operation increases data turn-around times.

1.3 Model Number Codes

The radio model number is printed on the end of the radio enclosure and provided through the software command **MODEL** (Page 25). It provides key information about how the radio was configured when it was shipped from the factory. This number is subject to many variations depending on what options are installed and where (country) the product

is used. Contact GE MDS if you have questions on the meaning on the code.

1.4 Contents of Standard Shipping Packages

Table 1 and Table 2 list the content of routine shipments of MDS 4710/9710 transceivers. The contents might be modified to reflect customer-specific requirements specified at the time the order was placed.

Table 1. Standard—Accessories (Supplied with All Orders)

Item Description	GE MDS Part Number
Transceiver Power Cable Assembly 12 Vdc, (UL-Approved)	03-1846A02
Cable, TELCO-Type, 84", RJ12 to RJ12	03-2198A05
Radio Configuration Software for Windows OS	03-3156A01
Installation & Operation Guide	05-3305A01
Connector, RJ-11 to DB-9 (Female)	73-2434A02

Table 2. Items Supplied with Diagnostic Option

Item Description	GE MDS Part Number
InSite 6 Network Diagnostics Software (CD-ROM)	03-3533A01
InSite Network Diagnostics Manual	05-3467A01

1.5 Accessories

The transceiver can be used with one or more of the accessories listed in Table 3. Contact GE MDS for ordering information.

Table 3. Optional Accessories for MDS 4710/9710 Transceivers

Accessory	Description	GE MDS P/N
Power Supply Kit	Provides nominal 13.8 Vdc from a 120 Vac power source. Includes DC cable for transceiver.	01-3682A01
Hand-Held Terminal Kit (HHT)	Terminal that plugs into the radio for programming, diagnostics and control. Includes carrying case and cable set.	02-1501A01
RTU Simulator	Test unit that simulates data from a remote terminal unit. Comes with polling software that runs on a PC. Useful for testing radio operation.	03-2512A01
Orderwire Module	External device that allows temporary voice communication. Useful during setup and testing of the radio system.	02-1297A01

Table 3. Optional Accessories for MDS 4710/9710

Accessory	Description	GE MDS P/N
Orderwire Handset	Used with Orderwire Module (above)	
	Standard Handset	12-1307A01
	Handset w/PTT	12-1307A02
RJ-11 to DB-9 adapter	Used to connect a PC to the radio's DIAG. (Diagnostics) port	03-3246A01
EIA-232 to EIA-422 Converter Assembly	External adapter plug that converts the radio's DATA INTERFACE connector to EIA-422 compatible signaling.	03-2358A01
Radio Configuration Software	Provides diagnostics of the transceiver (Windows-based PC required.)	03-3156A01

2.0 INSTALLATION

There are three main requirements for installing the transceiver:

- Adequate and stable primary power
- A good antenna system, and the correct data connections between the transceiver, and
- The data device.

Figure 4 shows a typical remote station arrangement.

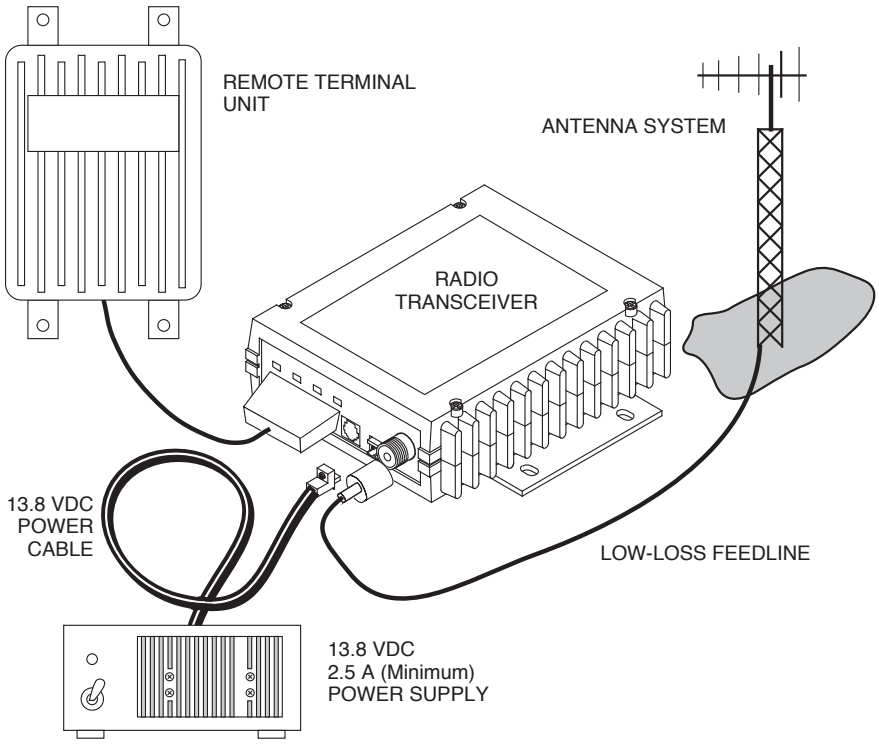


Figure 4. Typical Remote Station Arrangement

2.1 Installation Steps

Below are the basic steps for installing the transceiver. In most cases, these steps alone are sufficient to complete the installation. More detailed explanations appear at the end of these steps.

1. Mount the transceiver to a stable surface using the brackets supplied with the radio.

2. Install the antenna and feedline for the station. Point directional antennas in the direction of the associated network's Master Station.

3. Connect the data equipment to the transceiver's DATA INTERFACE connector. Use only the required pins for the application—Do *not* use a fully pinned (25-conductor) cable. Basic applications might require only the use of Pin 2 (Transmit Data—TXD), Pin 3 (Received Data—RXD) and Pin 7 (Signal Ground). The radio can be keyed by using the **DATAKEY** command.

   Additional connections might be required for some installations. Refer to the complete list of pin functions provided in Table 6 on Page 10.

4. Measure and install the primary power for the radio. The red wire on the GE MDS-provided power cable is the positive lead; the black is negative.

CAUTION

POSSIBLE EQUIPMENT DAMAGE

Only use the MDS 4710/9710 radio transceivers in negative-ground systems.

Connection to a positive-ground system or an accidental reversal of the power leads can damage the transceiver.

5. Set the radio configuration. In most cases, the transceiver requires only minimal software configuration. The selections that *must* be made for new installations are:

   - Transmit frequency ("TX [xxx.xxxx]" on Page 28)
   - Receive frequency ("RX [xxx.xxxx]" on Page 26)

   The operating frequencies are not set at the factory unless they were specified at the time of order. Determine the transmit and receive frequencies to be used, and follow the steps below to program them.

6. Connect a hand-held terminal (HHT) to the DIAG. (diagnostic) connector. When the HHT beeps, press **ENTER** to receive the ready ">" prompt.

7. Set the operating frequencies using the **TX xxx.xxxx** (transmit) and **RX xxx.xxxx** (receive) commands.

   Press **ENTER** after each command. After programming, the HHT reads **PROGRAMMED OK** to indicate successful entry.

2.2 Transceiver Mounting

NOTE: To prevent moisture from entering the radio, do not mount the radio with the cable connectors pointing up. Also, dress all cables to prevent moisture from running along the cables and into the radio.

Figure 5 shows the mounting dimensions of the transceiver.

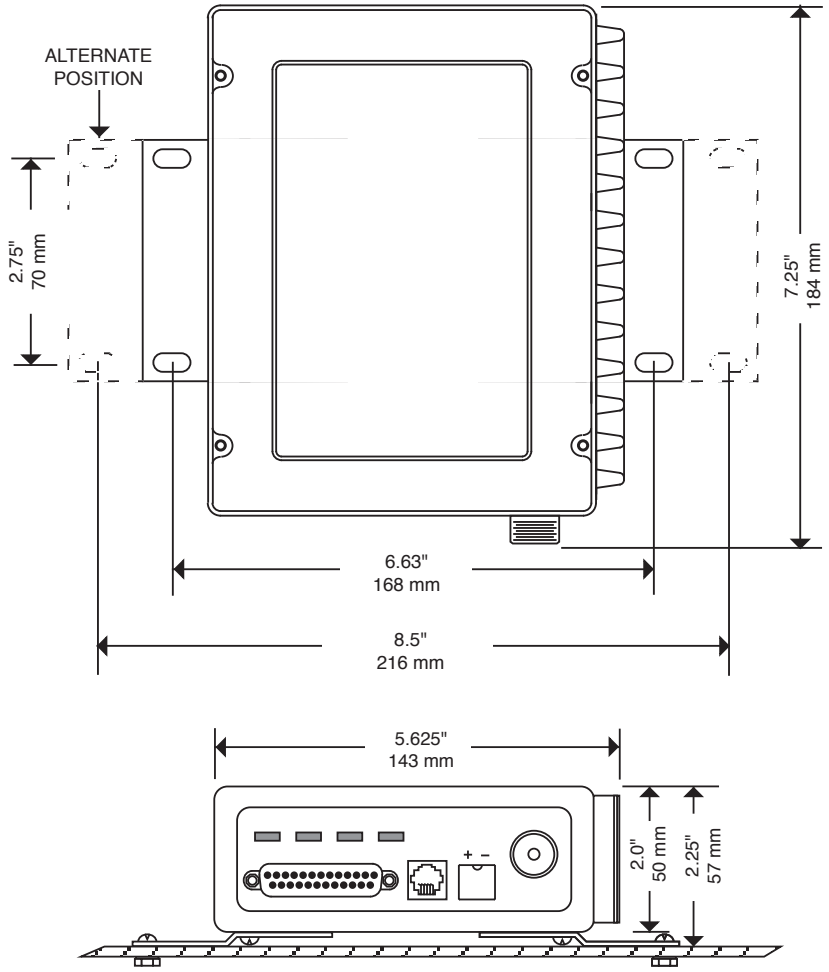


Figure 5. Transceiver Mounting Dimensions

CAUTION
POSSIBLE EQUIPMENT DAMAGE

Using screws longer than 1/4 inch (6 mm) to attach the brackets to the radio may damage the internal PC board. Use only the supplied screws.

