MDS SD9™

Software-Controlled Digital Communications

Preliminary

MDS 05-4659A01, Rev. 02
JULY 2008

GE MDS
industrial wireless networks

Start-Up Guide

OPERATIONAL & SAFETY NOTICES

RF Exposure

Concentrated energy from a directional antenna may pose a health hazard to humans. Do not allow people to come closer to the antenna than the distances listed in the table below when the transmitter is operating. More information on RF exposure can be found online at the following website: www.fcc.gov/oet/info/documents/bulletins.

Antenna Gain vs. Recommended Safety Distance
(MDS SD9 Radio)

	Antenna Gain		
	0–5 dBi	**5–10 dBi**	**10–16.5 dBi**
Minimum RF Safety Distance	0.46 meter	.82 meters	1.74 meters

FCC Part 15 Notice

Users must comply with the following requirements:

Operation of this device 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. Any unauthorized modification or changes to this device without the express approval of the manufacturer 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 void the user's authority to operate this device.

CSA/us Notice

This product is pending approval 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.

INTRODUCTION

This guide presents basic installation and operating instructions for the MDS SD9 Series wireless transceiver.

The transceiver (Figure 1) is designed to operate in point-to-multi-point environments, including utility automation/distribution systems, and other telemetry functions.

These radios are software-configurable to provide flexible operation in a variety of applications using one hardware platform. They employ microprocessor control and Digital Signal Processing (DSP) technology to provide robust communications even under adverse conditions.

Figure 1. SD9 Data Transceiver

The transceiver is designed for trouble-free operation with data equipment provided by other manufacturers, including remote terminal units (RTUs), programmable logic controllers (PLCs), flow computers, transaction terminals, and similar devices.

NOTE: Some features may not be available on all units, based on the options purchased and the applicable regulatory constraints for the region in which the radio will operate.

Front Panel Connectors

Figure 2 shows the interface connectors and indicators on the transceiver's front panel. These items are referenced in the installation steps given later in this guide.

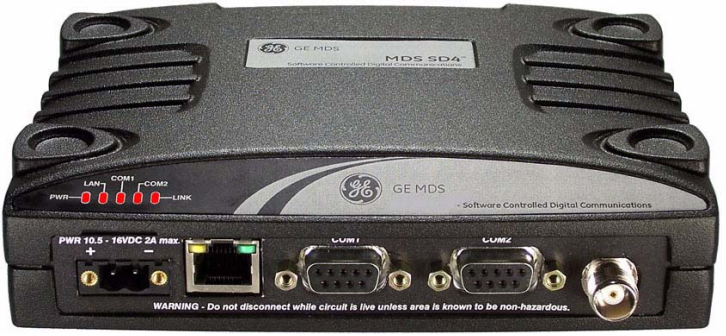

Figure 2. Front Panel Connectors & Indicators

Connector functions (left to right) in Figure 2 are as follows:

- POWER
- LAN (RJ-45)
- COM1—Management/Diagnostics (DB-9)
- COM2—Payload Data (DB-9)
- ANTENNA (TNC)

A list of LED functions is presented in Table 3 on Page 10.

Accessories

Table 1 lists available accessories for the transceiver. The contents of a shipment may have been modified to reflect customer-specific requirements given at the time of order. Additional accessories are available for our products. Contact your factory representative for assistance.

Table 1. SD9 Available Accessories

Accessory	Description	Part Number
DC Power Plug, 2-pin, polarized	Mates with power connector on radio. Screw terminals provided for wires, threaded locking screws to prevent accidental disconnect.	73-1194A39
Retrofit Kit, Digital	Contains all items needed to replace an existing MDS x710A/C/M digital transceiver.	98-6190ACC1
Retrofit Kit, Analog	Contains all items needed to replace an existing MDS x710A/C/M transceiver used in the analog mode.	98-6190ACC2
Reference Manual	Contains technical information, system design data, and a complete list of software commands.	05-4670A01

INSTALLATION

There are three main requirements for installing the transceiver:

- Adequate and stable primary power
- An efficient and properly installed antenna system
- Correct data connections between the transceiver and the data device.

Figure 3 shows a typical remote station arrangement. This is followed by step-by-step procedures for installing the transceiver and making front panel connections.

