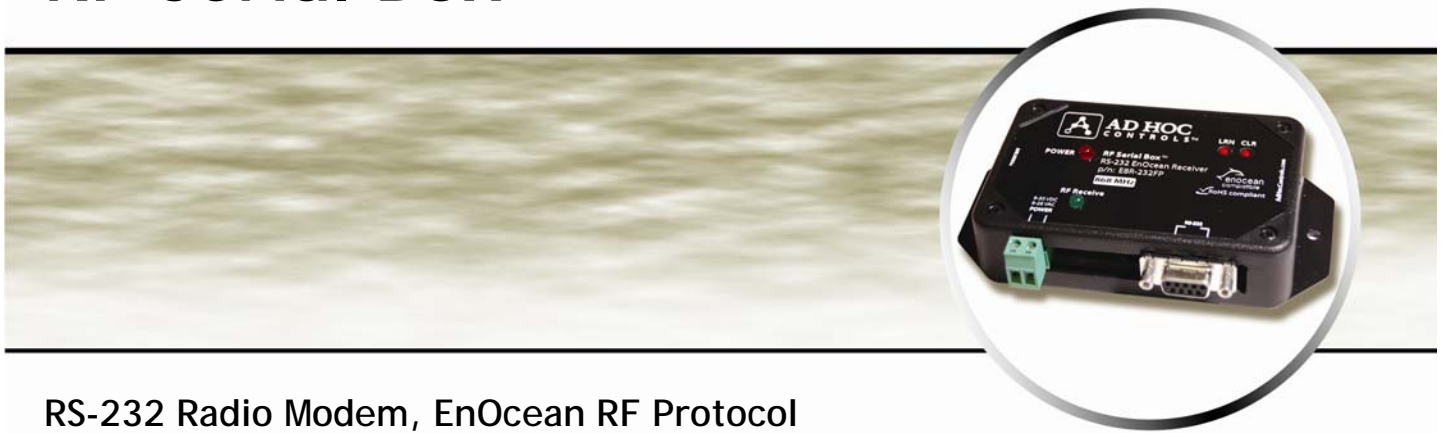


# RF Serial Box™



RS-232 Radio Modem, EnOcean RF Protocol  
Installation and Operating Instructions

AHD0043a

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# 1. Overview

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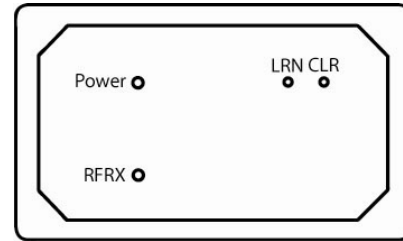
The RF Serial Box is a high performance radio receiver which can be connected to any system that uses a serial port. The Serial Box receives radio packets from STM Sensors and PTM Switches. The information in the radio packets is sent out the serial port. It serves as a bridge between the STM and the PTM devices and other security/control/automation systems, allowing other systems to be stimulated with EnOcean compatible switches and sensors.

## Top Panel

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**Figure 1. DB-9 Serial Port Pin Signals**

- Power LED – Illuminates while power is applied
- Learn Button – Used to activate learn mode
- Clear Button – Used to clear stored switch /sensor associations
- RF RX (Receive) LED – Illuminates while receiving



## Specifications

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**Table 1. RF Serial Box (RS-232 Data Radio Modem)**

Specifications	
Range (indoor / non line-of-sight)	Typically 50 to 150 ft.
Power Supply Input	8-28 VAC or 8-30 VDC
Current	25mA @ 12 VDC, 15mA @ 24 VDC
Memory	Up to 30 transmitter addresses
Frequency	868 MHz or 315 MHz
Operating Temperature	-25° up to 65° C
Serial Port Settings	9600 baud, 8 bits, No parity, 1 stop bit

## Mounting Considerations

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The Serial Box can be mounted almost anywhere. The following considerations should be taken into account.