2.3 Antennas and Feedlines

Antennas

The transceiver can be used with a number of antenna styles. The exact style depends on the physical size and layout of the radio system. A directional Yagi (Figure 6) or corner reflector antenna is generally recommended at remote sites to minimize interference to and from other users. Antennas of this type are available from several manufacturers.

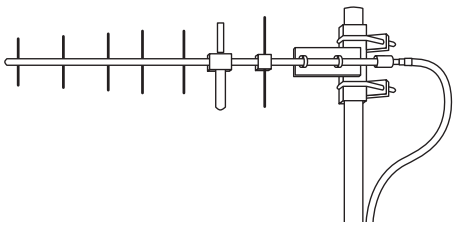


Figure 6. Typical Yagi Antenna (mounted to mast)

Feedlines

The selection of antenna feedline is very important. Avoid using poor quality cables as they will result in power losses that can reduce the range and reliability of the radio system.

Table 4 and Table 5 show the losses that will occur when using various lengths and types of cable at 400 and 960 MHz. Keep the cable as short as possible to minimize signal loss.

Table 4. Length vs. Loss in Coaxial Cables at 400 MHz

Cable Type	10 Feet (3.05 Meters)	50 Feet (15.24 Meters)	100 Feet (30.48 Meters)	500 Feet (152.4 Meters)
RG-8A/U	0.51dB	2.53 dB	5.07 dB	25.35 dB
1/2 inch HELIAX	0.12 dB	0.76 dB	1.51 dB	7.55 dB
7/8 inch HELIAX	0.08 dB	0.42 dB	0.83 dB	4.15 dB
1-1/4 inch HELIAX	0.06 dB	0.31 dB	0.62 dB	3.10 dB
1-5/8 inch HELIAX	0.05 dB	0.26 dB	0.52 dB	2.60 dB

Table 5. Length vs. Loss in Coaxial Cables at 960 MHz

Cable Type	10 Feet (3.05 Meters)	50 Feet (15.24 Meters)	100 Feet (30.48 Meters)	500 Feet (152.4 Meters)
RG-8A/U	0.85 dB	4.27 dB	8.54 dB	42.70 dB

Table 5. Length vs. Loss in Coaxial Cables at 960 MHz

1/2 inch HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 inch HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB
1-1/4 inch HELIAX	0.10 dB	0.48 dB	0.95 dB	4.75 dB
1-5/8 inch HELIAX	0.08 dB	0.40 dB	0.80 dB	4.00 dB

2.4 Power Connection

The transceiver is compatible with any well-filtered 10.5 to 16 Vdc power source. The power supply should be capable of providing at least 2.5 amperes of continuous current.

The red wire on the power cable is the positive lead; the black is negative.

NOTE: The radio is designed for use only in negative ground systems.

2.5 Safety/Earth Ground

To minimize the chances of damage to the transceiver and connected equipment, a good safety ground is recommended which bonds the antenna system, the radio transceiver, power supply, and connected data equipment to a single-point ground. Normally, the transceiver is adequately grounded if the GE MDS mounting brackets are used to mount the radio to a well-grounded metal surface.

If the transceiver is not mounted to a grounded surface, connect a safety ground to the transceiver case. A ground can be connected to one of the four screws on the bottom of the transceiver. Do not use any of the four screws that clamp together the upper and lower parts of the transceiver case.

Connect all rack equipment and associated hardware grounds to the building's ground system for the primary power. The objective is to create a single-point ground system, keeping all grounds leads as short as possible.

To prevent damage, provide a good ground connection for the equipment connected to the INTERFACE connector.

Finally, use lightning protectors where the antenna transmission lines enter the building; bond them to the tower ground, if it is nearby.

2.6 Data Interface Connections

Connect the transceiver's DATA INTERFACE connector to an external DTE data terminal that supports the EIA-232 (formally RS-232) format. The transceiver supports autobaud asynchronous data rates of up to 19200 bps. The data rate at the DATA INTERFACE connector might differ from the data rate used over the air.

Table 6 lists each pin on the DATA INTERFACE connector and describes its function.

CAUTION

USE ONLY REQUIRED PINS

Do not use a 25 wire (fully pinned) cable for connection to the DATA INTERFACE connector. Use *only* the required pins for the application. Damage can result if improper connections are made. Typical applications require the use of *only* Pins 1 through 8 for EIA-232 signaling.

Table 6. DATA INTERFACE Connector Pinouts

Pin Number	Input/ Output	Pin Description
1	--	**Protective Ground.** Connects to ground (negative supply potential) on the radio's PC board and chassis.
2	IN	**TXD—Transmitted Data.** Accepts TX data from the connected device.
3	OUT	**RXD—Received Data.** Outputs received data to the connected device.
4	IN	**RTS—Request-to-Send Input.** Keys the transmitter when RTS is at logic high.
5	OUT	**CTS—Clear-to-Send Output.** Goes "high" after the programmed CTS delay time has elapsed (DCE) or keys an attached radio when RF data arrives (CTS KEY).
6	OUT	**DSR—Data Set Ready.** Provides a +6 Vdc DSR signal through a 2.5 kΩ resistor.
7	--	**Signal Ground.** Connects to ground (negative supply potential) at radio's PC board.
8	OUT	**DCD—Data Carrier Detect.** Goes "high" when the modem detects a data carrier from the master station.
9	IN	**Transmit Audio Input.** Connects to the audio output of an external (AFSK) modem. The input impedance is 600 Ω. Use Pin 7 for the modem's return lead.
10	OUT	**RUS—Receiver Unsquelched Sensor.** Not used in most installations, but is available as a convenience. Provides +8 Vdc through a 1 kΩ resistor whenever the receiver squelch is open, and drops to less than 1 Vdc when the squelch is closed.
11	OUT	**Receive Audio Output.** Connects to the audio input of an external (AFSK) modem. The output impedance is 600 Ω, and the level is factory set to suit most installations. Use Pin 7 for the modem's return lead.

Table 6. DATA INTERFACE Connector Pinouts *(Continued)*

Pin Number	Input/ Output	Pin Description
12	IN	**Radio Inhibit (Sleep).** A ground on this pin places the radio in sleep mode. It turns off most circuits in the radio, including transmit, receive, modem and diagnostic functions. This allows for greatly reduced power consumption, yet preserves the radio's ability to be quickly brought online.
13	--	Do not connect—Reserved for future use.
14	IN	**PTT—Push-to-Talk.** This line is used to key the radio with an active-high signal of +5 Vdc.
15	--	**User-Programmable Output 2—**EIA-232-compatible output controllable though GE MDS' InSite NMS program. See "User-Programmable Interface Output Functions" on Page 36 for details.
16	IN	**$\overline{\text{PTT}}$—Push to Talk.** This line is used to key the radio with an active-low signal of 0 Vdc.
17	--	Do not connect—Reserved for future use.
18	OUT	**Accessory Power.** Unregulated Output. Provides a source of input power for low current accessories. Excessive drain on this connection trips the self-resetting fuse F1 on the transceiver PC board. The voltage at this pin matches the input voltage to the transceiver.
19	OUT	**9.9 Vdc Regulated Output.** Provides a source of regulated voltage at 100 mA for low power accessories.
20	--	Do not connect—Reserved for future use.
21	OUT	**RSSI—Received Signal Strength Indication.** Connect a DC voltmeter to this pin to read the relative strength of the incoming signal. Figure 7 on Page 13 shows RSSI vs. DC voltage.
22	--	**User-Programmable Output 1—**CMOS-compatible output controllable though GE MDS' InSite NMS program. See "User-Programmable Interface Output Functions" on Page 36 for details.
23	IN	**Diagnostic Channel Enable.** A ground on this pin causes the radio's microcontroller to open the DB-25 DATA INTERFACE for diagnostics and control instead of the normal RJ-11 DIAG. connection.
24	--	Do not connect—Reserved for future use.
25	OUT	**Alarm.** A logic low (less than 0.5 volts) on this pin indicates normal operation. A logic high (greater than 4 volts) indicates that some alarm condition is present. This pin can be used as an alarm output, provided the internal series resistance of 1 kΩ is considered.

2.7 Using the Radio's Sleep Mode

In some installations, such as at solar-powered sites, use Sleep Mode to keep the transceiver's power consumption to an absolute minimum. In Sleep Mode, power consumption is reduced to less than 16 milliamperes (nominal).

Enable Sleep Mode through RTU control by asserting a ground (or RS-232 low) on Pin 12 of the radio's DATA INTERFACE connector.

When Pin 12 is opened (or an RS-232 high is asserted), the radio is ready to receive data within 75 milliseconds.

All normal functions are suspended while the radio is in Sleep Mode. The PWR LED is off, except for a quick flash every five seconds.

System Example

The following example describes Sleep Mode implementation in a typical system. Use this information to configure a system that meets your own particular needs.

Sleep Mode Example:

> Suppose you need communication to each remote site only once per hour. Program the RTU to raise an RS-232 line once each hour (DTR for example), and wait for a poll and response before lowering it again. Connect this line to Pin 12 of the radio's DATA INTERFACE connector. This allows each RTU to be polled once per hour with a significant savings in power consumption.

3.0 OPERATION

In-service operation of the transceiver is completely automatic. Once the unit is properly installed and configured, operator actions are limited to observing the front panel LED status indicators for proper operation.

If all parameters are correctly set, start radio operation by following these steps:

1. Apply DC power to the transceiver.

2. Observe the LED status panel for the proper indications (Table 7).

3. If not done earlier, refine the antenna heading of the station to maximize the received signal strength (RSSI) from the master station.

   Use the **RSSI** command from an HHT connected to the radio's DIAG. connector. See *Section 4.0, TRANSCEIVER PROGRAMMING* on Page 14. This can also be done with a DC voltmeter as described in *Section 3.2, RSSI Measurement* (Page 13).

3.1 LED Indicators

Table 7 describes the function of each status LED.

Table 7. LED Status Indicators

LED Name	Description
PWR	• Continuous—Power is applied to the radio, no problems detected. • Rapid flash (five times-per-second)—Fault indication. • Flashing once every 5 seconds—Radio is in Sleep mode.
DCD	• Flashing—Indicates the radio is receiving intermittent data frames. • Continuous—Radio is receiving a data signal from a continuously keyed radio.
TXD	An EIA-232 mark signal is being received at the DATA INTERFACE connector.
RXD	An EIA-232 mark signal is being sent out from the DATA INTERFACE connector.

