RN41/42 Evaluation Kit
User's Guide

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QUALITY MANAGEMENT SYSTEM
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═ ISO/TS 16949 ═

Object of Declaration: RN41/42 Evaluation Kit

EU Declaration of Conformity

Manufacturer: Microchip Technology Inc.
                       2355 W. Chandler Blvd.
                       Chandler, Arizona, 85224-6199
                       USA

This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).

This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.

This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson
VP Development Tools

12-Sep-14
Date

RN41/42 Evaluation Kit User's Guide

NOTES:

RN41/42 EVALUATION KIT USER'S GUIDE

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/ or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the Product Name. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This user's guide describes how to use the RN-41-EK and RN-42-EK Evaluation Boards. The document is organized as follows:

- **Chapter 1. "Overview"** – This chapter describes the hardware and software setup for RN41 and RN42 Evaluation Kits.
- **Chapter 2. "Getting Started"** – This chapter describes the RN41 and RN42 Evaluation Kit board as an independent development board for exploring the ASCII command set and prototyping of embedded systems.
- **Chapter 3. "Application Design Concerns"** – This chapter describes the application design concerns of the RN41 and RN42 modules.
- **Appendix A. "RN41 and RN42 Evaluation Kit Schematics"** – This appendix includes a schematic of the RN-41-EK and RN42-EK Evaluation Boards, PCB layout and the Bill of Materials.

RN41/42 Evaluation Kit User's Guide

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: {	}	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use the RN-41-EK and RN42-EK Evaluation Boards. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

RN41 Module Data Sheet

RN42 Module Data Sheet

PICDEM™ PIC18 Explorer Demonstration Board User's Guide (DS51721)

Explorer 16 Development Board User's Guide (DS51589)

Bluetooth Data Module Command Reference and Advanced Information User's Guide

RN41/42 Evaluation Kit User's Guide

THE MICROCHIP WEB SITE

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• **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software

• **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing

• **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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The Development Systems product group categories are:

• **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB® C compiler; MPASM™ and MPLAB 16-bit assemblers; MPLINK™ and MPLAB 16-bit object linkers; and MPLIB™ and MPLAB 16-bit object librarians.

• **Emulators** – The latest information on the Microchip MPLAB REAL ICE™ in-circuit emulator.

• **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3.

• **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB SIM simulator, MPLAB IDE Project Manager and general editing and debugging features.

• **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 device programmer and the PICkit™ 3 development programmers.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

• Distributor or Representative
• Local Sales Office
• Field Application Engineer (FAE)
• Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

Revision A (November 2014)

This is the initial released version of this document.

NOTES:

Chapter 1. Overview

1.1   INTRODUCTION

This user's guide describes the hardware and software setup for RN41 and RN42 Evaluation Kits. The RN41 and RN42 evaluation boards are field-ready with Bluetooth® SIG qualified platforms based on RN41 and RN42 modules, respectively. The boards have the flexibility to connect directly to computer/laptops via a standard USB interface (via the FTDI chipset), or to embedded controllers through the TTL UART interface. The status LEDs, DIP switches and Signal headers/connectors enable integration into existing systems. The user can configure and control the modules from a console using simple ASCII command language. Once the configuration is setup, the module can connect over Bluetooth.

The evaluation kit configures the Bluetooth module using the command interface, create connections, and transfer data. The RN-41-EK and RN-42-EK evaluation boards support the Serial Port Profile (SPP) and Human Interface Device (HID) profiles. In this user's guide, the SPP profile is used for the instructions. For more information on the profiles and how to switch between these profiles, refer to the *Bluetooth Data Module Command Reference and Advanced Information User's Guide*.

For data sheet and other details related to RN41 and RN42 modules, refer to the Microchip web site at http://www.microchip.com.

This chapter discusses the following topics:

1.2   RN41/42 EVALUATION KIT FEATURES

1.2.1   RN41 Evaluation Board Features

The RN41 Evaluation Board has the following features:

- Supports fully qualified Bluetooth version 2.1 module, supports version 2.1 + Enhanced Data Rate (EDR)
- UART (SPP or HCI) and USB (*only* HCI) data connection interfaces
- Sustained SPP data rates: 240 Kbps (slave), 300 Kbps (master)
- HCI data rates: 1.5 Mbps sustained, 3.0 Mbps burst in HCI mode
- Embedded Bluetooth stack profiles included (requires no host stack): GAP, SDP, RFCOMM, and L2CAP protocols, with SPP and DUN profile support
- Supports Class 1 high-power amplifier with on-board ceramic RF chip antenna (RN41) or without antenna (RN41N)
- Supports 2 LEDs, 4 DIP switches for Configuration, SPI pads for firmware programmings
- Postage-stamp sized form factor of 44 mm x 24 mm x 13 mm.

1.2.2   RN42 Evaluation Board Features

The RN42 Evaluation Board has the following features:

• Supports fully qualified Bluetooth version 2.1 module, supports version 2.1
• UART (SPP or HCI) and USB (*only* HCI) data connection interfaces
• Sustained SPP data rates: 240 Kbps (slave), 300 Kbps (master)
• HCI data rates: 1.5 Mbps sustained, 3.0 Mbps burst in HCI mode
• Embedded Bluetooth stack profiles included (requires no host stack): GAP, SDP, RFCOMM, and L2CAP protocols, with SPP and DUN profile support
• Supports 2 LEDs, 4 DIP switches for Configuration, SPI pads for firmware pro-grammings
• Postage-stamp sized form factor of 44 mm x 24 mm x 13 mm.

1.3   RN41/42 EVALUATION KIT CONTENTS AND PART DETAILS

The evaluation kit includes the hardware required to connect the evaluation board to the host computer, see Table 1-1. To evaluate the module on the evaluation board, the user needs a computer with a USB port running the Microsoft Windows or Mac OS-X operating system.

> **Note:** Prior to the evaluation, install the FTDI drivers for the USB cable. If the drivers are *not* automatically installed, download and install the FTDI drivers from http://ww1.microchip.com/downloads/en/DeviceDoc/FTDI-Drivers.zip.

Depending on the development kit ordered, the package contains one of the the following development boards:

• **RN-41-EK** or **RN-42-EK Board** - Contains the RN41 (Class 1)/RN42 (Class 2) Bluetooth module.
• **USB cable** - Connects user's computer to the evaluation board.

Table 1-1 lists the part number of RN-41/42-EK Evaluation Kit.

TABLE 1-1:   RN41/42 EVALUATION KIT PART DETAILS

Description	Part Number
RN41 Evaluation board	RN-41-EK
RN42 Evaluation board	RN-42-EK

Figure 1-1 and Figure 1-2 show the evaluation kit contents and part number information.

FIGURE 1-1: **RN41 EVALUATION KIT CONTENTS**

RN-41-EK

RN41 Evaluation Board
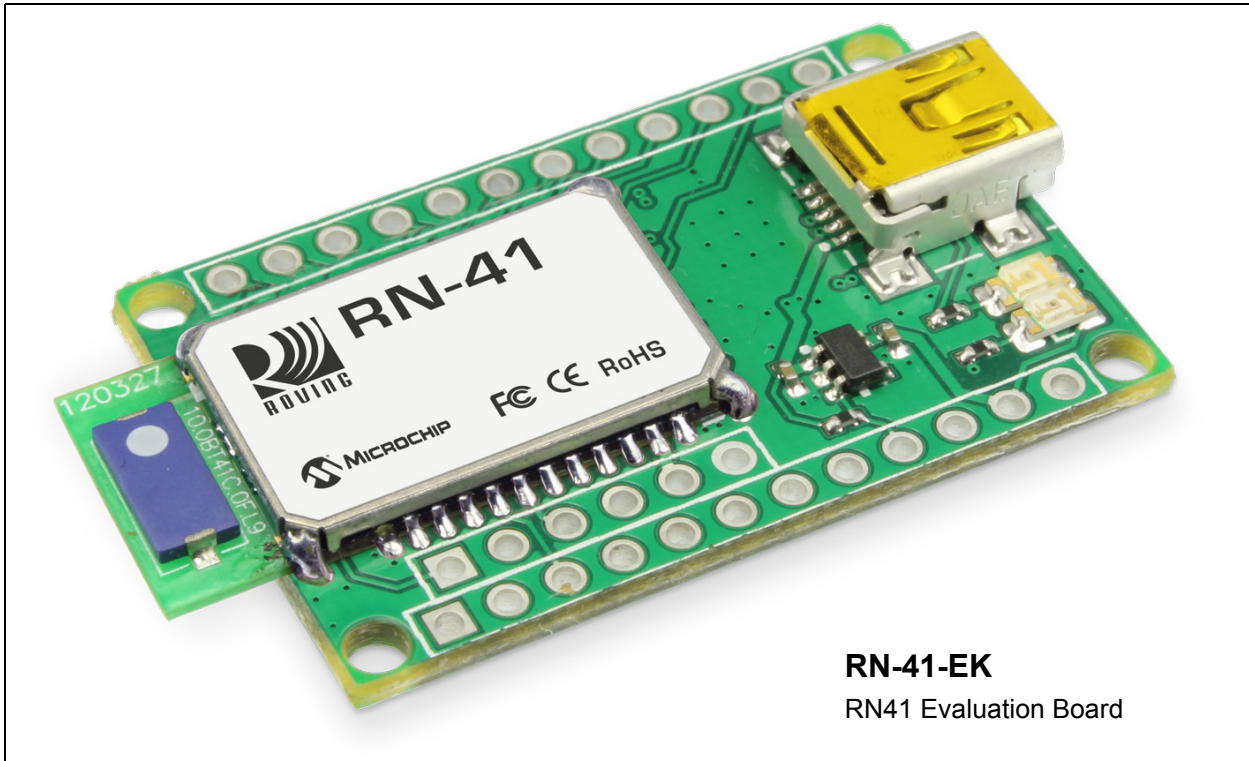
FIGURE 1-2: **RN42 EVALUATION KIT CONTENTS**