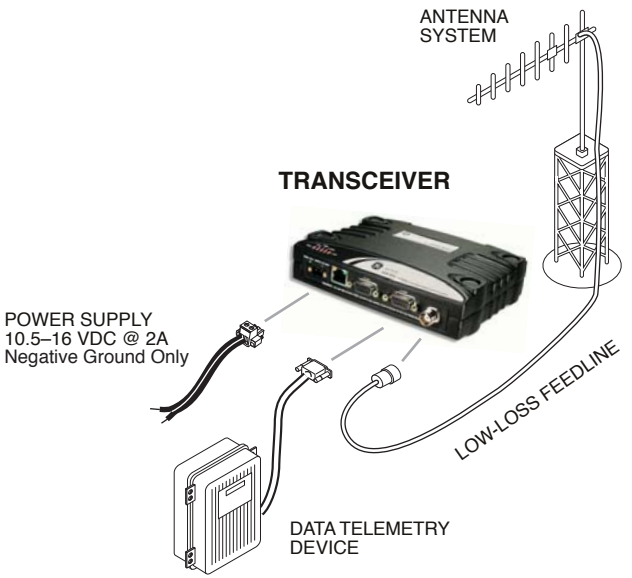

Figure 3. Typical Remote Station Arrangement

Installation Steps

Below are the basic steps for installing the transceiver. In most cases, these steps alone are sufficient to complete the installation. Refer to the *Reference Manual* for additional details, if required.

1. **Mount the transceiver to a stable surface** using the brackets supplied with the radio. Begin by attaching the radio's mounting brackets to the bottom of the transceiver case (if not already attached) using the four 6-32 x 1/4 inch (6 mm) screws supplied. Figure 4 shows the mounting bracket dimensions.

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

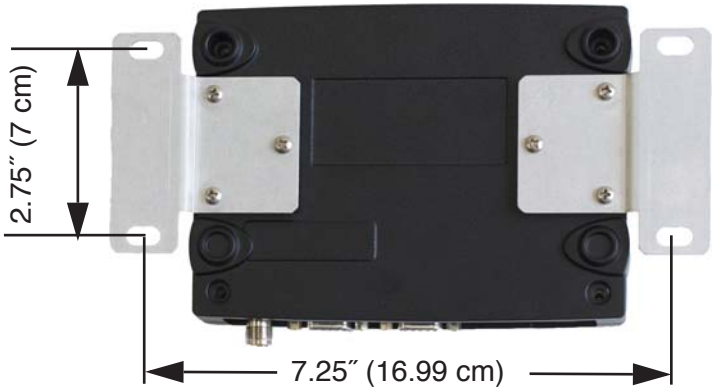

Figure 4. Transceiver Mounting Bracket Dimensions

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. **Install the antenna and feedline** for the station. Aim directional antennas toward the master station. The antenna used with the transceiver must be designed to operate in the radio's frequency band, and be mounted in a location that provides a clear path to the associated master station. Use low loss coaxial feedline and keep the cable as short as possible.
3. **Connect the data equipment** to COM2 on the front panel. The radio is hardwired as a DCE device. A straight-thru cable may be used in most applications. Check Table 5 on Page 14 for pin wiring details.

   Note: The radio's LAN port is used for reprogramming the radio's firmware. Refer to the Reference Manual for details.
4. **Connect primary power to the transceiver.** Power applied must be within 10.5–30 Vdc and capable of continuously providing at least 2.5 Amperes. A power connector with screw-terminals is pro-

vided with each unit (see Figure 5). Strip the wire leads to 6 mm (1/4 inch) and insert in the wire ports. Be sure to observe proper polarity as shown in the Figure 5.

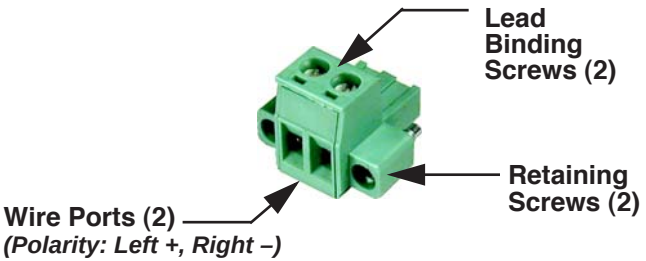

Figure 5. DC Power Connector

CAUTION
POSSIBLE EQUIPMENT DAMAGE

The transceiver is designed for use with negative-ground systems only. The power supply should be equipped with overload protection (NEC Class 2 rating), to protect against a short circuit between its output terminals and the radio's power connector.