3.2 RSSI Measurement

As an alternative to using an HHT, the radio's received signal strength (RSSI) can be read with a DC voltmeter connected to Pin 21 of the DATA INTERFACE connector. Figure 7 shows the relationship between received signal level and the DC voltage on Pin 21 of the DATA INTERFACE connector. (Note: Readings are not accurate for incoming signal strengths above –50 dBm.)

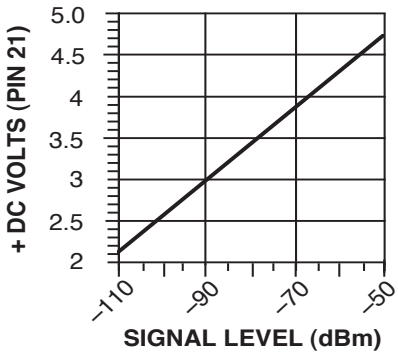


Figure 7. RSSI vs. Vdc (Typical)

4.0 TRANSCEIVER PROGRAMMING

To program and control the transceiver, use the radio's RJ-11 DIAG. (Diagnostics) connector with an GE MDS Hand-Held Terminal (MDS P/N 02-1501A01). This section contains a reference chart (Table 9) and detailed descriptions for each user command.

NOTE: In addition to HHT control, Windows-based software is available (MDS P/N 03-3156A01) to allow diagnostics and programming using a personal computer. An installation booklet and on-line instructions are included with the software. Contact GE MDS for ordering information.

4.1 Hand-Held Terminal Connection & Startup

This section provides basic information for connecting and using the GE MDS Hand-Held Terminal. For more information about the terminal, refer also to the instructions included with each HHT kit.

The steps below assume that the HHT is configured for use with the transceiver (80 character screen display). If the HHT was previously used with a different model transceiver, or if its default settings were changed, refer to *Section 4.2, Hand-Held Terminal Setup* (Page 15) for setup details.

Follow these steps to connect the HHT:

1. Connect the HHT's coiled cord to the DIAG. (RJ-11) jack on the radio as shown in Figure 8. This automatically places the radio into the control and programming mode.

   As an alternative, the DATA INTERFACE (DB-25) connector can be used for programming instead of the DIAG. jack. With this arrangement, Pin 23 of the HHT cable must be grounded to enable the diagnostic channel. (See Table 6 on Page 10.)

2. When the HHT is connected, it runs through a brief self-check, and ends with a beep. After the beep, press **ENTER** to receive the ready "**>**" prompt.

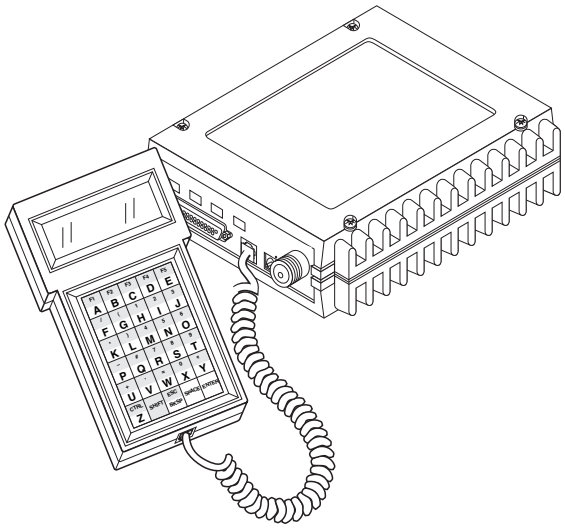


Figure 8. Hand-Held Terminal Connected to the Transceiver

4.2 Hand-Held Terminal Setup

The following is a set of instructions for re-initializing an HHT for use with the transceiver. These steps might be required if the HHT was previously used with a different radio, or if the HHT default settings were inadvertently altered.

1. Plug the HHT into the DIAG. connector. Enable the setup mode by pressing the **SHIFT**, **CTRL** and **SPACE** keys in sequence. The display shown in Figure 9 appears.

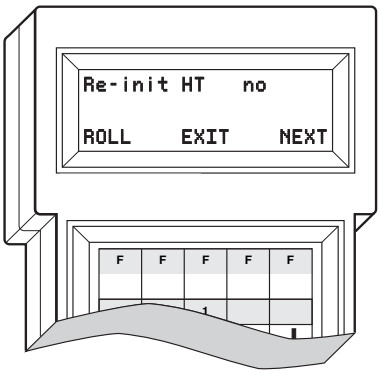


Figure 9. HHT Setup Display

2. The display shows the first of 15 menu items. To review settings, press the **E** key. This controls the NEXT function. To change parameter settings, press the **A** key. This controls the ROLL function.

3. Configure the HHT as listed in Table 8.

Table 8. HHT Operational Settings

Parameter	Setting	Parameter	Setting
Re-init HHT	NO	Scroll On	33rd
Baud Rate	9600	Cursor	ON
Comm bits	8,1,n	CRLF for CR	OFF
Parity Error	OFF	Self Test	FAST
Key Repeat	OFF	Key Beep	ON
Echo	OFF	Screen Size	80
Shift Keys	YES	Menu Mode	LONG
Ctl Chars	PROCS		

NOTE: In rare cases, it may be necessary to reset the HHT to its factory defaults before any configuration can be performed. To do this: Hold the CTRL/Z and ENTER keys *simultaneously*, while plugging in the power cable into the HHT.

4.3 Keyboard Commands

Table 9 on Page 17 is a reference chart of software commands for the transceiver. Programmable information is shown in brackets [ ] following the command name. See *Section 4.4, Detailed Command Descriptions* (Page 19) for detailed command descriptions.

Entering Commands

To enter a command, type the command, and then press the ENTER key.

For programming commands:

1. Type the command.

2. Press the SPACE key.
   The appropriate information or values follow.

3. Press the ENTER key.

Here are some additional points to remember when using the HHT:

- Use the SHIFT key to access numbers; press again to return to letter mode.
- Use the ESC/BKSP key to edit information or command entries.
- The flashing square cursor (▫) indicates that Letter Mode is selected.
- The flashing superscript rectangular cursor (▭) indicates that Number Mode is selected.

Error Messages

Below are some possible error messages encountered when using the HHT:

UNKNOWN COMMAND—The command was not recognized. Refer to the command description for command usage information.

INCORRECT ENTRY—The command format or its associated values were not valid. Refer to the command description for command usage information.

COMMAND FAILED—The command was unable to successfully complete. This is a possible internal software problem.

NOT PROGRAMMED—Software was unable to program the internal radio memory or the requested item was not programmed. This is a serious internal radio error. Contact GE MDS.

TEXT TOO LONG—Response to **OWN** or **OWM** command when too many characters are entered. Refer to the command description for command usage information.

NOT AVAILABLE—The entered command or parameter was valid, but it referred to a currently unavailable choice. Refer to the command description for command usage information.

ACCESS DENIED—The command is unavailable to the user. Refer to the command descriptions for command information.

EEPROM FAILURE— The **INIT** command was unable to write to EEPROM. This is a serious internal radio error. Contact GE MDS.

See Table 9 for a summary of the user commands.

Table 9. Command Summary

Command name	Function
ALARM *Details Page 19*	Read current operating condition of radio.
AMASK [0000 0000–FFFF FFFF] *Details Page 19*	Set or display hex code identifying which events trigger an alarm.
ASENSE [HI/LO] *Details Page 20*	Set or display the state of the alarm output signal to ACTIVE HI or ACTIVE LO.
BAUD [xxxxx abc] *Details Page 21*	Set or display the DATA INTERFACE data rate and control bits.
BUFF [ON, OFF] [xxx] *Details Page 21*	Enables or disables the internal radio data buffer.
CTS [0–255] *Details Page 22*	Set or display the Clear-to-Send delay in seconds.
CKEY [ON–OFF] *Details Page 22*	Enables or disables the continuously keyed mode. Note: Remotes cannot receive when keyed.
DATAKEY [ON, OFF] *Details Page 22*	Enables or Disables key-on-data mode (ON = key-on-data or RTS, OFF = key-on-RTS).
DEVICE [DCE, CTS KEY] *Details Page 22*	Set/display device mode.
DKEY *Details Page 23*	Dekey the radio (transmitter OFF). This is generally a radio test command.

Table 9. Command Summary *(Continued)*

Command name	Function
DIN [ON/OFF] *Details Page 23*	Configures local diagnostic link protocol.
DTYPE [NODE/ROOT] *Details Page 23*	(*diagnostics*) Sets up a radio as a root or node radio.
DUMP *Details Page 23*	Display all programmable settings.
HREV *Details Page 24*	Display the Hardware Revision level.
INIT *Details Page 24*	Set radio parameters to factory defaults.
INIT [4710/9710] *Details Page 24*	Configure radio for use *outside* of P-20 chassis. Restores certain transceiver defaults changed by the **INIT x720** command.
INIT [4720/9720] *Details Page 24*	Configure radio for service *within* a P-20 redundant/protected chassis.
KEY *Details Page 25*	Key the radio (transmitter ON). This is generally a radio test command.
MODEL *Details Page 25*	Display the model number of the radio.
MODEM [xxxx, NONE] *Details Page 25*	Set the modem characteristics of the radio.
OWM [XXX...] *Details Page 25*	Set or display the owner's message.
OWN [XXX...] *Details Page 25*	Set or display the owner's name.
PTT [0–255] *Details Page 25*	Set or display the Push-to-Talk delay in milliseconds.
PWR [20–37] *Details Page 25*	Set or display the transmit power setting.
RSSI *Details Page 26*	Display the Received Signal Strength Indication.
RTU [ON/OFF/0-80] *Details Page 26*	Re-enables or disables the radio's internal RTU simulator and sets the RTU address.
RX [xxx.xxxx] *Details Page 26*	Set or display receiver frequency.
RXLEVEL [–20 to +6] *Details Page 27*	Set or display the receive audio input level.
RXTOT [NONE, 1-1440] *Details Page 27*	Set or display the value of the receive time-out timer.
SCD [0-255] *Details Page 27*	Set or display the Soft-Carrier Dekey delay in milliseconds.
SER *Details Page 27*	Display the radio serial number.
SHOW [DC, PORT, PWR] *Details Page 27*	Display the DC voltages, diagnostics port, and transmit power level.
SREV *Details Page 28*	Display the Software Revision Level.
STAT *Details Page 28*	Display radio status and alarms.
TEMP *Details Page 28*	Display the internal temperature of the radio in degrees C.
TOT [1-255, ON, OFF] *Details Page 28*	Set or display the Time-out Timer delay in seconds.

