MDS SD4™
Software-Controlled
Digital Communications

Firmware Release 1.x.x

MDS 05-4669A01, Rev. A
December 2007

GE MDS
industrial wireless networks

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 SD4 Radio)

	Antenna Gain		
	0–5 dBi	**5–10 dBi**	**10–16.5 dBi**
Minimum RF Safety Distance	0.79 meter	1.41 meters	3.05 meters

FCC Part 15 Notice *(Pending Approval)*

The transceiver is approved under Part 15 of the FCC Rules. 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. 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 void the user's authority to operate this device.

CSA/us Notice *(Pending Approval)*

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 SD4 Series wireless transceiver. It is a companion guide to the *MDS SD4 Series Reference Manual* (Part No. 05-4670A01). Refer to the Reference Manual for additional details and system design information.

The transceiver (Figure 1) is designed to operate in point-to-multipoint 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. SD4 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 other 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 Layout

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.
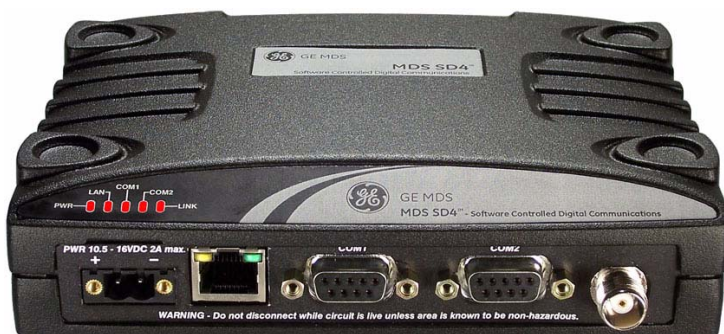
GE MDS

Figure 2. Front Panel Connectors & Indicators

Connector functions *(left to right)* are as follows:

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

LED functions are described in Table 3 on Page 9.

Standard Accessories

Table 1 lists accessories normally shipped with the transceiver. The contents may have been modified to reflect customer-specific requirements specified at the time of order. Additional accessories are available. Refer to the *SD4 Reference Manual* for a complete list.

Table 1. Accessories Supplied with the Unit

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
Radio Configuration Software	PC software used for setting the basic operating parameters of the radio.	03-3156A01
Start-Up Guide	Brief instructions for initial setup and commissioning of the radio.	05-4669A01
Reference Manual	Full technical information for the radio, including a complete description of software commands.	05-4670A01

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 3 shows a typical remote station arrangement. This is followed by step-by-step procedures for installing the transceiver and making external connections.
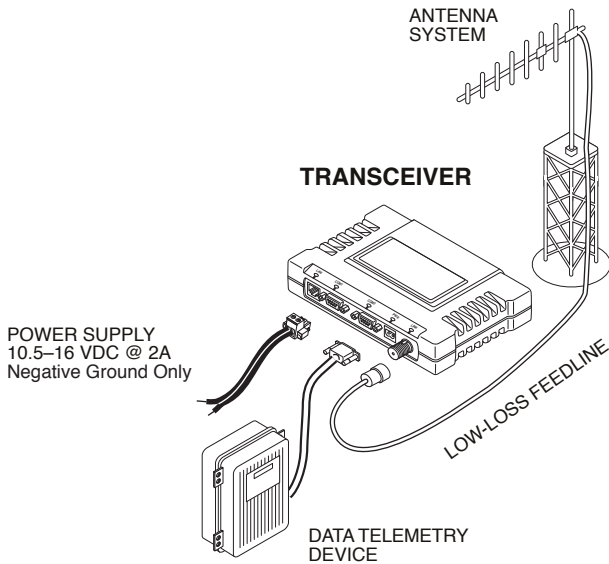
ANTENNA SYSTEM

TRANSCEIVER

POWER SUPPLY
10.5–16 VDC @ 2A
Negative Ground Only

LOW-LOSS FEEDLINE

DATA TELEMETRY
DEVICE

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 information.

