MDR210A-232

General Purpose
900 MHz. Spread Spectrum Frequency Hopping Transceivers

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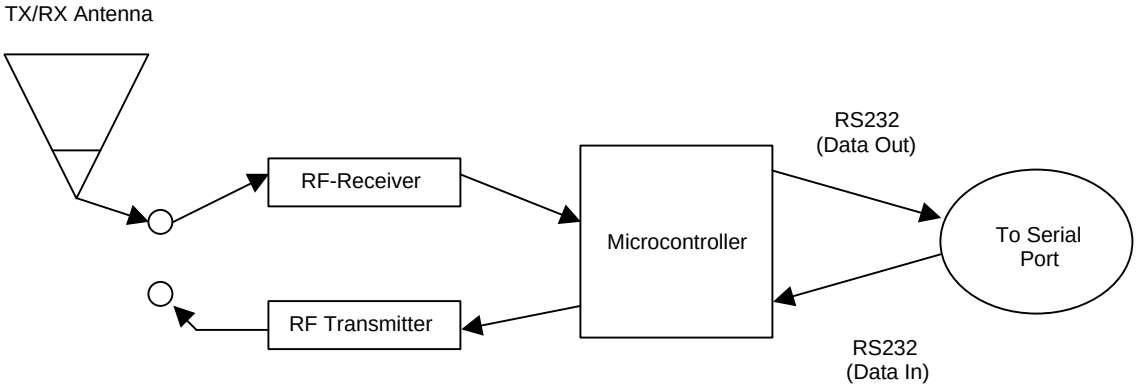
Overview

The MDR210A-232 is a 100-milliwatt, frequency-hopping wireless module that will allow wireless communication between equipment using a standard asynchronous serial data stream. The half-duplex transmission of MDR210A-232 can sustain a continuous data stream at 9600 Baud data rate. The MDR210A-232 has been engineered for use with the following applications (among others):

- Supervisory Control and Data Acquisition (SCADA)
- Remote meter reading
- Home Automation
- Security
- Instrument monitoring
- Point of Sale Systems (POS)

The MDR210A-232 operates within the 900MHz ISM Band and is approved by the FCC under Part 15 of FCC Rules and Regulations.



Features

General Purpose
900 MHz. Spread Spectrum Frequency Hopping Transceivers

The **MDR210A-232** is a general purpose compact data transceiver perfect for those needing high performance and dependable operation. It's wireless modem transfers data at 9600 baud up to ¼ mile in a city environment or greater than 10 miles line-of-sight with a directional antenna.

It is ideally suited for applications in supervisory control and data acquisition (SCADA), remote meter reading, home automation, security, instrument monitoring, point of sale systems (POS) and a myriad of other applications.

Transceiver modules have built-in support for multi-drop networking protocols. Multiple independent networks can operate in the same vicinity by using distinct network identifiers.

The radios integrate quickly and seamlessly into any new or existing design. Simply output serial data from a microcontroller or RS-232 port into the radio to send FCC approved, frequency hopping spread spectrum data through the air and capture it on all receivers within range on the same network. The system behaves as a virtual half-duplex, parallel-wired network.

General	**MDR210A-232**
Frequency Range	900 MHz., unlicensed ISM Band
Type	Frequency Hopping Spread Spectrum Transceiver
Frequency Control	Direct FM
Transport Protocol	Various Monitoring and Addressing Modes
Channel Capacity	Hops through 25 channels. Features 7 diff. hop sequences. 65,000 network identifiers.
Serial Data Interface	Asynchronous RS232 levels
Serial Interface Baud Rate	Configurable from 2400-57600 bps
Data Throughput	9600 bps
Network Topology	Point – multipoint, point-to-point multi-drop transparent networking

Performance	
Channel Data Rate	10k
Transmit Power Output	100mW
Rx Sensitivity	-110dBm
Range*	Indoor: 600' to 1500' Outdoor: 7 mi. with dipole, over 20 mi. with high gain antenna
Interface Rejection	70 dB at pager and cellular phone frequencies

*Range calculations are for 9600 baud line of sight. Actual range will vary based upon specific antenna selection and environment

MDR210A-232 Setup Utility

Overview

The MDR210A-232 Setup program is intended to configure an MDR210A-232 for use as a general purpose RS232 half duplex interface.