Table 9. Command Summary *(Continued)*

Command name	Function
TX [xxx.xxxx] *Details Page 28*	Set or display the transmit frequency.
TXLEVEL [–20 to +6, AUTO] *Details Page 29*	Set or display the transmit audio input level.
UNIT [10000...65000] *Details Page 29*	Set or display the transceiver's unit address.

4.4 Detailed Command Descriptions

The only *critical* commands for most applications are transmit and receive frequencies (**RX xxx.xxxx,TX xxx.xxxx**). However, proper use of the additional commands allows you to tailor the transceiver for a specific use, or conduct basic diagnostics on the radio. This section provides more detailed information for the user commands previously listed in Table 9 (Page 17).

In many cases, the commands shown here can be used in two ways:

- You can type *only* the command name to view the currently programmed data.
- You can set or change the existing data by typing the command, followed by a space, and then the desired entry. In the list below, acceptable programming variables, if any, are shown in brackets following the command name.

ALARM

The **ALARM** command displays a summary of the radio's current operating condition. An eight-digit hexadecimal code is presented that can be decoded as described in "Major Alarms vs. Minor Alarms" on Page 30.

AMASK [0000 0000–FFFF FFFF]

Alarm Mask

The **AMASK** command displays or sets a mask indicating which events cause the alarm output signal to be active. Normally, the mask is **FFFF FFFF**, meaning that any of the 32 possible events can activate the alarm output signal.

Entering the **AMASK** command alone displays the current setting of alarm events in hexadecimal format.

Entering the **AMASK** command followed by an eight-digit hexadecimal number reprograms the specified events to trigger an alarm.

The eight-digit hexadecimal number used as the command parameter specifies 0 to 32 events that can trigger the external alarm output. (See Table 10 below for a list of events.) The hex value for the mask corresponds to the hex value for the **ALARM** command (Page 28). Each bit that is a '1' identifies an alarm condition that can trigger the external output. For more information on configuring the alarm response, contact GE MDS.

Table 10. Text messages of alarm event codes

Event Number	Text Message
01	Hardware mismatch
02	Model number not programmed
03	Authorization fault
04	Synthesizer out-of-lock
07	Voltage regulator fault detected
08	Radio not calibrated
09	DSP download fault
10	EEPROM write failure
11	Checksum fault
12	Receiver time-out
16	Unit address not programmed
17	Data parity error
18	Data framing error
20	Configuration error
25	6-Volt regulator output not in valid range
26	DC input power is not in valid range
31	Internal temperature not in valid range

ASENSE [HI/LO]

Alarm Sense

The **ASENSE** command sets or displays the sense of the alarm output at Pin 25 of the DATA INTERFACE connector.

Entering the **ASENSE** command alone shows whether the alarm output is active high or low. Entering the **ASENSE** command followed by **HI** or **LO** resets the alarm output to active high or low.

BAUD [xxxxx abc]

Data Interface Port Baud Rate

This command sets (or displays) the communication attributes for the DATA INTERFACE port. It has no effect on the RJ-11 DIAG. port.

The first parameter (**xxxxx**) is baud rate. Baud rate is specified in bits-per-second (bps) and must be set to one of the following speeds: 1200, 2400, 4800, 9600, or 19200.

The second parameter of the **BAUD** command (**abc**) is a three-character block indicating how the data is encoded:

a = Data bits (7 or 8)
b = Parity (N for None, O for Odd, E for Even)
c = Stop bits (1 or 2)

The factory default setting is 9600 baud, 8 data bits, no parity, 1 stop bit (Example: **9600 8N1**).

NOTE: 7N1, 8O2, and 8E2 are invalid communication settings and are not supported by the transceiver.

BUFF [ON, OFF] [xxx]

RX Data Buffer

This command sets or displays the received data handling mode of the radio. The command parameter is either **ON** or **OFF**. The default is **ON**. This command affects the timing of how received RF data is sent out from the DATA INTERFACE connector. Outgoing (transmitted) data is not affected by this command.

If data buffering is **OFF**, the radio operates with the lowest possible average latency. Data bytes are thus sent out the DATA INTERFACE port as soon as an incoming RF data frame is disassembled. Average and typical latency will both be below 10 ms, but idle character gaps might be introduced into the outgoing data flow.

If data buffering is **ON**, the radio operates in Seamless Mode. Data bytes will be sent over the air as quickly as possible, but the receiver buffers (stores) the data until enough bytes have arrived to cover worst-case gaps in transmission. This mode of operation is required for protocols such as MODBUS™ that do not allow gaps in their data transmission.

Note that Seamless Mode (**BUFF ON**) is intended only for applications where the transmitter's baud rate is greater than or equal to the receiver's baud rate. Enforcement of this rule is left up to the user.

In some rare cases, the default timing parameters for Seamless Mode are not optimal. In these cases, the user might need to specify an exact delay time. To set a custom delay time, enter **BUFF xxx** (**xxx** is a value between 1 and 255). Entering **BUFF xxx** resets the default delay time.

CKEY [ON–OFF]

Key TX Continuously

The **CKEY** command enables or disables the continuously-keyed function of the radio. When **CKEY** is set to **ON**, the radio is continuously keyed and the Timeout Timer is disabled.

CTS [0–255]

Clear-to-Send Time

The **CTS** (clear-to-send) command selects or displays the timer value associated with the CTS line response. The command parameter ranges from 0 to 255 milliseconds.

For DCE operation, the timer specifies how long to wait after the RTS line goes high, before the radio asserts CTS and the DTE transmits the data. A CTS value of zero keys the radio and asserts the CTS line immediately after the RTS line goes high.

For CTS Key operation (see **DEVICE** command), the timer specifies how long to wait after asserting the CTS, before sending data out through the DATA INTERFACE port. A timer value of zero means that data is sent out through the data port without imposing a key-up delay. (Other delays might be present based on selected radio operating commands.)

DATAKEY [ON, OFF]

Key on Data Activity

The **DATAKEY** command enables or disables the ability of the radio to key the transmitter as data is received at the DATA INTERFACE connector. Asserting RTS keys the radio regardless of this command setting.

If **DATAKEY** is set to **ON**, the radio will key when a full data-character is received at the transceiver's DATA INTERFACE connector. If **DATAKEY** is set to **OFF**, the radio needs to be keyed by asserting either the RTS or PTT signal or with the **CKEY** or **KEY** command.

DEVICE [DCE, CTS KEY]

Data Device Mode

The **DEVICE** command controls or displays the device behavior of the radio. The command parameter is either **DCE** or **CTS KEY**.

In **DCE** mode (the default setting), CTS will go high following RTS, subject to the CTS programmable delay time. If the **DATAKEY** command is set to **ON**, keying can be stimulated by the input of characters at the data port. Hardware flow control is implemented by signaling the CTS line if data arrives faster than it can be buffered and transmitted.

In **CTS KEY** mode, the transceiver is assumed to be controlling another radio. It will still key based on the RTS line, but the CTS line is used as a keyline control for the *other* radio. CTS is asserted immediately following the receipt of RF data, but data will not be sent out the DATA INTERFACE port until after the CTS programmable delay time has expired. (This gives the other radio time to key.)

DKEY

Unkey Transmitter

This command deactivates the transmitter after it has been keyed with the **KEY** command.

DIN [ON/OFF]

Digital Input

When **DIN ON** is selected, the "not" PTT line (Pin 16 on the DB-25) is re-defined as a digital input for network-wide diagnostics.

See "User-Programmable Interface Output Functions" on Page 36 for more information. The default is **DIN OFF**.

To change the diagnostic link, enter **DLINK** followed by one of the following baud rates: 1200, 2400, 4800, 9600, 19200 (default).

DLINK [ON/OFF/xxxx]

Diagnostic Link

This command is used to configure the local diagnostic link protocol used in network-wide diagnostics.

DLINK ON enables the diagnostic link. **DLINK OFF** disables the diagnostic link.

To change the diagnostic link, enter **DLINK** followed by one of the following baud rates: 1200, 2400, 4800, 9600, 19200 (default).

DTYPE [NODE/ROOT]

Unit's Diagnostics Type

This command establishes the local radio as a root radio or node radio for network-wide diagnostics. Entering **DTYPE NODE** configures the radio as a node radio. Entering **DTYPE ROOT** configures the radio as a root radio. Entering the **DTYPE** command alone displays the current setting. See "Performing Network-Wide Remote Diagnostics" on Page 34

DUMP

Read Current Unit Profile

This command displays all the programmed settings with this one command. The HHT display is too small to list all the command settings at one time. Therefore, this command is most useful if the command is issued from a computer or full-screen terminal.

EMP [ON/OFF]

Modem TX Audio Pre-Emphasis

This command displays or sets the TX pre-emphasis and RX De-Emphasis when the radio is operating with the analog mode and the radio's MODEM is turned off (**MODEM NONE**). It should match the other radios in the system. The use of pre and de-emphasis helps to reduce the detrimental influence of high frequency audio noise.

HREV

Hardware Revision

This command displays the transceiver's hardware revision level. If nothing is displayed, the hardware revision level was not programmed by the factory.

INIT

Initialize EEPROM Defaults

The **INIT** command is used to re-initialize the radio's operating parameters to the factory defaults. This is helpful when trying to resolve configuration problems that might have resulted from the entry of one or more improper command settings. If you are unsure of which command setting caused the problem, this command allows you to get back to a known working state. The following changes to the radio are made when **INIT** is entered:

- **CTS** is set to 0
- **DATAKEY** is set to **ON**
- **DEVICE** is set to **DCE**
- **PTT** is set to 0
- **SCD** is set to 0
- **TOT** is set to 30 seconds and set to **ON**
- **PWR** is set to +37 dBm (5 watts)

All other commands stay in the previously established setting.

INIT [4710/9710]

Packaged Model Initialization

This command sets the transceiver for "normal" operation *outside* the P-20 chassis by setting the following parameters to the values shown below:

ASENSE	**ACTIVE HI**
AMASK	**FFFF FFFF** (assert alarm output on all alarms)
RXTOT	**NONE** (receive time-out timer disabled)

Use this command can to restore these three parameters to the standard transceiver defaults if it was used in a P20 package.