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.
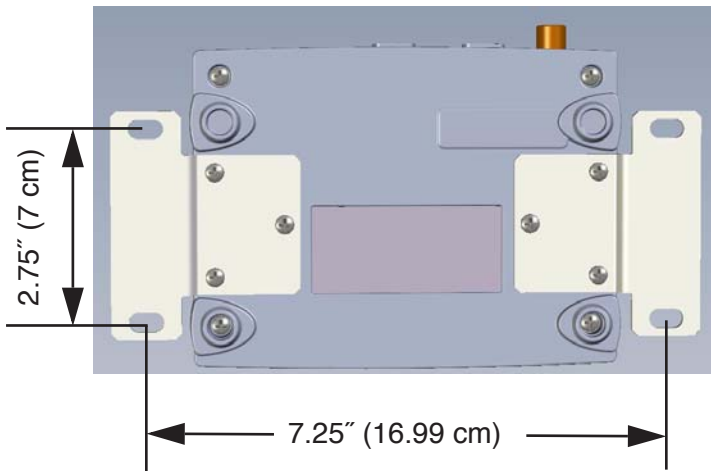
Figure 4. Transceiver Mounting Bracket Dimensions

CAUTION **POSSIBLE EQUIPMENT DAMAGE**	Using screws longer than 1/4 inch (6 mm) may damage the unit's internal PC board.

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 wired as a DCE device. Most applications will require the use of a straight-thru cable. Check Table 5 on Page 13 for pin details.

   Note: The LAN/Ethernet port is used for upgrading the radio's firmware. Refer to the Reference Manual for usage details.

4. **Connect primary power to the transceiver.** Power applied must be within 10.5–16 Vdc and capable of continuously providing up to 2 Amperes. A power connector with screw-terminals is provided 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.
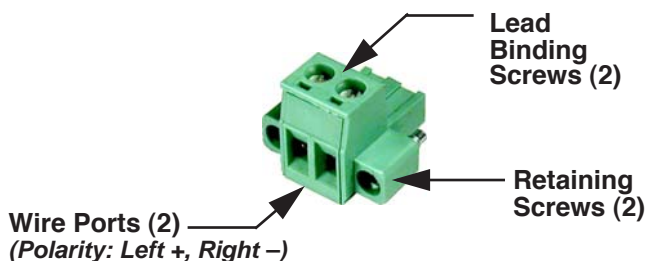
Lead Binding Screws (2)

Retaining Screws (2)

Wire Ports (2)
(Polarity: Left +, Right –)

Figure 5. DC Power Connector

CAUTION	The transceiver must be used with negative-ground sys-
POSSIBLE EQUIPMENT DAMAGE	tems only. The power supply used with the transceiver 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 using a straight-through cable. Launch a terminal communications program, such as HyperTerminal (included with most Windows™ systems). Press **ENTER** a few times to receive the ready ">" prompt on the screen.
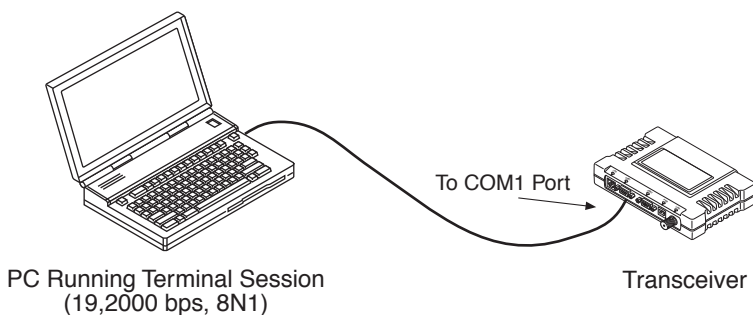

To COM1 Port

PC Running Terminal Session
(19,2000 bps, 8N1)

Transceiver

Figure 6. PC Configuration Setup

b. 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.

c. 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.

d. Set the radio's bandwidth using the **BW xxxx** command, where **xxxx** equals **12.5**, or **25** kHz.

NOTE: The radio's bandwidth must be properly set *before* making modem settings. A modem setting will not be respected if there is insufficient bandwidth to accommodate it.

e. Set the radio's modem type using the **MODEM xxxx** command, where xxxx equals the bps speed of the radio (9600 or 19200 bps). An entry of **NONE** selects analog operation, for use with an external modem.