RN-42-EK
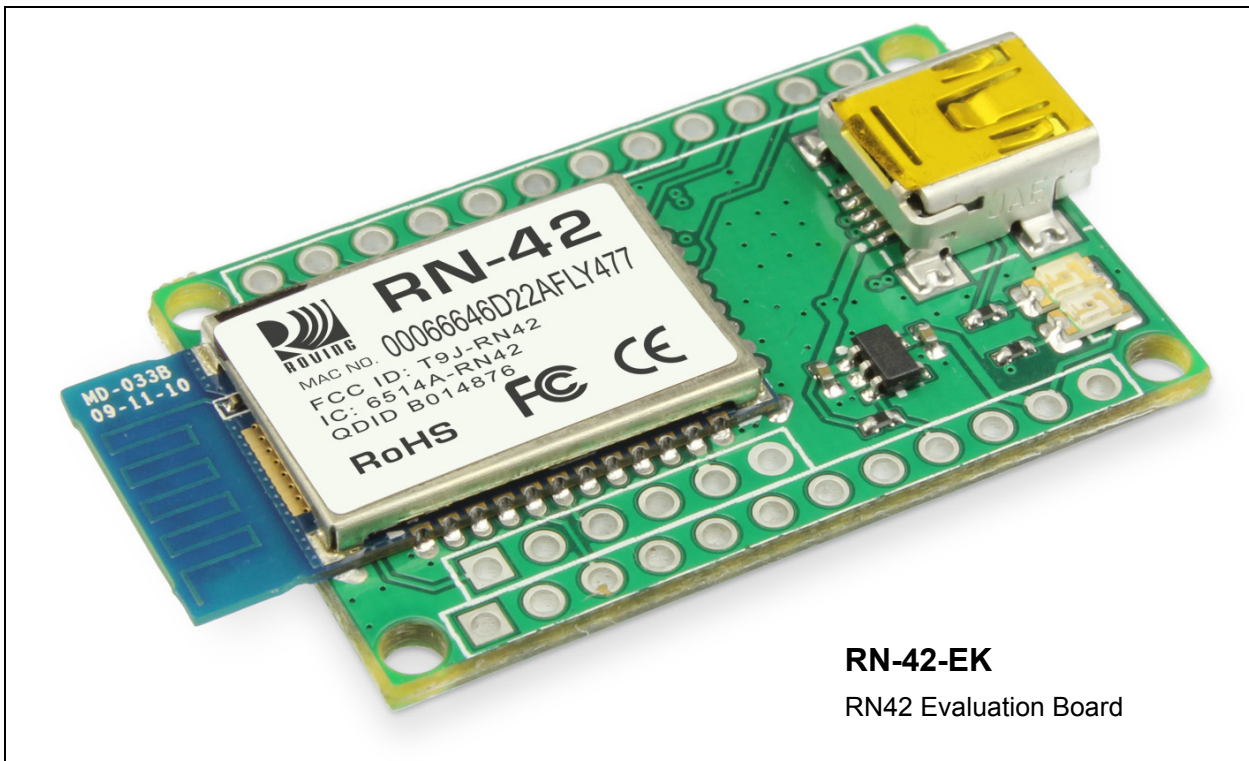
RN42 Evaluation Board

1.4   RN41/42 EVALUATION KITS/BOARD CONTENTS

The components of the RN41/42 Evaluation Board are shown in Figure 1-3. This figure describes the evaluation board's interfaces and connectors. Table 1-2 describes the status LEDs. The Green LED indicates the status of the Bluetooth connection and the device in Configuration mode. The RN41 and RN42 modules are pin compatible and the description applies to both RN-41-EK and RN-42-EK boards. For the board's schematic, refer to **Appendix A. "RN41 and RN42 Evaluation Kit Schematics"**.

FIGURE 1-3:   RN-41-EK & RN-42-EK EVALUATION BOARD
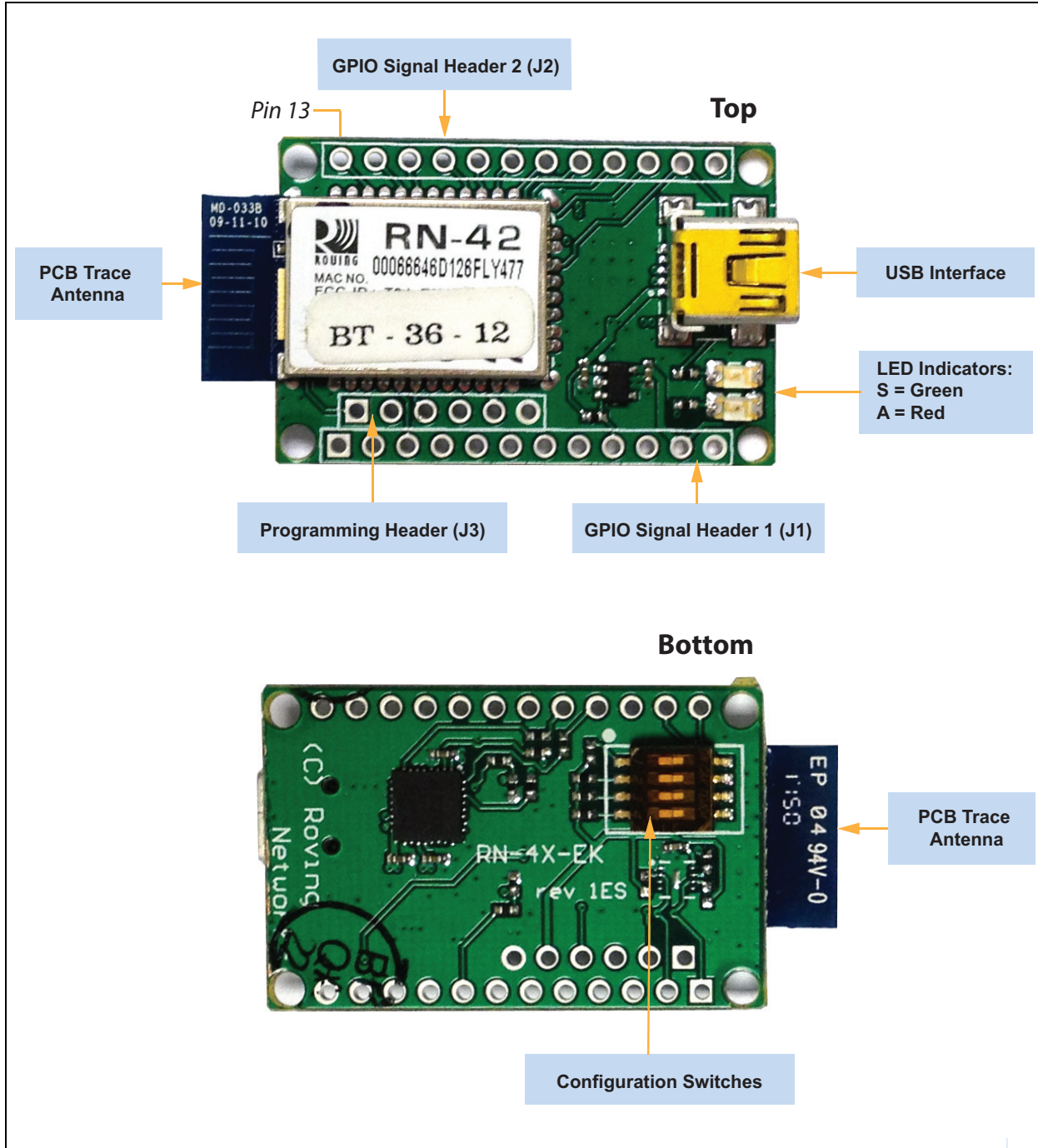
Note: Figure 1-3 shows the RN-42-EK board. This figure is similar to RN-41-EK board.

GPIO Signal Header 1 (J1)

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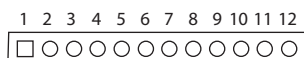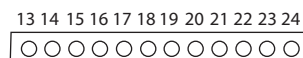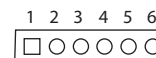
Pin	Description
1	GPIO6
2	GPIO7
3	RESET_N
4	No Connect
5	No Connect
6	No Connect
7	No Connect
8	Sensor Input 1 (AIO1)
9	Shutdown (SHDN)
10	No Connect
11	3.3 V
12	GND

GPIO Signal Header 2 (J2)

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

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)

Programming Header (J3)

1 2 3 4 5 6

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 1-2: 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	—

TABLE 1-3: RN41/42 EVALUATION KIT HARDWARE

Hardware	Description	RN-41-EK	RN-42-EK
Evaluation board	Contains the Bluetooth® module and connectors	For RN41 Module	For RN42 Module
Power-Up	Interface for powering up the evaluation boards	USB	USB
LEDs	To indicate Status and for Debugging	Available	Available
Switches	Used to access/configure functions in RN41/42 module such as factory default, Connection mode, and so on	Available	Available
10-Pin Sensor Interface	Analog sensor interface supported provides direct connections to read the temperature, acceleration, and analog data	Available	Available
Communication Interface	UART and USB	Available	Available
USB Connector On-board	Provides power to the evaluation board and supports communication (COM Port)	Available	Available

1.5   RN41/42 EVALUATION KIT RELATED INFORMATION CONTENTS

To obtain the sample application codes, see details from the Bluetooth User Manual using the following links:

- http://www.microchip.com/RN-41-EK
- http://www.microchip.com/RN-42-EK.

> **Note:**   All the factory-shipped RN modules are available with firmware version and profile details. For more information, refer to "*Bluetooth Data Module Command Reference and Advanced Information User's Guide*" available at http://www.microchip.com.

Chapter 2. Getting Started

2.1 INTRODUCTION

This chapter describes the RN41/42 Evaluation Kit board as an independent development board for exploring the ASCII command set and prototyping of embedded systems. Certain hardware and software/utilities are essential to support the development of demo applications. This chapter discusses the following topics:

- Hardware Requirements
- Software/Utility Requirements
- Module Configuration

2.2 HARDWARE REQUIREMENTS

Along with RN-41-EK or RN-42-EK boards, an USB cable is connected (virtual COM port) to evaluate hardware setup and to run the firmware/demo appplications.

2.2.1 Hardware Setup

To setup the RN41/42 Evaluation Board demo, perform the following steps:

1. Connect the USB cable to a USB port on the host system (computer/laptop) and to the USB connector on the evaluation board.
2. Power to RN-41/42-EK evaluation board is *only* obtained through the host computer/ laptop.

> **Note:** If the drivers are *not* automatically installed, download and install the FTDI drivers from http://ww1.microchip.com/downloads/en/DeviceDoc/FTDI-Drivers.zip.

3. Once the FTDI drivers are installed, the COM port is automatically assigned based on the active connection.
4. Note the COM port to which the USB cable is connected.

Figure 2-1 shows the setup arrangement of RN41/RN42 Evaluation Boards connected to a computer/laptop.

FIGURE 2-1: COMPLETE HARDWARE SETUP

2.3 USING THE EVALUATION KIT

Program 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. The set command configures the Bluetooth module and get commands echoes 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. To configure the Bluetooth devices, a Bluetooth enabled PC (either built-in or using a USB Bluetooth dongle) is required. *Only* one device can be configured at a time. Once configured, device settings are saved (independent of power-down) until users explicitly change settings or the factory defaults are restored.

> **Note:** For detailed information on the ASCII commands used to configure the Bluetooth module, refer to the *Bluetooth Data Module Command Reference and Advanced Information User's Guide*.

2.4   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 over the Bluetooth SPP connection. Thus, the entire process of sending/receiving data to the host is transparent to the end micro-processor. Figure 2-2 illustrates the Bluetooth communication pipe.

