

RN-41-EK & RN-42-EK Evaluation Kit User's Guide

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1.0 OVERVIEW

This document describes the hardware and software setup for Roving Networks RN-41-EK and RN-42-EK evaluation boards. The RN-41-EK and RN-42-EK evaluation boards are field-ready, Bluetooth SIG qualified prototyping platforms for the RN41 and RN42 modules, respectively. The boards have the flexibility to connect directly to PCs via a standard USB interface (via the FTDI chipset) or to embedded processors through the TTL UART interface. The status LEDs, dipswitches, and signal headers enable rapid prototyping and integration into existing systems.

You configure and control the modules from a console with a simple ASCII command language. Once the configuration is set up, the module can connect over Bluetooth. You use the evaluation kit to configure the Bluetooth module using the command interface, create connections, and transfer data. See “Resources & Related Documents” on page 16 for information on available documentation.

The RN-41-EK and RN-42-EK evaluation boards support the serial port profile (SPP) and human interface device (HID) profiles. The instructions in this document use the SPP profile. For more information on these profiles and how to switch between them, refer to the *Bluetooth Command Reference & Advanced Information User's Guide*.

2.0 EVALUATION KIT DESCRIPTION

The evaluation kit includes the hardware required to connect the evaluation board to your computer. See Table 2-1. To evaluate the module on the evaluation board, you need a computer with a USB port running the Microsoft Windows or Mac OS-X operating system.

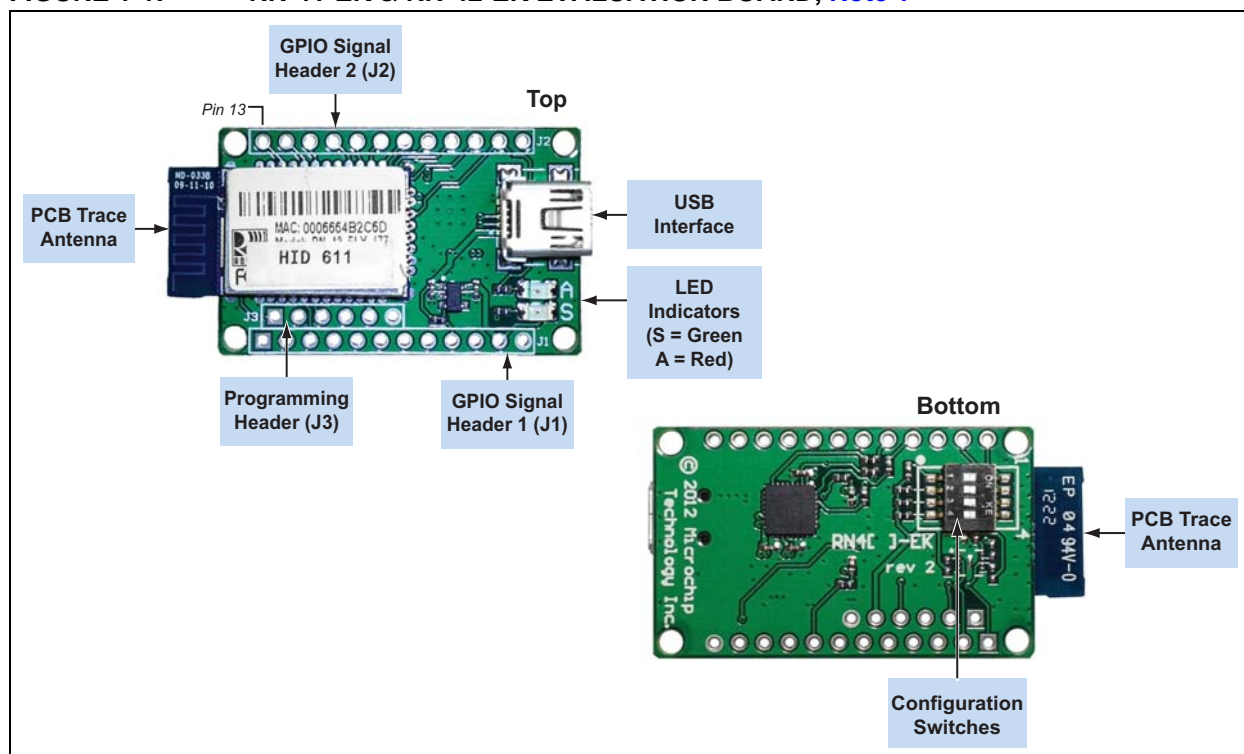
Note: Before beginning your evaluation, you may need to install the FTDI driver for the USB cable. You can download the driver (as well as other tools and utilities) from the Roving Networks website at <http://www.rovingnetworks.com/support.php>.

TABLE 2-1: EVALUATION KIT CONTENTS

Hardware	Description
Evaluation board	Contains the Bluetooth module, status LEDs, and dipswitches.
Mini-USB cable	Links your computer to the evaluation board.

Figure 2-1 describes the evaluation board's interfaces and connectors. Table 2-2 describes the status LEDs. The green LED indicates the status of the Bluetooth connection and when the device is in configuration mode. The RN41 and RN42 modules are pin compatible; therefore, the description applies to both the RN-41-EK and RN-42-EK boards. Refer to “RN-41-EK & RN-42-EK Schematic” on page 17 for the board's schematic.

FIGURE 1-1: RN-41-EK & RN-42-EK EVALUATION BOARD, Note 1



Note 1: This figure shows the RN-42-EK board. The RN-41-EK board is similar.

