



MDR29x Wireless 900 MHz Modem

User's Manual
Version 1.5



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MDR29X RF TRANSCEIVER

The MDR29x transceiver is a Frequency-Hopping Spread Spectrum (FHSS) radio designed for license-free operation in the 900 MHz ISM band. The radio sustains a standard asynchronous serial data stream between two or more radios out of the box. Housed in a compact and rugged die-cast enclosure, the radio is equipped to replace miles of serial cable using an RS232, RS485, or USB interface.

MDR29X FEATURES

NETWORKING AND SECURITY

- Retries and Acknowledgements
- API Commands to control packet routing and acknowledgement on a packet-by-packet basis
- Frequency Hopping Spread Spectrum for security and interference rejection
- Customizable RF Channel number and system ID
- Dynamic link analysis, remote radio discovery
- Low latency and high throughput

EASY TO USE

- Continuous 76.8 kbps RF data stream
- Software selectable interface baud rates from 1200 bps to 115.2 kbps
- Advanced configuration available using AT commands

OVERVIEW

The MDR29x uses Frequency Hopping Spread Spectrum modulation, where the units "hop" from frequency to frequency many times per second using a specific hop pattern applied to all the transceivers in the same network. A distinct hopping pattern is provided for each Channel Number, thereby allowing multiple networks to co-exist in the same area without interference.

MDR29x transceivers operate in a Point-to-Point or Point-to-Multipoint, Client-Server architecture. One transceiver is configured as a Server and there can be one or many Clients. To establish communication between transceivers, the Server emits a beacon and upon detecting a beacon, RF link is established with the Client(s).

MDR29x's implement a proprietary communication protocol to provide secure data transmissions. The use of FHSS technology ensures data reliability over long distances. Use of license free frequency bands ensure that the units are ready for use with no further certification requirements.

Each unit is small and easily portable for use in mobile and temporary settings as well as for fixed installations. The Black Box MDR29x configuration software enables custom configurations based on unique application requirements.

This document contains information about the hardware and software interface between an Black Box MDR29x transceiver and an OEM Host. Information includes the theory of operation, specifications, interface definition, configuration information and mechanical drawings. The OEM is responsible for ensuring the final product meets all appropriate regulatory agency requirements listed herein before selling any product.

Note: MDR29x modules will be referred to as the “radio” or “transceiver”. Individual naming is used to differentiate product specific features. The host (PC, Microcontroller, or any device to which the MDR29x is connected) will be referred to as “OEM Host”.

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SPECIFICATIONS

TABLE 1: MDR29X SPECIFICATIONS

INTERFACE			
Serial Interface Connector	DB-9 Male (RS-232), Terminal Block (RS-485), Type B USB (USB)		
RF Connector	RPSMA Jack		
Serial Interface Data Rate	Baud rates from 1200 bps to 115,200 bps		
Power Consumption (typical)	400 mA @ 12VDC		
Channels	32 (USA); 7 (Australia)		
Supported Network Topologies	Point-to-Point, Point-to-Multipoint		
Security	One byte System ID. 56-bit DES encryption key.		
Interface Buffer Size	Input/Output: 256 bytes each		
OPERATIONAL			
Frequency Band	902 – 928 MHz (USA); 915-928 MHz (Australia)		
RF Data Rate	76.8 kbps fixed		
RF Technology	Frequency Hopping Spread Spectrum		
Output Power		<u>Conducted (no antenna)</u>	<u>EIRP (3dBi gain antenna)</u>
	MDR292/4A:	743mW typical	1486mW typical
	MDR291A:	100mW typical	200mW typical
Supply Voltage	MDR292/4A:	7-18VDC	
	MDR291A:	USB Supplied 5V	
Sensitivity	-100dBm typical @ 76.8kbps RF Data Rate		
Range, Line of Site (based on 3dBi gain antenna)	MDR291A:	Up to 4 miles	
	MDR292/4A:	Up to 20 miles	
ENVIRONMENTAL			
Temperature (Operating)	-40°C to 80°C		
Temperature (Storage)	-50°C to +85°C		
PHYSICAL			
Dimensions	4.4 x 2.7 x 1.4 inches		
Weight	6 oz (170 g)		
CERTIFICATIONS			
FCC Part 15.247	MDR291A:	KQLAC4490-100	
	MDR292/4A:	KQLAC4490	
Industry Canada (IC)	MDR291A:	2268C-AC4490	
	MDR292/4A:	2268C-AC44901000	

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SERIAL INTERFACE

The MDR29x supports RS232, RS485, and USB protocols (separate products). Black Box wireless solutions are not subject to the cabling restrictions for distance, and either interface is available when ordering.

Figure 1: MDR29x Status LEDs

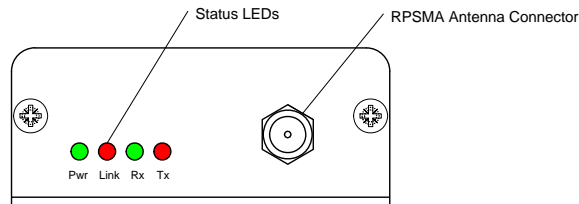


TABLE 2: STATUS LEDS

LED	COLOR	DESCRIPTION
Pwr	Green	On indicates that the unit is powered up.
Link	Red	On indicates that the Client unit(s) and Server unit are in range of each other. Client units activate the Link LED when in Range of the Server unit. Always lit on a Server unit.
RXD	Green	When flashing, indicates that the MDR29x is receiving data.
TXD	Red	When flashing, indicates that the MDR29x is transmitting data.

Figure 2: MDR292A

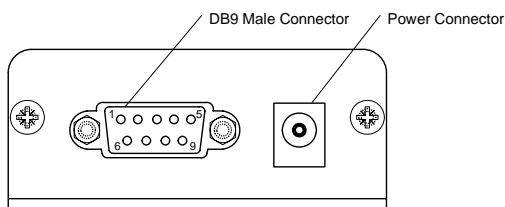


Figure 3: MDR294A

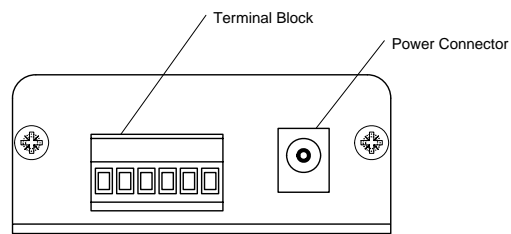
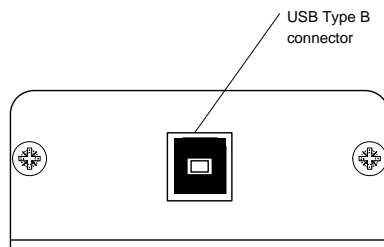


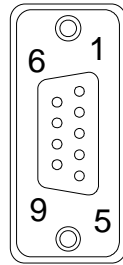
Figure 4: MDR291A



RS232 - MDR292A

RS232 is a single-ended data transmission protocol. The RS232 signals are represented by voltage levels with respect to a system common (power/logic ground). The "idle" state (MARK) has the signal level negative with respect to common, and the "active" state (SPACE) has the signal level positive with respect to common.