If all checks are OK, you are finished with the installation at this site.

SOFTWARE COMMAND SUMMARY

Table 2 lists software commands commonly used during initial installation and setup of the transceiver. For a complete list of commands and detailed descriptions, refer to the transceiver's *Reference Manual*.

Table 2. Command Summary

Command Name	Function
ALARM	Read current operating condition of radio.
BAUD [xxxxx abc]	Set or display the DATA INTERFACE data rate and control bits.
BW [xxx]	Sets radio's channel bandwidth (in kHz).
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.
MODEL	Display the model number of the radio.
MODEM [xxxx, NONE]	Set the modem characteristics of the radio.

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

Command Name	Function
OWM [XXX...]	Set or display the owner's message.
OWN [XXX...]	Set or display the owner's name.
PORT [RS232, RS485]	Selects signaling standard to be used on DATA port.
PWR [20–37]	Set or display the transmit power setting.
RSSI	Display the Received Signal Strength Indication.
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.
SPECTRUM [xxx.xx x.x]	Display internal spectrum analyzer, where **x** characters denote center frequency and span frequency in MHz, respectively.
SREV	Display the Software Revision Level.
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.
UNIT [10000...65000]	Set or display the transceiver's unit address.

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)
- An efficient and properly aligned antenna system with a 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 SOFTWARE COMMAND SUMMARY on Page 7).

- 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 tool 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)—Fault indication.
LAN	• Continuous—Local area network detected.
	• Flashing—Data is being transmitted and received.
	• Off—LAN not detected or excessive traffic is present.
COM1 and COM2	COM1 indicator shows activity on the Management/Diagnostic port of the radio. COM2 indicator shows activity on the payload data port.
LINK	When lit, indicates that a communication link is established with the master station.

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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	One or both of the internal programmable synthesizer loops 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.
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.
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. This utility is helpful in diagnosing interference problems, or for use during initial setup of the radio.

The spectrum analyzer display is accessed by entering **spectrum xxx.xx x.x** at the command prompt, where the **x** characters denote the *center frequency* and *span frequency*, respectively. The frequencies are entered in megahertz. For example, a sample entry would be **spectrum 410.00 1.5**, corresponding to a center operating frequency of 410.00 MHz and a span (sweep width) of 1.5 MHz.

A sample display with these parameters is shown in Figure 8. The display creates a received signal strength indication (RSSI) vs. frequency plot for the center frequency and all surrounding signals within the span. By analyzing the display, you can determine the presence of other signals near the transceiver's operating frequency. Refer to the *SD4 Reference Manual* for additional details.
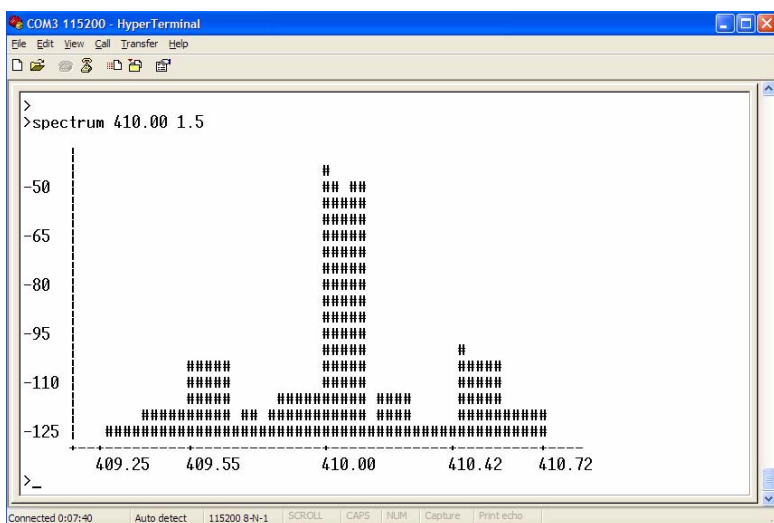