FIGURE 2-2:   **DATA & COMMAND MODES**
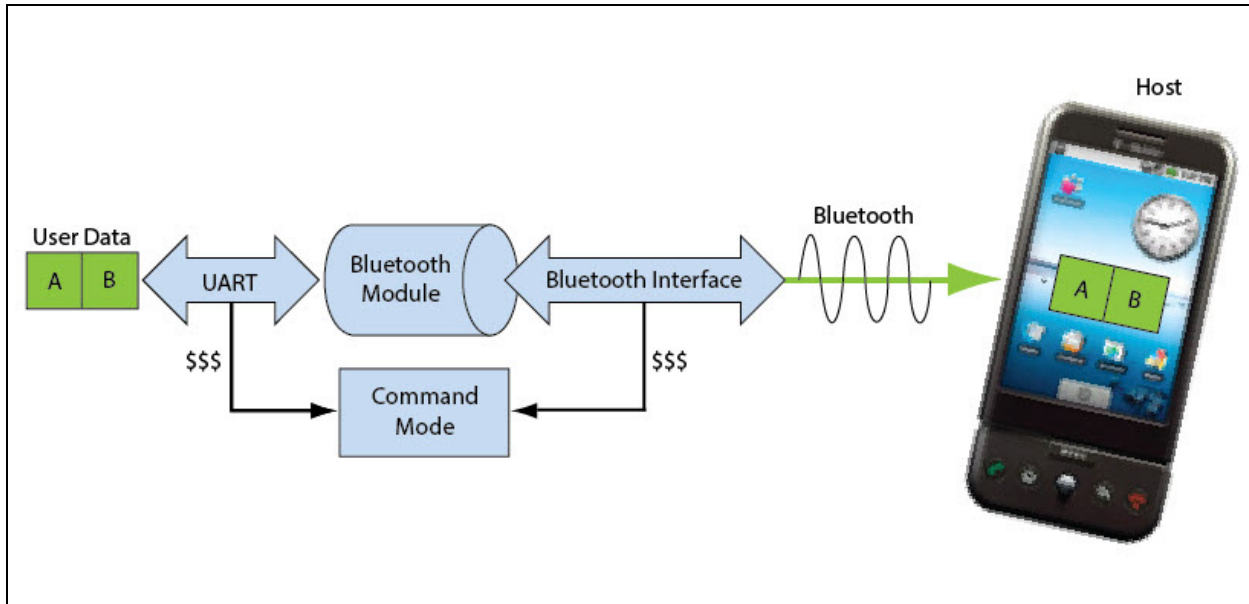
The default configuration for the Bluetooth device are as follows:

• 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.

The device is configurable if set into Command mode and ASCII commands are sent over a serial port or the Bluetooth link. Once the configuration parameters are changed, parameter values persist until it is changed or perform a factory reset.

Note: User can *only* configure the Bluetooth module in two ways: locally using host computer's USB port and via Bluetooth.

Terminal emulator application/program on PC is required to complete the setup.

Note: Depending on the operating system, the users can opt to use either the TeraTerm (Windows OS) or CoolTerm (Mac OS-X) terminal emulator programs.

2.5   CONFIGURE THE MODULE LOCALLY USING THE USB PORT

Setup the RN-41-EK or RN-42-EK hardware as described in **Section 2.2.1 "Hardware Setup"**. With the Bluetooth device connected and powered on, run a terminal emulator and open the COM port to which the cable is connected. Configure the virtual COM port connected to the RN-41-EK or RN-42-EK as shown in Table 2-1.

Command mode can be switched through the UART interface via the USB connector at any time or during certain conditions when the device does *not* have a Bluetooth connection. If the device is in Configuration mode and gets connected, 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, user *cannot* enter the Command mode when connected over Bluetooth. For more information on the various Operating modes, see **Section 2.7 "Operating Modes"**.

2.6   ENTER COMMAND MODE

To enter Command mode, launch a terminal emulator from the PC and specify the module's default serial port settings. See Table 2-1.

TABLE 2-1:   SERIAL PORT SETTINGS

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

Type $$$ (sequentially without any delays between $ characters) into the terminal emulator to enter Command mode. The module returns the string CMD, which indicates that the connection and terminal settings are correct. While in Command mode, the device accepts ASCII bytes as commands.

When the module is powered up and no command is entered within a 60-second configuration window, the module goes into fast Data mode and all characters are ignored including $$$. When user enters 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 the user is in Command mode, type the X <cr> command after entering Command mode. This command shows a summary of the module's current settings, such as the Bluetooth name, device class, and serial port settings, see Figure 2-3. To return to Data mode, type --- <cr> or reset the device and reconnect.

FIGURE 2-3:   VIEW CURRENT SETTINGS

```
COM18:115200baud - Tera Term VT
File  Edit  Setup  Control  Window  Help
CMD
Ver 6.30beta 08/26/2014
(c) Microchip Technology
***Settings***
BTA=0006666AB872
BTName=RNBT-B872
Baudrt(SW4)=115K
Mode  =Slav
Authen=1
PinCod=1234
Bonded=0
Rem=NONE SET
***ADVANCED Settings***
SrvName= RNI-SPP
SrvClass=0000
DevClass=1F00
InqWindw=0100
PagWindw=0100
CfgTimer=255
StatuStr=NULL
HidFlags=200
DTRtimer=8
KeySwapr=0
***OTHER Settings***
Profile= SPP
CfgChar= $
SniffEna=0
LowPower=0
TX Power=0
IOPorts= 0
IOValues=0
Sleeptmr=0
DebugMod=0
RoleSwch=0
```

2.7   OPERATING MODES

The Bluetooth device has several Operating modes, which user can set using the SM command in Command mode.

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

2.7.1   Slave Mode (SM,0)

This is the default mode, in which other Bluetooth devices can discover and connect to the device. Outbound connections can also be performed in this mode.

2.7.2   Master Mode (SM,1)

In this low-speed connection mode, the device makes a connection 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. To set the break character, use the so command. This mode is useful when user needs the device to initiate connections (*not* to receive them). In this mode, the device is *not* discoverable or connectable.

2.7.3   Trigger Mode (SM,2)

In this low-speed connection mode, the device automatically connects 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 (user can 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.

2.7.4 Auto-Connect Master Mode (SM,3)

In this mode, the device automatically reconnects to the stored address on power-up when the connection is lost. This mode can be set by command, or by setting the external DIP switch 3 during power-up. If an address is *not* stored and DIP switch 2 is set, the device performs an inquiry process and the first device found that matches the Class Of Device (COD) is stored. In this mode, high-speed data is passed without being interpreted which means the connection *cannot* be broken through commands or software break characters. If a disconnect occurs, the device attempts to reconnect until successful.

2.7.5 Auto-Connect DTR Mode (SM,4)

This mode must be set by command. It operates like Auto-Connect Master Mode, except that user has to control the connection and disconnection with DIP switch 3. Turning the DIP switch on initiates the auto-connect process, while turning the DIP switch off causes a disconnect.

2.7.6 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 DIP switch 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.

2.7.7 Pairing Mode (SM,6)

In this mode, the device attempts to connect with the remote device that matches the stored remote address. To set the remote address, use the SR command.

2.8 CONFIGURATION SWITCHES

The evaluation boards have small configuration switches at the bottom. These can be configured or flipped using a paper clip or a small screwdriver. Holding the board with the PCB antenna facing to the right, the switch numbering and on/off positions are shown in Figure 2-4.
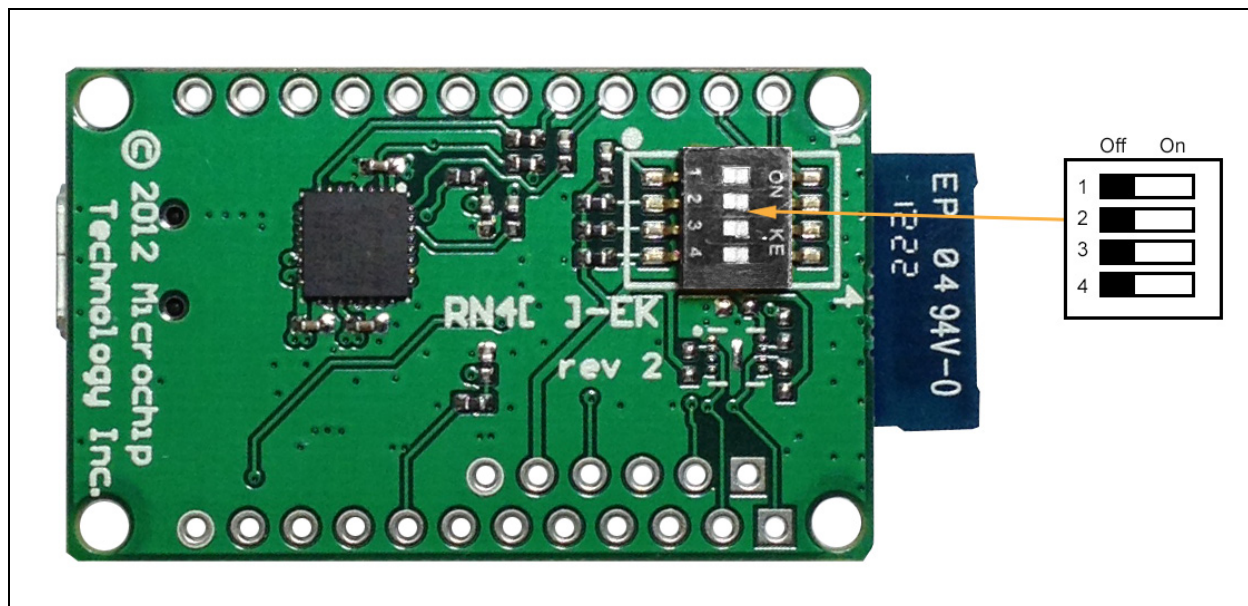
FIGURE 2-4:   CONFIGURATION SWITCHES

Table 2-2 describes the functions controlled by the switches.

TABLE 2-2:   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 three times to return the module to its factory settings. The Green LED (labeled as S) 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, if DIP switch 2 is set and DIP switch 3 is not set, it results in a special class of device that the master uses to auto-connect. If switch 3 also turned on, the module performs a search, stores, and connects to a remote RN41/42 Bluetooth device.
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. If DIP switch 2/GPIO3 is also set, a new discovery/pairing can be made.
4	Default baud rate	With this switch turned off, the default 115200 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.

2.9   MAKING A BLUETOOTH CONNECTION

As a default, the Bluetooth module acts as a slave and the PC is the master. Connect to the Bluetooth module using the host computer's Bluetooth device manager, which varies depending on the operating system. Regardless of the operating system, it follows the same process: Discovery, Pairing, and Connecting.