- Proximity to STM/PTMs, obstructions limit range
- Although the Serial Box is very efficient, it should not be mounted in a location where heat will be allowed to accumulate
- Power source available
- Do not exceed max RS-232 cable length

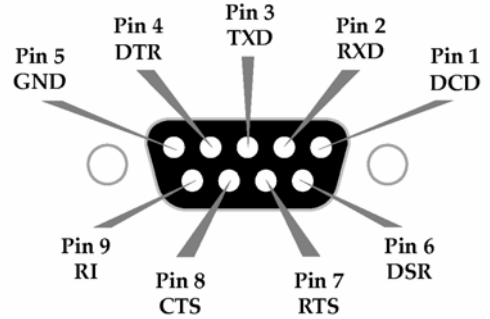
# 2. Connections (Interfacing Protocol)

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The RF Serial Box can accept external power through either the power connector, or through pin 9 of the DB9 port. When using an external power source, connect to the power jack using the provided screw terminals. The power connector accepts 8-28 VAC or 8-30 VDC. The power connector is polarity insensitive, but power provided through the DB9 port must be DC, not AC, and connected with correct polarity (+ to Pin 9, - to GND).

A standard DB-9 female connector is provided for making connections to its serial port.

**Figure 2. RS-232 (DB-9) Serial Port Pin Signals**



It may be necessary to connect the Serial Box to the security/control/automation panel using a null-modem cable, but connection to a PC requires a standard straight-through cable.

**Table 2. RS-232 Pin Signals and their implementations**

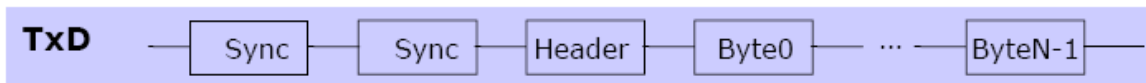
Pin #	Name	Description	Implementation
1	DCD	Data-Carrier-Detect	Connected to DSR (pin6)
2	RXD	Received Data	Serial data exiting the RF modem (to host)
3	TXD	Transmitted Data	Serial data entering into the RF modem (from host)
4	DTR	Data-Terminal-Ready	Can enable Power-Down on the RF modem
5	GND	Ground Signal	Ground
6	DSR	Data-Set-Ready	Connected to DCD (pin1)
7	RTS / CMD	Request-to-Send / Command Mode	Provides RTS flow control or enables Command Mode
8	CTS	Clear-to-Send	Provides CTS flow control
9	RI	Ring Indicator	Optional power input that is connected internally to the positive lead of the front power connector

### 3. Packet Structure

#### Message format

The following figure shows the message format. A data block of length n is composed of 2 synchronization bytes, 1 octet for the header and n-1 octets for the message data.

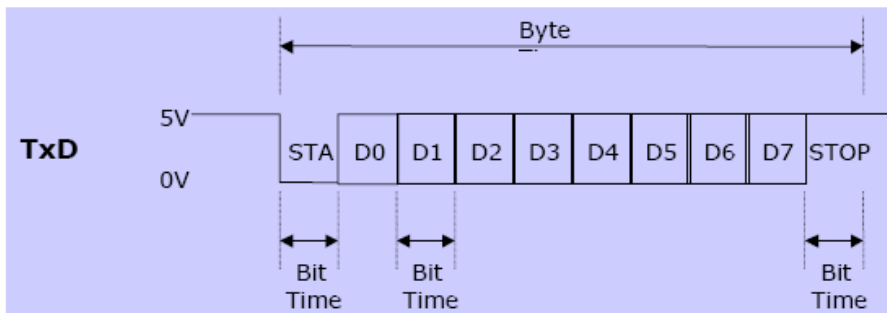
**Figure 3. Message format for asynchronous serial communication**



#### Octet signals and bit order

- 9600 bps; 8 data bits, no parity bit, one start bit, one stop bit
- Line idle is binary 1 (standard)
- Each character has one start bit (binary 0), 8 information bits (least significant bit first) and one stop bit (binary 1)
- The signal levels shown in the timing diagram are inverted from the voltages that appear on the RS232 connector.

**Figure 4. Octet signals and bit order**



## Serial Data Structure

The structure of the serial data is as follows:

Bit 7	Bit 0
SYNC_BYTE1 (A5 Hex)	
SYNC_BYTE0 (5A Hex)	
H_SEQ	LENGTH
ORG	
DATA_BYTE3	
DATA_BYTE2	
DATA_BYTE1	
DATA_BYTE0	
ID_BYTE3	
ID_BYTE2	
ID_BYTE1	
ID_BYTE0	
STATUS	
CHECKSUM	

SYNC\_BYTE 0..1           (8 bit each)       Synchronization Bytes  
H\_SEQ                     (3 bit)             Header Identification [refer to table below]