GPIO Signal Header 1 (J1)

Pin	1	2	3	4	5	6	7	8	9	10	11	12
Description												

Pin	Description
1	GPIO6
2	GPIO7
3	RESET_N
4	No Connect
5	No Connect
6	No Connect
7	No Connect
8	Sensor Input 1 (AIO1)
9	Shutdown (SHDN)
10	No Connect
11	3.3 V
12	GND

GPIO Signal Header 2 (J2)

Pin	13	14	15	16	17	18	19	20	21	22	23	24
Description												

Pin	Description
13	GPIO4
14	GPIO3
15	GPIO2
16	CTS
17	RTS
18	TXD
19	RXD
20	GPIO11
21	GPIO10
22	GPIO9
23	GPIO8
24	Sensor Input 0 (AIO0)

Programing Header (J3)

Pin	1	2	3	4	5	6
Description						

Pin	Description
1	SPI_MISO
2	SPI_MOSI
3	SPI_SCK
4	SPI_SS
5	3.3 V
6	GND

Configuration Switches

Switch	Description
1	Restore Factory Defaults
2	Automatic Discovery
3	Automatic Master
4	Default Baud Rate

TABLE 2-2: STATUS LEDS

Mode	Green LED (S)	Red LED (A)
Fast blink, 10 times per second	Command mode	–
Blinks twice per second	Boot up, remotely configurable	–
Blinks once per second	Discoverable/idle	Data over the UART
Solid on	Connected	–

3.0 HARDWARE SETUP

To set up the evaluation hardware, perform the following steps:

1. Connect the mini-USB cable to your computer's USB port and to the evaluation board's mini-USB connector. This connection provides power to the board and provides a data connection to the command console.

Note: Windows prompts you to install the FTDI drivers (that create a virtual COM port to the module's USB port) if they are not already installed. You can download the drivers from the Support page on the Roving Networks website at <http://www.rovingnetworks.com/support.php>.

2. Note the COM port to which you have attached the cable.

Figure 3-1 shows the completed hardware setup for the evaluation boards.

FIGURE 1-2: COMPLETED HARDWARE SETUP


4.0 USING THE EVALUATION KIT

You program Roving Networks Bluetooth devices over the Bluetooth link or through the serial interface (USB port) using a simple ASCII command language, which is similar to the industry-standard Hayes AT protocol. `set` commands configure the module and `get` commands echo the current configuration. Configuration settings modified with the `set` command do not take effect until the module has been rebooted, even though the `get` command may show otherwise.

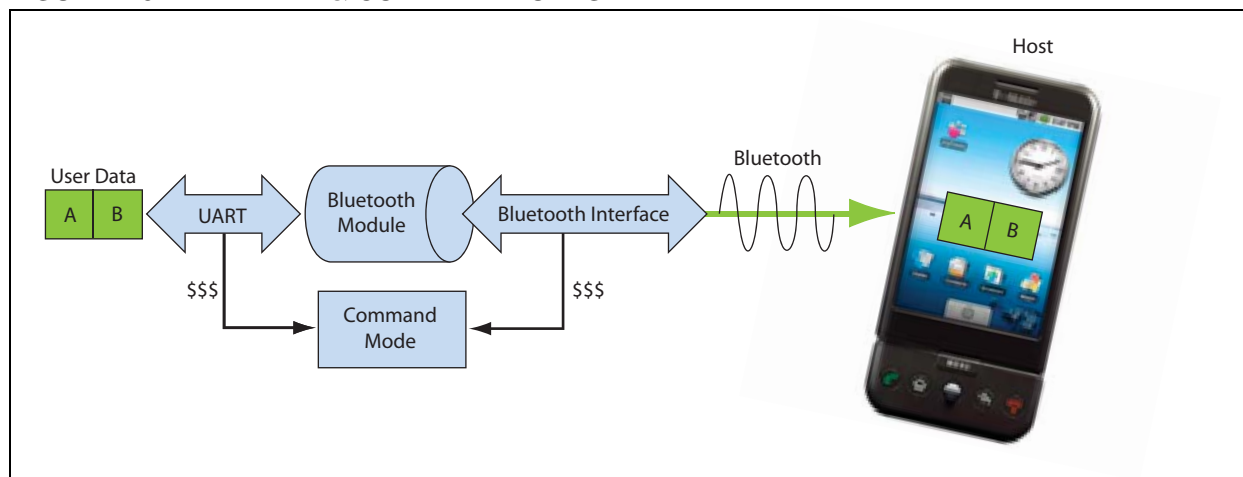
This section assumes that you have a working knowledge of Bluetooth operation and communications. To configure the Roving Networks devices you need a Bluetooth-enabled PC (either built-in or using a USB Bluetooth dongle). You can only configure one device at a time. Once configured, device settings are saved (independent of power down) until they are explicitly changed or the factory defaults are restored.

Note: For detailed information on the ASCII commands you use to configure the Bluetooth module, refer to the *Bluetooth Command Reference & Advanced Information User's Guide*.

4.1 Command Mode vs. Data Mode

The Bluetooth device operates in two modes: data mode (default) and command mode. Upon power up the device is in data mode. While in data mode, the module is essentially a data pipe. When the module receives data from a remote Bluetooth device over a serial port profile (SPP) connection, it strips the Bluetooth headers and trailers and passes the user data to the UART. When data is written to the UART, the module constructs the Bluetooth packet and sends it out over the Bluetooth SPP connection. Thus, the entire process of sending/receiving data to the host is transparent to the end microprocessor. See [Figure 1-1](#).

FIGURE 1-3: DATA & COMMAND MODES



The default configuration for the Bluetooth device is:

- Bluetooth slave mode
- Keyboard default authentication mode (no pin code required)
- Serial port 115,200 Kbps baud rate, 8 bits, no parity, 1 stop bit
- Serial port flow control disabled
- Low power mode off

You configure the device by putting it into command mode and sending ASCII commands over a serial port or the Bluetooth link. Once you change the configuration parameters, they persist until you change them or perform a factory reset.

