User's Guide

MIDLAND®

SD-225 Series

16 Channel UHF/VHF Data Radio

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www.midlandradio.com

FCC RF EXPOSURE COMPLIANCE REQUIREMENTS FOR OCCUPATIONAL USE ONLY

The Federal Communications Commission (FCC), within its action in General Docket 93-62, November 7, 1997, has adopted a safety standard for human exposure to Radio Frequency (RF) electromagnetic energy emitted by FCC regulated equipment. Midland Radio Corporation subscribes to the same safety standard for the use of its products. Proper operation of this radio will result in user exposure far below the Occupational Safety and Health Act (OSHA) and FCC limits.

⚡ **DO NOT transmit for more than 50% of total use time (50% duty cycle). Transmitting more than 50% of the time can cause FCC RF exposure compliance requirements to be exceeded.**

⚡ **This radio is NOT approved for use by the general population in an uncontrolled environment. This radio is restricted to occupational use, work related operations only, where the radio operator must have the knowledge to control the user's exposure conditions for satisfying the higher exposure limit allowed for occupational use.**

⚡ **The antenna used with this radio should not have gain of more than 6 dBi. Make sure no one is closer than 20 inches to the antenna when transmitting. The radio is transmitting when the red LED on the cover of the radio is illuminated. You can cause the radio to transmit by grounding pin 3 on the radio connector.**

⚡ **These are required operating conditions for meeting FCC RF exposure compliance. Failure to observe these restrictions means violation.**

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Contents

Conventions and Symbols in this Book

⚡ **This symbol marks a "caution". Cautions are special notices which you should read and follow carefully to avoid possible damage to your equipment and to avoid potential danger to yourself or other people.**

! **This symbol marks an "important point". Important points are specific instructions which should be followed closely for proper operation.**

▤ *This symbol marks a "note". Notes are hints or tips which offer additional information to help you.*

Disclaimer

Midland Radio Corporation is committed to continuous quality improvements, for this reason specifications may change without prior notice.

Every effort has been made to ensure that the information in this document is complete, accurate, and up-to-date. Midland assumes no responsibility for the results of errors beyond its control. The manufacturer of this equipment also cannot guarantee that changes in the equipment made by unauthorized people will not affect the transceiver's performance or functions.

Safety

Your SD-225 data radio has been carefully designed to give you years of safe, reliable performance. As with all electrical equipment, however, there are a few basic precautions you should take to avoid injury to yourself or damage to the radio:

⚡ **Read the instructions in this book carefully.** Be sure to save it for future reference.

⚡ **Read and follow all warning and instruction labels on the radio itself.**

⚡ **Do not operate the radio near unshielded electrical blasting caps or in an explosive atmosphere.**

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⚡ **Do not operate the transmitter of any radio unless all RF connectors are secure.**

⚡ **All equipment must be properly grounded for safe operation.**

⚡ **Do not allow children to operate or play with or near the radio equipment.**

⚡ **Never attempt to service the radio yourself**. All equipment should be serviced by a qualified technician. Contact you local dealer or communications coordinator for assistance.

⚡ **Do not allow the antenna to touch or come in very close proximity with the eyes, face, or any exposed body parts while the radio is transmitting.**

📄 *The above warning list is not intended to include all hazards that may be encountered when using this radio.*

Introduction

Congratulations! By choosing the Midland SD-225 data radio, you have selected a flexible, easily configured communication device. Its rugged design will provide years of reliable service and exceptional performance.

Radio Models

The SD-225 data radio is available in three frequency ranges.

SD-225V2: 5 W, VHF high band, 148-174 MHz
SD-225U1: 5 W, UHF high band, 400-440 MHz
SD-225U2: 5 W, UHF high band, 440-480 MHz

Radio Features

The SD-225 series data radio is a programmable, synthesized 16 channel radio featuring:

☑ Compact, rugged die cast enclosure.

☑ Tri-color LED for operating, warning and programming status indications.

☑ 9-18 Vdc supply voltage operating range.

☑ 5 Watts transmit power. A low power selection (1 Watt) may be chosen if full power is not needed.

☑ 12.5 KHz and 25 KHz channel spacing, programmable per channel.