2.9.1   Discovery

When user turns 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 the host PC's Bluetooth device manager and choose to "Add a device". The Bluetooth device manager's icon is located at the bottom right corner on the host's computer screen in the taskbar for Windows, and at the upper right corner for Mac OS-X. The Bluetooth device manager displays a list of discoverable Bluetooth devices. Figure 2-5 illustrates the discovery of Bluetooth devices on host computer.

FIGURE 2-5: **DISCOVERY - ADD A BLUETOOTH® DEVICE**
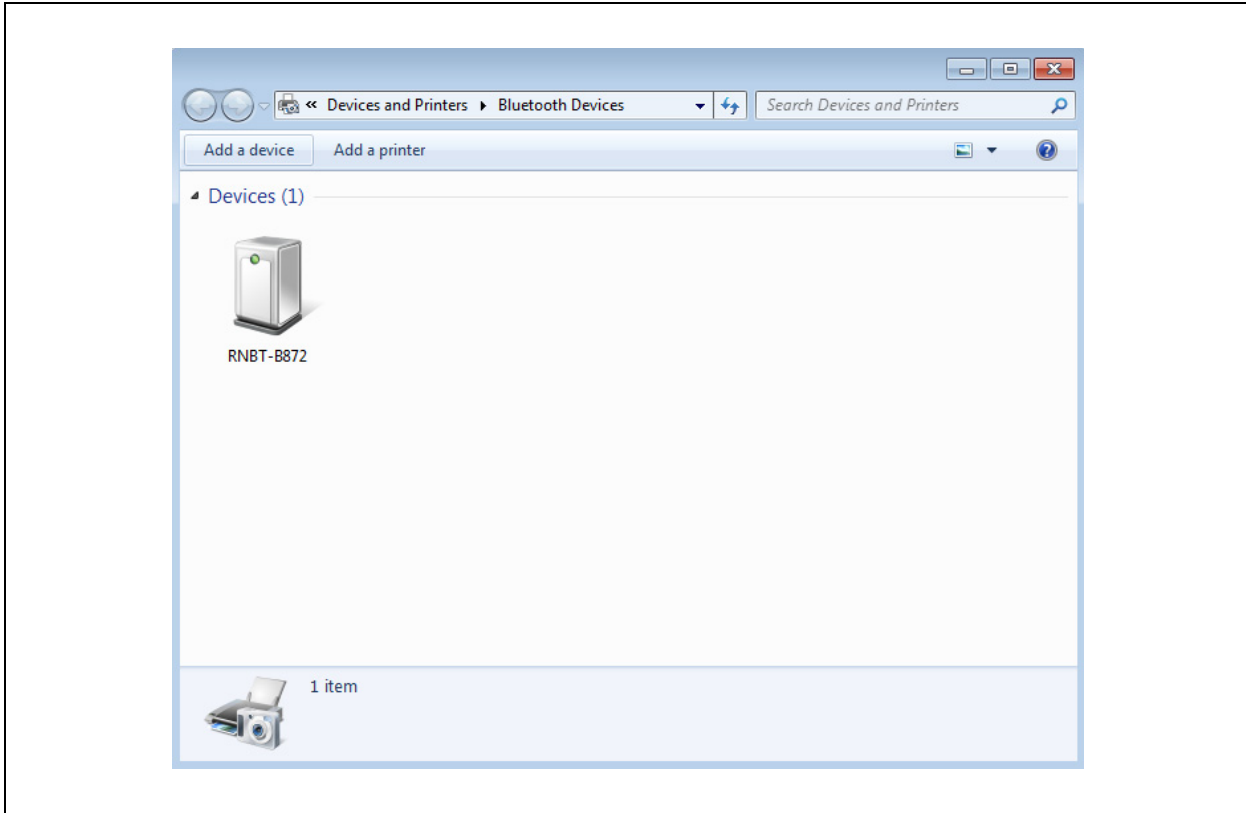
2.9.2 Pairing

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 using the First-In, First-Out (FIFO) method. The evaluation board's Default Authentication mode is the SSP keyboard mode (no pin required). However, most PCs require authentication and display a pin code. If a user uses a Bluetooth USB dongle (e.g., RN-USB-T), host PC prompts the user to choose how the pairing must be done. Figure 2-6 shows examples of pairing with and without a pin code.

> **Note:** If host PC displays a pin code, user must select the YES button to confirm if correct.

FIGURE 2-6: PAIRING - COMPARING PIN CODES AND PAIRING OPTIONS
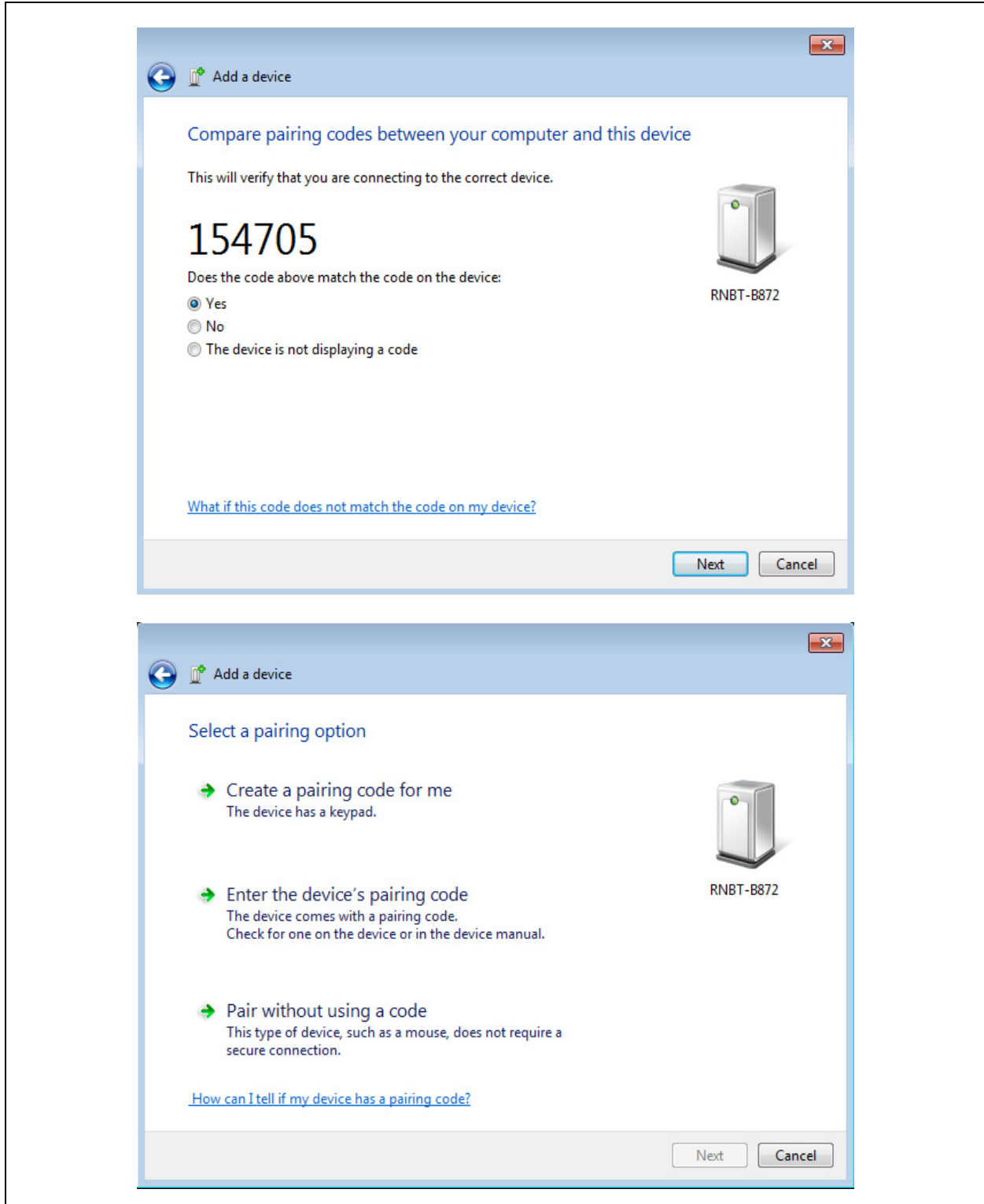
When the Bluetooth device manager completes pairing, it issues a message that the Bluetooth device is installed on COM*X* where COM*X* is unique to the used host computer. In some cases, the Bluetooth device ma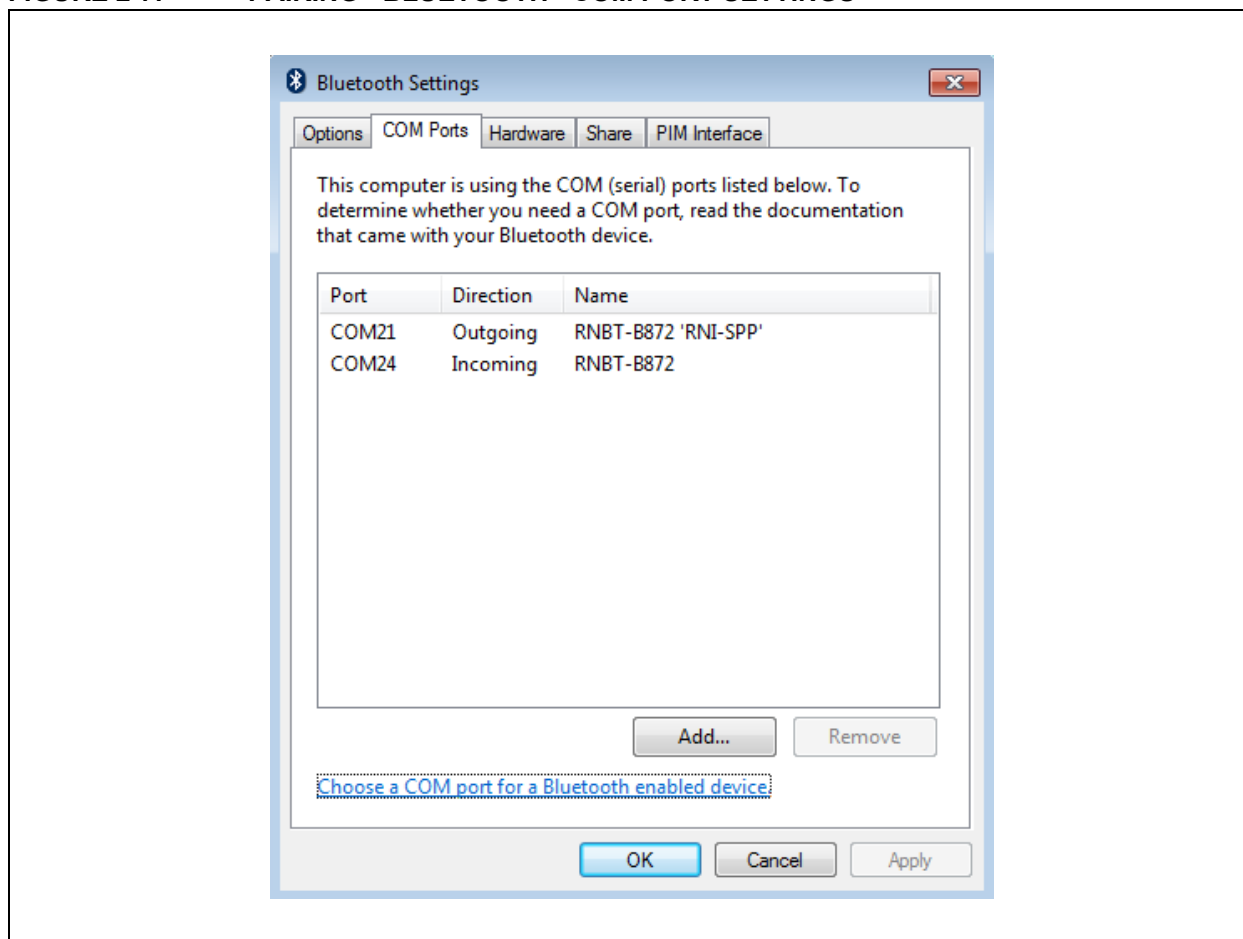nager creates two COM ports; in this case, *only* use the COM port labeled as outgoing. Figure 2-7 shows an example of COM port settings.