There are two ways to configure the Bluetooth module:

- Local configuration using your computer's USB port
- Via Bluetooth

You need a terminal emulator to complete the setup.

Note: Suggested terminal emulator programs are TeraTerm (Windows OS) or CoolTerm (Mac OS-X).

4.2 Configure the Module Locally Using the USB Port

Set up the RN-41-EK or RN-42-EK hardware as described in ["Hardware Setup" on page 5](#). With the Bluetooth device connected and powered on, run a terminal emulator and open the COM port to which the cable is connected. You should configure the virtual COM port connected to the RN-41-EK or RN-42-EK USB interface with the default settings (115,200 Kbps baud, no parity, 8 bits, 1 stop bit).

You can use command mode through the UART interface via the USB connector at any time when the device does NOT have a Bluetooth connection, as well as under certain conditions. If the device is in configuration mode and a connection occurs, the device exits configuration mode and data passes back and forth from the remote device.

Note: If the device is in Auto-Connect Master Mode, you cannot enter command mode when connected over Bluetooth. See ["Operating Modes" on page 9](#) for more information on the various operating modes.

4.3 Enter Command Mode

To enter command mode, launch a terminal emulator and specify the module's default settings. [Table 4-1](#) shows the serial port settings.

TABLE 4-1: SERIAL PORT SETTINGS

Setting	Value
Port	COM port to which you attached the module
Baud rate	115200
Data rate	8 bits
Parity	None
Stop bits	1
Flow control	None

Type \$\$\$ into the terminal emulator to enter command mode.

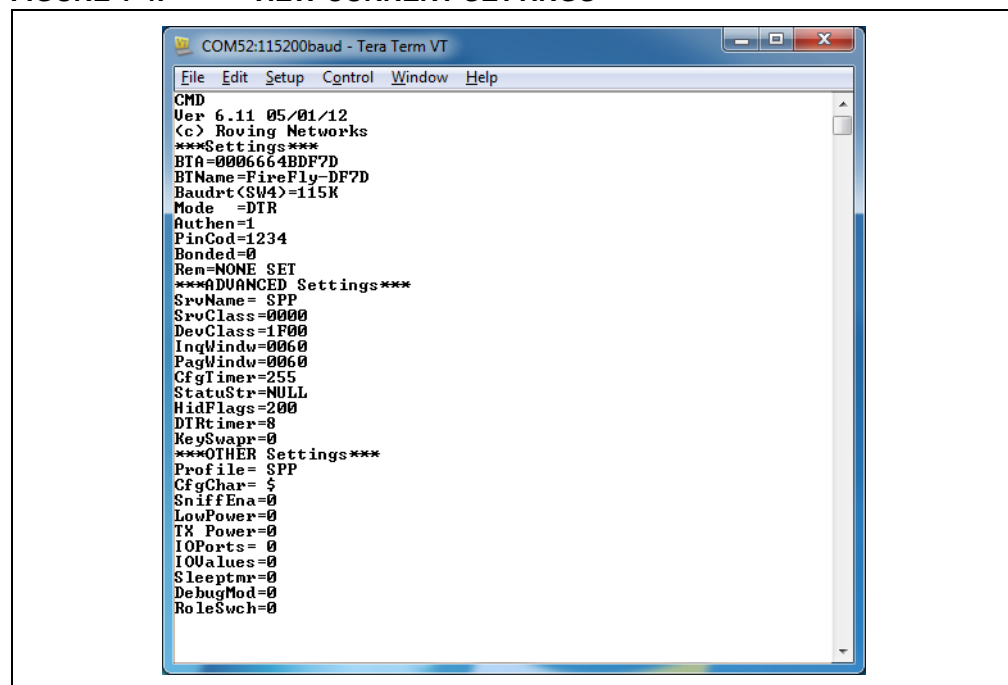
The module returns the string CMD, which indicates that your connection and terminal settings are correct. While in command mode, the device accepts ASCII bytes as commands.

When you power up the module, you must enter command mode within a 60 second configuration window; otherwise, the module goes into fast data mode in which all characters are ignored including \$\$\$\$. If the configuration timer expires while the device is in command mode, the device does not go into fast data mode after exiting command mode. When you enter a valid command, the module returns AOK. It returns ERR for an invalid command and ? for unrecognized commands. Type h <cr> to see a list of commands.

A quick check to confirm that you are in command mode is to type the x <cr> command after entering command mode. This command shows the a summary of the module's current settings, such as the Bluetooth name, device class, and serial port settings. See [Figure 1-2](#).

To return to data mode, type --- <cr> or reset the device and re-connect.

FIGURE 1-4: VIEW CURRENT SETTINGS



4.4 Operating Modes

The Bluetooth device has several operating modes, which you set using the `SM` command in command mode.