**Table 3. Header Identification**

H_SEQ	Meaning	Mode
0b 000	Unknown transmitter ID received (serial telegram only if no ID has been learned so far!) For RPS also: -- Known transmitter ID and unknown rocker -- U-message from known transmitter ID received For HRC also: -- Known transmitter ID and unknown rocker -- Scene switch command (last three bits of ID 0b111) from known transmitter ID (only first 29 bits are compared!)	Operating Mode
0b 001	For 1BS and 4BS: Known transmitter ID received For RPS: Known transmitter ID and at least 1 known rocker (1 or 2 rockers operated) For HRC: Known transmitter ID and known rocker	Operating Mode
0b 010	New transmitter learned (If a switch telegram is received (RPS or HRC), the rocker code (RID) is stored together with the ID.) Mode 3: a telegram with this header information will be sent also when in LRN mode a transmitter which is already learned is operated again	Learn Mode
0b 110	Mode 0: Transmitter just deleted (If a switch telegram is received (RPS or HRC), the rocker code (RID) and module ID are checked. The entry is only deleted if module ID and rocker are known.)	Learn Mode

LENGTH                   (5 bit)             Number of octets following the header octet (11 dec)  
ORG                       (8 bit)             Type of telegram (see detail description)  
DATA\_BYTE 0..3           (8 bit each)       Data bytes 0..3 (see detail description)  
ID\_BYTE 0..3             (8 bit each)       32-bit transmitter ID  
STATUS                   (8 bit)             Status field (see detail description)  
CHECKSUM                 (8 bit)             Checksum (Last LSB from addition of all octets except sync bytes and checksum)

## Detailed description of ORG field

**Table 4. ORG field values**

ORG field value (decimal)	Acronym	Description
5	RPS	Telegram from a PTM switch module received (e.g. PTM 100 or PTM 200)
6	1BS	1 byte data telegram from a STM sensor module (e.g. STM 250)
7	4BS	4 byte data telegram from a STM sensor module (e.g. STM 100)
8	HRC	Telegram from a CTM module received
0-47, 9-255	--	Reserved

\*\* For more detailed instructions refer to the following manual:

[www.adhocelectronics.net/download/EnOcean/RCM1xx\\_Product\\_Manual.pdf](http://www.adhocelectronics.net/download/EnOcean/RCM1xx_Product_Manual.pdf)

## 4. Operation

The following operations enable functions of the RF Serial Box.

- Clear memory – Press Clear button for > 4 seconds (Same process as most EnOcean enabled devices)
- Program – Press Learn button (Same process as most EnOcean enabled devices)
- Verify Serial Port – Connect to terminal program, like “HyperTerminal” or “Portmon” and monitor activity on serial port. Each time a PTM is pressed; a few copies of the data packet should flow through to the serial port. Same for release. Data from an STM module is similar.

### Clear Memory

If the CLR key is pressed and held for ~4 seconds, the receiver’s memory is deleted (condition upon delivery). The receiver then enters Learn Mode which is indicated by the Toggling output relays.

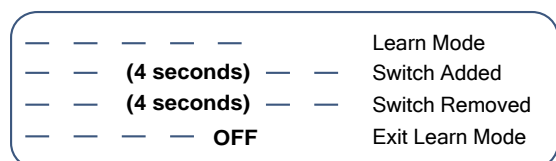
### Program

In order for the relay receiver to communicate with light switches, the receiver must LEARN the switches’ addresses. This is accomplished by programming the receiver.

1. The receiver must be powered when programming (settings are retained after power is disconnected). To prevent LEARNING unintentional transmitter addresses, receiver sensitivity is reduced when in Learn Mode. Transmitting devices should be within 5 meters of the receiver when programming.
2. To enter Learn Mode, push and hold the LRN button (~4 seconds).
3. Once in Learn Mode, the Receiver will begin 1-second cyclic switching of output relays (“Toggling”) – If a light is connected, it will be switched on and off every second.
4. When the receiver is in Learn Mode, send packets from a transmitter (for example, press a rocker of a Transmitting Wireless Light Switch). The transmitter is then assigned to the RF Serial Box and the relay stops toggling for ~4 seconds. The idle period indicates the transmitter has been saved or a previously learned address has been deleted.
5. As soon as the Toggling of the relays resumes, additional transmitters can be LEARNED or deleted. If the Receiver’s memory is full (30 transmitter maximum), the receiver exits Learn Mode. In this case, at least one ID has to be deleted before LEARNING a new transmitter address.
6. To exit Learn Mode, press the LRN button.  
[or] The Receiver automatically exits Learn Mode after 30 sec. of inactivity.