In order for multiple MDR210A-232s to interact with each other they must share the same Network ID and Hop Table. The Hop Table allows different Networks to coexist with minimal radio packet collisions. The Baud Rate only affects the MDR210A-232 to host interactions. Therefore select any available Baud Rate convenient to the application. Interacting MDR210A-232s may be set to different Baud Rates because the radio modems within are always communicating at 9600 Baud.

Serial Port Scanning

The Scan Function is provided to assist the user when they are unsure which communication port the MDR210A-232 is attached to or what baud rate it has been set to. The Scan Function will attempt to communicate with the MDR210A-232 over every port installed on the PC at every allowed baud rate. While this is not a fast process, it does allow the recovery of a device whose configuration is unknown. If the Scan Function is unable to determine the port which the MDR210A-232 is attached to, the user will be notified. The user should then ensure that no other application has the communication port in use before re-attempting the Scan.

Application Fields

COM Port - Specifies which PC communication port the MDR210A-232 to be configured is attached.

Scan - The scan function iterates each available PC communication port looking for an attached MDR210A-232. If an MDR210A-232 is found, its COM Port and current Baud Rate values are provided.

Network ID - All communicating MDR210A-232s must be programmed to the same Network ID. The valid values are from hexadecimal 1 to FFF.

Hop Table - All communicating MDR210A-232s must be programmed to the same Hop Table. The valid values are 0 to 6. Independent networks in the same vicinity should use different Hop Tables to minimize packet collisions.

Baud Rate - This is the desired communication Baud Rate between the host and the MDR210A-232.

Setup - Send the currently selected values to the MDR210A-232 attached to the specified communication port.

Close - Exits the Application.

Networks

There are seven available **networks (Hop Tables)**. Each network utilizes a different pseudo-random hopping sequence to navigate through the shared hopping channels. In the event that two modules from different networks collide on a channel (because they hop in a different sequence) the two modules will jump to separate channels on the next hop. Using networks, multiple module pairs can operate in the same vicinity with minimal interference from each other. The network parameter is user-definable using the MDR210A-232 Set-up Hop Table.

Module Address

Module Addresses provide another level of addressing among the MDR210A-232 modules. Each module in a network can be configured with a 16-bit Module Address to establish selective communications within a network. This address is set to 65535 values using the MDR210A-232 Set-up Hop Table command.

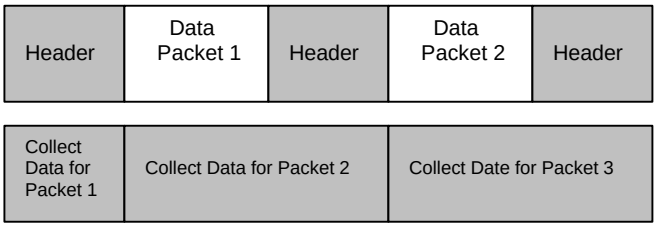
All modules with the same Module Address can transmit and receive data among themselves. Any modules on a network with different Module Addresses will still detect and listen to the data in order to maintain network synchronization. However, they will not send the data to their serial ports if their Module Addresses do not match the Module Addresses of the transmitter.

Data Validity

The first data packet transmitted contains all bytes that accumulated in the data buffer while the header (see Figure 2a below) was being sent. After the first data packet is sent, another header will be sent if data is available in the buffer. The header is followed by another data packet. The second data packet (and all subsequent data packets) will consist of data that accumulated in the buffer while the previous data packet and header were being sent (see Figure 2a). The size of each data packet can vary up to 64 bytes. This progression can be seen in Figure 2b.

Data Validity (cont.)