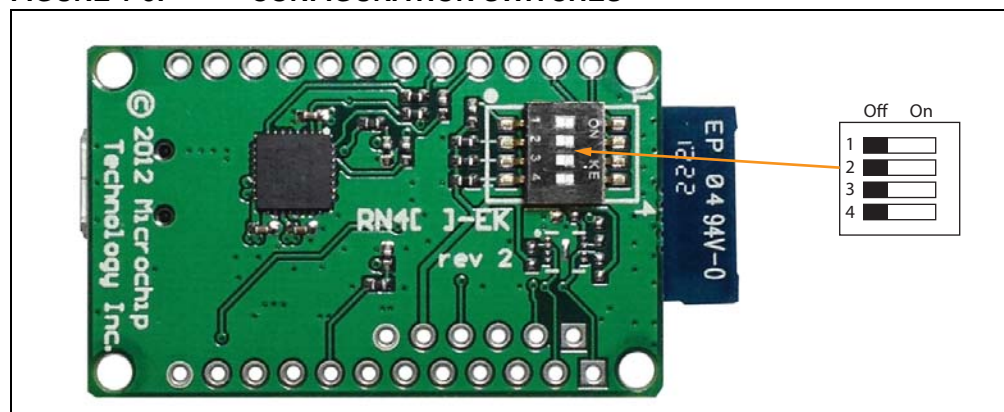
Note: In all master modes, the device cannot be discovered or configured remotely over Bluetooth.

- *Slave Mode (SM,0)*—Default mode, in which other Bluetooth devices can discover and connect to the device. You can also make outbound connections in this mode.
- *Master Mode (SM,1)*—In this low-speed connection mode, the device makes connections when a connect command (`C`) is received. This command can also contain the Bluetooth address of the remote device. If a device is not specified, the module uses the stored remote address. The connection can be broken if the special break character or string is sent (use the `SO` command to set the break character). This mode is useful when you want the device to initiate connections (not receive them). In this mode, the device is NOT discoverable or connectable.
- *Trigger Mode (SM,2)*—In this low-speed connection mode, the device makes connections automatically when a character is received on the serial port (UART). The connection continues as long as characters are received on either end. The device has a configurable timeout (which you set using the `ST` command) that disconnects the module after the specified number of seconds of inactivity (1 to 255) or a configurable break character is received.
- *Auto-Connect Master Mode (SM,3)*—In this mode, the device makes connections automatically on power-up and re-connects when the connection is lost. This mode can be set by command, or by setting the external dipswitch 3 during power up. If an address is not stored, the device performs an inquiry process and the first device found that matches the COD is stored. In this mode, high-speed data is passed without being interpreted; therefore, the connection cannot be broken via commands or software break characters. If a disconnect occurs, the device attempts to re-connect until successful.
- *Auto-Connect DTR Mode (SM,4)*—This mode must be set by command. It operates like Auto-Connect Master Mode, except that you control connection and disconnection with dipswitch 3. Turning the dipswitch on initiates the auto-connect process; turning the dipswitch off causes a disconnect.
- *Auto-Connect ANY Mode (SM,5)*—This mode must be set by command. This mode operates like Auto-Connect DTR Mode, except that each time the dipswitch is set, an inquiry is performed and the first device found is connected. The stored address is NOT used, and the address found is never stored.
- *Pairing Mode (SM,6)*—In this mode, the device attempts to connect with the remote device matching the store remote address. You set the remote address using the `SR` command.

4.5 Configuration Switches

The evaluation boards have small configuration switches on the bottom. You need a paper clip or small screwdriver to flip them. Holding the board with the PCB antenna facing to the right, refer to [Figure 1-3](#) for the switch numbering and on/off positions.

FIGURE 1-5: CONFIGURATION SWITCHES



[Table 4-2](#) describes the functions controlled by the switches.

TABLE 4-2: CONFIGURATION SWITCH FUNCTIONS

Switch	Function	Default (Off)	Description
1	Restore factory defaults	Do not restore factory defaults.	Turn on the switch, power up the evaluation kit, and toggle the switch ON-OFF-ON-OFF-ON to return the module to its factory settings. The green (labeled as S) LED blinks quickly for a moment and then continues to blink about once per second.
2	Automatic discovery	Automatic discovery is turned off.	In slave mode, this switch sets a special class of device that is used by the master to auto connect. If switch 3 also turned on, the module performs a search, stores, and connects to a remote Roving Networks Bluetooth device that has switch 2 turned on.
3	Automatic master	Automatic master is turned off.	With this switch turned on, the module acts as Bluetooth master and auto-connects to a stored remote address. You must first set the Bluetooth address of the slave device using the SR command or using instant cable replacement settings.
4	Default baud rate	With this switch turned off, the default 115 K baud rate is overridden by software baud rate configuration commands.	If this switch is turned on, the baud rate is 9600 and the module ignores the software configuration.