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FIGURE 2-7: **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. The RN41/RN42 modules default to an Open mode, such that the module does *not* require authentication. For more information on using pass keys, see **Section 2.10 "Security Modes"**. The module may use simple pairing (SSP) if it attempts 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.

2.9.3 Connecting

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

2.9.3.1   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 host application or a terminal emulator. When the user 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 user closes the COM port, remove power from the board, or terminate the connection using the `K, 1` command. Refer to the *Bluetooth Data Module Command Reference and Advanced Information User's Guide* for more information on using commands.

Once connected, the device is in Data mode enabling 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. For more information, see **Section 2.6 "Enter Command Mode"**.

> **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.

2.9.3.2   INCOMING CONNECTIONS

For an incoming connection, use the port specified in host Bluetooth settings as incoming (refer to Figure 2-7). The PC of host listens for an incoming connection from the remote Bluetooth device, in this case the RN-41-EK or RN-42-EK.

To make an incoming connection, perform the following steps:

1. User needs 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. Figure 2-8 shows the Bluetooth Radio MAC addresses that are connected to the PC.
2. Pair evaluation board with the PC, see **Section 2.9.2 "Pairing"**.
3. Open a terminal (for example, terminal A) and connect it to the evaluation board's outgoing COM port. Run this terminal on the host PC or another computer.
4. Open a second terminal (for example, terminal B) 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 2-9 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 user Type in terminal B are sent over Bluetooth to the host PC and display in terminal A. Any characters entered in terminal A are transmitted to terminal B.
7. To kill the connnection, type the `K,1` <cr> command in terminal B.

2.9.3.3   CONNECTING TWO RN-41-EK OR RN-42-EK BOARDS

Open the COM ports assigned to the two modules. As a default, the modules are in Slave mode when powered up. The two slaves can be connected to each other or one of the modules reconfigured to be a master, can connect to a slave.

To make a connection between two RN-41-EK (Module A and Module B) or between two RN-42-EK (Module A and Module B) boards, perform the following steps:

1. Enter the Command mode in both the modules by executing `$$$` command in the corresponding terminals.
2. Execute `GB` command in the terminal of module B to get its Bluetooth MAC address. Module A will require this address.
3. Set the Authentication mode in both the modules by using `SA,<value>` command.

> **Note:**   The Authentication mode must be the same in both modules.

4. Type `C`, *<MAC address>* <cr> in terminal A to establish an SPP connection from Module A to Module B.
5. Try the following commands in both the terminals:
   - `$$$` to enter Command mode
   - `SO, %` to enable status message to see connect/disconnect conditions
   - `R, 1` to reboot
   - `$$$` to re-enter Command mode
   - `+` to enable local echo
   - `C`, *<MAC address>* to attempt a connection with a remote device. Characters user Type in terminal B are sent over Bluetooth and display in terminal A.. Any characters entered in terminal A are transmitted to terminal B.
6. To kill the connnection, type the `K, 1` <cr> command in terminal B or terminal A.

FIGURE 2-8: PC'S BLUETOOTH® RADIO MAC ADDRESS
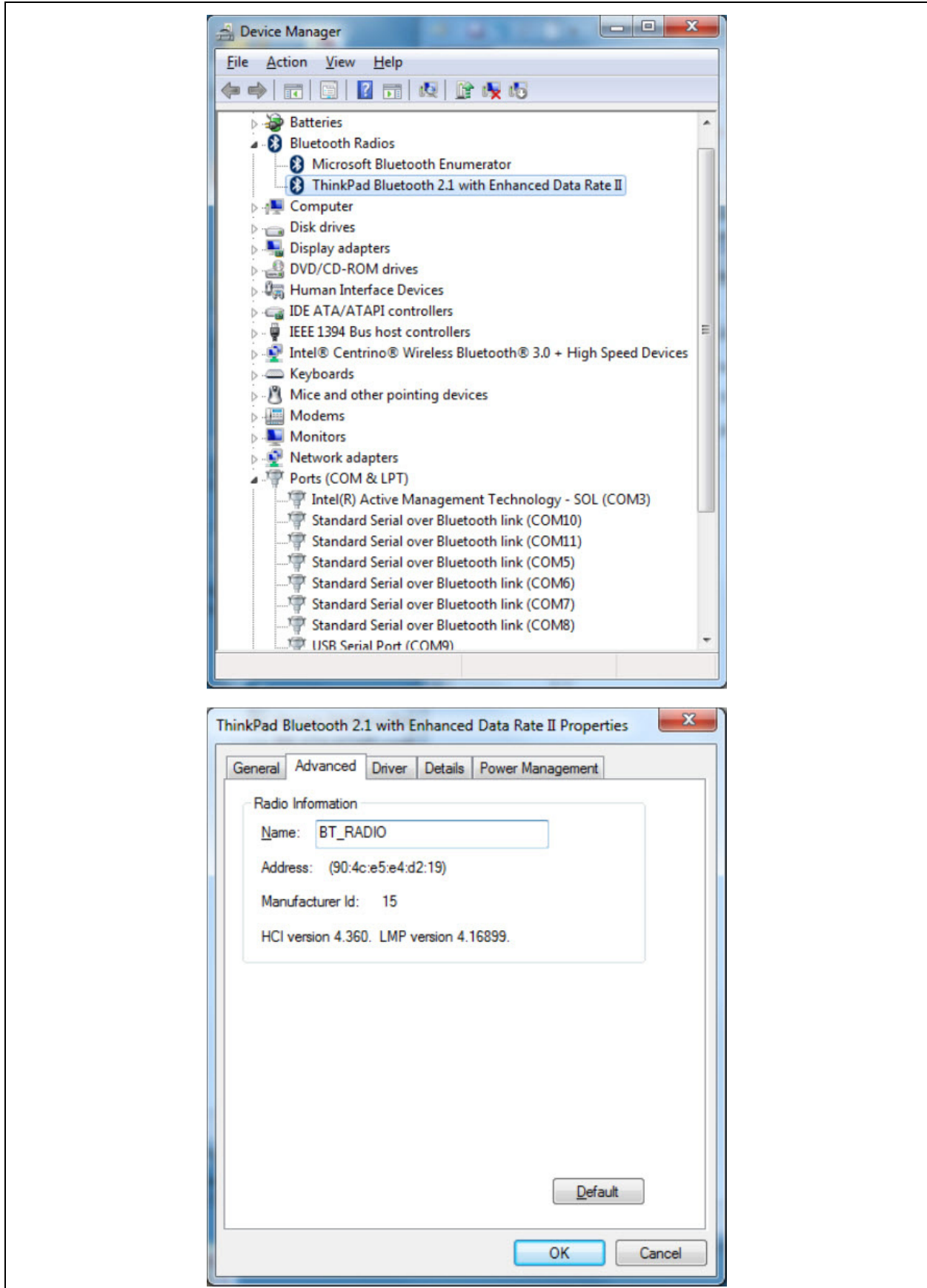
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FIGURE 2-9: **TERMINALS A AND B**
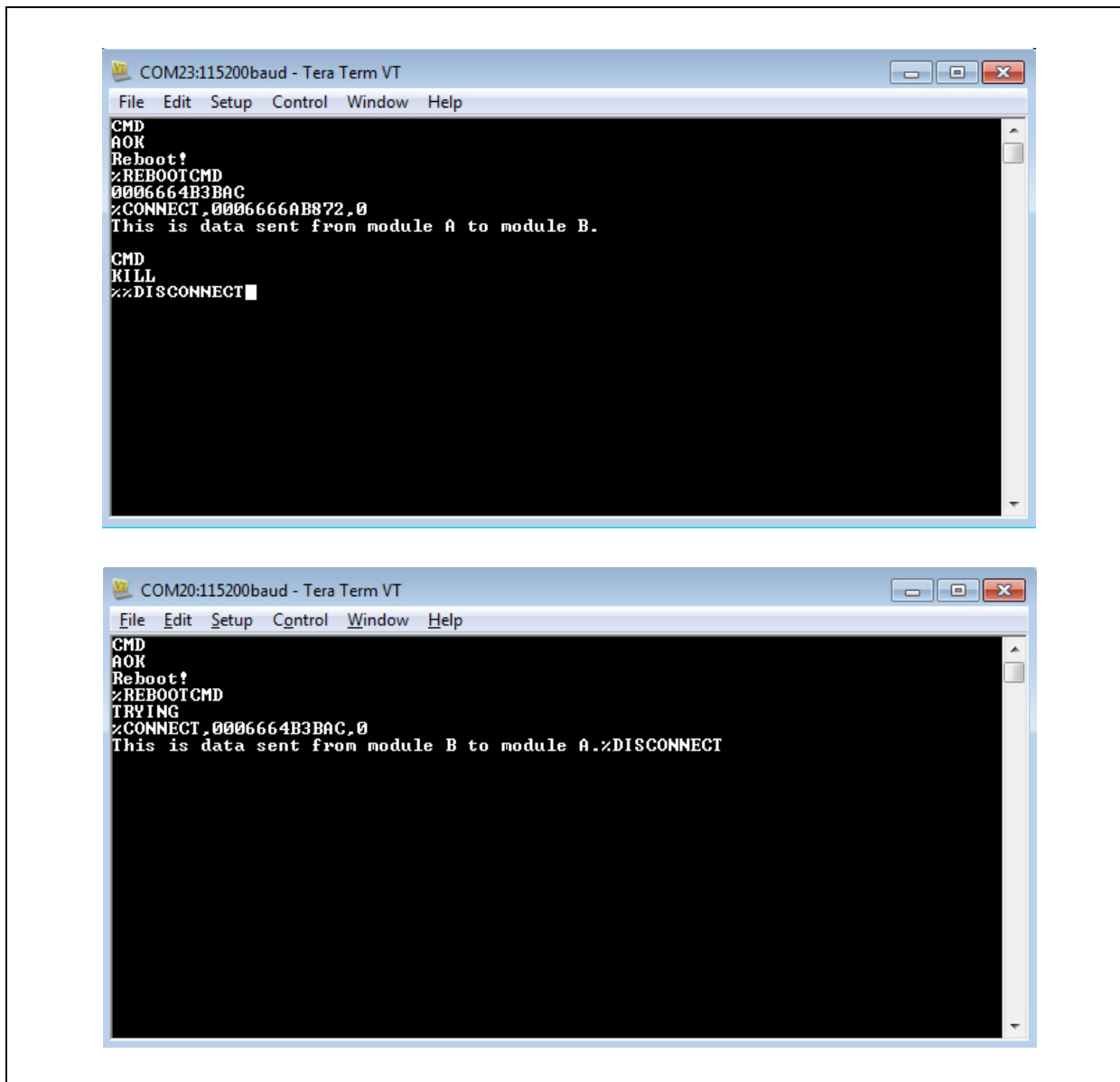
2.10 SECURITY MODES

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 the user enters the pin code, the Bluetooth devices compare these codes. If a match is found, 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 correct, the user must *not* 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, the user typically needs to "unpair" or remove the device from the Bluetooth manager. User 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.