TABLE 3: MDR29X DB9 MALE CONNECTOR PINOUT



DB9 PIN	SIGNAL NAME	DESCRIPTION
1	DCD	Data Carrier Detect
2	RXD	Received Data
3	TXD	Transmitted Data
4	DSR	Data Set Ready
5	GND	Ground
6	DTR	Data Terminal Ready
7	CTS	Clear To Send
8	RTS	Request To Send
9	RI	Ring Indicator

INTERFACING TO OTHER RS232 EQUIPMENT

The MDR292A is a DCE (Data Communications Equipment) device. Typically devices like PC's are considered DTE (Data Terminal Equipment) devices while peripheral devices are classified as DCE. A DCE device can be interfaced to a DTE device using a straight through serial cable. When interfacing two DCE or

two DTE devices together, a null modem cable is required to swap the pins and convert the signals accordingly.

Figure 5: DTE to DCE Interface

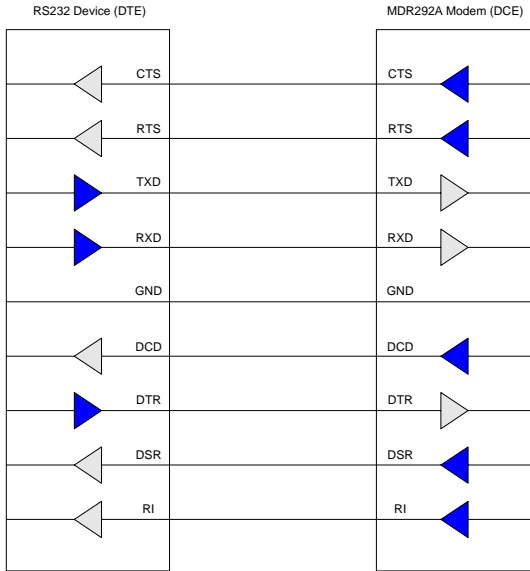
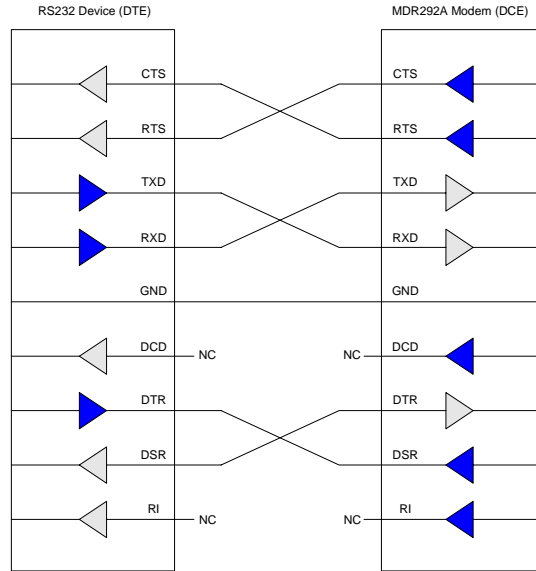
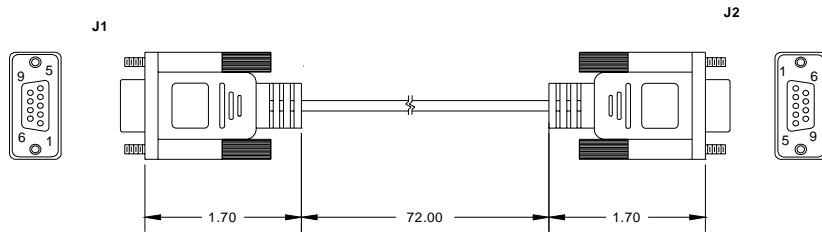


Figure 6: DCE to DCE Interface



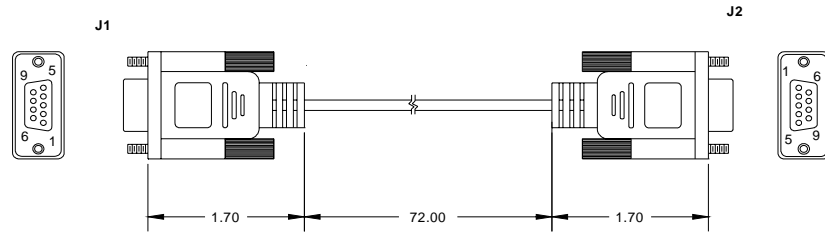
J1	J2	SIGNAL
1	1	DCD
2	2	RXD
3	3	TXD
4	4	DTR
5	5	GND
6	6	DSR
7	7	RTS
8	8	CTS
9	9	RI
Shell	Shell	GND

Figure 7: DB9F to DB9F Straight Through Cable



J1	J2	SIGNAL
1	N/C	DCD
2	3	RXD
3	2	TXD
4	6	DTR
5	5	GND
6	4	DSR
7	8	RTS
8	7	CTS
9	N/C	RI
Shell	Shell	GND

Figure 8: DB9M to DB9 Female Null Modem Cable



DESIGN TIP

If you previously used a straight through cable to connect your PC to your device, you'll need to use a null modem cable or adapter to connect the MDR292A to that device.

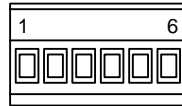
RS485 - MDR294A

The RS-485 interface uses a Differential Data Transmission that can help nullify the effects of ground shifts and induced noise signals that can appear as common mode voltages on a network.

The MDR294A implements a RS-485 (2-wire Half Duplex) multi-drop interface. Typically, a RS-485 bus will consist of a master and several slaves. The nodes will have unique addresses and can send addressed packets to specific nodes. Because the bus is half duplex, no two nodes should try to talk at the same time. The MDR294A does not have a RS-485 address, therefore, it will transmit all RS-485 traffic over the RF. Conversely, as soon as a MDR294A receives a packet over the RF, it will transmit the packet over the RS-485 bus.