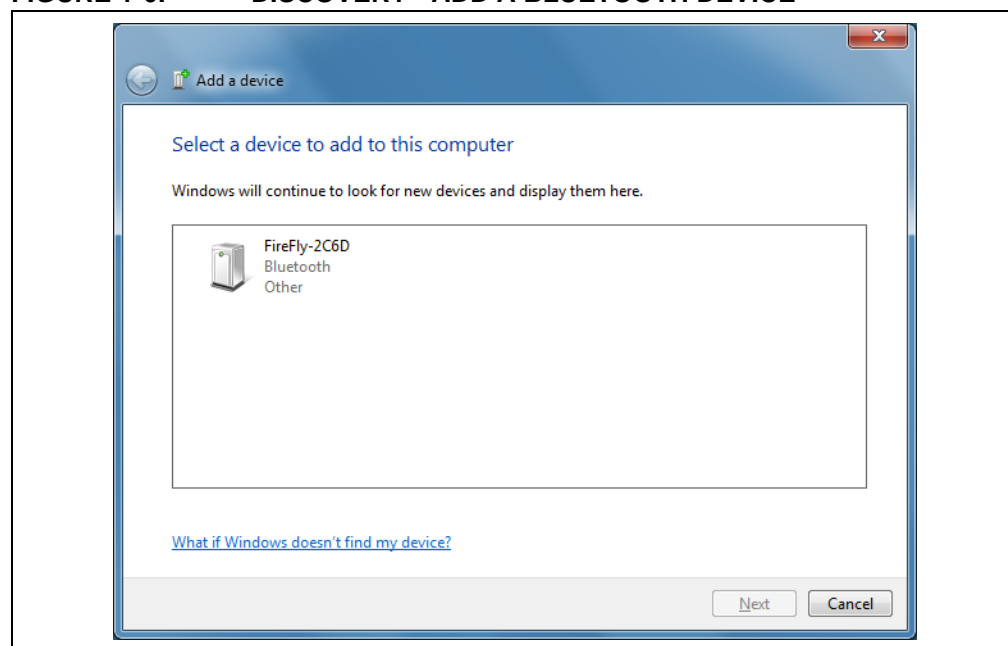
4.6 Making a Bluetooth Connection

By default, the Bluetooth module acts as a slave and the PC is the master. You connect to the Bluetooth module using your computer's Bluetooth device manager, which varies depending on the operating system. Regardless of the operating system, the process is the same: discovery, pairing, and connecting.

4.6.1 DISCOVERY

When you turn on the RN-41-EK or RN-42-EK, the green LED (labeled as S) blinks once per second and the module is discoverable. Open your PC's Bluetooth device manager and choose to add a new device. The Bluetooth device manager's icon is located in the bottom right corner of your screen in the taskbar for Windows and in the upper right corner for Mac OS-X. The Bluetooth device manager displays a list of discoverable Bluetooth device. The board displays as **FireFly-XXXX**, where XXXX are the last 2 bytes of the device's Bluetooth address. See [Figure 1-4](#).

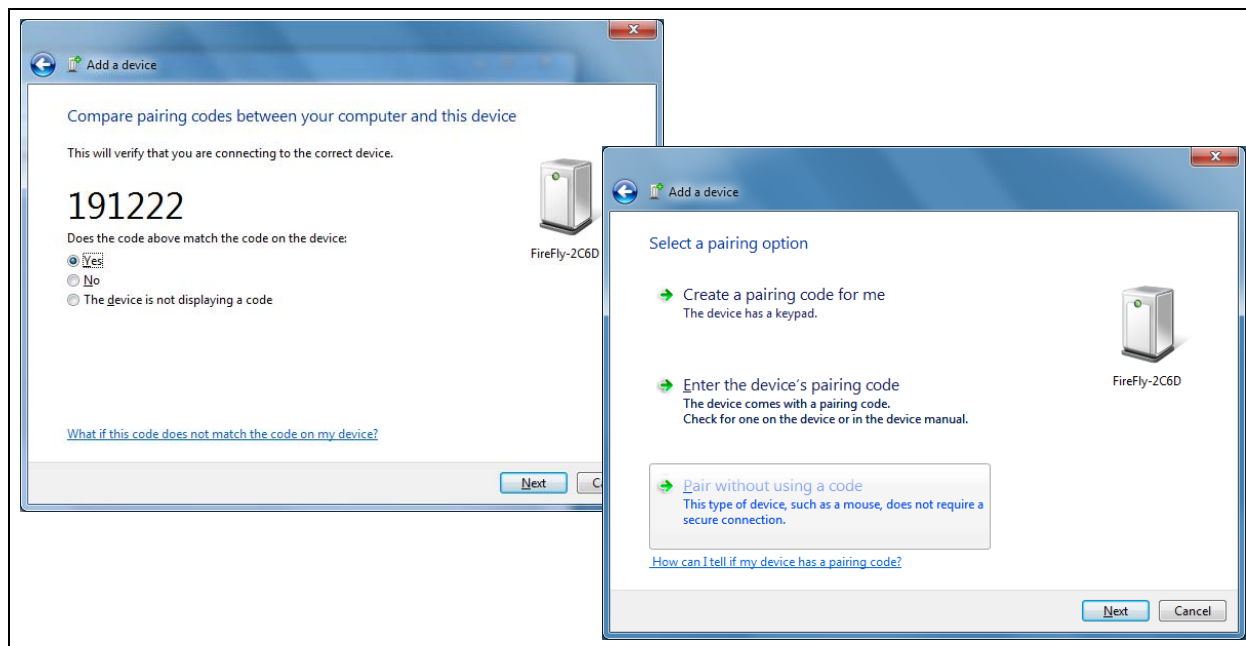
FIGURE 1-6: DISCOVERY - ADD A BLUETOOTH DEVICE