Chapter 3. Application Design Concerns

3.1 INTRODUCTION

The following sections provide information on designing with the RN41 and RN42 modules, including radio interference, factory reset, solder reflow profile, connection status, and so on.

3.2 CONCERNS RELATED TO RN41/42

3.2.1 Reset Circuit

The RN41 contains a 1k pull-up to VCC, and the reset polarity is active-low. The module's reset pin has an optional power on-reset circuit with a delay, which must be *only* required if the input power supply has a very slow ramp or tends to bounce or have instability on power-up. Often a microcontroller or embedded CPU I/O is available to generate the reset once power is stable. If *not*, the designers can use one of the many low-cost power supervisor chips currently available, such as the MCP809 and MCP102/121.

3.2.2 Factory Reset Using GPIO4

It is recommended that the designers connect the GPIO4 pin to a switch, jumper, or resistor so it can be accessed. This pin can be used to reset the module to its factory default settings, which is critical in situations where the module has been *not* properly configured. To reset the module to the factory defaults, GPIO4 must be high on power-up and then toggle the switch in an ON-OFF-ON-OFF-ON sequence with one second interval between the transitions.

3.2.3 Connection Status

GPIO5 is available to drive an LED, and it blinks at various speeds to indicate status, see Table 3-1. GPIO2 is an output that directly reflects the connection state as shown in Table 3-2.

TABLE 3-1:   GPIO5 STATUS

GPIO5 Status	Description
Toggle at 1 Hz	The module is discoverable and waiting for a connection.
Toggle at 10 Hz	The module is in Command mode.
High	The module is connected to another device over Bluetooth.

TABLE 3-2:   GPIO2 STATUS

GPIO2 Status	Description
High	The module is connected to another device over Bluetooth.
Low	The module is *not* connected over Bluetooth.

3.2.4 HCI Mode

RN41/42 module offers the Host Controller Interface (HCI) mode in addition to the standard operational mode of its Bluetooth modules (standard mode refers to the on-board stack running on the module). In HCI mode, the on-board stack is bypassed and the module is put in a state that runs the Bluetooth baseband. The HCI provides a command reference interface to the baseband controller and the link manager, and provides access to the hardware status and control registers. This interface provides a uniform method for accessing the Bluetooth baseband capabilities.

In this mode, The Bluetooth stack is no longer on-board the module. It is offloaded to the interfacing host processor. The Bluetooth module is used as a radio, performing the lower level MAC functionalities, while the application stack runs on the host processor. Using the module in HCI mode enables designers to implement profiles that are *not* natively supported on the Bluetooth module.

> **Note:** HCI mode requires a separate firmware build that must be loaded into the module's flash at the factory. It is *not* upgradeable in the field.

RN41 module offers HCI mode in two hardware interfaces:
- HCI over UART (RN41/42HCI-I/RM)
- HCI over USB (RN41/42U-I/RM)

3.2.4.1 HCI OVER UART

In this mode, UART is the hardware interface between the host processor and the Bluetooth module. User must interface the flow control signals between the host processor and the Bluetooth module for the HCI inteface to work. Failure to do so can cause the host processor and the Bluetooth module to become out of sync and break the Bluetooth link.

3.2.4.2 HCI OVER USB

In this mode, USB is the hardware interface between the host processor and the Bluetooth module. In this architecture, the Bluetooth module is the USB slave and the host processor is the USB host. Using the USB interface offers the advantage of a faster data link between the Bluetooth module and the host processor. With this architecture, it is possible to achieve Bluetooth's theoretical maximum throughput of 3 Mpbs.

3.2.5 Using the SPI Bus to Upgrade the Flash Memory

While *not* required, this bus is very useful for configuring the Bluetooth module's advanced parameters. The bus is required when upgrading the module's firmware. In typical application schematic a 6-pin header can be implemented to gain access to this bus. A minimum-mode version might simply use the SPI signals (4 pins) and obtain ground and VCC from elsewhere in the design.

3.2.6 Minimizing Radio Interference

When laying out the carrier board for the RN41 module, the areas under the antenna and shielding connections must *not* have surface traces, ground planes, or exposed vias. For optimal radio performance, the RN41 module's antenna end must protude at least 5 mm beyond any metal enclosure.

3.2.7 Low Power

For RN42, to achieve low-power operation, hold the module's RESET pin low. With RESET = 0 VDC, the module consumes 35 uA of power. If RESEST is left floating or high, the module consumes 3 mA in Sleep mode. To obtain the lowest power, the RN42 must be passive (in Slave mode and *not* trying to make connections).

Appendix A. RN41 and RN42 Evaluation Kit Schematics

A.1   INTRODUCTION

This appendix provides the RN41 and RN42 Evaluation Boards schematic, PCB layout and Bill of Materials (BOM).
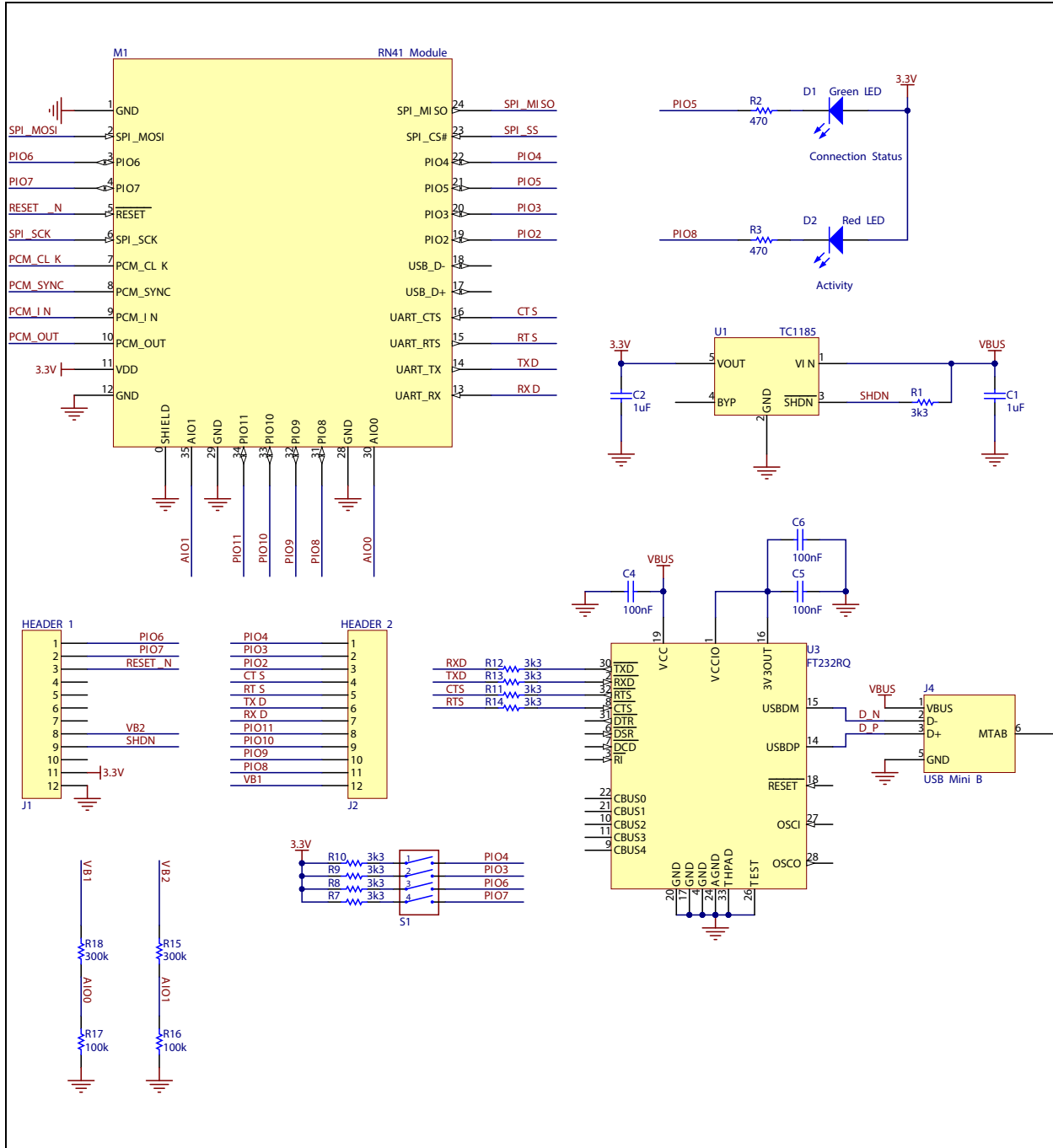
A.2   RN41 AND RN42 EVALUATION KIT SCHEMATIC

Figure A-1 and Figure A-2 show the Evaluation Boards schematic.