INIT [4720/9720]

This command sets the transceiver for service *within* a P-20 by setting the following parameters to the values shown below:

ASENSE	**ACTIVE LO**
AMASK	**FFFF 0000** (trigger on major alarms)
RXTOT	**20** (20 minute time-out timer)

KEY

TX Key

This command activates the transmitter. See also the **DKEY** command.

MODEL

Model Number Code

This command displays the radio's model number code.

MODEM [xxxx, NONE]

Analog/Digital Modem Selection

This command selects the radio's modem characteristics. For digital operation, enter **9600** (MDS x710A) or **19200** (MDS x710C). For analog operation, enter **NONE**.

When the **MODEM** is set to **NONE**, the analog TX Input and RX Audio outputs of the DATA INTERFACE are used to interface with the connected external modem. These levels must match the audio signal level requirements of the external modem. See "RXLEVEL [–20 to +6]" on Page 27 and "TXLEVEL [–20 to +6, AUTO]" on Page 29 for details on setting these levels.

OWM [XXX...]

Owner's Message

This is a command to display or program an owner's message. To program the owner's message, type **OWM** then the message, followed by **ENTER**.

To display the owner's message, type **OWM** then **ENTER**. The owner's message appears on the display.

OWN [XXX...]

Owner's Name

This is a command to display or program an owner's name. To program the owner's name, type **OWN** then the name, followed by **ENTER**.

To display the owner's name, type **OWN** then **ENTER**. The owner's name appears on the display.

PTT [0–255]

Push-to-Talk Delay

This command sets or displays the key-up delay in milliseconds.

This timer specifies how long to wait after the radio receives a key signal from either the PTT or RTS lines (on the DATA INTERFACE), before actually keying the radio.

PWR [20–37]

TX RF Power Output Level

NOTE: This function might not be available, depending on certification requirements in a particular country.

This command displays or sets the desired RF forward output power setting of the radio. The **PWR** command parameter is specified in dBm and can range from 20 through 37. The default setting is 37 dBm (5 watts). To read the actual (measured) power output of the radio, use the **SHOW PWR** command. A dBm-to-watts conversion chart is provided in Section 6.7 (Page 40).

RSSI

Received Signal Strength Indicator

This command continuously displays the radio's Received Signal Strength Indication (RSSI) in dBm units, until you press the **ENTER** key. Incoming signal strengths from –50 dBm to –120 dBm can be read.

NOTE: The RSSI samples the incoming signal for one to two seconds before providing an average reading to your computer terminal or HHT.

RTU [ON/OFF/0-80]

RTU Simulator

This command enables or disables the radio's internal RTU simulator, which runs with GE MDS' proprietary polling programs (poll.exe and rsim.exe). The internal RTU simulator is available whenever diagnostics is enabled in a radio. This command also sets the RTU address that the radio responds to.

Use the internal RTU for testing system payload data or pseudo bit error rate testing. It can be helpful in isolating a problem to either the external RTU or the radio.

Use the RTU simulator in a polled environment for testing purposes. See GE MDS Publication 05-3467A01 for more information.

RX [xxx.xxxx]

Receive Frequency

This command selects or displays the radio's receive frequency in MHz. The frequency step size is 6.25 kHz. Some models might be set to 5 kHz steps to match the frequency plans of some band plans.

If the customer frequency is not programmed at the factory, a default frequency is programmed in the radio near the center of the frequency band.

NOTE: A large change in receive frequency (more than 5 MHz) requires adjustment of the receiver helical filters for maximum performance and RSSI. See *Section 6.2, Helical Filter Adjustment* (Page 33) for details.

RXLEVEL [–20 to +6]

RX Audio Output Level

The **RXLEVEL command** selects or displays the receive output level present on Pin 11 of the DATA INTERFACE's DB-25 connector. This function is used in **MODEM NONE** mode with analog audio.

RXTOT [NONE, 1-1440]

Loss of RX Data Alarm Time

The **RXTOT** command selects or displays the receive time-out timer value in minutes. This timer triggers an alarm (event 12) if data is not detected within the specified time.

Entering the **RXTOT** command without a parameter displays the timer value in minutes. Entering the **RXTOT** command with a parameter ranging from 0 to 255 resets the timer in minutes. Entering the **RXTOT** command with the parameter **NONE** disables the timer.

SCD [0-255]

Soft-Carrier Dekey

This command displays or changes the soft-carrier dekey delay in milliseconds.

This timer specifies how long to wait after the removal of the keying signal before actually releasing the transmitter. A value of 0 milliseconds unkeys the transmitter immediately after the removal of the keying signal.

SER

Radio's Serial Number

This command displays the radio's serial number as recorded at the factory.

SHOW [DC, PORT, PWR]

Show Power Settings

The **SHOW** command displays different types of information based on the command variables. The different parameters are:

- **DC**—Display DC input/output voltages
- **PORT**—Display the connector port (RJ-11 or DB-25) that is active for diagnostics and control.
- **PWR**—Display RF power output

SNR

RX Signal-to-Noise Ratio

This command continuously displays the signal-to-noise (SNR) ratio of the received signal expressed in dB, until you press the **ENTER** key. As used in this guide, the SNR measurement is based upon the signal level following equalization for received frames.

The SNR is an indication of the received signal quality. The SNR indication ranges from 10 dB to 33 dB. A value of 10 dB represents a very poor signal. A value of 24 dB represents a very good signal.

Using the SNR command causes the DIAG. port to enter an update mode, and the SNR is updated and redisplayed every two seconds. The SNR continuously updates until the ENTER key is pressed.

SREV

Software/Firmware Revision Level

This command displays the software revision level of the transceiver firmware.

STAT

Alarm Status

This command displays the current alarm status of the transceiver.

If no alarms exist, the message **NO ALARMS PRESENT** appears at the top of the HHT display.

If an alarm does exist, a two-digit code (00–31) is displayed and the alarm is identified as “Major” or “Minor.” A brief description of the alarm code is also provided.

If more than one alarm exists, the word **MORE** appears at the bottom of the screen and additional alarms are viewed by pressing the ENTER key. Detailed descriptions of event codes are provided in Table 11 on Page 31.

TEMP

Internal Temperature

This command displays the internal temperature of the transceiver in degrees Celsius.

TOT [1-255, ON, OFF]

TX Timeout-Timer

This command sets or displays the transmitter Time-out Timer value (1–255 seconds), as well as the timer status (**ON** or **OFF**). If the timer is on, and the radio remains keyed for a longer duration than the **TOT** value, the transmitter is automatically unkeyed.

When this happens, the radio must be commanded back to an unkeyed state before a new keying command is accepted. The default timer value is 30 seconds.

TX [xxx.xxxx]

TX Frequency

This command selects or displays the radio’s transmit frequency in MHz. The frequency step size is 6.25 kHz.

If the customer frequency is not programmed at the factory, a default frequency is programmed in the radio near the center of the frequency band.

TXLEVEL [–20 to +6, AUTO]

TX Audio Input Level

The **TXLEVEL command** selects or displays the transmit audio input level expected to be present on Pin 9 of the DATA INTERFACE's DB-25 connector from an external modem present on Pin 11 of the DATA INTERFACE's DB-25 connector. This function is used in **MODEM NONE** mode with analog audio.

For optimum performance, set this command to match the external modem level. For example, **TXLEVEL –10**. **TXLEVEL AUTO** also available. This setting directly affects the TX Deviation. (Default: –10 dBm)

UNIT [10000...65000]

Unit Address

The unit address is the radio's unique identity for the network's diagnostic activities. The default number is programmed by the factory to the last four digits of the serial number.

5.0 TROUBLESHOOTING

Successful troubleshooting of the radio system is not difficult, but it requires a logical approach. It is best to begin troubleshooting at the master station, as the rest of the system depends on the master for polling commands. If the master station has problems, the operation of the entire network can be compromised.

It is good practice to start by checking the simple things. For proper operation, all radios in the network must meet these basic requirements:

- Adequate and stable primary power. The radio contains an internal self-resetting fuse (4A). Remove primary power to reset.
- Secure connections (RF, data and power)
- An efficient and properly aligned antenna system with a good received signal strength of at least –90 dBm. (It is possible for a system to operate with weaker signals, but reliability will be degraded.)
- Proper programming of the transceiver's operating parameters (see *Section 4.0, TRANSCEIVER PROGRAMMING* on Page 14).
- The correct interface between the transceiver and the connected data equipment (correct cable wiring, proper data format, timing, etc.)

5.1 LED Indicators

The LED status indicators are an important troubleshooting tool and should be checked whenever a problem is suspected. Table 7 on Page 13 describes the function of each status LED.

5.2 Event Codes

When an alarm condition exists, the transceiver creates a code that can be read on an HHT connected to the DIAG. port. These codes can help resolve many system difficulties. Refer to Table 11 (Page 31) for a definition of the event codes.

Checking for Alarms—*STAT command*

To check for alarms, enter **STAT** on the HHT. If no alarms exist, the message **NO ALARMS PRESENT** appears at the top of the display (Figure 10).

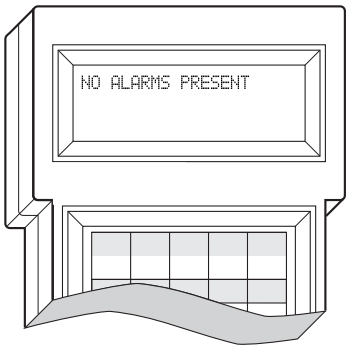


Figure 10. HHT Display in Response to STAT Command

If an alarm does exist, a two-digit alarm code (00–31) is displayed and the event is identified as a Major or Minor Alarm. A brief description of the alarm is also given.

If more than one alarm exists, the word **MORE** appears at the bottom of the screen. To view additional alarms, press **ENTER**.

Major Alarms vs. Minor Alarms

Major Alarms—report serious conditions that generally indicate a hardware failure, or other abnormal condition that prevents (or seriously hamper) further operation of the transceiver. Major alarms generally indicate the need for factory repair. Contact GE MDS for further assistance.