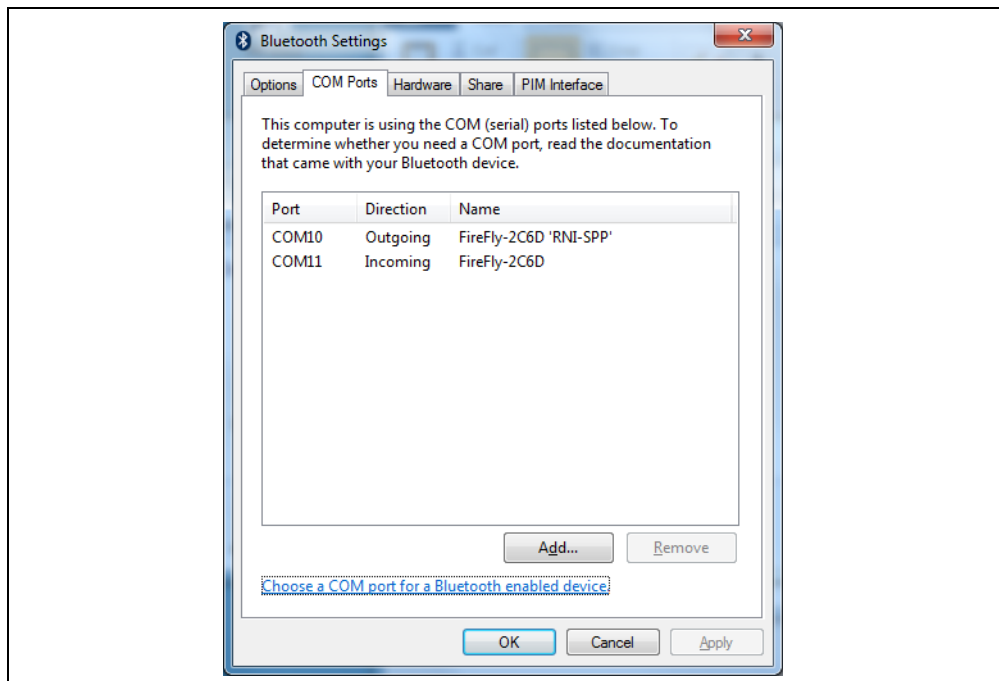
4.6.2 PAIRING

To pair with the evaluation board, double-click the board's name in the list. The firmware automatically stores up to 8 pairings from remote hosts in a first in, first out fashion. The evaluation board's default authentication mode is keyboard (no pin code required). However, most PCs require authentication and display a pin code. If you are using a Bluetooth USB dongle (e.g., RN-USB-T), your PC prompts you to choose how you want to pair. [Figure 1-5](#) shows examples of pairing with and without a pin code.

Note: If your PC displays a pin code and asks you to confirm if it is correct, choose **Yes**.

FIGURE 1-7: PAIRING - COMPARING PIN CODES & PAIRING OPTIONS


When the Bluetooth device manager completes pairing, it issues a message that the Bluetooth device is installed on COMX where COMX is unique to your computer. In some cases, the Bluetooth device manager creates two COM ports; in this situation, only use the COM port labeled outgoing. Figure 1-6 shows example COM port settings.

FIGURE 1-8: PAIRING - BLUETOOTH COM PORT SETTINGS


If the remote Bluetooth device does not require authentication, a connection can occur without the pairing process. However the Bluetooth specification requires that if either device involved in the pairing process requires authentication, the other device must participate to ensure a secure link. Roving Networks modules default to an open mode, such that the module does NOT require authentication. See [“Security Modes” on page 15](#) for more information on using pass keys.

The module may use simple secure pairing (SSP) if it is attempting to pair with devices that support the Bluetooth specification version 2.1 + EDR. SSP does not require the user to remember the pin code, but it asks to confirm the 6-digit number if the device has a display capability.

4.6.3 CONNECTING

In most cases, you connect from another device to the RN-41-EK or RN-42-EK as an outgoing Bluetooth connection. You can also make an incoming connection in which the evaluation board initiates the connection to the remote device.

4.6.3.1 Outgoing Connections

To establish an outgoing Bluetooth connection from a PC to the RN-41-EK or RN-42-EK board, open the module's outgoing COM port from your application or a terminal emulator. When you establish a connection by opening the COM port, the evaluation board's green LED (labeled as S) goes on solid (not blinking) to indicate that the device is connected. The device remains connected until you close the COM port, remove power from the board, or terminate the connection using the `⌘, 1` command. Refer to the *Bluetooth Command Reference & Advanced Information User's Guide* for more information on using commands.

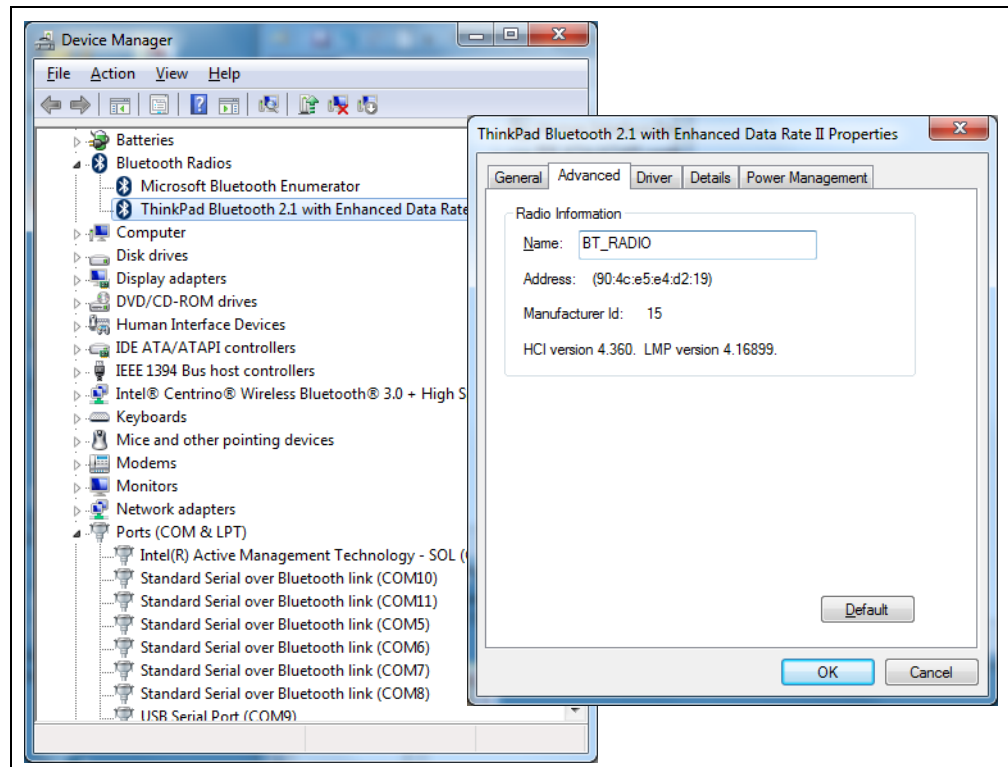
Once connected, the device is in data mode allowing data to flow in both directions. The board's red LED (labeled as A) blinks once per second when data is transferred over the UART. For configuration and programming, the device must be in command mode. See [“Enter Command Mode” on page 7](#) for more information.