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FIGURE A-1: RN41 EVALUATION BOARD SCHEMATIC

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FIGURE A-2: **RN42 EVALUATION BOARD SCHEMATIC**
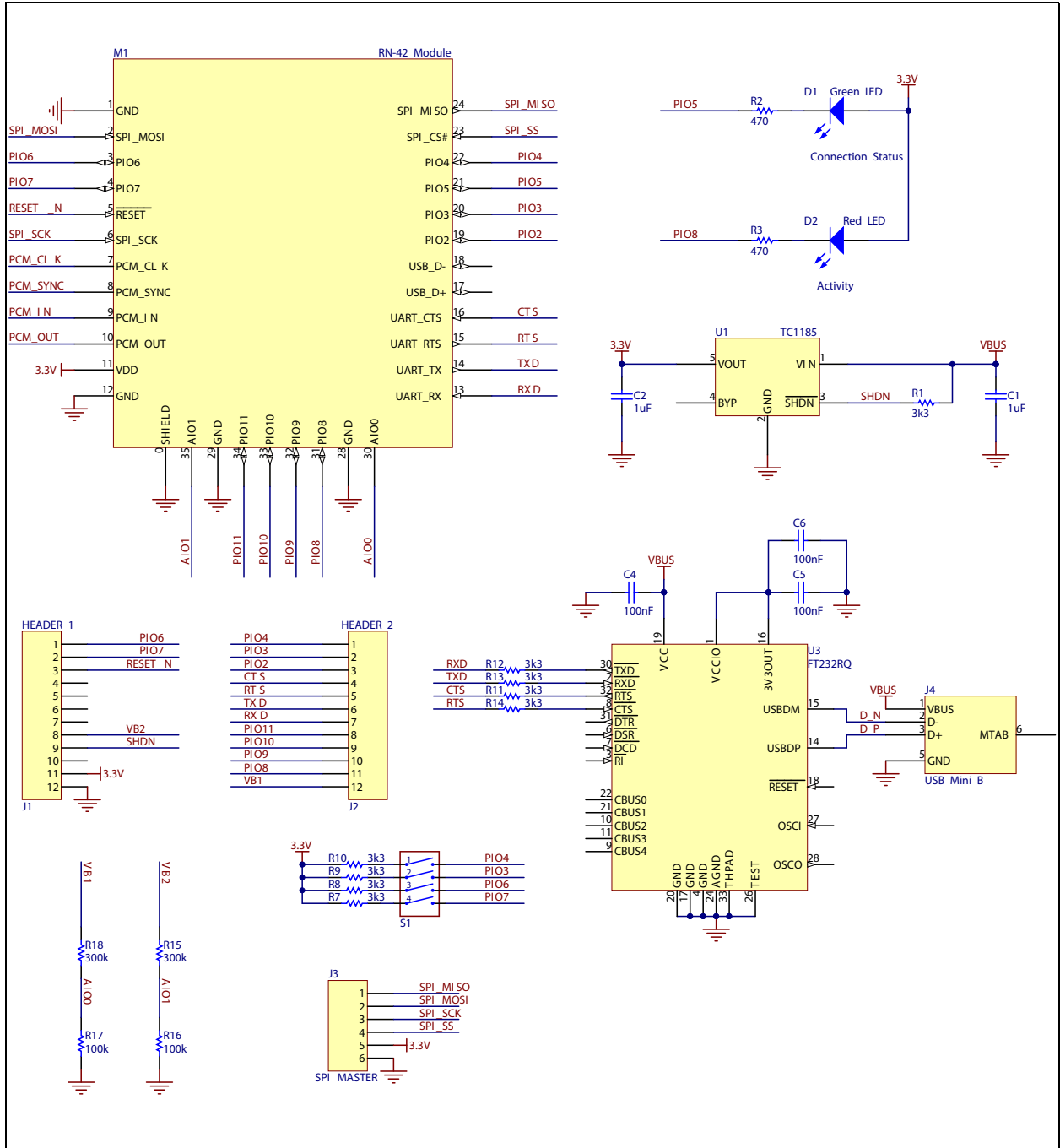
A.3   RN41 AND RN42 EVALUATION KIT PCB LAYOUT AND ASSEMBLY DRAWINGS

The RN41/42 Evaluation Board is a 2-layer, FR4, 0.062 inch, plated through a hole PCB construction. Figure A-3 through Figure A-6 show the PCB constructions and Assembly Drawings.

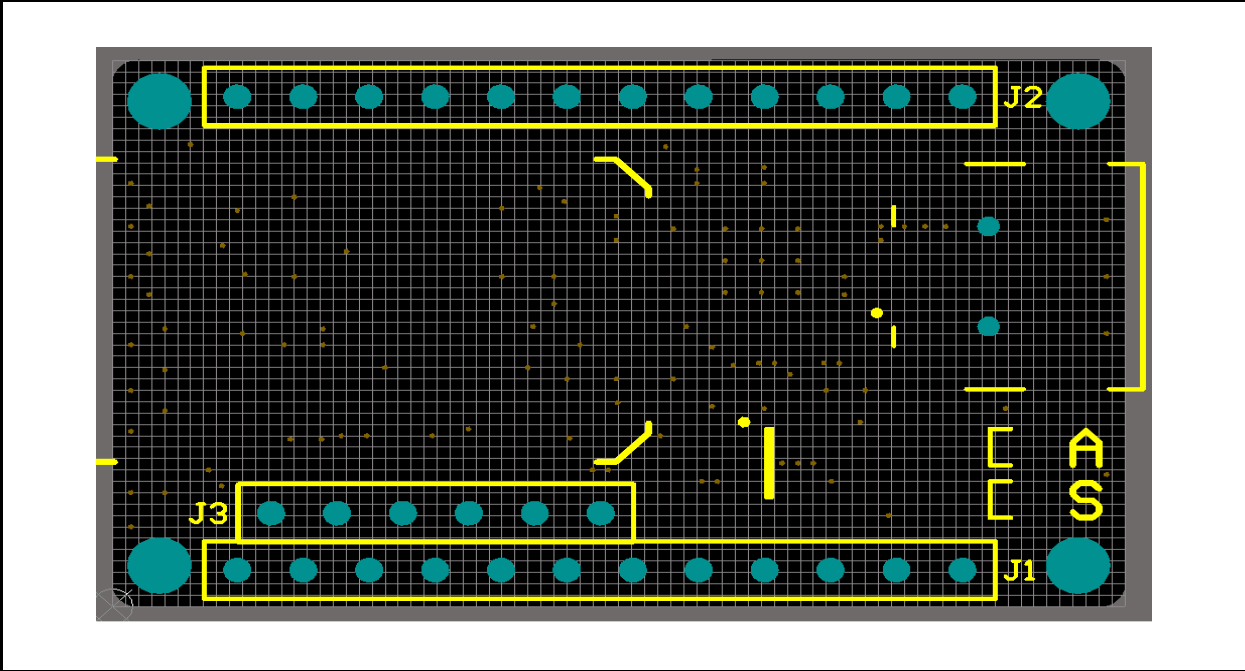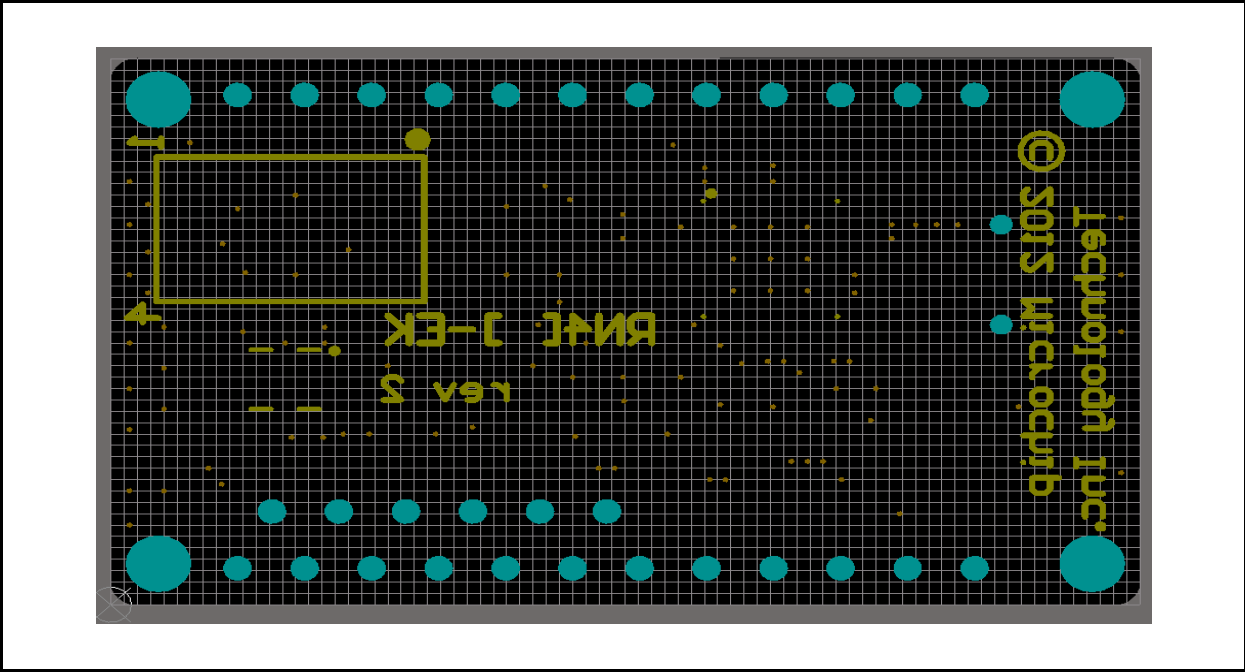**FIGURE A-3:**   **RN41/RN42 EVALUATION BOARD TOP SILKSCREEN**