Minor Alarms—report conditions that, under most circumstances do not prevent transceiver operation. This includes out-of-tolerance conditions, baud rate mismatches, etc. The cause of these alarms should be investigated and corrected to prevent system failure.

Event Code Definitions

Table 11 contains a listing of all event codes that are reported by the transceiver.

Table 11. Event Codes

Event Code	Event Class	Description
01	Major	Improper software detected for this radio model.
02	Major	The model number of the transceiver is unprogrammed.
04	Major	One or both of the internal programmable synthesizer loops is reporting an out-of-lock condition.
06	Major	An unrecoverable fault was detected on the auto-D chip. The radio will not receive data.
07	Major	One or more of the radio's internal voltage regulators is reporting a failure. The radio will not operate.
08	Major	The system is reporting that it has not been calibrated. Factory calibration is required for proper radio operation.
09	--	Not used.
10	Major	The internal microcontroller was unable to properly program the system to the appropriate EEPROM defaults. A hardware problem might exist.
11	--	Not used.
12	Major	Receiver time-out. No data received within the specified receiver time-out time.
13–15	--	Not used.
16	Minor	Not used.
17	Minor	A data parity fault is detected on the DATA INTERFACE connector. This usually indicates a parity setting mismatch between the radio and the RTU.
18	Minor	A data framing error is detected on the DATA INTERFACE connector. This can indicate a baud rate mismatch between the radio and the RTU.
19–24	--	Not used.
25	Minor	The 5.6 volt power regulator is out-of-tolerance. If the error is excessive, operation may fail.
26	Minor	The DC input voltage is out-of-tolerance. If the voltage is too far out of tolerance, operation can fail.
27, 28	--	Not used.
31	Minor	The transceiver's internal temperature is approaching an out-of-tolerance condition. If the temperature drifts outside of the recommended operating range, system operation can fail.

6.0 TECHNICAL REFERENCE

6.1 MDS 4710A/C/M and 9710A/C/M/T Transceivers' Specifications

GENERAL

Frequency Range*:	**MDS 4710A/C/M** 330–512 MHz	**MDS 9710A/C/M/T** 800–960 MHz
	* w/One or more sub-bands as permitted by regulatory agencies	
Frequency Stability:	±1.5 ppm	

RECEIVER

Maximum Usable Sensitivity:	MDS x710A/T: –110 dBm at $1x10^{-6}$ BER MDS x710C: –105 dBm at $1x10^{-6}$ BER MDS x710M: –106 dBm at $1x10^{-6}$ BER
Co-Channel Rejection:	MDS x710A/M/T: –12 dB MDS x710C: –18 dB
Adjacent-Channel Selectivity:	60 dB
Spurious-Response Rejection:	70 dB
Intermodulation Response Rejection:	65 dB
Spurious Conducted Emissions:	–57 dBm (9 kHz to 1 GHz) –47 dBm (1 GHz to 12.75 GHz)
Bandwidth:	MDS x710A/M/T: 12.5 kHz MDS x710C: 25 kHz

TRANSMITTER

Modulation Type:	Binary CPFSK
Carrier Power:	0.1 Watts to 5 Watts
Carrier Power Accuracy:	±1.5 dB
Transmit Attack Time:	5 ms maximum
Transmit Release Time:	5 ms maximum
Duty Cycle:	Continuous
Output Impedance:	50 Ω
Frequency Stability:	±1.5 ppm
Channel Spacing:	MDS x710A/M/T: 12.5 kHz MDS x710C: 25 kHz
Adjacent Channel Transient Power:	MDS x710A/M/T:–50 dBc MDS x710C: –40 dBc
Transmitter Spurious Conducted Emissions:	–36 dBm [73 dBc], 9 kHz to 1 GHz –30 dBm [67 dBc], 1 GHz to 12.5 GHz
Standby:	–57 dBm, 9 kHz to 1 GHz –47 dBm, 1 GHz to 12.5 GHz
Intermodulation:	–40 dBc
Time-Out Timer:	30 seconds (Default), User selectable
Transmitter Keying:	Data activated, or RTS
FCC Emission Designators:	11K2F1D, 11K2F2D, 11K2F3D (928–960 MHz) 11K2F1D (806–940 MHz) 11K0F1D, 11K2F2D, 11K2F3D (403–512 MHz)

FCC Identifiers:	E5MDS9710N (928–960 MHz) E5MDS9710N-1 (806–940 MHz E5MDS4710 (403–512 MHz)

DATA CHARACTERISTICS

Signaling Type:	EIA/RS-232; DB-25 Female connector
Data Interface Rates:	1200–19200 bps, asynchronous
Data Latency:	10 ms maximum

PRIMARY POWER

Voltage:	13.8 Vdc Nominal (10.5 to 16 Vdc) Negative-Ground Systems Only
TX Supply Current:	2.5 Amps (Maximum) @ 5 Watts RF Output
RX Supply Current:	*Operational*—125 mA, Nominal *Standby (sleep)*—15 mA, Nominal
Power Connector:	2-Pin polarized & locking connector
Fuse:	4-Amp Thermal Fuse, Self-Resetting, Internal (Remove primary power to reset)

ENVIRONMENTAL

Humidity:	95% at 40 degrees C (104°F), non-condensing
Temperature Range:	–30 to 60 degrees C (–22°F to +140°F)
Weight:	1.0 kilograms
Case:	Die-cast Aluminum

DIAGNOSTICS INTERFACE

Signalling Standard:	RS-232
Connector:	DIAG—RJ-11 (Dedicated) DATA INTERFACE—DB-25 (Alternate, See “Performing Network-Wide Remote Diagnostics” on Page 34)
I/O Devices:	GE MDS Hand-Held Terminal, PC with GE MDS software, or other Terminal Communications program.

6.2 Helical Filter Adjustment

If the frequency of the radio is changed more than 5 MHz, adjust the helical filters for maximum received signal strength (RSSI) as follows:

1. Remove the top cover from the transceiver by loosening the four screws and lifting straight up.

2. Locate the helical filters on the PC board. See Figure 11 on Page 34.

3. Apply a steady signal to the radio at the programmed receive frequency (–80 dBm level recommended; no stronger than –60 dBm). This can be done with a signal generator or an over-the-air signal.

4. Measure the radio's RSSI using one of the following methods:
   - With an HHT (See *Section 4.0, TRANSCEIVER PROGRAMMING* on Page 14).
   - With GE MDS Radio Configuration Software (See *Section 6.5, Upgrading the Radio's Software* on Page 37).
   - With a voltmeter connected to Pin 21 of the DATA INTERFACE connector (See *Section 3.2, RSSI Measurement* on Page 13).

5. With a non-metallic adjustment tool, adjust each section of the helical filters for maximum RSSI. Re-install the cover to the transceiver.

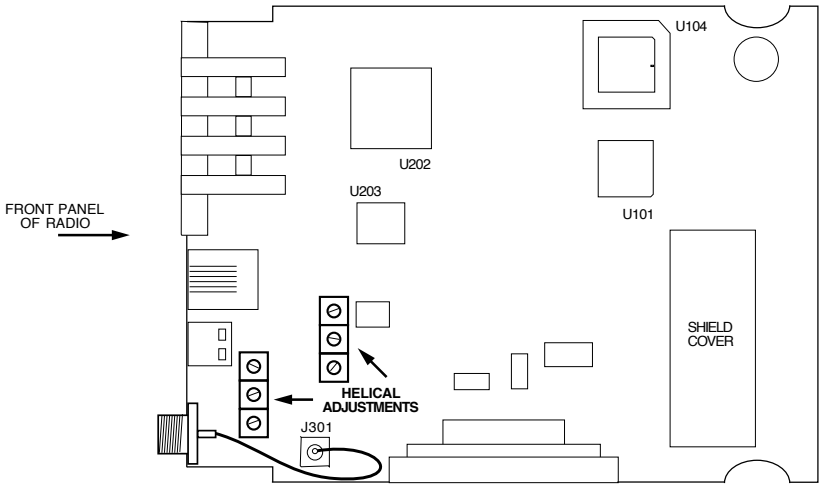


Figure 11. Helical Filter Locations

6.3 Performing Network-Wide Remote Diagnostics

Diagnostics data from a remote radio can be obtained by connecting a laptop or personal computer running GE MDS InSite NMS software to any radio in the network. Figure 12 shows an example of a setup for performing network-wide remote diagnostics.

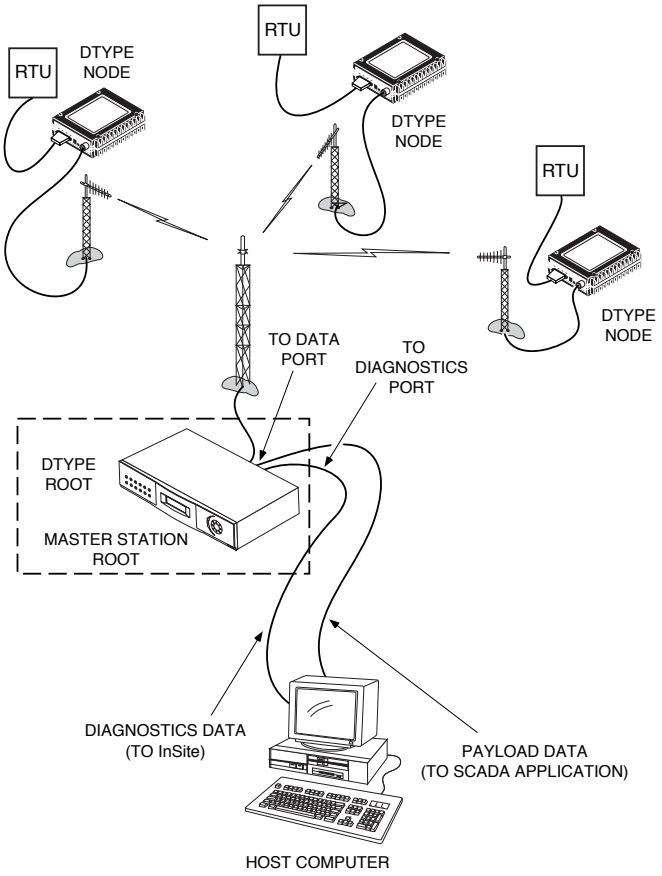


Figure 12. Network-Wide Remote Diagnostics Setup

If a PC is connected to any radio in the network, intrusive polling (polling that briefly interrupts payload data transmission) can be performed. To perform diagnostics without interrupting payload data transmission, connect the PC to a radio defined as the "root" radio. A radio is defined as a root radio using the **DTYPE ROOT** command locally, at the radio.