Note: Only one client can connect to a slave device at a time. As a master, the device can make multiple connections, but only in a point-to-point, serialized fashion. The RN41 and RN42 modules do not currently support multi-point master mode.

4.6.3.2 Incoming Connections

For an incoming connection you use the port specified in your Bluetooth settings as incoming (refer back to [Figure 1-6](#)). The PC or host listens for an incoming connection from the remote Bluetooth device, in this case the RN-41-EK or RN-42-EK. Perform the following steps to make an incoming connection.

1. You need the MAC address of the PC's Bluetooth radio to connect from the RN-41-EK or RN-42-EK to the host PC. Open the PC's Bluetooth advanced settings to find the MAC address. See [Figure 1-7](#).

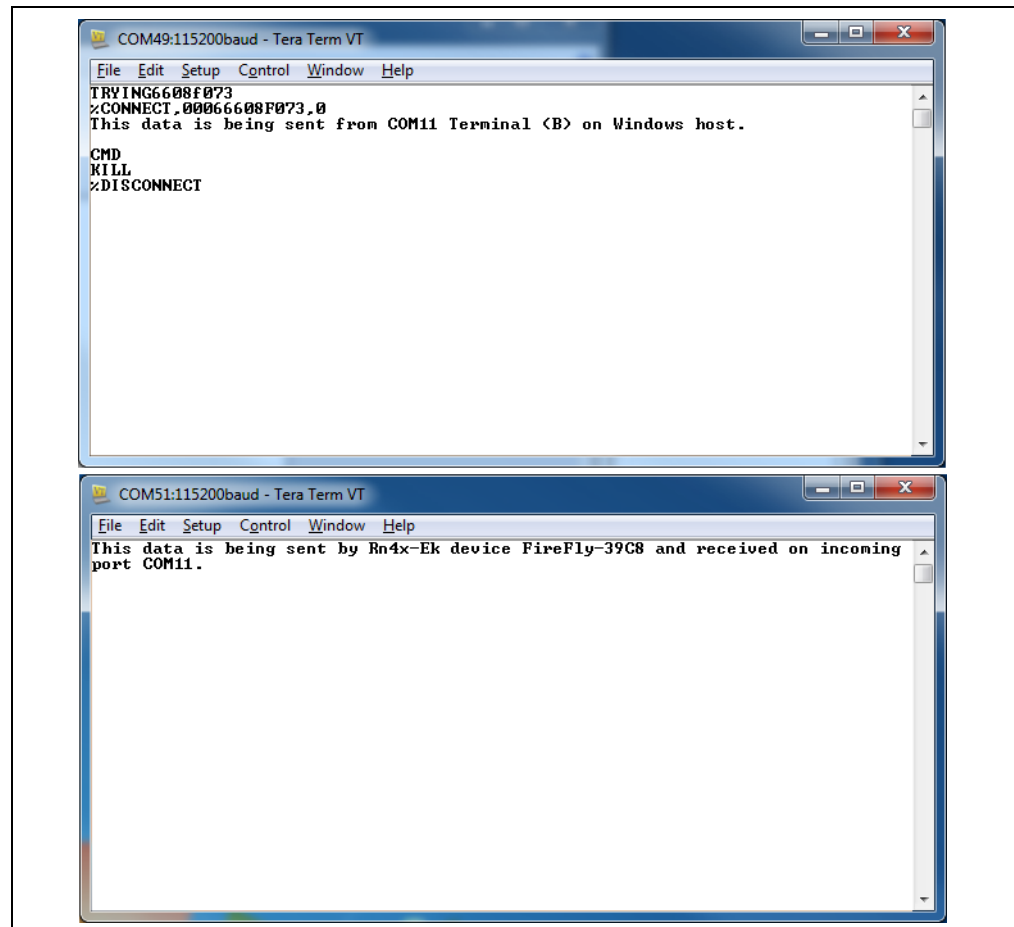
FIGURE 1-9: PC'S BLUETOOTH RADIO MAC ADDRESS


2. Pair your evaluation board with the PC as described in ["Pairing" on page 11](#).
3. Open a terminal (called terminal A in this example) and connect it to the evaluation board's outgoing COM port. You can run this terminal on the host PC or another computer.
4. Open a second terminal (called terminal B in this example) on the host PC to listen for the incoming Bluetooth connection using the incoming COM port number.
5. Type `C, <MAC address> <cr>` in terminal A to establish an SPP connection to the host PC. See [Figure 1-8](#) for an example connection.
6. Try the following commands:

- `$$$` to enter command mode
- `SO, %` to enable status message to see connect/disconnect conditions
- `R, 1` to reboot
- `$$$` to re-enter command mode
- `+` to enable local echo
- `C, <MAC address>` to attempt a connection with a remote device

Characters you type in terminal B are sent over Bluetooth to the host PC and appear in terminal A. Any characters entered in terminal A are transmitted to terminal B.

7. To kill the connection, type the `K, 1 <cr>` command in terminal B.

FIGURE 1-10: TERMINALS A & B


4.7 Security Modes

The Bluetooth module supports authentication. If the local or remote Bluetooth device has authentication enabled, a pin code is required the first time a connection is attempted. The pin code is a series of numbers or characters from 1 to 16 characters in length. After you enter the pin code, the Bluetooth devices compare them. If they match, a link key is generated and stored. Usually, but not always, the remote device stores the link key. For subsequent connections, the devices compare link keys. If they are correct, you do not need to re-enter the pin code.