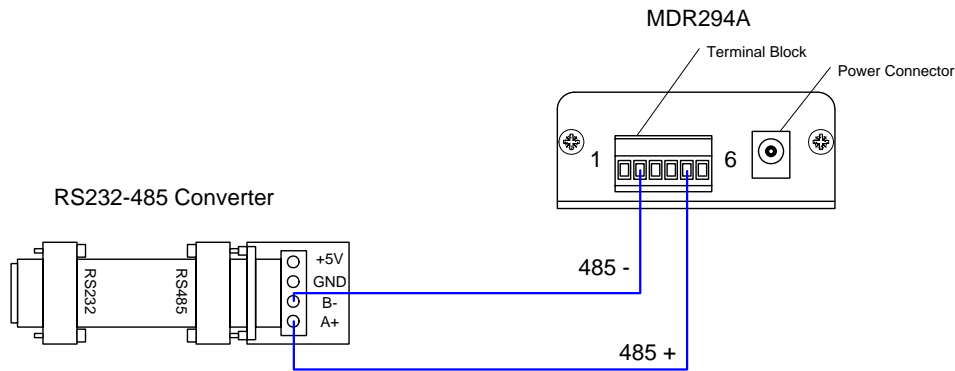
TABLE 4: MDR29X TERMINAL BLOCK PINOUT

TERMINAL BLOCK PIN	SIGNAL NAME	DESCRIPTION
1	VCC	6-18V (1.3A required)
2	485 -	485B
3	N/C	No Connect
4	N/C	No Connect
5	485 +	485A
6	GND	Ground



Note: When using RS485 (2-wire Half Duplex), a RS485 to RS232 converter is required to configure the unit.

Figure 9: RS232-485 Converter



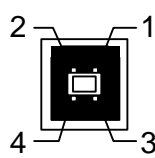
DESIGN TIP Many simple 2 or 4-wire converters do not provide hardware flow control capabilities and therefore require Handshaking to be disabled in the Black Box Configuration Utility to configure the radio. Check with your converter Manufacturer for any specific requirements.

USB - MDR291A

Universal Serial Bus (USB) is a connectivity specification developed by Intel and other technology industry leaders. USB provides ease of use, expandability, and speed for the end user.

The USB bus supplies 5V DC regulated power (maximum 500mA) through each port on pins 1 and 4. Low-power devices that might normally require a separate AC adapter can therefore be powered via the USB cable, eliminating the need for associated AC adaptors. The MDR291A draws all of its power directly from the USB bus and requires no external power supply.

TABLE 5: MDR291A USB TYPE B PINOUT



TERMINAL BLOCK PIN	SIGNAL NAME	DESCRIPTION	CABLE COLOR
1	V _{BUS}	4.75 - 5.25V @ 500mA	Red
2	D-	Transmit/Receive Data	White
3	D+	Transmit/Receive Data	Green
4	GND	Ground	Black

USB DEVICE TYPES

There are two types of USB devices; Masters & Slaves. A USB Master device is essentially a host device (i.e. PC) that supplies the USB drivers. A USB Slave device (peripheral devices such as a keyboard, mouse, etc.) gets connected to a USB Master device and uses the USB driver supplied by the Host.

When a USB Slave device gets connected to the Host (i.e. PC), the Host prompts the device for the appropriate USB driver. Once the driver has been located, the Host loads and retains it for all subsequent connections of the Slave device. **Note:** The MDR291A is a USB Slave device (peripheral) and cannot be connected to another USB Slave device.

USB DRIVER

The MDR291A is a stand-alone RF module that interfaces to a USB port on the Host device. It uses a Virtual COM Port driver that causes the device to appear as an additional COM Port on the PC. Application software can then access the USB device in the same manner as it would access a standard COM Port.

The MDR291A is a plug-and-play device that will automatically be detected by the PC upon connection. Once detected, the PC starts the Add New Hardware wizard and installs the USB driver.

DESIGN TIP

The Black Box USB Driver is installed automatically with the OEM Configuration Utility. It can also be installed manually using the procedure below:

- 1 Connect the MDR291A device to the PC using a USB cable
- 2 Insert the Black Box Tools & Literature Disk into the CD drive.
- 3 Select **Install from a specific location** and then press the **Next** button.
- 4 Select **Search for the best driver** option.
- 5 Check **the Search removable media (CD-ROM)** box and then press **Next**.
- 6 If a **Windows logo testing** dialog appears, select **Continue anyway**.
- 7 Select **Finish** and reboot if prompted.

HARDWARE FLOW CONTROL

Flow control refers to the control of data flow between the host and the MDR29x. It is the method used to handle data in the transmit/receive buffer of the MDR29x interface, and determines how data flow between the host and the MDR29x is throttled. Often in serial communication, one device is capable of sending data much faster than the other can receive. Flow control allows the slower device to tell the faster device to pause and resume data transmission. (Flow control CTS and RTS are used by the MDR29x and its Host, locally - **NOT over the air**. Therefore, one MDR29x cannot tell the other to slow down or speed up as is mentioned above in the paragraph).

When the RTS Enable option is selected on the Configuration Utility, the transceivers use hardware flow control to regulate data flow. While using hardware flow control, the transceiver that is ready to receive data sends a Clear To Send signal to its host (or the device it is connected to). On the other hand, when a transceiver has something it wants to send to its host, it checks the state of Ready To Send and if it is logic low, will send data to its host. If RTS is logic high, it will not send data to its host. These signals are sent apart from the data itself on separate wires. **Note: CTS is always enabled by default. RS-485 Interface does not support Hardware flow control.**

DESIGN TIP

Can I implement a design using just Txd, Rxd and Gnd (Three-wire Interface)?

Yes. However, it is strongly recommended that your hardware monitor the CTS pin of the radio. CTS is taken High by the radio when its interface buffer is getting full. Your hardware should stop sending at this point to avoid a buffer overrun (and subsequent loss of data).

You can perform a successful design without monitoring CTS. However, you need to take into account the amount of latency the radio adds to the system, any additional latency caused by Transmit Retries or Broadcast Attempts, how often you send data, non-delivery network timeouts and interface data rate. Polled type networks, where the Server host requests data from the Client host and the Client host responds, are good candidates for avoiding the use of CTS. This is because no one transceiver can monopolize the RF link. Asynchronous type networks, where any radio can send to another radio at any point in time, are much more difficult to implement without the use of CTS.

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THEORY OF OPERATION

RF ARCHITECTURE

The MDR29x utilizes a Server-Client network where all Clients synchronize their hopping to the Server. The Server transmits a beacon during the first 1 ms of every hop (20 ms). The Client transceivers listen for this beacon and upon hearing it assert their In_Range Low and synchronize their hopping with the Server.

Each network should consist of only one Server and there should never be two servers on the same RF Channel number in the same coverage area as the interference between the two servers will severely hinder RF communications.

MODES OF OPERATION

The MDR29x has three different operating modes; Receive, Transmit, & Command Mode. If the transceiver is not communicating with another radio, it will be in Receive Mode actively listening for a beacon from the Server. If the Client determines that the beacon is from a server operating on the same RF Channel and System ID, it will respond by asserting In_Range Low. A transceiver will enter Transmit or Command mode when the OEM Host sends data over the serial interface.

TRANSMIT MODE

All packets sent over the RF are either Addressed or Broadcast packets. Broadcast and Addressed delivery can be controlled dynamically with the API Control byte and corresponding on-the-fly commands. To prohibit transceivers from receiving broadcast packets, Unicast only can be enabled.