Sent Data:



Group Data into Packets:

Figure 2a – Generation of Data Packets

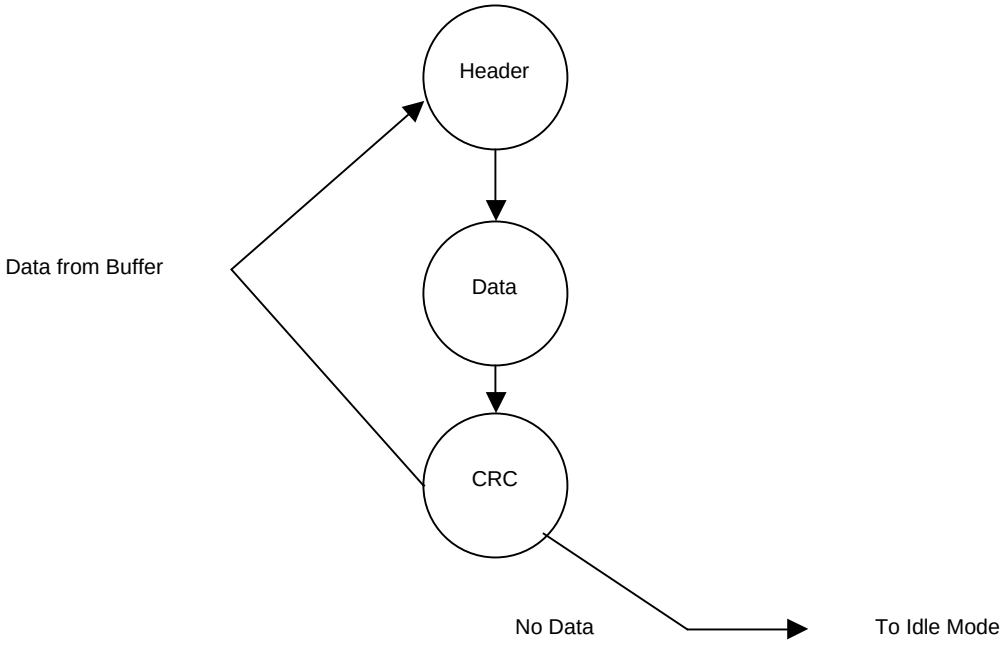


Figure 2b – Transmit Mode Description

To verify data integrity, a 16-bit cyclic redundancy check (CRC) is computed for the transmitted data and attached to the end of each data packet before transmission. The receiver will then compute the CRC on all incoming data. Any received data that has an invalid CRC is discarded.

Glossary

Data Buffer – Collects incoming serial data prior to over-the-air data transmission. The data buffer can hold up to 132 bytes at a given time.

Data Packets – A grouping of data to be sent over-the-air. Each data packet contains a header and data that is collected from the data buffer. The size of the packets varies up to 64 bytes depending on how many bytes of data are in the data buffer.

Frequency Hopping Spread Spectrum (FHSS) – Method employed by the MDR210A-232 module which involves transmitting data over several different channels in a specific channel hopping sequence known by the transmitter and the receiver(s).

Half-duplex – A mode for radio operations. Radios that operate in half-duplex are able to either transmit data or receive data at a given time, but cannot do both simultaneously. When one module is transmitting, all modules within range listen to the transmission and will only transmit when the transmission is complete.

Module Addresses – Provides a layer of addressing among modules. Modules with the same Module Addresses can communicate together.

Networks – Provides a layer above Module Addresses for communicating between modules. Each network has a unique hopping sequence that allows modules on the same network to remain synchronized together.

RS-232 logic – Standard logic levels implemented in devices using the RS-232 communication protocol.

Sensitivity – A measurement specification that describes how weak a signal can be (in dBm) and still be detected by the receiver.

Serial Data – Data that enters the MDR210A-232 module through its serial port.

Start bit – A low UART signal to signify the beginning of an eight-bit data sequence.

Stop bit – The last bit in a UART data sequence. The stop bit is high and indicates the end of an eight-bit data sequence.