☑ 49 CTCSS tones / 104 DCS codes available, programmable per channel.

☑ Software adjusted noise squelch level. The squelch opening and closing levels may easily be set using the programming software and an RF signal generator.

☑ External modem / direct FM modulation input.

☑ Bell 202 / V.23 internal 1200 baud modem option.

☑ Busy channel lockout feature may be programmed. An override function for matched sub-audible is available to allow transmission during repeater hangtime.

☑ Transmit time-out timer may be programmed to limit continuous transmission time.

☑ Transmit hang timer may be programmed to keep the transmitter active for a short time after the PTT signal is removed..

☑ Basic radio controls (transmit mode, receive mode, channel change, and modem test) are available via serial commands.

Recommended Accessories and Options

Software
    ACC-917   PC programming and adjustment software

Cables
    ACC-2025   USB PC programming cable

Options
    ACC-512?   Bell 202/V.23 internal 1200 baud modem

Radio Connections

Connection Overview

The SD-225 features two standard interfaces. The data interface is used for connection to external modems and provides flat, unfiltered input and output. The audio interface is used for voice and some voiceband (300 – 3000 Hz) signaling applications.

> 📄 *If the internal modem option is installed, the data interface may be configured for direct asynchronous RS232 data input and output. PTT and Busy may also be configured for RS232 levels. More information using the internal modem is available in the modem manual.*

Once the interface type is selected, the appropriate connections may be chosen based on the information given below.

Power Connection

The SD-225 needs a stable 12V DC power source, capable of supplying at least 2 amps of current. The power connections should be made to DB9 pins 4 (-) and 5 (+).

> 📄 *The nominal input voltage for the SD-225 is 12 Vdc, but it is capable of operating in a 9-18 Vdc range.*

PTT Connection

A connection to the PTT input, DB9 pin 3, is required to put the SD-225 into transmit mode. Switching the PTT input to 0V will initiate transmit mode. With the internal modem option, the PTT input may be changed to RS232 level.

Busy Connection

A connection may be made to the BUSY_DET output, DB9 pin 6, which indicates the receive status of the SD-225. Pin 6 is normally +5Vdc and switches to 0V when a signal exceeding the programmed squelch threshold is received. If CTCSS/DCS is programmed on the channel, the CTCSS/DCS must also be

decoded, before pin 6 will switch low. With the internal modem option, the BUSY output may be changed to RS232 level.

Modulation Input Connections

The two choices for modulation are DATA_IN, DB9 pin 1 or MIC_IN, DB9 pin 7. When the SD-225 is used in low speed data applications (with an external modem), the modem data to be transmitted is usually connected to pin 1. The SD-225 connects the pin 1 input to the transmitter by default.

For audio applications, the transmit audio is usually connected to pin 7. The SD-225 must detect a load on pin 7, before it will switch pin 7 into the transmit circuit. This load could be a microphone element that is switched into the circuit by PTT. Alternatively, a 10KΩ resistor may be connected from PTT (pin 3) to MIC_IN (pin 7). This will load pin 7 when transmitting.

> 🗎 *Pin 7 has a second function in receive mode. If this pin is switched low in receive mode the SD-225 will enter monitor mode (open squelch). The MIC_IN load should only be in the circuit during transmit mode. It may be necessary to use an A/C coupling capacitor from the external modulation source to prevent the SD-225 from entering monitor mode.*

Demodulated Output Connections

The demodulated output from the receiver is available on DATA_OUT, DB9 pin 2 and SPK_OUT, DB9 pin 9. For low speed data applications, the flat, discriminator output, pin 2, is usually connected to the external modem. Pin 2 will provide 200-300 mVrms into a 10KΩ load when receiving a 1 KHz audio signal modulated at 60%.

For audio applications, the bandpass filtered (300 – 3000 Hz) and de-emphasized audio available on pin 9 is typically used. Pin 9 is adjusted for a nominal 1 Vrms into an 8Ω load, when receiving a 1 KHz audio signal modulated at 60%. RV403 may be used to adjust the pin 9 output level.