FIGURE A-4:   **RN41/42 EVALUATION BOARD BOTTOM SILKSCREEN**

FIGURE A-5:   **RN41/RN42 EVALUATION BOARD TOP COPPER**
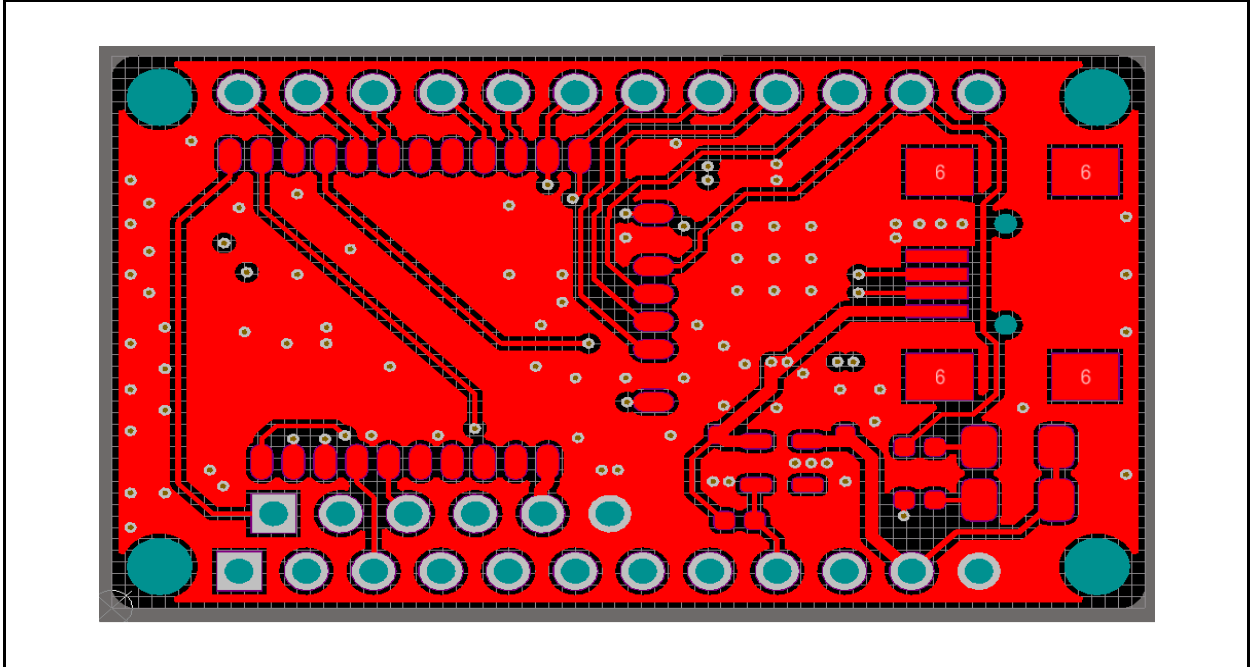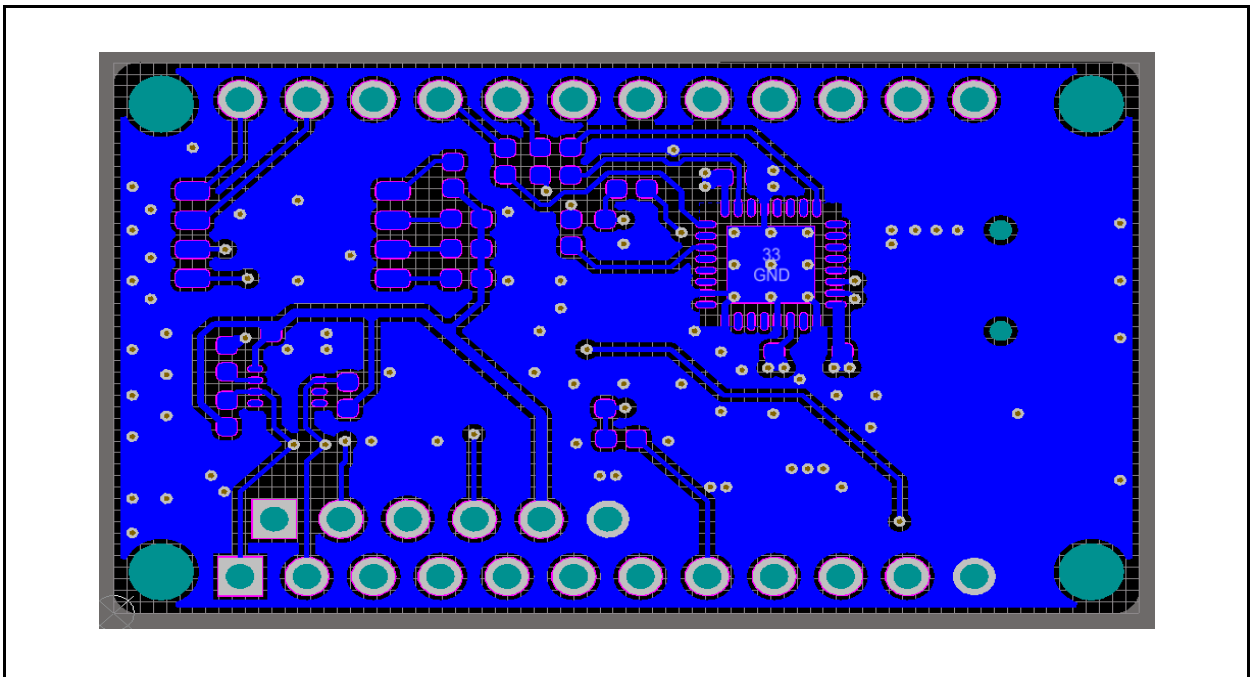

FIGURE A-6:   **RN41/42 EVALUATION BOARD BOTTOM COPPER**

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A.4   RN41 AND RN42 EVALUATION KIT BILL OF MATERIALS

TABLE A-1:   RN41 EVALUATION BOARD BILL OF MATERIALS (BOM)

Reference	Value	Description	Vendor	Vendor P/N
C1, C2	1 uF	Cap ceramic, 10%, 16V, X5R, 0402	TDK Corporation	C1005X5R1C105K
C4, C5, C6	100 nF	Cap ceramic, -20%, 80%, 16V, Y5V, 0402	Yageo	CC0402ZRY5V7BB104
D1	Green LED	Clear, Green LED, 10 mA, 2.1V, 569 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150GKT
D2	Red LED	Clear, Red LED, 10 mA, 1.8 V, 638 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150CKT
J4	USB Mini B	CONN USB RCPT MINI B 5PS R/A SMD	JAE	DX2R005HN2E700
M1	RN-41	RN41 Module	Microchip	RN41
R1, R7, R8, R9, R10, R11, R12	3k3	Res, 5%, 0.1 W, 0402	Panasonic - ECG	ERJ-2GEJ332X
R2, R3	470	Res, 5%, 0.1 W, 0402	Panasonic - ECG	ERJ-2GEJ471X
R15, R18	300k	Res, 1%, 0.1 W, 0402	Panasonic - ECG	ERJ-2RKF3003X
R16, R17	100k	Res, 1%, 0.1 W, 0402	Panasonic - ECG	ERJ-2RKF1003X
S1	4 x DIP Switch	SWITCH DIP 4POS HALF PITCH SMD	C&K Components	TDA04H0SB1R
U1	TC1185-3.3V	Linear Voltage Regulator	Microchip	TC1185-3.3VCT713
U3	FT232RQ	IC USB FS SERIAL UART 32-QFN	FTDI	FT232RQ-REEL

**TABLE A-2:   RN42 EVALUATION BOARD BILL OF MATERIALS (BOM)**

Reference	Value	Description	Vendor	Vendor P/N
C1, C2	1 uF	Cap ceramic, 10%, 16V, X5R, 0402	TDK Corporation	C1005X5R1C105K
C4, C5, C6	100 nF	Cap ceramic, -20%, 80%, 16V, Y5V, 0402	Yageo	CC0402ZRY5V7BB104
D1	Green LED	Clear, Green LED, 10 mA, 2.1V, 569 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150GKT
D2	Red LED	Clear, Red LED, 10 mA, 1.8 V, 638 nm, 130 degrees, 1206	Lite-On Inc	LTST-C150CKT
J4	USB Mini B	CONN USB RCPT MINI B 5PS R/A SMD	JAE	DX2R005HN2E700
M1	RN-42	RN42 Module	Microchip	RN42
R1, R7, R8, R9, R10, R11, R12	3k3	Res, 5%, 0.1 W, 0402	Panasonic - ECG	ERJ-2GEJ332X
R2, R3	470	Res, 5%, 0.1 W, 0402	Panasonic - ECG	ERJ-2GEJ471X
R15, R18	300k	Res, 1%, 0.1 W, 0402	Panasonic - ECG	ERJ-2RKF3003X
R16, R17	100k	Res, 1%, 0.1 W, 0402	Panasonic - ECG	ERJ-2RKF1003X
S1	4 x DIP Switch	SWITCH DIP 4POS HALF PITCH SMD	C&K Components	TDA04H0SB1R
U1	TC1185-3.3V	Linear Voltage Regulator	Microchip	TC1185-3.3VCT713
U3	FT232RQ	IC USB FS SERIAL UART 32-QFN	FTDI	FT232RQ-REEL

A.5 RN41 AND RN42 EVALUATION KIT PHYSICAL DIMENSIONS

Figure A-7 shows the physical dimensions of the RN41/42 Evaluation Board.

FIGURE A-7: RN41/42 PHYSICAL DIMENSIONS
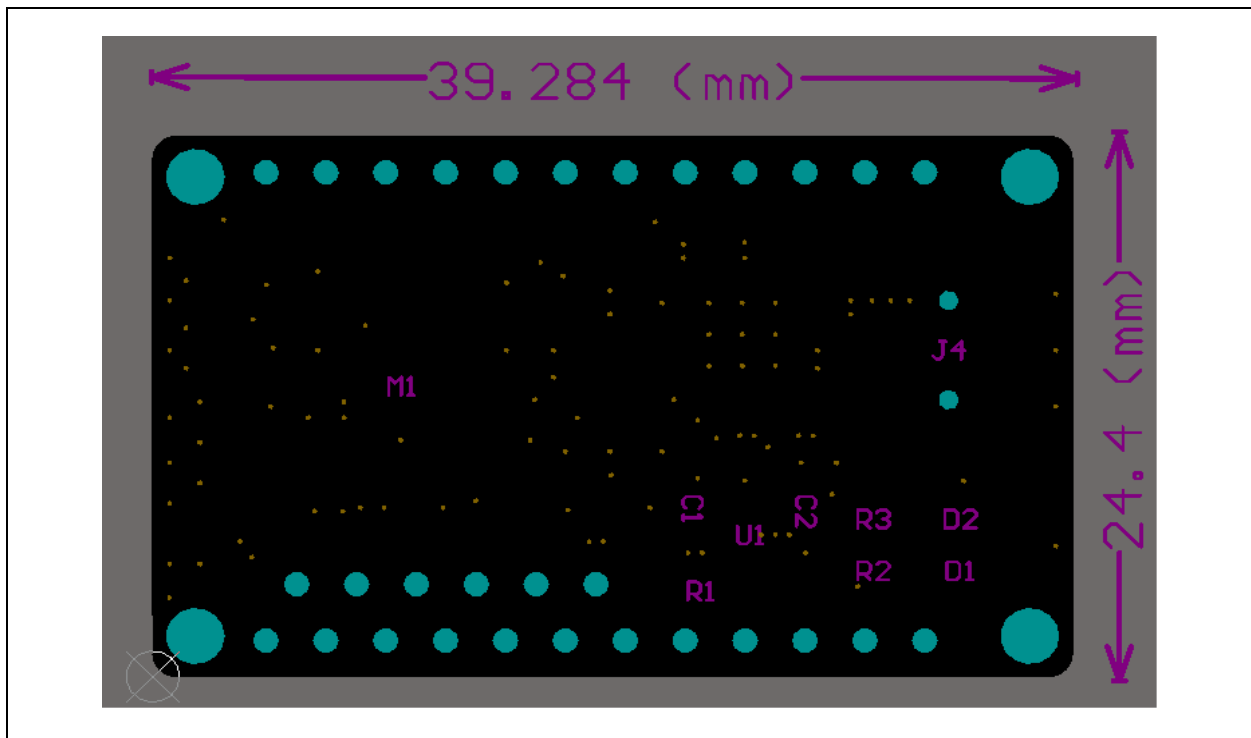
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Fax: 33-1-69-30-90-79

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