A complete explanation of remote diagnostics can be found in GE MDS' Network-Wide Diagnostics System Handbook. See the handbook for more information about the basic diagnostic procedures outlined below.

1. Program one radio in the network as the root radio by entering the **DTYPE ROOT** command at the radio.

2. At the root radio, use the **DLINK ON** and **DLINK [baud rate]** commands to configure the diagnostic link protocol on the RJ-11 port.

3. Program all other radios in the network as nodes by entering the **DTYPE NODE** command at each radio.

4. Use the **DLINK ON** and **DLINK [baud rate]** commands to configure the diagnostic link protocol on the RJ-11 port of each node radio.

5. Connect same-site radios using a null-modem cable at the radios' diagnostic ports.

6. Connect a PC with GE MDS InSite software installed to the root radio, or to one of the nodes, at the radio's diagnostic port. (This PC can also be the PC being used to collect payload data, as shown in Figure 12.)

   To connect a PC to the radio's DIAG. port, an RJ-11-to-DB-9 adapter (MDS P/N 03-3246A01) is required. If desired, an adapter cable can be made using the information shown in Figure 13.

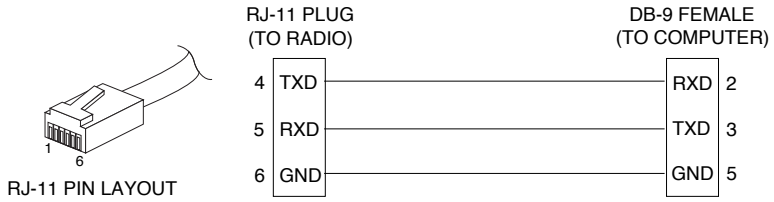


Figure 13. RJ-11 to DB-9 Adapter Cable

7. Start the GE MDS InSite application at the PC. (See the GE MDS InSite User's Guide for instructions.)

6.4 User-Programmable Interface Output Functions

Two pins of the DATA INTERFACE can be manually activated through GE MDS' InSite NMS software. These two outputs (#1–Pin 22 and #2–Pin 15) can be connected to compatible user-provided data devices. The pins provide either a logic high or low depending on the last command from the **USER I/O SETTINGS** in the **Network Wide Radio Configuration** screen of InSite. In this InSite window, clicking the **SET** button sets the output to high, and clicking on **CLEAR** sets the associated output low. See Figure 14 for a screen capture of the software controls.

One pin on the **DATA INTERFACE** can be configured as a digital input. If **DIN ON** is selected, Pin 16 becomes a digital input. The input is set when 5 V is applied, and clear when grounded. The same physical input can be queried as the analog input value on other InSite screens.

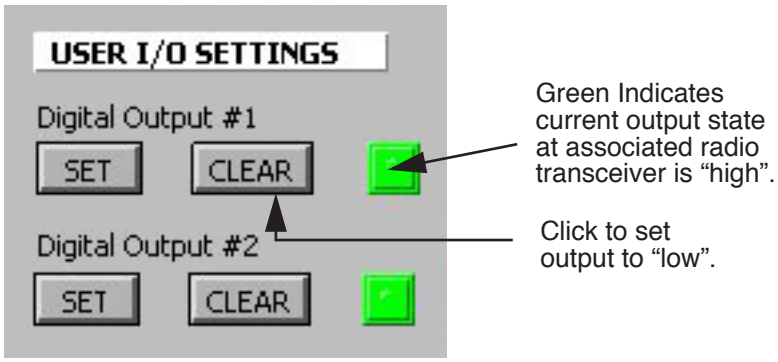


Figure 14. GE MDS InSite Radio Device User I/O Settings
(Bottom Left-hand Corner of Network Wide Radio Configuration Screen)

These output-only pins are designed for low switching rates and do not pass high-speed data, nor are they suitable for latency-sensitive remote controls. An example of this function is to reset the connected remote RTU or turn on a security device at the associated transceiver’s location.

Table 12. User-Programmable Interface Output Functions
via Transceiver Interface Port

Function	Interface Pin	States[a]	Compatibility
Digital Output #1	Pin 22	Set = 3 Volts Clear = 0 Volts	CMOS
Digital Output #2	Pin 15	Set = +9.5 volts Clear = –9.5 Volts	EIA-232 Compatible
Digital Input	Pin 16	Set = 5 volts Clear = 0 volts	CMOS

a.Voltages are typical and varies with load.

6.5 Upgrading the Radio’s Software

Windows-based Radio Configuration software is available (MDS P/N 03-3156A01) for upgrading the internal radio software when new features become available from GE MDS. Contact GE MDS for ordering information.

To connect a PC to the radio’s DIAG. port, an RJ-11 to DB-9 adapter (MDS P/N 03-3246A01) is required. If desired, an adapter cable can be made using the information shown in Figure 13.

Using the Radio Configuration software, select **RADIO SOFTWARE UPGRADE** under the **SYSTEM** menu. Follow the prompts and online instructions to determine how to proceed.

Software upgrades are distributed as ASCII files with a ".S28" extension. These files use the Motorola S-record format. When the download is activated, the radio's PWR LED flashes rapidly to confirm that a download is in process. The download takes about two minutes.

NOTE: If a download fails, the radio is left unprogrammed and inoperative. This is indicated by the PWR LED flashing slowly (1 second on/1 second off). This condition is only likely if there is a power failure to the computer or radio during the downloading process. The download can be attempted again when the fault is corrected.

6.6 External Orderwire Module

During installation or troubleshooting activities, it is desirable to communicate by voice between personnel at the Master Station and the Remote Station sites to coordinate their activities. An optional external orderwire module from GE MDS (P/N 12-1297A01) is available that can be inserted between the radio's DATA INTERFACE and the user's data communication device.

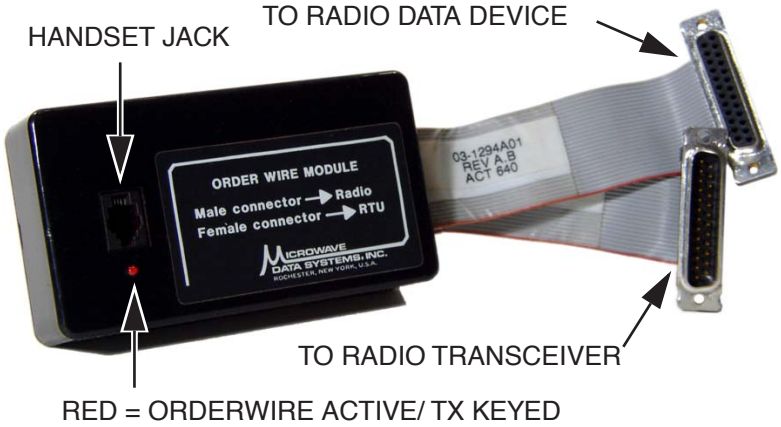


Figure 15. Orderwire Adapter Module
(MDS P/N 12-1307A01)

Installation

Install the Orderwire (O/W) Module between the radio transceiver's DATA INTERFACE connector and the connected device. A handset should also be connected to the associated Master Station's orderwire jack.

The payload data exchanges pass through the Orderwire Module uninterrupted until the Orderwire Module is in use. The module has a voice-operated switch (VOX) that keys the connected transceiver whenever audio is picked up by a handset plugged into the RJ-11 phone jack. Any standard telephone handset can be used or a rugged handset (P/N

12-1307A01 w/o PTT; 12-1307A01 w/PTT;) can be purchased from GE MDS. Handsets must have carbon microphone elements installed. Dynamic microphones do not work with the module. (Handsets with a push-to-talk (PTT) button are supported and recommended, as background noise can activate the VOX circuit and interrupt the payload data.)

Operation

To operate the orderwire, activate the handset (PTT or VOX). This keys the transmitter and passes the audio over the network to the handset of the Master Station. Only one person can speak at a time (simplex). In noisy locations, it might be necessary to cover the handset mouthpiece to prevent accidental keying of the transmitter.

NOTE: When the transmitter is keyed by the orderwire operation, normal payload data is interrupted.

Be sure to disconnect the module or handset to restore normal data communications.

6.7 dBm-Watts-Volts Conversion Chart

Table 13 is provided as a convenience for determining the equivalent wattage or voltage of an RF power expressed in dBm.

Table 13. dBm-Watts-Volts Conversion—for 50 Ohm Systems

dBm	V	Po
+53	100.0	200W
+50	70.7	100W
+49	64.0	80W
+48	58.0	64W
+47	50.0	50W
+46	44.5	40W
+45	40.0	32W
+44	32.5	25W
+43	32.0	20W
+42	28.0	16W
+41	26.2	12.5W
+40	22.5	10W
+39	20.0	8W
+38	18.0	6.4W
+37	16.0	5W
+36	14.1	4W
+35	12.5	3.2W
+34	11.5	2.5W
+33	10.0	2W
+32	9.0	1.6W
+31	8.0	1.25W
+30	7.10	1.0W
+29	6.40	800mW
+28	5.80	640mW
+27	5.00	500mW
+26	4.45	400mW
+25	4.00	320mW
+24	3.55	250mW
+23	3.20	200mW
+22	2.80	160mW
+21	2.52	125mW
+20	2.25	100mW
+19	2.00	80mW
+18	1.80	64mW
+17	1.60	50mW
+16	1.41	40mW
+15	1.25	32mW
+14	1.15	25mW
+13	1.00	20mW
+12	.90	16mW
+11	.80	12.5mW
+10	.71	10mW
+9	.64	8mW
+8	.58	6.4mW
+7	.500	5mW
+6	.445	4mW
+5	.400	3.2mW
+4	.355	2.5mW
+3	.320	2.0mW
+2	.280	1.6mW
+1	.252	1.25mW

dBm	V	Po
0	.225	1.0mW
-1	.200	.80mW
-2	.180	.64mW
-3	.160	.50mW
-4	.141	.40mW
-5	.125	.32mW
-6	.115	.25mW
-7	.100	.20mW
-8	.090	.16mW
-9	.080	.125mW
-10	.071	.10mW
-11	.064	
-12	.058	
-13	.050	
-14	.045	
-15	.040	
-16	.0355	