ADDRESSED PACKETS

When sending an addressed packet, the RF packet is sent only to the receiver specified in destination address. To increase the odds of successful delivery, Transmit retries are utilized. transparent to the OEM Host; the sending radio will send the RF packet to the intended receiver. If the receiver receives the packet free of errors, it will return an RF acknowledge within the same 20 ms hop. If a receive acknowledgement is not received, the radio will use a transmit retry to resend the packet. The radio will continue sending the packet until either (1) an acknowledgement is received or (2) all transmit retries have been used. The received packet will only be sent to the OEM Host if and when it is received free of errors.

BROADCAST PACKETS

When sending a broadcast packet, the RF packet is sent out to every eligible transceiver on the network. To increase the odds of successful delivery, Broadcast attempts are utilized. Transparent to the OEM Host, the sending radio will send the RF packet to the intended receiver(s).

Unlike transmit retries, all broadcast attempts are used; regardless of when the RF packet is actually received and without RF acknowledgements. If the packet is received on the first attempt, the receiver will ignore the remaining broadcast attempts. The received packet will only be sent to the OEM Host if and when it is received free of errors.

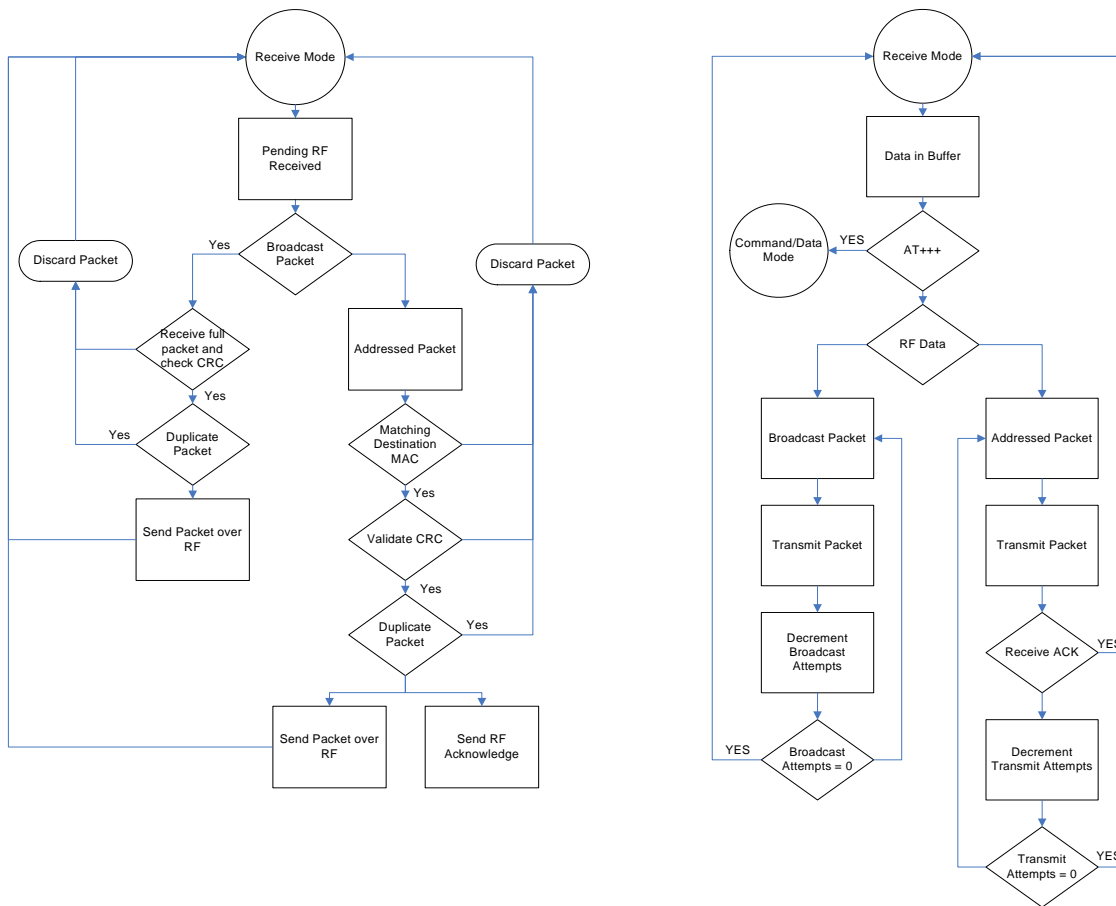
RECEIVE MODE

When a transceiver is not in Transmit or Command mode, it will be in Receive Mode listening for data. While in Receive Mode, subsequent data of up to 80 bytes can be received every hop (20 ms).

COMMAND MODE

A radio will enter Command Mode when data is received over the serial interface from the OEM Host and contains the "AT+++" (Enter AT Command Mode) command. Once in Command Mode, all data received by the radio is interpreted as command data. Command Data can be either EEPROM Configuration or On-The-Fly commands.

FIGURE 10: PENDING RF AND DATA IN BUFFER FLOW

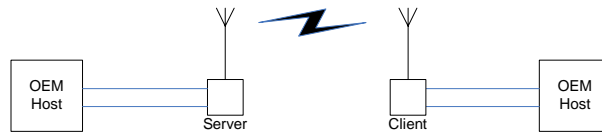


NETWORK TOPOLOGIES

Topology refers to the shape of a network, or the network's layout. How different nodes in a network are connected to each other and how they communicate, is determined by the network's topology. The MDR29xs support a Point-to-Point and a Point-to-Multipoint network topology.

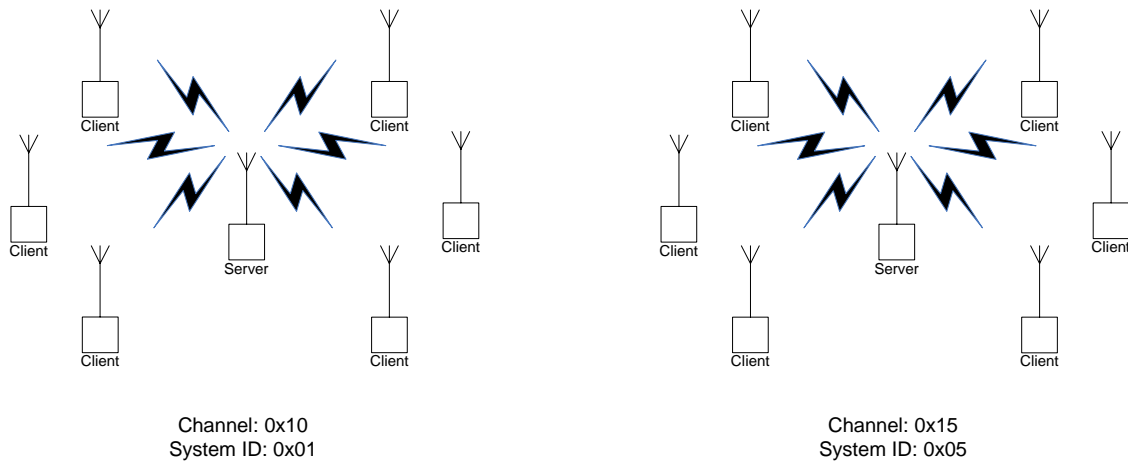
POINT-TO-POINT

A point-to-point network consists of a single Server and Client pair. Sometimes referred to as a wireless bridge, a point-to-point link replaces a single communications cable.