**Figure 5. Mode Indicators**

(Receiver toggles power on and off to indicate modes)

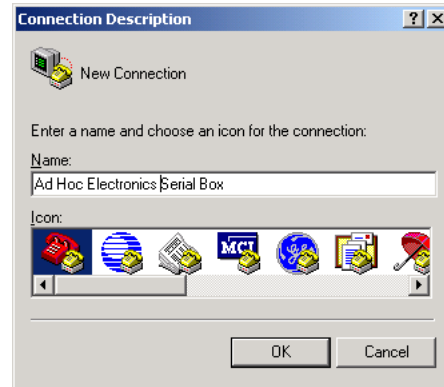


## Verify Serial Port

In order to test and observe the data received by the Serial Box, connect the RS232 DB9 port on the unit to a PC with a straight-through (not null-modem) DB9 cable. Some new PCs do not include serial ports, in which case a USB to Serial adapter device may be used. Connect the Serial Box to a power source, 8 to 28 VAC or 8 to 30 VDC. If power is connected through the DB9 port (pin 9) it is required to provide DC power with the correct polarity (positive to pin 9, negative to pin 5 (ground)). If power is provided through the power connector; either polarity is supported and AC power is allowed.

Run HyperTerminal (usually found under Start->All Programs->Accessories->Communication).

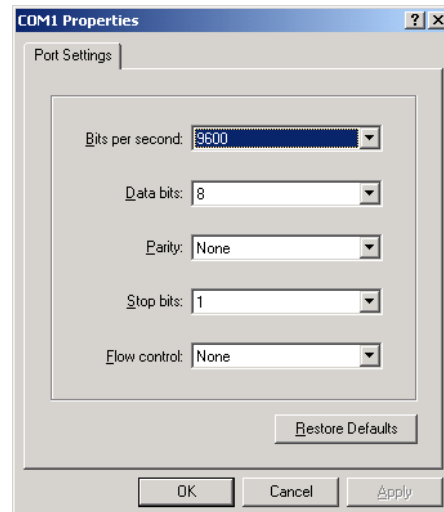
Give the connection a name and Click OK.



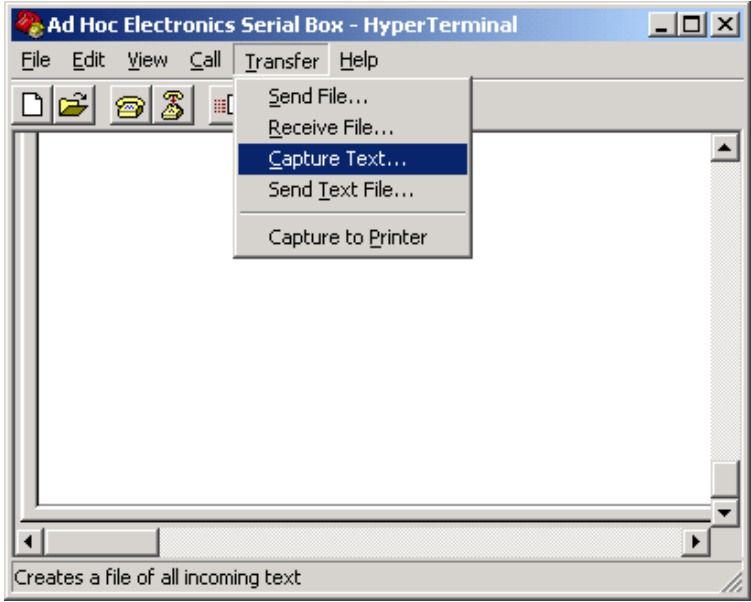
Select the appropriate COM port and click OK.



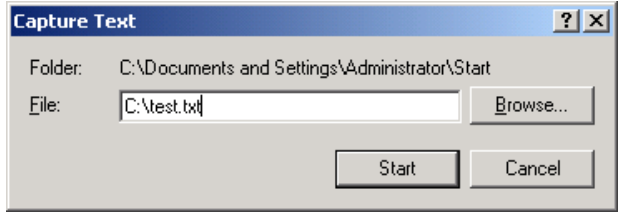
Select 9600 Bits per second and set Flow control to None.