dBm	mV	Po
-17	31.5	
-18	28.5	
-19	25.1	
-20	22.5	.01mW
-21	20.0	
-22	17.9	
-23	15.9	
-24	14.1	
-25	12.8	
-26	11.5	
-27	10.0	
-28	8.9	
-29	8.0	
-30	7.1	.001mW
-31	6.25	
-32	5.8	
-33	5.0	
-34	4.5	
-35	4.0	
-36	3.5	
-37	3.2	
-38	2.85	
-39	2.5	
-40	2.25	.1μW
-41	2.0	
-42	1.8	
-43	1.6	
-44	1.4	
-45	1.25	
-46	1.18	
-47	1.00	
-48	0.90	

dBm	mV	Po
-49	0.80	
-50	0.71	.01μW
-51	0.64	
-52	0.57	
-53	0.50	
-54	0.45	
-55	0.40	
-56	0.351	
-57	0.32	
-58	0.286	
-59	0.251	
-60	0.225	.001μW
-61	0.200	
-62	0.180	
-63	0.160	
-64	0.141	

dBm	μV	Po
-65	128	
-66	115	
-67	100	
-68	90	
-69	80	
-70	71	.1nW
-71	65	
-72	58	
-73	50	
-74	45	
-75	40	
-76	35	
-77	32	
-78	29	
-79	25	
-80	22.5	.01nW
-81	20.0	
-82	18.0	
-83	16.0	
-84	11.1	
-85	12.9	
-86	11.5	
-87	10.0	
-88	9.0	
-89	8.0	
-90	7.1	.001nW
-91	6.1	
-92	5.75	
-93	5.0	
-94	4.5	
-95	4.0	
-96	3.51	
-97	3.2	

dBm	μV	Po
-98	2.9	
-99	2.51	
-100	2.25	.1pW
-101	2.0	
-102	1.8	
-103	1.6	
-104	1.41	
-105	1.27	
-106	1.18	

dBm	nV	Po
-107	1000	
-108	900	
-109	800	
-110	710	.01pW
-111	640	
-112	580	
-113	500	
-114	450	
-115	400	
-116	355	
-117	325	
-118	285	
-119	251	
-120	225	.001pW
-121	200	
-122	180	
-123	160	
-124	141	
-125	128	
-126	117	
-127	100	
-128	90	
-129	80	.1ƒW
-130	71	
-131	61	
-132	58	
-133	50	
-134	45	
-135	40	
-136	35	
-137	33	
-138	29	
-139	25	
-140	23	.01ƒW

7.0 GLOSSARY OF TERMS

If you are new to digital radio systems, some of the terms used in this guide may be unfamiliar. The following glossary explains many of these terms and will prove helpful in understanding the operation of the transceiver.

Active Messaging—This is a mode of diagnostic gathering that may interrupt SCADA system polling communications (contrast with *passive messaging*). Active (or intrusive) messaging is much faster than passive messaging because it is not dependent upon the RTU polling cycle.

Antenna System Gain—A figure, normally expressed in dB, representing the power increase resulting from the use of a gain-type antenna. System losses (from the feedline and coaxial connectors, for example) are subtracted from this figure to calculate the total antenna system gain.

Bit—The smallest unit of digital data, often represented by a one or a zero. Eight bits (plus start, stop, and parity bits) usually comprise a byte.

Bits-per-second—See *BPS*.

BPS—Bits-per-second. A measure of the information transfer rate of digital data across a communication channel.

Byte—A string of digital data usually made up of eight data bits and start, stop and parity bits.

Decibel (dB)—A measure computed from the ratio between two signal levels. Frequently used to express the gain (or loss) of a system.

Data Circuit-terminating Equipment—See *DCE*.

Data Communications Equipment—See *DCE*.

Data Terminal Equipment—See *DTE*.

dBi—Decibels referenced to an “ideal” isotropic radiator in free space. Frequently used to express antenna gain.

dBm—Decibels referenced to one milliwatt. An absolute unit used to measure signal power, as in transmitter power output, or received signal strength.

DCE—Data Circuit-terminating Equipment (or Data Communications Equipment). In data communications terminology, this is the “modem” side of a computer-to-modem connection. The MDS 4710/9710 is a DCE device.

Digital Signal Processing—See *DSP*.

DSP—Digital Signal Processing. In the MDS 4710/9710 transceiver, the DSP circuitry is responsible for the most critical real-time tasks; primarily modulation, demodulation, and servicing of the data port.

DTE—Data Terminal Equipment. A device that provides data in the form of digital signals at its output. Connects to the DCE device.

Equalization—The process of reducing the effects of amplitude, frequency or phase distortion with compensating networks.

Fade Margin—The greatest tolerable reduction in average received signal strength that will be anticipated under most conditions. Provides an allowance for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. A fade margin of 20 to 30 dB is usually sufficient in most systems.

Frame—A segment of data that adheres to a specific data protocol and contains definite start and end points. It provides a method of synchronizing transmissions.

Hardware Flow Control—A transceiver feature used to prevent data buffer overruns when handling high-speed data from the RTU or PLC. When the buffer approaches overflow, the radio drops the clear-to-send (CTS) line, which instructs the RTU or PLC to delay further transmission until CTS again returns to the high state.

Host Computer—The computer installed at the master station site, which controls the collection of data from one or more remote sites.

Intrusive Diagnostics—A mode of remote diagnostics that queries and commands radios in a network with an impact on the delivery of the system "payload" data. See *Active messaging*.

Latency—The delay (usually expressed in milliseconds) between when data is applied to TXD (Pin 2) at one radio, until it appears at RXD (Pin 3) at the other radio.

MAS—Multiple Address System. A radio system where a central master station communicates with several remote stations for the purpose of gathering telemetry data.

Master (Station)—Radio which is connected to the host computer. It is the point at which polling enters the network.

MCU—Microcontroller Unit. This is the processor responsible for controlling system start-up, synthesizer loading, and key-up control.

Microcontroller Unit—See *MCU*.

Multiple Address System—See *MAS*.

Network-Wide Diagnostics—An advanced method of controlling and interrogating GE MDS radios in a radio network.

Non-intrusive diagnostics—See *Passive messaging*.

Passive messaging—This is a mode of diagnostic gathering that does not interrupt SCADA system polling communications. Diagnostic data is collected non-intrusively over a period of time; polling messages are carried with SCADA system data (contrast with *active messaging*).

Payload data—This is the application's user communication data which is sent over the radio network. It is the transfer of payload data that is the primary purpose of the radio communications network.

Point-Multipoint System—A radio communications network or system designed with a central control station that exchanges data with a number of remote locations equipped with terminal equipment.

Poll—A request for data issued from the host computer (or master PLC) to a remote radio.

PLC—Programmable Logic Controller. A dedicated microprocessor configured for a specific application with discrete inputs and outputs. It can serve as a host or as an RTU.

Programmable Logic Controller—See *PLC*.

Remote (Station)—A radio in a network that communicates with an associated master station.

Remote Terminal Unit—See *RTU*.

Redundant Operation—A station arrangement where *two* transceivers and two power supplies are available for operation, with automatic switchover in case of a failure.

RTU—Remote Terminal Unit. A data collection device installed at a remote radio site. An internal RTU *simulator* is provided with 4710/9710 radios to isolate faults to either the external RTU or the radio.

SCADA—Supervisory Control And Data Acquisition. An overall term for the functions commonly provided through an MAS radio system.

Standing Wave Ratio—See *SWR*.

Supervisory Control And Data Acquisition—See *SCADA*.

SWR—Standing Wave Ratio. A parameter related to the ratio between forward transmitter power and the reflected power from the antenna system. As a general guideline, reflected power should not exceed 10% of the forward power (≈ 2:1 SWR).

NOTES

INDEX

S

T

U

IN CASE OF DIFFICULTY...

GE MDS products are designed for long life and trouble-free operation. However, this equipment, as with all electronic equipment, may have an occasional component failure. The following information will assist you in the event that servicing becomes necessary.

TECHNICAL ASSISTANCE

Technical assistance for GE MDS products is available from our Technical Support Department during business hours (8:00 A.M.—5:30 P.M. Eastern Time). When calling, please give the complete model number of the radio, along with a description of the trouble/symptom(s) that you are experiencing. In many cases, problems can be resolved over the telephone, without the need for returning the unit to the factory. Please use one of the following means for product assistance:

Phone: 585 241-5510 E-Mail: TechSupport@GEmds.com

FAX: 585 242-8369 Web: www.GEmds.com

FACTORY SERVICE

Component level repair of this equipment is not recommended in the field. Many components are installed using surface mount technology, which requires specialized training and equipment for proper servicing. For this reason, the equipment should be returned to the factory for any PC board repairs. The factory is best equipped to diagnose, repair and align your radio to its proper operating specifications.

If return of the equipment is necessary, you must obtain a Service Request Order (SRO) number. This number helps expedite the repair so that the equipment can be repaired and returned to you as quickly as possible. Please be sure to include the SRO number on the outside of the shipping box, and on any correspondence relating to the repair. No equipment will be accepted for repair without an SRO number.

SRO numbers are issued online at **www.GEmds.com/support/product/sro/**. Your number will be issued immediately after the required information is entered. Please be sure to have the model number(s), serial number(s), detailed reason for return, "ship to" address, "bill to" address, and contact name, phone number, and fax number available when requesting an SRO number. A purchase order number or pre-payment will be required for any units that are out of warranty, or for product conversion.

If you prefer, you may contact our Product Services department to obtain an SRO number:

Phone Number: 585-241-5540
Fax Number: 585-242-8400
E-mail Address: productservices@GEmds.com

The radio must be properly packed for return to the factory. The original shipping container and packaging materials should be used whenever possible. All factory returns should be addressed to:

GE MDS, LLC
Product Services Department
(SRO No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements. To inquire about an in-process repair, you may contact our Product Services Group using the telephone, Fax, or E-mail information given above.

GE MDS
industrial wireless networks

GE MDS, LLC
175 Science Parkway
Rochester, NY 14620
General Business: +1 585 242-9600
FAX: +1 585 242-9620
Web: www.microwavedata.com