External Interface
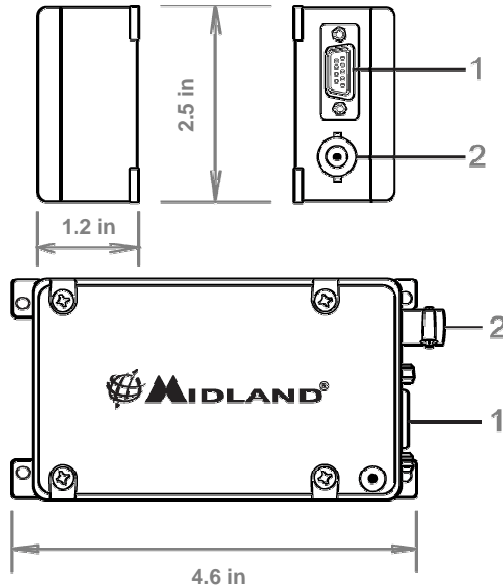
1. DB9 male: modulation input, demodulation output, control inputs and power supply.

2. BNC female: antenna connection.

DB9 Radio Interface Connector Details

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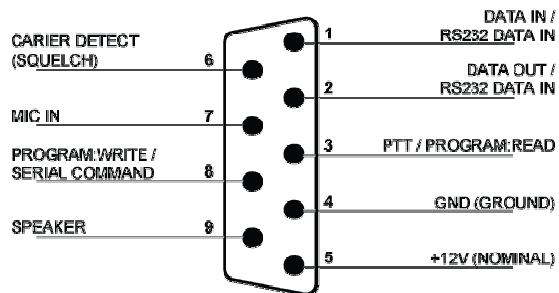
| Pin No.	Name/Function	Description	Signal Type
1 (default)	DATA_IN Data modulation input	LK409 in, LK412 out: A/C coupled signal to modulator through the data low pass filter, without pre-emphasis.	Analog signal 100-120 mVrms of 1KHz audio for 60% deviation
1 (alternate)	DATA_IN RS232 data input	LK409 out, LK412 in: Asynchronous data input to Bell 202/V.23 modem option. See modem manual.	RS232 level
2 (default)	DATA_OUT Data demodulation output	LK413 in, LK414 out: Buffered, unfiltered discriminator audio output.	Analog signal 1KHz audio @ 60% deviation produces 200-300 mVrms
2 (alternate)	DATA_OUT RS232 data output	LK413 out, LK414 in: Asynchronous data output from Bell 202/V.23 modem option. See modem manual.	RS232 level
3 (default)	PTT/PROG_READ PTT input (Program read)	Active low input which keys the transmitter. Also used for program data output during read mode.	TTL level 0V = TX
3 (alternate)	PTT/PROG_READ PTT key input	CON407 configured for RS232 PTT: PTT input to modem option. See modem manual.	RS232 level +12V = TX -12V = RX
4	GND Ground	Ground connection to chassis of the radio.	
5	B+ DC supply input	Power connection.	9-18Vdc, 12Vdc nominal
6 (default)	BUSY_DET Busy detect output	Active low output to indicate presence of carrier, or carrier + CTCSS/DCS.	TTL level 0V = carrier
6 (alternate)	BUSY_DET Busy detect output	CON407 configured for RS232 Busy: Carrier detect output from modem option. See modem manual.	RS-232 level +12V = carrier -12V = no carrier
7	MIC_IN Microphone (audio) modulation input	A/C coupled audio signal to the modulator through 300 Hz high pass filter, pre-emphasis and data low pass filter. Sub-audible tone is mixed with the audio after the data filter. Also used for monitor function. If this input is pulled low in RX, the radio will enter monitor mode (open squelch).	Analog signal 6-8mVrms of 1KHz audio for 60% deviation 0V = Monitor
8	PROG_WRITE Programming data input (serial control input)	Data input used during read/write programming mode. Also used for serial control data input.	TTL level (Level converter required for RS232 connection)
9	SPK_OUT Speaker (audio) demodulation output	Filtered and de-emphasized audio output.	Analog signal 1KHz audio @ 60% deviation produces nominal 1Vrms into 8Ω