5. **Set the radio's configuration.** The transceiver is designed for quick installation with a minimum of software configuration required.

   a. Connect a PC to the transceiver's DB-9 COM1 connector as shown in Figure 6. A straight-through cable may be used in most applications. If desired, a cable may be built using the information shown on Page 12 of this guide.

   b. Launch a terminal communications program, such as HyperTerminal (included with most Windows™ systems). Press the ENTER key a few times (at half-second intervals) to receive the ready ">" prompt on the screen.

NOTE: To prevent unintended keying of the transmitter during management activities, set **PTTSIG** to **OFF**, or do not connect to Pin 6 of the COM1 port.

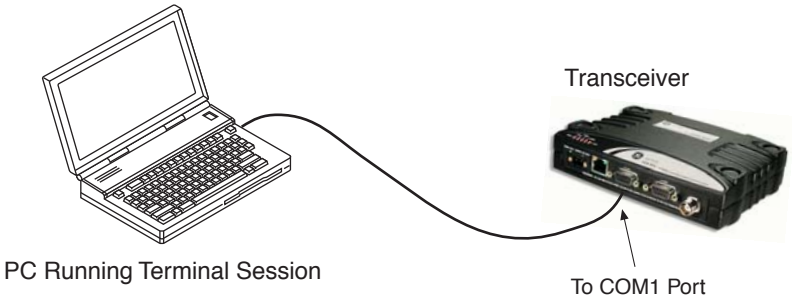

Figure 6. PC Configuration Setup

c. Set the transmit frequency by entering **TX xxx.xxxx**, where **xxx.xxxx** is the frequency in MHz. Press **ENTER**. The response **PROGRAMMED OK** indicates successful entry.

d. Set the receive frequency by entering **RX xxx.xxxx**, where **xxx.xxxx** is the frequency in MHz. Press **ENTER**. The response **PROGRAMMED OK** indicates successful entry.

e. Set the radio's modem type if necessary, using the **MODEM xxxx** command, where **xxxx** is the modem selection (typically **4800** or **9600**). The default setting is **9600**.

f. Set the radio's serial data interface rate (typically **BAUD 9600 8N1**).

This completes the initial setup and configuration of the radio.

SOFTWARE COMMAND SUMMARY

Table 2 lists software commands commonly used during initial installation and setup of the transceiver. A complete list of commands and detailed descriptions is contained in the *Reference Manual*.

Table 2. Command Summary

Command Name	Function
BAUD [xxxx xxx]	Sets radio's serial data interface rate/format. Default setting is BAUD 9600 8N1.
DATAKEY	Keys the transmitter on receipt of data.
DKEY	Dekey the radio (transmitter OFF). This is generally a radio test command.
KEY	Key the radio (transmitter ON). This is generally a radio test command.
MODEM [xxxx]	Set the modem characteristics of the radio.
PORT [RS232, RS485]	Selects signaling standard to be used on COM2 DATA port. For RS-485 operation, see *Reference Manual*.
PWR [20–37]	Set or display the transmit power setting.
PTTSIG [ON, OFF]	Set/display push-to-talk configuration.
RSSI	Display the Received Signal Strength Indication.
RTSKEY	Set/display how the radio responds to RTS keying. Default is RTSKEY ON, which causes the radio to key the transmitter when RTS is raised.
RTU [ON/OFF/0-80]	Re-enables or disables the radio's internal RTU simulator and sets the RTU address.
RX [xxx.xxxx]	Set or display receiver frequency.
SER	Display the radio serial number.
SNR	Signal-to-Noise Ratio (in dB).
SPECTRUM [xxx.xx]	Display internal spectrum analyzer, where **xxx.xx** characters denote center frequency in MHz. The command **spectrum** may be entered alone to view current operating channel.
SREV	Display the Software Revision Level.

Table 2. Command Summary *(Cont'd)*

Command Name	Function
STAT	Display radio status and alarms.
TEMP	Display the internal temperature of the radio in degrees C.
TX [xxx.xxxx]	Set or display the transmit frequency.

TROUBLESHOOTING

For proper operation, all radios in the network must meet these basic requirements:

- Adequate and stable primary power
- Secure connections (RF, data and power)
- A clear transmission path between stations
- An efficient and properly aligned antenna system providing adequate received signal strength.
- Proper programming of the transceiver's operating parameters
- The correct interface between the transceiver and the connected data equipment (correct cable wiring, proper data format, timing, etc.)