POINT-TO-MULTIPOINT

Point-to-Multipoint systems have one base station, or access point, that controls communications with all of the other wireless nodes in the network. This allows for the creation of a wireless network consisting of multiple nodes. By programming each MDR29x with a network specific Channel Number and System ID multiple networks can be created.



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MDR29X SETTINGS

SETTINGS

1) Client/Server: Designates MDR29x type. In each network, there must be only one Server. All other MDR29x units must be programmed as Clients. The number of Clients in the network is not limited; however, if performance diminishes, consider additional RF Networks.

2) Interface Baud Rate: This defines the baud rate used for communicating with the MDR29x over the serial interface. The RF baud rate is fixed at 76.8 Kbps and is independent of the Interface Baud Rate. The default baud rate setting is 57600 bps unless the units have been pre-configured by Black Box. **The Interface Baud Rate setting of the MDR29x must match the Baud Rate setting of its host device.**

3) Channel Number: A number that designates an independent network of MDR29x units. Up to 32 independent networks can be created. The valid range of values for this field is 16 to 47.

4) Max Transmit Retries (For Clients and Servers in Point-to-Point networks only): This value represents the maximum number of times a particular data packet will be transmitted unsuccessfully, or without an acknowledgement, before the MDR29x discards the packet. The default value is 16 attempts. If communication is lost and the Client's Link LED is on, try increasing this value in small increments until communication is reestablished.

Note: This value is always associated to Client radios and Server radios in Point to Point Mode. The valid range of values for this field is 1 to 255.

5) Broadcast Attempts (For Servers in Point-to-Multipoint networks only): This value represents the number of times a data packet will be transmitted by the Server MDR29x. The default value is 4 attempts. If communication is lost and the Clients' Link LED is on, try increasing this value in small increments until communication is reestablished. The valid range of values for this field is 1 to 255.

6) System Identification: A number from 0 to 256 that provides added security to each independent network of MDR29x units. The System ID is used in conjunction with the Channel Number and serves as an RF password to maintain secure transfers of data. The combination of the Channel Number and System ID must be unique to each network of MDR29xs to establish communication. Multiple Servers in the same coverage area must be programmed with different Channel Numbers to prevent inoperability of the networks. The System ID will not prevent inoperability that occurs from locating multiple Servers with the same Channel Number in the same coverage area.

Note: Separate Collocated MDR29x networks must operate on different Channel Numbers. All units in a given MDR29x network must have identical Channel Numbers and System IDs.

7) Data Encryption Key: Encryption is the process of encoding an information bit stream to secure the data content. The DES algorithm is a common, simple and well-established encryption routine. An encryption key of 56 bits is used to encrypt the packet. The receiver must use the exact same key to decrypt the packet; otherwise garbled data will be produced.

8) Destination Address: The MAC Address of the remote MDR29x in a Point-to-Point network. Used to optimize Point-to-Point communications by utilizing RF Acknowledgement.

9) Firmware Version: Displays the MDR29x's firmware version.

10) MAC Address: A unique 6 Byte, IEEE 802.3 Ethernet address assigned by Black Box to each MDR29x.

RADIO FEATURES

1) Data Encryption: Enables the Data Encryption Key. All MDR29xs in the same network must have the same encryption setting.

2) RTS Enable: Enables the Request To Send control line. When enabled, enables Hardware Flow Control.

3) Parity: Needs to be enabled if host requires even or odd parity and 8 data bits. This is considered as 9-bit mode. **Note:** Enabling Parity cuts the overall throughput into half.

4) Full Duplex: This mode restricts Client radios to transmitting on odd numbered frequency hop bins and the Server to even numbered frequency hop bins. Though the RF hardware is still technically half duplex, it makes the transceiver seem full duplex. This can cause overall throughputs to be cut in half. **Note:** All transceivers on the same network must have the same setting for Full Duplex.

5) Modem Mode: Full modem handshaking is supported by the transceivers when Modem Mode is enabled. Modem Mode is incompatible with RS-485 Interface. Enables DCD, DTR, DSR and Ring Indicator control lines.

PROGRAMMING THE MDR29X RADIO

- 1 Connect a MDR29x unit to the serial communications port on the PC.
- 2 Connect the power supply to the MDR29x unit. Make sure the Pwr LED is on.
- 3 Start the Black Box Configuration Utility.
- 4 Select the COM Port that is connected to the MDR29x unit on the PC Settings page.
- 5 Select the Interface Baud Rate of the MDR29x unit. All MDR29x units are shipped with a default rate of 57600 (unless units have been pre-configured to match specific serial settings). If the Interface Baud Rate of the MDR29x unit is changed, the PC Setting Baud Rate must be set to the same Baud Rate to allow proper programming of the units.
- 6 Select Read Radio to display the current settings of the MDR29x unit.
- 7 Change desired settings.
- 8 After all changes have been made, select Write Radio to save the changes.
- 9 Cycle Power to the unit after all changes has been saved. This will set the MDR29x unit to its normal mode of operation.

Note: The Show Defaults button can be used to display the default Radio settings.

DESIGN TIP

The Black Box Configuration utility automatically programs the mode (point-to-point or point-to-multipoint) based on the radio's current settings:

- 1 If the Destination Address field is set to any value other than FF FF FF FF FF FF, the radio will send data only to the radio whose MAC matches that specified in the Destination Address field (point-to-point).
- 2 If the Destination Address field is set to FF FF FF FF FF FF on a client radio, it will be set to auto destination mode & transmit to the radio whom it last received a packet from.
- 3 If the Destination Address field is set to FF FF FF FF FF FF on a server radio, it will be set to Broadcast mode & transmit to all available clients (point-to-multipoint).

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CONFIGURATION UTILITY

OVERVIEW

Black Box provides an easy to use Configuration utility to program and test the MDR29x. The GUI based software is compatible with Microsoft® Windows 95, 98, 2000, ME, NT, & XP. The MDR29x is a plug and play device which requires minimal or no configuration.

SOFTWARE INSTALLATION

Locate the OEM software folder on the Black Box Tools & Literature CD and install the development kit software. To install the software, run Setup.exe and follow the installation prompts. During the installation, the software will prompt the user to install the Black Box USB Driver. It is recommended that the user installs the driver at the same time as the software.