Setup and Operation

Mounting
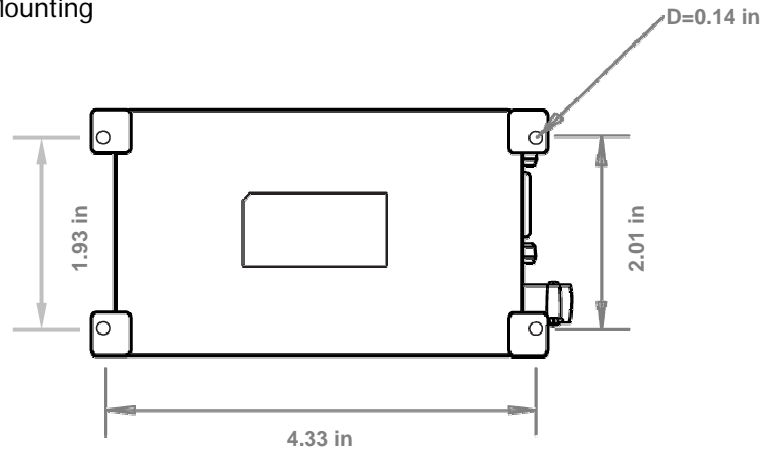
The SD-225 data radio should be secured to the mounting surface or bracket using suitable screws through the four mounting flanges. The mounting hole center to center dimensions are shown above.

The RF cabling should be routed separately from the control cabling to avoid interference.

Channel Selection
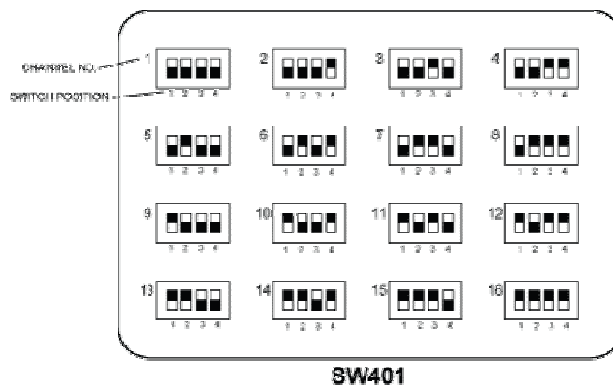
The normal operating channel should be selected using the internal DIP switch, SW401. The radio channel may also be selected by serial commands, but the radio will always power up on the channel selected by the DIP switch.

1. Remove the four screws securing the top cover and remove the top cover.

2. Set the DIP switch for binary channel selection according to the chart above, i.e. channel 1 is all switches off, channel 16 is all switches on.

3. Replace the top cover and secure with the four screws.

Status LED

The LED on the top cover indicates the status of the data radio. If a speaker has been connected to pin 9 of the radio interface connector, audible tones can be heard indicating certain conditions.

Radio Mode	Radio Status	LED Indication	Beep Indication
Normal Operation	Power-on	Green→orange→red	
	Busy channel	Steady orange	
	Busy channel w/correct CTCSS/DCS	Steady green	
	Transmit	Steady red	
Warning	Busy channel lockout	Continuous green flash when PTT activated	Continuous beep
	Time out timer expired	Continuous green flash while transmitting	
	5 sec before time out timer expires	One green flash	Single beep
	Subaudible disabled for data input	Two green flashes then red when PTT active	
	EEPROM error	One orange flash	
	Out of lock	Four yellow flashes	
	Communication error with modem MCU	Continuous green flash	
	Transmit hang time	Continued steady red when PTT released	
Program	Program read	Continuous red flash	
	Program write	Continuous green flash	
Squelch set	Initial data load	Green→orange→red	
	Open level set	Three green flashes	
	Close level set	Two green flashes	
	Squelch level save	One green flash	