Synchronization – Synchronization is used to ensure that the transmitter and receiver are communicating properly with each other and following the same channel hopping sequence.

Glossary (cont.)

Transmission Latency – Time required to send a packet of data. This value is dependent on the number of bytes being sent and the baud rate of the module.

Transmit Mode – Mode of operation in which over-the-air data can be transmitted from a module to other modules.

Application Notes

Why does Sensitivity Matter?

Receiver sensitivity is the lowest power level at which the receiver can detect a wave and demodulate data. Sensitivity is purely a receiver specification and is independent of the transmitter. As the wave propagates away from the transmitter, it attenuates as the distance increases. Lowering the sensitivity on the receiver (making it more negative) will allow the radio to detect weaker signals, and thus increase the transmission range. Sensitivity is vitally important since even slight differences in receiver sensitivity can account for large discrepancies in the range. To better understand this relationship, the following example is provided.

Example:

Compare the MDR210A-232 module (with –110dBm sensitivity) to a commercial radio receiver with a sensitivity of –90 dBm. The Friis transmission formula can be used to calculate received power (or signal strength) at any receiver location under line-of-sight conditions. This formula is given by

$$P(r) = \frac{P(t) \times G(t) \times G(r) \times \lambda^2}{F(s) \times 4\pi r^2}$$

P(r) = received power (mW)
P(t) = transmitted power (mW)
G(t) = gain of transmit antenna (linear)
G(r) = gain of receive antenna (linear)
F(s) = fading margin (linear)
λ = wavelength (meters)
r = distance between Transmitter and Receiver (meters)

The following values were used to compare the range limitations of these modules:

P(t) = 100mW
G(t) and G(r) = 2dB, or 1.585 linear
λ = 0.333 meters
F(s) = 21dB, or 125.89 (experimentally determined.

The table below demonstrates the power received at the receiver over the specified range between the TX and RX antennas, assuming line of sight conditions.

Application Notes **(cont.)**

Range (meters)	Received Power	Detectable by MDR210A-232	Detectable by Commercial Radio
100	-68.526 dBm	YES	YES
500	-82.506 dBm	YES	YES
1000	-88.526 dBm	YES	YES
3000	-92.048 dBm	YES	NO
5000	-102.506 dBm	YES	NO
8000	-106.588 dBm	YES	NO
10000	-108.526 dBm	YES	NO
11265 (7miles)	-109.559 dBm	YES	NO
12000	-110.805 dBm	NO	NO

Since the range doubles every 6dB, the 20dB sensitivity difference in radios corresponds to 2^(20/6) = 10.08 times the range using the MDR210A-232 radio!

Appendix A – Specifications

General	
Frequency Range	902 to 928 MHz, unlicensed ISM Band
Type	Frequency Hopping Spread Spectrum Transceiver
Frequency Control	Direct FM
Transport Protocol	Various Monitoring and Addressing Modes
Channel Capacity	Hops through 25 channels. Features 7 different hop sequences
Serial Data Interface	Asynchronous RS-232 levels
Serial Interface Baud Rate	Configurable from 2400-57600 bps
Data Throughput	9600 bps
Performance	
Channel Data Rate	10k
Transmit Power Output	100mW
Rx Sensitivity	-110 dBm
Range*	Indoor: 600' to 1500' Outdoor: 7mi. With dipole, over 20 mi. with high gain antenna
Interference Rejection	70 dB at pager and cellular phone frequencies
Power Requirements	
Supply Voltage	7-25V DC
Current Consumption	Tx - 170 mA nominal, Rx - 70 mA nominal
Physical Properties	
Board Size	4.3" x 3.2" x 1.7"
Weight	8 oz.
Connectors	DB9, Reverse Polarity SMA Female
Operating Temperature	-40° to 85° C
Antennas	
Antenna Connector	Reverse Polarity SMA Male
Approved Antennas	1/4 wave flexible monopole 1/2 wave flexible dipole, SMA

FCC Compliance

Warning: This device complies with part 15 of the FCC Rules. Operation is subject to the following 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.