The installer will notify the user when the software has successfully been installed. The user may be prompted to reboot the PC to complete the installation.

Click **OK** to complete the installation. By default, the software is stored in the following location on the Start Menu:

Start -> All Programs -> Black Box Network Services -> Black Box Config

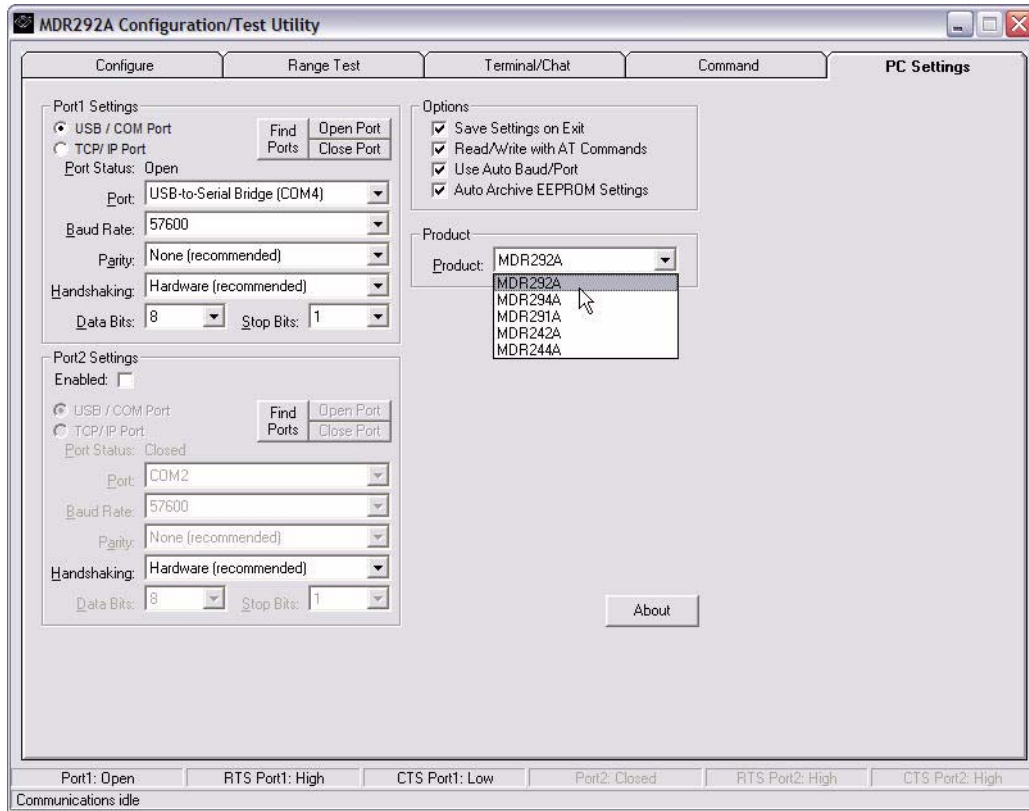
The software will attempt to open COM1 of the PC. If there is a conflict or the port does not exist, the software will show the port as unavailable. This has occurred for one of the following reasons:

- 1 There is other software running that has control over the COM1 port. Locate this software and shut it down while running "Black Box Config" software.
- 2 The PC either does not have a COM1 port or the port has been disabled.

PC SETTINGS PAGE

The PC Settings page is shown below, as it will appear the first time the program is run.

Select the correct product in the Product pull-down menu. Doing this will automatically select the default baud rate for that particular transceiver. If the COM port is listed as unavailable, a different COM port can be selected in the Port pull-down menu. The software can use two serial ports if the Enabled: box is checked.



PORT1/PORT2 OPTIONS

The software can control up to (2) COM ports including virtual COM ports, which physically map to USB or Ethernet ports. The Port pull-down menu allows selection of COM1 through COM16. An error message will be displayed if a port is selected that is either nonexistent or already occupied by another software program. When a port selection is made, the software will attempt to open the port and list its status as; Unavailable, Open or Closed. Although menus are shown for Data Bits, Parity and Stop Bits, only the Parity menu selection can be changed.

FIND PORTS BUTTON

If the available COM ports are unknown, the Find Ports button can be pressed to update the COM Port pull-down menu with all available COM ports.

HANDSHAKING

By default the OEM utility will use hardware handshaking and monitor the CTS/RTS lines. For cases where these lines are not readily available such as RS-485 communications, the handshaking can be disabled by selecting "None" from the dropdown box.

OTHER OPTIONS

These are additional options that can be enabled.

SAVE SETTINGS ON EXIT

When enabled, all changes made to the Settings page will be automatically loaded the next time the software is run. Otherwise, the changes will be discarded.

READ/WRITE WITH AT COMMANDS

When enabled, the software will use AT Commands for its read/write EEPROM functions instead of the standard configuration commands. This box should be checked at all times unless Pin 15 (CMD/DATA) is pulled Logic Low or the Program/Normal switch is set to Program Mode.

AUTO BAUD

When enabled, the software will scan all available COM Ports using the most common baud rates, until a radio is found. If no radio is found or the software cannot open the port, an error message will be reported. The software will only use Auto Baud when prompted by the user after an unsuccessful write process. To cancel the Auto Baud process, press the ESC key.

AUTO ARCHIVE

When enabled, the software will archive the EEPROM settings for each radio after a successful write process. Although not required, the software will prompt the user to type a description of the changes made. Auto Archive can be used to restore the radio to a previously known working configuration. The first time that a radio is read with Auto Archive enabled will be stored as the "Original Configuration Settings" with the date and time the record was created.