Specifications

General specifications	VHF	UHF
Frequency range	V2 – 146-174 MHz	U1 – 400-440 MHz U2 – 440-480 MHz
FCC ID numbers	MMASD225V2	MMASD225U1 MMASD225U2
FCC type acceptance	Part 90	
Maximum number of channels	16	
Channel spacing	12.5 / 15 / 25 / 30 KHz	12.5 / 25 KHz
Channel stepping	2.5 / 5.0 / 6.25 KHz	5.0 / 6.25 KHz
CTCSS/DCS	49 CTCSS / 104 DCS	
Input voltage	9-18 Vdc	
MIL spec		
Size (H x W x D)	1.2 x 2.5 x 4.8 inches (30 x 63 x 122 mm)	
Weight	0.5 lbs (0.23 kg)	
EIA/TIA-603 receiver specs		
Frequency stability (-30° to +60° C)	±2.5 ppm	
12 dB SINAD sensitivity	0.3 µV	
Selectivity	60 dB (±12.5 KHz) / 70 dB (±25 KHz)	
Intermodulation rejection	70 dB (±50 / ±100 KHz)	
Spurious rejection	70 dB	
Acceptable radio freq displacement	±1.75 KHz NB / ±3.5 KHz WB	
Squelch sensitivity	0.5 µV default (software adjustable)	
Audio response	per EIA/TIA-603 specs	
Audio output into 8Ω	1 Vrms nominal w/ < 3 % distortion	
RF input impedance	50 Ω	
EIA/TIA-603 transmitter specs		
RF power output	1 or 5 Watts	
Frequency stability (-30° to +60° C)	±2.5 ppm	
Modulation type	F3E / F2D	
Adjacent channel power ratio	60 dB (±12.5 KHz) / 70 dB (±25 KHz)	
Spurious emissions	< -30 dBm	
FM hum & noise	34 dB NB / 40 dB WB	
Audio response	per EIA/TIA-603 specs	
Audio distortion (1KHz @ 40%dev.)	< 3%	
RF output impedance	50 Ω	

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Warranty Statement

Midland Radio Corporation (herein, Midland) warrants each new radio product manufactured or supplied by it to be free from defects in material and workmanship under normal use and service for a period listed below, provided that the user has complied with the requirements stated herein.

The Warranty period begins on the date of purchase from an Authorized Midland Sales and Service Outlet. This Warranty is offered to the original end user and is not assignable or transferable. Midland is not responsible for any ancillary equipment attached to or used in conjunction with Midland products.

Midland offers to the original end user a Two (2) Year Limited Warranty on Midland Business and Industrial radio products. Accessories carry a One (1) Year Limited Warranty.

During this period, if the product fails to function under normal use because of manufacturing defect(s) or workmanship, it should be returned to the Authorized Midland Sales and Service Outlet from which it was purchased. The Sales and Service Outlet will repair the product or return the product for repair to Midland or its Authorized Repair Depot. The user is responsible for the payment of any charges or expenses incurred for the removal of the defective product from the vehicle or other site of its use; for the transportation of the product to the Sales and Service Outlet; for the return of the repaired / replacement product to the site of its use and for the reinstallation of the product.

Midland shall have no obligation to make repairs or to cause replacement required, which results from normal wear and tear or is necessitated in whole or in part by catastrophe, fault or negligence of the user, improper or unauthorized alterations or repairs to the Product, incorrect wiring, use of the Product in a manner for which it was not designed or by causes external to the Product. This Warranty is void if the product serial number is altered, defaced or removed.

Midland's sole obligation hereunder shall be to replace or repair the Product covered in this Warranty. Replacement, at Midland's option, may include a similar or higher-featured product. Repair may include the replacement of parts or boards with functionally equivalent reconditioned or new parts or boards. Replaced parts, accessories, batteries or boards are warranted for the balance of the original time period. All replaced parts, accessories, batteries or boards become the property of Midland.

THE EXPRESS WARRANTIES CONTAINED HEREIN ARE IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

FOR ANY PRODUCT WHICH DOES NOT COMPLY WITH THE WARRANTY SPECIFIED, THE SOLE REMEDY WILL BE REPAIR OR REPLACEMENT. IN NO EVENT WILL MIDLAND BE LIABLE TO THE BUYER OR ITS CUSTOMERS FOR ANY DAMAGES, INCLUDING ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR FOR THE LOSS OF PROFIT, REVENUE OR DATA ARISING OUT OF THE USE OF OR THE INABILITY TO USE THE PRODUCT.

This warranty is void for sales and deliveries outside of the U. S. A. and Canada.

📄 *This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.*

📄 *This radio operates in FCC regulated frequency bands. All radios must be licensed by the FCC before use. Because this radio contains a transmitter, Federal law prohibits unauthorized use or adjustments of this radio.*