If the remote device is a PC or PDA, the user generally is prompted to enter this pin code. To remove the stored link key on the remote device, you typically “unpair” or remove the device from the Bluetooth manager. You can change the pin code to remove the link key on the Bluetooth module, forcing a new pin code exchange to occur upon subsequent connection attempts.

Note: Only one master can connect to the Bluetooth module at a time.

5.0 RESOURCES & RELATED DOCUMENTS

For more information, refer to the following sources:

- RN41/RN41N Class 1 Bluetooth Module Data Sheet
- RN42/RN42N Class 2 Bluetooth Module Data Sheet
- Bluetooth Command Reference & Advanced Information User's Guide

6.0 DOCUMENT REVISION HISTORY

6.1 Version 1.0

Initial release.

7.0 ORDERING INFORMATION

Table 7-1 provides ordering information for the evaluation kits.

TABLE 7-1: EVALUATION KIT ORDERING INFORMATION

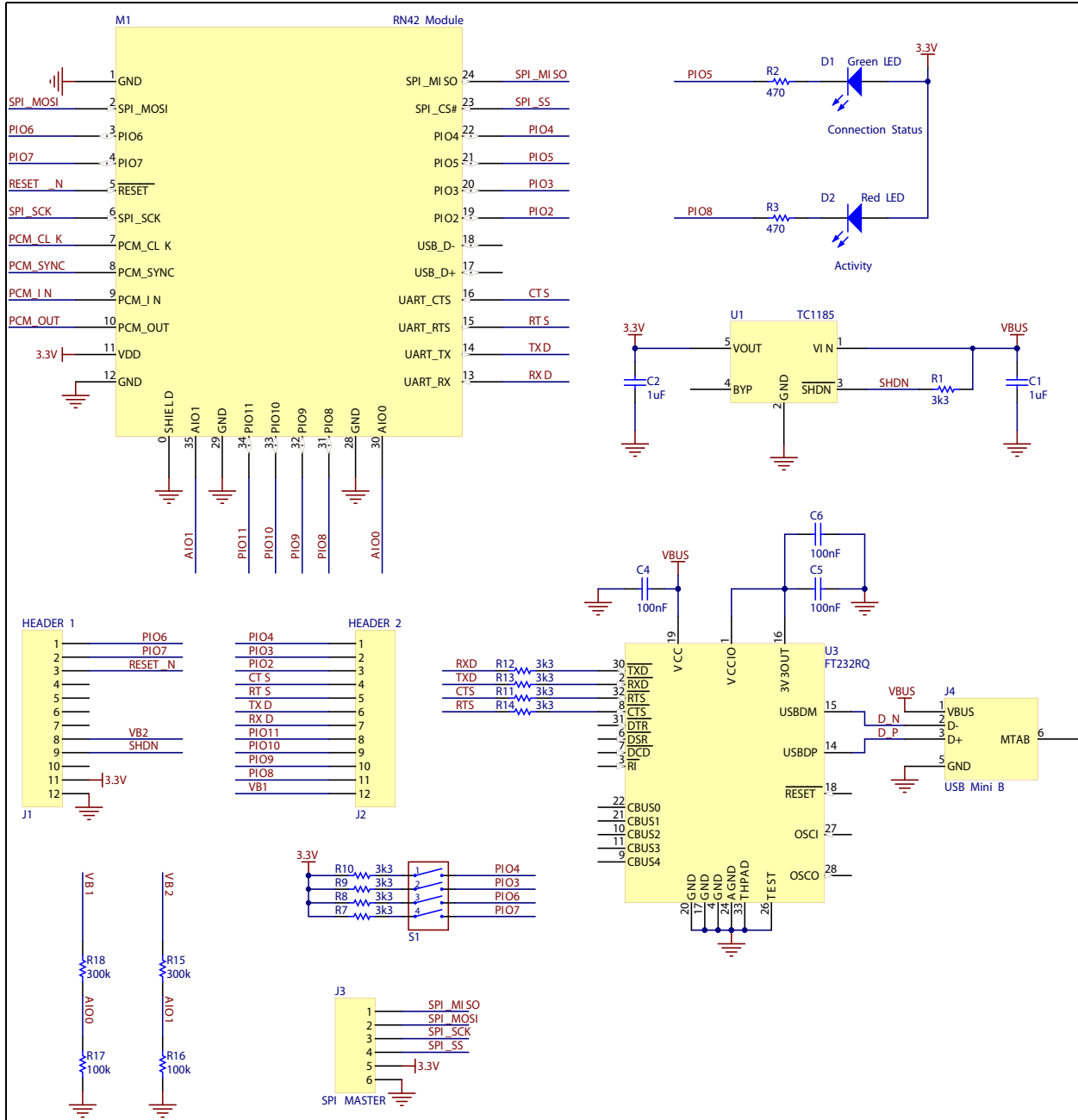
Part Number	Description
RN-41-EK	Evaluation kit for the RN41 (Class 1) Bluetooth module.
RN-42-EK	Evaluation kit for the RN42 (Class 2) Bluetooth module.

Go to <http://www.rovingnetworks.com> for current pricing and a list of distributors carrying Roving Networks products.

APPENDIX A: RN-41-EK & RN-42-EK SCHEMATIC

Figure 1-9 shows the schematic for the RN-42-EK evaluation board. The RN41 and RN42 modules are pin compatible; therefore, the schematic applies to both boards.

FIGURE 1-11: RN-41-EK & RN-42-EK SCHEMATIC



NOTES:

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