LED Indicators

The LED status indicators (Figure 7) are an important troubleshooting aid and should be checked whenever a problem is suspected. Table 3 describes the function of each status LED on the top panel of the radio.

In addition to the top panel LEDs, the ETHERNET/LAN connector has two integrated LEDs. A steady green LED indicates that an Ethernet link has been established, a flashing green indicates data activity, and a yellow LED indicates 100 Mbps operation.

Figure 7. LED Indicators

Table 3. LED Status Indicators

LED Name	Description
PWR	• Continuous—Power applied, no problems detected. • Rapid flash (5 times-per-second)—Alarm indication.
LAN	• Continuous—Local area network detected. • Flashing—Data is being transmitted and received. • Off—LAN not detected or excessive traffic is present.
COM1/COM2	The COM LEDs show activity on the serial payload data port(s). The left LED shows TX data and the right one shows RX data.
LINK	When lit, indicates that a communication link is established with the master station.

Event Codes

When an alarm condition exists, the transceiver creates a code that can be read on a connected terminal. These codes can be helpful in resolving many system difficulties. Refer to Table 4 (Page 11) for a definition of the event codes.

Checking for Alarms—*STAT command*

To check for alarms, connect a terminal to the radio's COM1 (diagnostics) connector. See "COM1 CONNECTIONS" on Page 12 for pinout information.

Enter **STAT** on the connected terminal. If no alarms exist, the message **NO ALARMS PRESENT** appears on the display.

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 on 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 will prevent (or seriously hamper) further operation of the transceiver. Major alarms generally indicate the need for factory repair. Contact your factory representative for assistance.

Minor Alarms—report conditions that, under most circumstances will 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 4 contains a listing of event codes that may be reported by the transceiver. The codes shown are a subset of a larger pool of codes used for various GE MDS products. *For this reason, the table does not show a sequential listing of all code numbers*. Only the codes applicable to this product are shown.

Table 4. Event Codes

Event Code	Event Class	Description
01	Major	Improper software detected for this radio model.
04	Major	The RF synthesizer is reporting an out-of-lock condition.
08	Major	The system is reporting that it has not been calibrated. Factory calibration is required for proper radio operation.
12	Major	Receiver time-out. No data received within the specified receiver time-out time.
13	Minor	A Transmitter timeout was detected. The radio stayed keyed longer than the duration specified by the TOT command.
17	Minor	A data parity fault has been detected on the COM2 INTERFACE connector. This usually indicates a parity setting mismatch between the radio and the RTU.

Table 4. Event Codes *(Cont'd)*

Event Code	Event Class	Description
18	Minor	A data framing error has been detected on the COM2 INTERFACE connector. This may indicate a baud rate mismatch between the radio and the RTU.
26	Minor	The DC input voltage is out-of-tolerance. If the voltage is too far out of tolerance, operation may fail.
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 may fail.

Internal Spectrum Analyzer

The radio contains a built-in spectrum analyzer tool that can be displayed on a connected PC. The tool is helpful in diagnosing interference problems on or near your channel frequency.

Access the spectrum analyzer by entering **spectrum** at the command prompt. A display appears showing detected signals on your *current channel*.

Optionally, you can specify a frequency at the command prompt to view the surrounding spectrum of that frequency. To do this, enter **spectrum xxx.xx**, where **xxx.xx** is the frequency in MHz.

The display creates a received signal strength indication (RSSI) vs. frequency plot for the frequency and surrounding signals. By analyzing the display, you can determine the presence of other signals near the transceiver's operating frequency. This information can be helpful in troubleshooting interference problems.

COM1/COM2 REFERENCE

COM1 CONNECTIONS

The COM1 connector is used to connect a PC to the radio for management or diagnostics. A straight-through cable is required that connects Pin 2 (RXD), Pin 3 (TXD), and Pin 5 (Ground). (See Figure 8.)

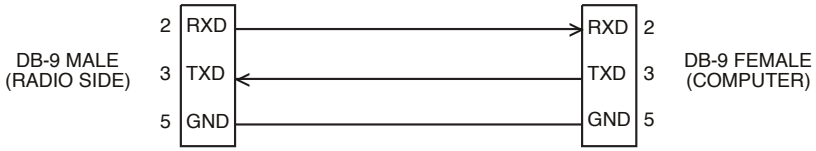

Figure 8. COM1 Wiring to Computer

NOTE: To prevent unintended keying of the transmitter during management activities, set **PTTSIG** to **OFF**, or do not connect to Pin 6 of the COM1 port.