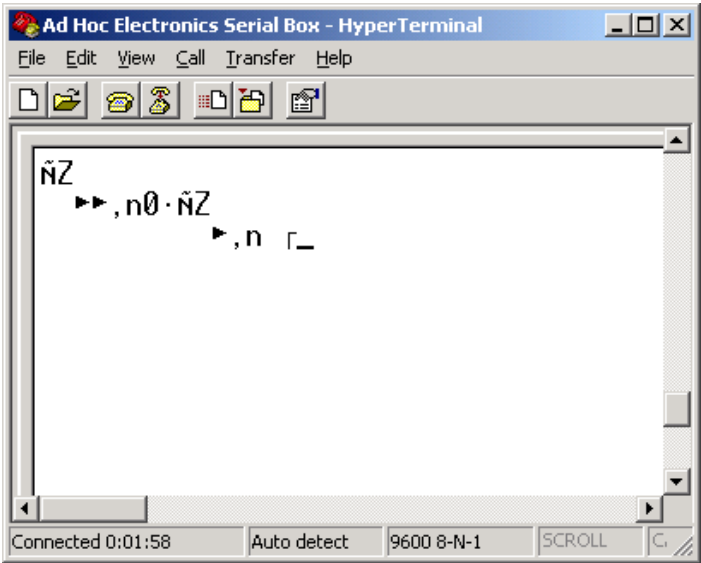
The data received from the modules contains non-printable characters. In order to see the exact contents of the received packets, set up a text capture with Transfer->Capture Text. An alternative to the text capture method is to run a serial port monitoring program (use Google to search for "portmon" which is available as a free download from microsoft.com, and can display the hexadecimal values during serial operation).



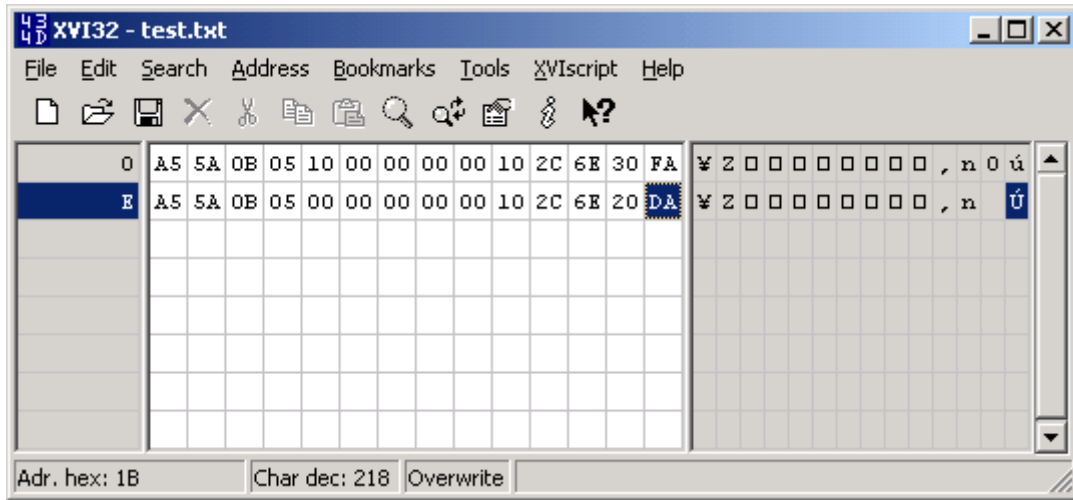
Save the file in a convenient location.



Press a switch button and two packets of 14 bytes each will be received and displayed. If a repeater is in range, two copies of each packet will be received, the later of which will contain a bit indicating that the packet has been repeated.



In order to view the actual contents of the data packet, stop the text capture process by selecting Transfer->Capture Text->Stop. This step is important, as it closes the file so it can be read by other programs. Now download a hex editor program. A free one called XVI32 is available on the web.



Use the hex editor to open the captured text file, and the full packet is visible in hexadecimal format. Note in the packets shown, the 5<sup>th</sup> byte indicates the state of one of the buttons on the PTM module. Note that the button was pressed for the first packet, (0x10) and released for the second packet (0x00). This is the sequence received when a user presses and releases the button on a battery-free wireless switch.

## 5. Contact Ad Hoc Electronics

### 30+ Years of RF Expertise

As always, Ad Hoc Electronics' RF engineers are dedicated to the success of your wireless systems. For questions or comments, please contact Ad Hoc Electronics technical support using any of the following means:

**E-mail:** [support@adhocelectronics.com](mailto:support@adhocelectronics.com)

**Telephone:** (801) 225-2226

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