STATUS BAR

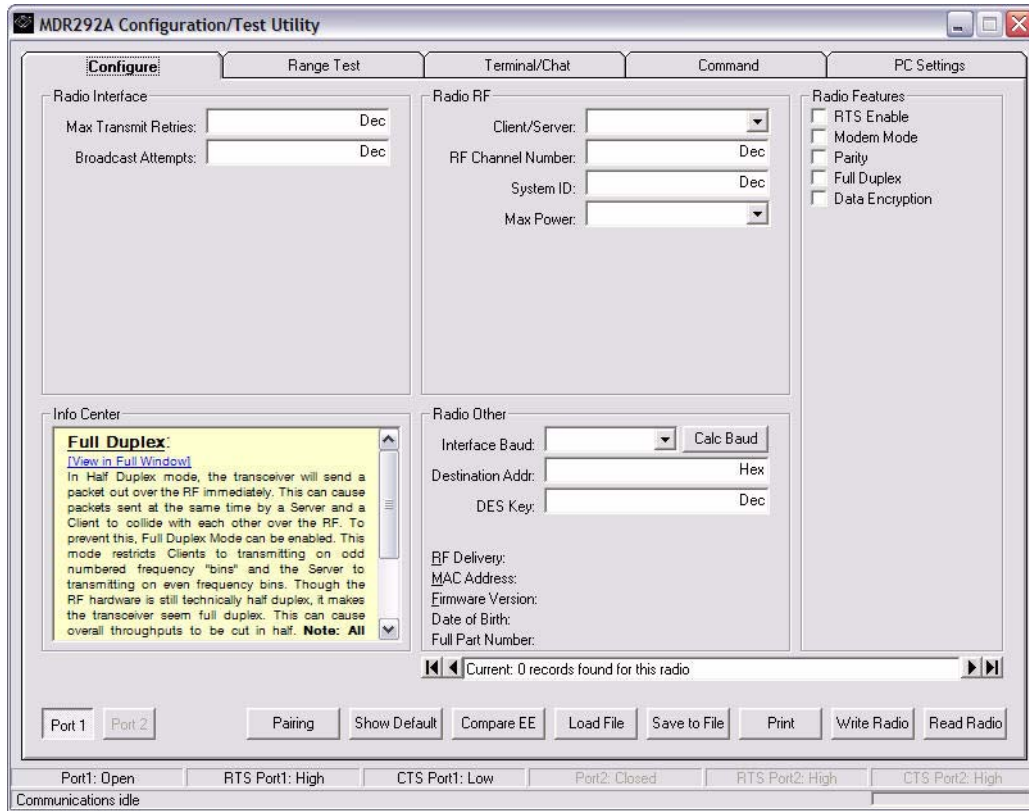
Located at the bottom of the software, the status bar gives the state of Port 1, RTS Port 1, CTS Port 1, Port 2, RTS Port 2, and CTS Port 2 lines. When the text appears black, the current state will be shown. When the text appears gray, the current state will not be shown. The text shown in the bottom status bar gives a simplified status of the current, pending software process. The software has no pending process when "Communications Idle" is shown.

ABOUT BUTTON

The About button can be pressed to determine the revision number of the software and the contact information for Black Box. Please include the software revision number in any correspondence with Technical Support.

CONFIGURE PAGE

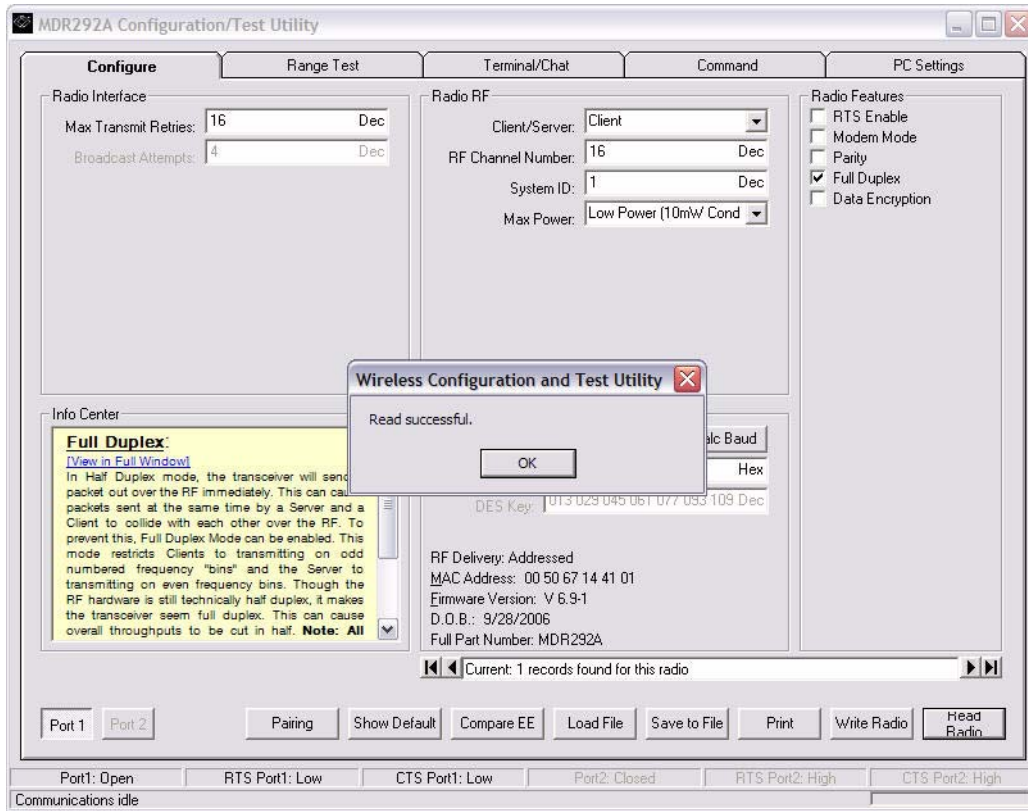
The Configure page is a GUI representation of the 256 byte EEPROM contents within the radio. The same data is shown in a full hexadecimal dump of the EEPROM in the EEPROM Editor View. The Configure page is shown below, as it will appear until a radio is successfully read:



There are five sections on the Configure page; Radio Interface, Radio RF, Radio Features, Radio Other, and Info Center. The fields displayed in these sections vary depending on the Product Mode. The Info Center provides a quick description of each setting/mode. For detailed descriptions of the individual settings, please refer to the OEM Module user's manual.

READ RADIO BUTTON

To update the Configure and EEPROM Editor View pages with the EEPROM contents of a radio currently connected to the proper port on the PC, click the Read Radio button. An example of the Configure page after a transceiver has successfully been read is shown below:



WRITE RADIO BUTTON

After making changes to the controls on the Configure page, the Write Radio button can be pressed to save those changes to the radio EEPROM. The user will be notified of a successful write with a "Write successful" prompt. If Auto Archive is enabled, the software will prompt the user to type a description of the changes made.

SHOW DEFAULTS BUTTON

When the Show Defaults button is pressed, the GUI view will be updated with the default settings for the selected product. This feature is only available on the GUI Page and will not work when using the EEPROM Editor View.

PAIRING BUTTON

The pairing button can be used to pair (address) two radios together. The two radios must both be connected to the PC and to the Ports specified on the PC Settings page. The pairing function sets one radio as a Server and the other as a Client and programs each radio's Destination Address with the other radio's MAC Address.

LOAD / SAVE TO FILE BUTTONS

A file previously created by this software can be loaded to restore an EEPROM to a former state. Files of type *.TXT and *.EE can be loaded.

An EEPROM can be saved to a file using the Save to File button. This allows for the current state of the EEPROM to be restored at a later time.

PORT 1/PORT 2 BUTTONS

When Port 1 is depressed, the Write Radio and Read Radio buttons communicate through Port 1. When Port 2 is depressed, the Write Radio and Read Radio buttons communicate through Port 2.