COM2 CONNECTIONS

The COM2 connector (Figure 9) is used to connect the radio to an external DTE telemetry device that supports the EIA/RS-232 or EIA/RS-485 (balanced) format, depending on how the radio is configured. The radio supports data rates of 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 bps (asynchronous data only).

The COM2 connector mates with a standard DB-9 plug that is available from many electronics parts distributors. Table 5 provides detailed pin descriptions for the COM2 data connector in RS/EIA-232 mode.

NOTE: To prevent unintended keying of the transmitter on RTS, set **RTSKEY** to **OFF**, or do not connect to Pin 7 (RTS) of the COM2 port.

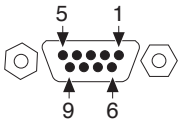

Figure 9. COM2 Connector (DB-9F)
As viewed from outside the radio

Pin Descriptions—RS/EIA-232 Mode

Table 5 lists the COM connector pin functions when configured to operate in RS/EIA-232 mode. For RS/EIA-422/485 mode, refer to the *Reference Manual*.

NOTE: The radio is hard-wired as a DCE device.

Table 5. COM2 Pin Descriptions—RS/EIA-232

Pin Number	Input/ Output	Pin Description
1	OUT	**DCD (Data Carrier Detect/Link)**—A low indicates signal received. Digital Modem Selections: Digital carrier detect Analog Modem Selections: Squelch indicator
2	OUT	**RXD (Received Data)**—Supplies received data to the connected device.
3	IN	**TXD (Transmitted Data)**—Accepts TX data from the connected device.
4	IN	**Sleep Mode Input**—Grounding this pin turns off most circuits in a remote radio. This allows for greatly reduced power consumption, yet preserves the radio's ability to be quickly brought on line. (See Using the Radio's Sleep Mode" for details.)
5	--	**Signal Ground—**Connects to ground (negative supply potential) on chassis.
6	OUT	**Alarm Output (DSR)—**An RS-232 high/space (+5.0 Vdc) on this pin indicates an alarm condition. An RS-232 low/mark (–5.0 Vdc) indicates normal operation. This pin may be used as an alarm output. (See *Reference Manual*.)
7	IN	**RTS (Request-to-Send)**—Keys the transmitter.
8	OUT	**CTS (Clear-to-Send)—**Goes "high" after the programmed CTS delay time has elapsed (DCE), or keys an attached radio when RF data arrives (CTS KEY).
9	--	Reserved—User I/O for special applications

NOTE: Additional information on Analog Mode operation (including cable wiring details) is contained in the *Reference Manual*.

SPECIFICATIONS

GENERAL

Frequency Range*: **MDS SD9:** 920–960 MHz

** Specific frequency authorizations are dependent on the type-approval of radio. Consult the factory for details.*

RECEIVER

Maximum Usable Sensitivity: –110 dBm at $1x10^{-6}$ BER (Preliminary)

Bandwidth: 12.5, 25 kHz

TRANSMITTER

Carrier Power: 0.1 Watts to 5 Watts

Duty Cycle: Continuous

Output Impedance: 50 Ω

Channel Spacing: 12.5, 25 kHz

FCC Emission Designators:

12.5 kHz B/W: 10K6F1D, F2D, F3D

25.0 kHz B/W: 16K2F1D, F2D, F3D

DATA CHARACTERISTICS

Signaling Type: EIA/RS-232; DB-9 Female connector

COM2 Data Rates: 300–115200 bps, asynchronous

Data Latency: 10 ms maximum

PRIMARY POWER

Voltage: 13.8 Vdc Nominal (10.5 to 30Vdc) Negative-Ground Systems Only

TX Supply Current: 2.0 Amperes (Typical) @ 5 Watts RF Output

RX Supply Current: *Operational*—125 mA, Nominal

Fuse: 5-Ampere, internal

ENVIRONMENTAL

Humidity: 95% at 40 degrees C (104°F), non-condensing

Temperature Range: –40 to 70 degrees C (–40°F to +158°F)

Weight: 1.0 kilograms

DIAGNOSTICS INTERFACE

Signaling Standard:	RS-232 (COM1) RS-232/RS-485 (COM2)
Connector:	COM1—DB-9F COM2—DB-9F

Specifications are subject to change without notice or obligation.

GE MDS

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