Figure 8. Internal Spectrum Analyzer Display

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 9.)
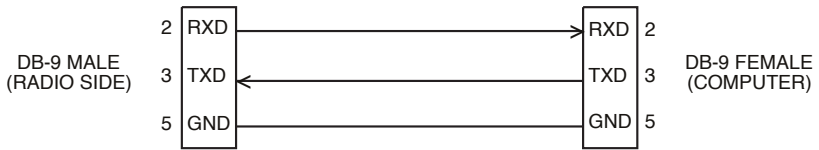
```
2  RXD  ────────────────────▶  RXD  2
3  TXD  ◀────────────────────  TXD  3
5  GND  ────────────────────   GND  5
```

DB-9 MALE
(RADIO SIDE)

DB-9 FEMALE
(COMPUTER)

Figure 9. COM1 Wiring to Computer

COM2 CONNECTIONS

The COM2 connector (Figure 10) 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 and Table 6 provide detailed pin descriptions for the DATA connector in RS/EIA-232 mode and RS/EIA-485 mode, respectively.
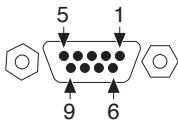
```
5   1
9   6
```

Figure 10. 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.

NOTE: The radio is hard-wired as a DCE device in EIA-232 mode.

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

Pin Number	Input/ Output	Pin Description
1	OUT	DCD (Data Carrier Detect)
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	--	Not Used—Do not connect

Table 5. COM2 Pin Descriptions—RS/EIA-232 *(Cont'd)*

Pin Number	Input/ Output	Pin Description
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)
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	--	Not Used—Do not connect

Pin Descriptions—RS/EIA-422/485 Mode

Table 6 lists the COM connector pin functions for radios configured to operate in RS/EIA-422/485 mode. See Figure 11 for wiring schemes.

Table 6. COM2 Connector Pin Descriptions—RS/EIA-485 Mode

Pin Number	Input/ Output	Pin Description
1	—	Not Used—Do not connect
2	OUT	TXD+/TXA—Non-inverting driver output. Supplies data to the connected device.
3	IN	RXD+/RXA—Non-inverting receiver input. Accepts data from the connected device.
4	--	Not Used—Do not connect
5	--	Signal Ground—Connects to ground (negative supply potential) on the radio's PC board and chassis.
6	--	Not Used—Do not connect
7	IN	RXD– /RXB—Inverting receiving input
8	OUT	TXD– /TXB—Inverting driver output.
9	--	Open (User configurable via internal jumper. See Reference Manual for details.)

NOTES:

• RXD+ / RXA and RXD– / RXB are data sent into the radio to be transmitted out

• RXD+ / RXA is positive with respect to RXD– / RXB when the line input is a "0"

• TXD+ / TXA and TXD– / TXB are data received by the radio and sent to the connected device

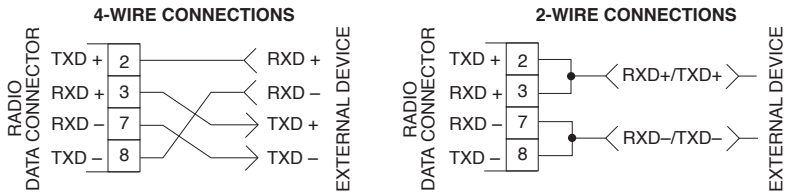• TXD+ / TXA is positive with respect to the TXD– / TXB when the line output is a "0"

Figure 11. EIA-422/485 Wiring Schemes
(Left: EIA-422, Right: EIA-485)

SPECIFICATIONS

GENERAL

Frequency Range*:   **MDS SD4:** 330–512 MHz in one of 3 bands as follows:
Band 1—330 to 400 MHz
Band 2—400 to 450 MHz
Band 3—450 to 512 MHz

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

RECEIVER

Maximum Usable Sensitivity: –110 dBm at 1×10^{-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: 11KOF1D, 11KOF2D, 11KOF3D

    25.0 kHz B/W: 23K4F1D, 23K4F2D, 23K4F3D

DATA CHARACTERISTICS

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

Data Interface Rates: 300–115200 bps, asynchronous

Data Latency: 10 ms maximum

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PRIMARY POWER

Voltage: 13.8 Vdc Nominal (10.5 to 16 Vdc)
                            Negative-Ground Systems Only

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

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

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

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.