CALC BAUD BUTTON

The Baud pull-down menu includes all standard PC baud rates. To select a non-standard baud rate, the Calc Baud button can be pressed. This will bring up the following window:

To calculate the settings for a particular baud rate, type that baud rate into the Desired Baud Rate window and click the Calculate button. If the baud rate is not supported by the radio, an error message will be displayed. Otherwise, the information will be filled in and the Update button will be enabled. An example is shown below:

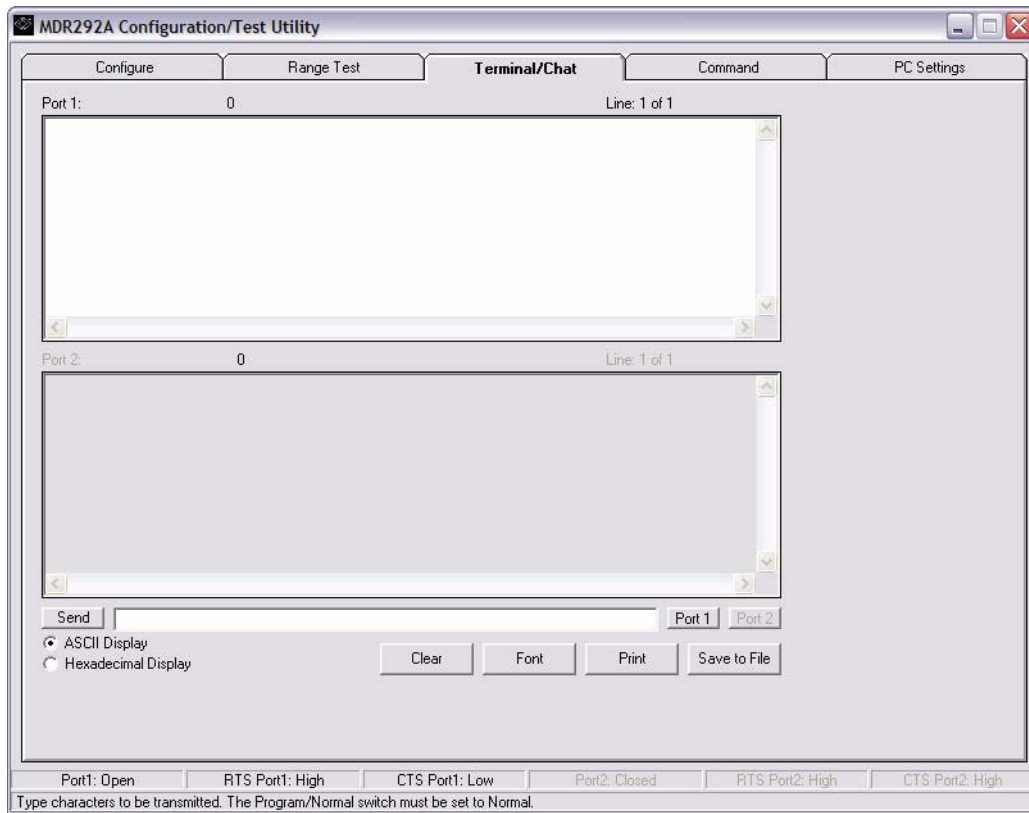
Clicking the Save button will cause the baud rate shown in the Actual Baud Rate window to be displayed in the Baud window on the Configure page of the software. Clicking Cancel will ignore these changes. The Actual Baud Rate will not always match the Desired Baud Rate. However, the program verifies that the Desired Baud Rate is within 3% of the Actual Baud Rate (as required by the radio).

HEX/DECIMAL BUTTON

All of the text entry type boxes found on the Configure page have a button located to the right of the box. When pressed a menu will be shown which allows the selection of either Hexadecimal or Decimal numbering format for that particular text box. When the program is restarted, all text boxes will revert back to Hexadecimal.

TERMINAL/CHAT PAGE

The Terminal/Chat page is a terminal emulator (similar to HyperTerminal) used to send small data packets between two COM ports. As data is received it is appended to the appropriate Port window. An example of the Terminal/Chat page is shown below.



SEND BUTTON

This button sends the data in the textbox out the selected port(s). The current user's Windows username is also sent over the RF with the data.

HEXADECIMAL / ASCII DISPLAY

New received data will be displayed in ASCII or Hexadecimal format; depending on the current setting.

RANGE TEST PAGE

The **Range Test** page allows packets of data to be sent between two radios and reports the numbers of successes and errors.

The screenshot shows the 'Range Test' configuration window. The 'Test Selection' section has 'Port 1 <-> Port 2' selected. 'Transmit Packet Selection' is set to 'Create Data' with a size of 64. 'Test Type' is set to 'Continuous'. 'Receive Packet Display' is set to 'ASCII'. 'Test Results' shows 42 runs, 0 errors, 100% good, and an approximate throughput of 16,748.2bps. The 'Port 1' and 'Port 2' text areas show a sequence of alphanumeric characters. The status bar at the bottom indicates 'Port1: Open', 'RTS Port1: High', 'CTS Port1: Low', 'Port2: Open', 'RTS Port2: High', and 'CTS Port2: Low'.

TEST SELECTION

There are six test options that can be selected. There are three typical hardware setups.

- 1 One radio is plugged into a serial or USB port on a PC. The second radio is plugged into a separate power supply with a loopback adapter connected.
- 2 One radio is plugged into a serial or USB port on a PC. The other radio is plugged into a different serial or USB port on the same computer.
- 3 One radio is plugged into a serial or USB port on a PC. The other radio is connected to a serial or USB port on another PC.

If using two PCs for the test, the software run on both sides should have the second COM port disabled on the settings page.

TABLE 6: TEST SELECTION SETTINGS

TEST SELECTION	PORT 1 ACTION	PORT 2 ACTION	HARDWARE SETUP
Port 1 -> Port 2	TX	RX	2
Port 2 -> Port 1	RX	TX	2
Port 1 <-> Port 2	TX/RX	TX/RX	2
Port 1 Send Only	TX	N/A	3
Port 1 Receive Only	RX	N/A	3
Port 1 Loopback	TX/RX	N/A	1

TRANSMIT PACKET SELECTION

This section allows you to select the data packet used to perform the Range Test. You may either create data of a specified byte length or load your own text or configuration file.

TEST TYPE

The test type allows you to select how long the test will be performed.

TABLE 7: TEST TYPE

TEST TYPE	DESCRIPTION
Continuous	Test will run until stopped.
Timed	Test will run for a specified time period
Number of Runs	Test will run for a specified number of runs
Single Step	Test will run for a single step.
Break on Error	Test will run until an error occurs

RECEIVE PACKET DISPLAY

This section allows you to select how the received packets will be displayed. Received packets can either be displayed in ASCII or Hexadecimal format, marked with a time stamp, and show only when an error has occurred.

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MECHANICAL

Figure 11: MDR29x Mechanical

